Authorization for Credit Card Transactions

Department of Homeland Security

Form G-1450

How To Fill Out Form G-1450

1. Type or print legibly in black ink.
2. Complete the "**Applicant's/Petitioner's/Requester's Information**," "**Credit Card Billing Information**," and "**Credit Card Information**" sections and sign the authorization. **NOTE:** The credit card must be issued by a U.S. bank.
3. Place your Form G-1450 ON TOP of your application, petition, or request package.

NOTE: Failure to provide the requested information may result in DHS and your financial institution not accepting the payment. DHS cannot process credit card payments without an authorized signature.

NOTE: Please see the USCIS Form G-1450 website for additional information.

We recommend that you print or save a copy of your completed Form G-1450 to review in the future and for your records.

By completing this transaction, you agree that you have paid for a government service and that the filing fee, biometric services fee and all related financial transactions are final and not refundable, regardless of any action DHS takes on an application, petition, or request. You must submit all fees in the exact amounts. DHS will charge your credit card up to the amount you authorize below.

Please refer to the form(s) you are filing for additional information, or you may call the USCIS Customer Contact number at **1-800-375-5283**. For TTY (deaf or hard of hearing) call: **1-800-767-1833**.

Applicant's/Petitioner's/Requester's Information (Full Legal Name)		
Given Name (First Name) Alice Neri	Middle Name (if any) N/A	Family Name (Last Name) DA SILVA SOUSA

Credit Card Billing Information (Credit Card Holder's Name as it Appears on the Card)		
Given Name (First Name)	Middle Name (if any)	Family Name (Last Name)
Credit Card Holder's Billing Address:		
Street Number and Name	Apt. Ste. Flr. ☐ ☐ ☐	Number
City or Town	State	ZIP Code
Credit Card Holder's Signature and Contact Information:		
Credit Card Holder's Signature		
Credit Card Holder's Daytime Telephone Number	Credit Card Holder's Email Address	

Credit Card Information		
Credit Card Number	**Credit Card Type:** ☐ Visa ☐ MasterCard ☐ American Express ☐ Discover	Authorized Payment Amount $ 715.00
Credit Card Expiration Date (mm/yyyy) CVV Code		

Authorization for Credit Card Transactions

Department of Homeland Security

Form G-1450

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Applicant's/Petitioner's/Requester's Information (Full Legal Name)		
Given Name (First Name) Alice Neri	Middle Name (if any) N/A	Family Name (Last Name) DA SILVA SOUSA

Credit Card Billing Information (Credit Card Holder's Name as it Appears on the Card)		
Given Name (First Name)	Middle Name (if any)	Family Name (Last Name)

Credit Card Holder's Billing Address:		
Street Number and Name	Apt. Ste. Flr. ☐ ☐ ☐	Number
City or Town	State	ZIP Code

Credit Card Holder's Signature and Contact Information:	
Credit Card Holder's Signature	
Credit Card Holder's Daytime Telephone Number	Credit Card Holder's Email Address

Credit Card Information		
Credit Card Number	**Credit Card Type:** ☐ Visa ☐ MasterCard ☐ American Express ☐ Discover	Authorized Payment Amount $ 300.00
Credit Card Expiration Date (mm/yyyy) CVV Code		

YOUSA
Law Firm

EB-1A EXTRAORDINARY ABILITY IMMIGRANT PETITION

Petitioner: SOUSA, Alice Neri Da Silva

HS Law Corp
P.O Box 90487
San Diego - CA - United States

e-Notification of Application/Petition Acceptance

Department of Homeland Security
U.S. Citizenship and Immigration Services

USCIS
Form G-1145

What Is the Purpose of This Form?

Use this form to request an electronic notification (e-Notification) when U.S. Citizenship and Immigration Services accepts your immigration application. This service is available for applications filed at a USCIS Lockbox facility.

General Information

Complete the information below and clip this form to the first page of your application package. You will receive one e-mail and/or text message for each form you are filing.

We will send the e-Notification within 24 hours after we accept your application. Domestic customers will receive an e-mail and/or text message; overseas customers will only receive an e-mail. Undeliverable e-Notifications cannot be resent.

The e-mail or text message will display your receipt number and tell you how to get updated case status information. It will not include any personal information. The e-Notification does not grant any type of status or benefit; rather it is provided as a convenience to customers.

USCIS will also mail you a receipt notice (I-797C), which you will receive within 10 days after your application has been accepted; use this notice as proof of your pending application or petition.

USCIS Privacy Act Statement

AUTHORITIES: The information requested on this form is collected pursuant to section 103(a) of the Immigration and Nationality Act, as amended INA section 101, et seq.

PURPOSE: The primary purpose for providing the information on this form is to request an electronic notification when USCIS accepts immigration form. The information you provide will be used to send you a text and/or email message.

DISCLOSURE: The information you provide is voluntary. However, failure to provide the requested information may prevent USCIS from providing you a text and/or email message receipting your immigration form.

ROUTINE USES: The information provided on this form will be used by and disclosed to DHS personnel and contractors in accordance with approved routine uses, as described in the associated published system of records notices [**DHS/USCIS-007 - Benefits Information System and DHS/USCIS-001 - Alien File (A-File) and Central Index System (CIS)**, which can be found at **www.dhs.gov/privacy**]. The information may also be made available, as appropriate for law enforcement purposes or in the interest of national security.

Complete this form and clip it on top of the first page of your immigration form(s).

Applicant/Petitioner Full Last Name	Applicant/Petitioner Full First Name	Applicant/Petitioner Full Middle Name
DA SILVA SOUSA	**Alice Neri**	**N/A**

Email Address	Mobile Phone Number (Text Message)
nneri.alice@gmail.com	

Notice of Entry of Appearance as Attorney or Accredited Representative

Department of Homeland Security

DHS Form G-28
OMB No. 1615-0105
Expires 05/31/2021

Part 1. Information About Attorney or Accredited Representative

1. USCIS Online Account Number (if any)

► 0 0 7 4 9 2 6 2 5 4 3 8

Name of Attorney or Accredited Representative

2.a. Family Name (Last Name): HAVERROTH SILVA

2.b. Given Name (First Name): Otavio

2.c. Middle Name: N/A

Address of Attorney or Accredited Representative

3.a. Street Number and Name: PO Box 90487

3.b. ☐ Apt. ☐ Ste. ☐ Flr. N/A

3.c. City or Town: San Diego

3.d. State: CA **3.e.** ZIP Code: 92169 *(USPS ZIP Code Lookup)*

3.f. Province: N/A

3.g. Postal Code: N/A

3.h. Country: USA

Contact Information of Attorney or Accredited Representative

4. Daytime Telephone Number: 5102419336

5. Mobile Telephone Number (if any): 5102419336

6. Email Address (if any): otavio@legalhs.com

7. Fax Number (if any): N/A

Part 2. Eligibility Information for Attorney or Accredited Representative

Select **all applicable** items.

1.a. ☒ I am an attorney eligible to practice law in, and a member in good standing of, the bar of the highest courts of the following states, possessions, territories, commonwealths, or the District of Columbia. If you need extra space to complete this section, use the space provided in **Part 6. Additional Information**.

Licensing Authority: California

1.b. Bar Number (if applicable): 343486

1.c. I (select **only one** box) ☒ am not ☐ am subject to any order suspending, enjoining, restraining, disbarring, or otherwise restricting me in the practice of law. If you are subject to any orders, use the space provided in **Part 6. Additional Information** to provide an explanation.

1.d. Name of Law Firm or Organization (if applicable): HS Law Corp

2.a. ☐ I am an accredited representative of the following qualified nonprofit religious, charitable, social service, or similar organization established in the United States and recognized by the Department of Justice in accordance with 8 CFR part 1292.

2.b. Name of Recognized Organization: N/A

2.c. Date of Accreditation (mm/dd/yyyy): N/A

3. ☐ I am associated with N/A, the attorney or accredited representative of record who previously filed Form G-28 in this case, and my appearance as an attorney or accredited representative for a limited purpose is at his or her request.

4.a. ☐ I am a law student or law graduate working under the direct supervision of the attorney or accredited representative of record on this form in accordance with the requirements in 8 CFR 292.1(a)(2).

4.b. Name of Law Student or Law Graduate: N/A

Part 3. Notice of Appearance as Attorney or Accredited Representative

If you need extra space to complete this section, use the space provided in **Part 6. Additional Information**.

This appearance relates to immigration matters before (select **only one** box):

1.a. ☒ U.S. Citizenship and Immigration Services (USCIS)

1.b. List the form numbers or specific matter in which appearance is entered.

I-140

2.a. ☐ U.S. Immigration and Customs Enforcement (ICE)

2.b. List the specific matter in which appearance is entered.

N/A

3.a. ☐ U.S. Customs and Border Protection (CBP)

3.b. List the specific matter in which appearance is entered.

N/A

4. Receipt Number (if any)

► N/A

5. I enter my appearance as an attorney or accredited representative at the request of the (select **only one** box):

☐ Applicant ☒ Petitioner ☐ Requestor

☐ Beneficiary/Derivative ☐ Respondent (ICE, CBP)

Information About Client (Applicant, Petitioner, Requestor, Beneficiary or Derivative, Respondent, or Authorized Signatory for an Entity)

6.a. Family Name (Last Name): DA SILVA SOUSA

6.b. Given Name (First Name): Alice Neri

6.c. Middle Name: N/A

7.a. Name of Entity (if applicable)

N/A

7.b. Title of Authorized Signatory for Entity (if applicable)

N/A

8. Client's USCIS Online Account Number (if any)

► N/A

9. Client's Alien Registration Number (A-Number) (if any)

► A- N/A

Client's Contact Information

10. Daytime Telephone Number

+55 53 99946-7057

11. Mobile Telephone Number (if any)

+55 53 99946-7057

12. Email Address (if any)

nneri.alice@gmail.com

Mailing Address of Client

NOTE: Provide the client's mailing address. **Do not** provide the business mailing address of the attorney or accredited representative **unless** it serves as the safe mailing address on the application or petition being filed with this Form G-28.

13.a. Street Number and Name: PO Box 90487

13.b. ☐ Apt. ☐ Ste. ☐ Flr. N/A

13.c. City or Town: San Diego

13.d. State: CA **13.e.** ZIP Code: 92169

13.f. Province: N/A

13.g. Postal Code: N/A

13.h. Country

USA

Part 4. Client's Consent to Representation and Signature

Consent to Representation and Release of Information

I have requested the representation of and consented to being represented by the attorney or accredited representative named in **Part 1.** of this form. According to the Privacy Act of 1974 and U.S. Department of Homeland Security (DHS) policy, I also consent to the disclosure to the named attorney or accredited representative of any records pertaining to me that appear in any system of records of USCIS, ICE, or CBP.

Part 4. Client's Consent to Representation and Signature (continued)

Options Regarding Receipt of USCIS Notices and Documents

USCIS will send notices to both a represented party (the client) and his, her, or its attorney or accredited representative either through mail or electronic delivery. USCIS will send all secure identity documents and Travel Documents to the client's U.S. mailing address.

If you want to have notices and/or secure identity documents sent to your attorney or accredited representative of record rather than to you, please select **all applicable** items below. You may change these elections through written notice to USCIS.

1.a. ☒ I request that USCIS send original notices on an application or petition to the business address of my attorney or accredited representative as listed in this form.

1.b. ☒ I request that USCIS send any secure identity document (Permanent Resident Card, Employment Authorization Document, or Travel Document) that I receive to the U.S. business address of my attorney or accredited representative (or to a designated military or diplomatic address in a foreign country (if permitted)).

NOTE: If your notice contains Form I-94, Arrival-Departure Record, USCIS will send the notice to the U.S. business address of your attorney or accredited representative. If you would rather have your Form I-94 sent directly to you, select **Item Number 1.c.**

1.c. ☐ I request that USCIS send my notice containing Form I-94 to me at my U.S. mailing address.

Signature of Client or Authorized Signatory for an Entity

2.a. Signature of Client or Authorized Signatory for an Entity

➡ Alice N S Sawyer

2.b. Date of Signature (mm/dd/yyyy) 02/26/2026

Part 5. Signature of Attorney or Accredited Representative

I have read and understand the regulations and conditions contained in 8 CFR 103.2 and 292 governing appearances and representation before DHS. I declare under penalty of perjury under the laws of the United States that the information I have provided on this form is true and correct.

1. a. Signature of Attorney or Accredited Representative

1.b. Date of Signature (mm/dd/yyyy) 02/26/2026

2.a. Signature of Law Student or Law Graduate

N/A

2.b. Date of Signature (mm/dd/yyyy) N/A

Part 6. Additional Information

If you need extra space to provide any additional information within this form, use the space below. If you need more space than what is provided, you may make copies of this page to complete and file with this form or attach a separate sheet of paper. Type or print your name at the top of each sheet; indicate the **Page Number**, **Part Number**, and **Item Number** to which your answer refers; and sign and date each sheet.

1.a Family Name (Last Name): DA SILVA SOUSA

1.b. Given Name (First Name): Alice Neri

1.c. Middle Name: N/A

2.a. Page Number: N/A **2.b.** Part Number: N/A **2.c.** Item Number: N/A

2.d. N/A

3.a. Page Number: N/A **3.b.** Part Number: N/A **3.c.** Item Number: N/A

3.d. N/A

4.a. Page Number: N/A **4.b.** Part Number: N/A **4.c.** Item Number: N/A

4.d. N/A

5.a. Page Number: N/A **5.b.** Part Number: N/A **5.c.** Item Number: N/A

5.d. N/A

6.a. Page Number: N/A **6.b.** Part Number: N/A **6.c.** Item Number: N/A

6.d. N/A

Immigrant Petition for Alien Workers

Department of Homeland Security
U.S. Citizenship and Immigration Services

USCIS
Form I-140
OMB No. 1615-0015
Expires 02/28/2027

For USCIS Use Only	Fee Stamp	Priority Date	Consulate	Action Block

Classification

- ☐ 203(b)(1)(A) Alien of Extraordinary Ability
- ☐ 203(b)(1)(B) Outstanding Professor or Researcher
- ☐ 203(b)(1)(C) Multinational Executive or Manager
- ☐ 203(b)(2) Member of Professions with Advanced Degree/Exceptional Ability
- ☐ 203(b)(3)(A)(i) Skilled Worker
- ☐ 203(b)(3)(A)(ii) Professional
- ☐ 203(b)(3)(A)(iii) Other Worker

Certification

- ☐ National Interest Waiver (NIW)
- ☐ Schedule A, Group I
- ☐ Schedule A, Group II

Remarks

To be completed by an Attorney or Accredited Representative (if any).	☒ Select this box if Form G-28 or Form G-28I is attached.	Attorney State Bar Number (if applicable)	Attorney or Accredited Representative USCIS Online Account Number (if any)
		343486	0 0 7 4 9 2 6 2 5 4 3 8

► **START HERE - Type or print in black ink.**

Part 1. Information About the Person or Organization Filing This Petition

If an individual is filing this petition, answer **Item Numbers 1.a. - 1.c.** If a company or organization is filing this petition, answer **Item Number 2.**

1.a. Family Name (Last Name): DA SILVA SOUSA

1.b. Given Name (First Name): Alice Neri

1.c. Middle Name: N/A

2. Company or Organization Name: N/A

Mailing Address

(USCIS ZIP Code Lookup)

3.a. In Care Of Name: Otavio Haverroth Silva

3.b. Street Number and Name: PO Box 90487

3.c. ☐ Apt. ☐ Ste. ☐ Flr. N/A

3.d. City or Town: San Diego

3.e. State: CA **3.f.** ZIP Code: 92169

3.g. Province: N/A

3.h. Postal Code: N/A

3.i. Country: USA

Other Information

4. IRS Employer Identification Number (EIN) ► N/A

5. Are you a nonprofit organized as tax exempt or a governmental research organization? ☐ Yes ☒ No

6. Do you currently employ a total of 25 or fewer full-time equivalent employees in the United States, including all affiliates or subsidiaries of this company/organization? ☒ Yes ☐ No

7. U.S. Social Security Number (SSN) (if any) ► N/A

8. USCIS Online Account Number (if any) ► N/A

Part 2. Petition Type

This petition is being filed for (select **only one** box):

1.a. ☒ An alien of extraordinary ability.

1.b. ☐ An outstanding professor or researcher.

1.c. ☐ A multinational executive or manager.

1.d. ☐ A member of the professions holding an advanced degree or an alien of exceptional ability (who is **NOT** seeking a National Interest Waiver (NIW)).

1.e. ☐ A professional (at a minimum, possessing a bachelor's degree or a foreign degree equivalent to a U.S. bachelor's degree).

Part 2. Petition Type (continued)

1.f. ☐ A skilled worker (requiring at least two years of specialized training or experience).

1.g. ☐ Any other worker (requiring less than two years of training or experience).

1.h. ☐ An alien applying for an NIW (who **IS** a member of the professions holding an advanced degree or an alien of exceptional ability).

This petition is being filed (select **only one** box):

2.a. ☐ To amend a previously filed petition.

Previous Petition Receipt Number

► N/A

2.b. ☐ For the Schedule A, Group I or II designation.

Part 3. Information About the Person for Whom You Are Filing

1.a. Family Name (Last Name): DA SILVA SOUSA

1.b. Given Name (First Name): Alice Neri

1.c. Middle Name: N/A

Mailing Address

2.a. In Care Of Name: Otavio Haverroth Silva

2.b. Street Number and Name: PO Box 90487

2.c. ☐ Apt. ☐ Ste. ☐ Flr. N/A

2.d. City or Town: San Diego

2.e. State: CA **2.f.** ZIP Code: 92169

2.g. Province: N/A

2.h. Postal Code: N/A

2.i. Country: USA

Other Information

3. Date of Birth (mm/dd/yyyy): 08/08/1996

4. City/Town/Village of Birth: Ji-Parana

5. State or Province of Birth: Rondonia

6. Country of Birth: Brazil

7. Country of Citizenship or Nationality: Brazil

8. Alien Registration Number (A-Number) (if any)

► A- N/A

9. U.S. SSN (if any) ► N/A

Information About His or Her Last Arrival in the United States

If the person for whom you are filing is in the United States, provide the following information.

10. Date of Last Arrival (mm/dd/yyyy): N/A

11.a. Form I-94 Arrival-Departure Record Number

► N/A

11.b. Expiration Date of Authorized Stay Shown on Form I-94 (mm/dd/yyyy): N/A

11.c. Status on Form I-94 (for example, class of admission, or paroled, if paroled): N/A

12. Passport Number: N/A

13. Travel Document Number: N/A

14. Country of Issuance for Passport or Travel Document: N/A

15. Expiration Date for Passport or Travel Document (mm/dd/yyyy): N/A

Part 4. Processing Information

Provide the following information for the person named in **Part 3.** (select **only one** box):

1.a. ☒ Alien will apply for a visa abroad at a U.S. Embassy or U.S. Consulate at:

1.b. City or Town: Rio de Janeiro

1.c. Country: Brazil

2.a. ☐ Alien is in the United States and will apply for adjustment of status to that of lawful permanent resident.

Part 4. Processing Information (continued)

2.b. Alien's current country of residence or, if now in the United States, last country of permanent residence abroad.

Brazil

If you provided a United States address in **Part 3.**, provide the person's foreign address in **Item Numbers 3.a. - 3.f.**:

3.a. Street Number and Name: 715 Visconde do Rio Branco

3.b. ☐ Apt. ☐ Ste. ☐ Flr. House A

3.c. City or Town: Rio Grande

3.d. Province: Rio Grande do Sul

3.e. Postal Code: 96211011

3.f. Country: Brazil

If the person's native alphabet is other than Roman letters, type or print the person's foreign name and address in the native alphabet in **Item Numbers 4.a. - 4.c.**:

4.a. Family Name (Last Name): N/A

4.b. Given Name (First Name): N/A

4.c. Middle Name: N/A

Mailing Address

5.a. In Care Of Name: N/A

5.b. Street Number and Name: N/A

5.c. ☐ Apt. ☐ Ste. ☐ Flr. N/A

5.d. City or Town: N/A

5.e. Province: N/A

5.f. Postal Code: N/A

5.g. Country: N/A

If you answer "Yes" to **Item Numbers 6.a. - 10.**, provide the case number, office location, date of decision, and disposition of the decision in the space provided in **Part 11. Additional Information**.

6.a. Are you filing any other petitions or applications with this Form I-140? ☐ Yes ☒ No

6.b. If you answered "Yes" **to Item Number 6.a.**, select all applicable boxes:

- ☐ Form I-485
- ☐ Form I-131
- ☐ Form I-765
- ☐ Other (Provide an explanation in **Part 11. Additional Information**.)

7. Is the person for whom you are filing in removal proceedings? ☐ Yes ☒ No

8. Has any immigrant visa petition ever been filed by or on behalf of this person? ☐ Yes ☒ No

9. Are you filing this petition without an original labor certification because the original labor certification was previously submitted in support of another Form I-140? ☐ Yes ☒ No

10. If you are filing this petition without an original labor certification, are you requesting that U.S. Citizenship and Immigration Services (USCIS) request a duplicate labor certification from the Department of Labor (DOL)? ☐ Yes ☒ No

Part 5. Additional Information About the Petitioner

Type of petitioner (select **only one** box):

1.a. ☐ Employer

1.b. ☒ Self

1.c. ☐ Other (For example, Lawful Permanent Resident, U.S. citizen or any other person filing on behalf of the alien)

N/A

If a company or an organization is filing this petition, provide the following information:

2. Type of Business: N/A

3. Date Established (mm/dd/yyyy): N/A

4. Current Number of U.S. Employees: N/A

5. Gross Annual Income $ N/A

6. Net Annual Income $ N/A

7. NAICS Code ► N/A

8. Labor Certification DOL Case Number: N/A

Part 5. Additional Information About the Petitioner (continued)

9. Labor Certification DOL Filing Date (mm/dd/yyyy)

N/A

10. Labor Certification Expiration Date (mm/dd/yyyy)

N/A

If an individual is filing this petition, provide the following information.

11. Occupation

Forestry Engineer

12. Annual Income $ N/A

Part 6. Basic Information About the Proposed Employment

1. Job Title

Environmental Scientists and Specialists, Including Health

2. SOC Code ▶ 19 - 2041

3. Nontechnical Job Description

Conduct research to identify and mitigate environmental hazards by collecting, analyzing, and reporting data from soil and other sources.

4. Is this a full-time position? ☒ Yes ☐ No

5. If the answer to **Item Number 4.** is "No," how many hours per week for the position?

N/A

6. Is this a permanent position? ☒ Yes ☐ No

7. Is this a new position? ☐ Yes ☒ No

8. Wages (Specify hour, week, month, or year):

$ N/A per N/A

Worksite Location

For **Item Numbers 9.a. - 9.e.**, provide the address where the person will work if different from the address provided in **Part 1.**

9.a. Street Number and Name: To be determined

9.b. ☐ Apt. ☐ Ste. ☐ Flr. To be determined

9.c. City or Town: To be determined

9.d. State: TBD **9.e.** ZIP Code: To be determined

Part 7. Information About the Spouse and All Children of the Person for Whom You Are Filing

For **Part 7.**, provide information on the spouse and all children related to the individual for whom you are filing this petition. Also, note if the individual will apply for a visa abroad or adjustment of status as the dependent of the individual for whom the petition is filed. If you need extra space to provide information about additional family members, use the space provided in **Part 11. Additional Information**.

Person 1

1.a. Family Name (Last Name): BONIFACIO RANZULLA

1.b. Given Name (First Name): Stefano

1.c. Middle Name: N/A

2. Date of Birth (mm/dd/yyyy): 04/09/1994

3. Country of Birth

Brazil

4. Relationship: Spouse

5. Is he or she applying for adjustment of status? ☒ Yes ☐ No

6. Is he or she applying for a visa abroad? ☐ Yes ☒ No

Person 2

7.a. Family Name (Last Name): N/A

7.b. Given Name (First Name): N/A

7.c. Middle Name: N/A

8. Date of Birth (mm/dd/yyyy): N/A

9. Country of Birth

N/A

10. Relationship: N/A

11. Is he or she applying for adjustment of status? ☐ Yes ☐ No

12. Is he or she applying for a visa abroad? ☐ Yes ☐ No

Part 7. Information About Spouse and All Children of the Person for Whom You Are Filing (continued)

Person 3

13.a. Family Name (Last Name) N/A

13.b. Given Name (First Name) N/A

13.c. Middle Name N/A

14. Date of Birth (mm/dd/yyyy) N/A

15. Country of Birth
N/A

16. Relationship N/A

17. Is he or she applying for adjustment of status? ☐ Yes ☐ No

18. Is he or she applying for a visa abroad? ☐ Yes ☐ No

Person 4

19.a. Family Name (Last Name) N/A

19.b. Given Name (First Name) N/A

19.c. Middle Name N/A

20. Date of Birth (mm/dd/yyyy) N/A

21. Country of Birth
N/A

22. Relationship N/A

23. Is he or she applying for adjustment of status? ☐ Yes ☐ No

24. Is he or she applying for a visa abroad? ☐ Yes ☐ No

Person 5

25.a. Family Name (Last Name) N/A

25.b. Given Name (First Name) N/A

25.c. Middle Name N/A

26. Date of Birth (mm/dd/yyyy) N/A

27. Country of Birth
N/A

28. Relationship N/A

29. Is he or she applying for adjustment of status? ☐ Yes ☐ No

30. Is he or she applying for a visa abroad? ☐ Yes ☐ No

Person 6

31.a. Family Name (Last Name) N/A

31.b. Given Name (First Name) N/A

31.c. Middle Name N/A

32. Date of Birth (mm/dd/yyyy) N/A

33. Country of Birth
N/A

34. Relationship N/A

35. Is he or she applying for adjustment of status? ☐ Yes ☐ No

36. Is he or she applying for a visa abroad? ☐ Yes ☐ No

Part 8. Contact Information, Certification, and Signature of the Petitioner or Authorized Signatory

Petitioner or Authorized Signatory's Contact Information

1.a. Petitioner's or Authorized Signatory's Family Name (Last Name)
DA SILVA SOUSA

1.b. Petitioner's or Authorized Signatory's Given Name (First Name)
Alice Neri

2. Petitioner's or Authorized Signatory's Title
N/A

3. Petitioner's or Authorized Signatory's Daytime Telephone Number
+55 53 99946-7057

4. Petitioner's or Authorized Signatory's Mobile Telephone Number (if any)
+55 53 99946-7057

5. Petitioner's or Authorized Signatory's Email Address (if any)
nneri.alice@gmail.com

Petitioner's or Authorized Signatory's Certification and Signature

If filing this petition on behalf of an organization, I certify that I am authorized to do so by the organization:

a. I reviewed and provided or authorized all of the responses and information in my petition;

b. I understood all of the responses and information contained in, and submitted with, my petition; and

c. All of the responses and information were complete, true, and correct at the time of filing

Furthermore, I authorize the release of any information from any and all of my records as authorized signatory and the petitioner's records that USCIS may need to determine the petitioner's eligibility for an immigration request and to other entities and persons where necessary for the administration and enforcement of U.S. immigration law.

6.a. Petitioner's or Authorized Signatory's Signature
Alice N S Sousa

6.b. Date of Signature (mm/dd/yyyy) 02/26/2026

Part 9. Interpreter's Contact Information, Certification, and Signature

Interpreter's Full Name

1.a. Interpreter's Family Name (Last Name)
N/A

1.b. Interpreter's Given Name (First Name)
N/A

2. Interpreter's Business or Organization Name
N/A

Interpreter's Contact Information

3. Interpreter's Daytime Telephone Number
N/A

4. Interpreter's Mobile Telephone Number (if any)
N/A

5. Interpreter's Email Address (if any)
N/A

Interpreter's Certification and Signature

I certify, under penalty of perjury, that I am fluent in English and N/A, and I have interpreted every question on the petition and Instructions and interpreted the petitioner's or authorized signatory's answers to the questions in that language, and the petitioner or authorized signatory informed me that they understood every instruction, question, and answer on the petition.

6.a. Interpreter's Signature
N/A

6.b. Date of Signature (mm/dd/yyyy) N/A

Part 10. Contact Information, Certification, and Signature of the Person Preparing this Petition, if Other Than the Petitioner or Authorized Signatory

Preparer's Full Name

1. Preparer's Family Name (Last Name)

HAVERROTH SILVA

Preparer's Given Name (First Name)

Otavio

2. Preparer's Business or Organization Name

HS Law Corp

Preparer's Contact Information

3. Preparer's Daytime Telephone Number

5102419336

4. Preparer's Mobile Telephone Number (if any)

5102419336

5. Preparer's Email Address (if any)

otavio@legalhs.com

Preparer's Certification and Signature

I certify, under penalty of perjury, that I prepared this petition for the petitioner or authorized signatory at their request and with express consent and that all of the responses and information contained in and submitted with the petition are complete, true, and correct and reflects only information provided by the petitioner or authorized signatory. The petitioner or authorized signatory reviewed the responses and information and informed me that they understand the responses and information in or submitted with the petition.

6. Preparer's Signature

Date of Signature (mm/dd/yyyy) 02/26/2026

Part 11. Additional Information

If you need extra space to provide any additional information within this petition, use the space below. If you need more space than what is provided, you may make copies of this page to complete and file with this petition or attach a separate sheet of paper. Type or print your name and A-Number (if any) at the top of each sheet; indicate the **Page Number**, **Part Number**, and **Item Number** to which your answer refers; and sign and date each sheet.

1. Family Name (Last Name): DA SILVA SOUSA

Given Name (First Name): Alice Neri

Middle Name: N/A

2. IRS EIN ► N/A

3.

Page Number	Part Number	Item Number
N/A	N/A	N/A

N/A

4.

Page Number	Part Number	Item Number
N/A	N/A	N/A

N/A

5.

Page Number	Part Number	Item Number
N/A	N/A	N/A

N/A

6.

Page Number	Part Number	Item Number
N/A	N/A	N/A

N/A

7.

Page Number	Part Number	Item Number
N/A	N/A	N/A

N/A

February 17, 2026

Via USPS

USCIS
Attn: I-140
P.O. Box 88774
Chicago, IL 60680-1774

Re: EB-1 FIRST PREFERENCE: EMPLOYMENT-BASED IMMIGRATION PETITION

Petitioner/Beneficiary:	**DA SILVA SOUSA, Alice Neri**
Nature of submission:	**ORIGINAL SUBMISSION**
Type of Petition:	**I-140, EB-1 Employment-based, first preference visa based on petitioner's extraordinary ability**
Classification Sought:	**Immigration and Nationality Act 203(b)(1)(A)**

Dear USCIS Officer:

Our firm represents beneficiary and self-petitioner Alice Neri da Silva Sousa (hereinafter Mrs. Sousa) in her petition for classification as a person of extraordinary ability under the EB-1A category. Enclosed please find the following forms in support of her petition:

- Form G-1450 in the amount of $715 towards I-140 filing fee.
- Form G-1450 in the amount of $300 towards Asylum Program fee.
- Form, G-1145, e-Notification of Application/Petition Acceptance.
- Form G-28, Notice of Entry of Appearance as Attorney or Accredited Representative.
- Form I-140, Petition for Alien Worker.
- Supporting documents for Petitioner.

Mrs. Sousa qualifies as an alien of extraordinary ability **in the Sciences – Bioenergy & environmental/industrial chemistry** under INA§203(b)(1)(A). The regulation at 8 CFR § 204.5(h) defines "extraordinary ability" as follows:

> (a) Extraordinary ability means a level of expertise indicating that the individual is one of that small percentage who have risen to the very top of the field of endeavor.
>
> (b) Initial evidence. A petition for an alien of extraordinary ability must be accompanied by evidence that the alien has sustained national or international acclaim and that his or her achievements have been recognized in the field of expertise. Such evidence shall include evidence of a one-time achievement (that is, a major, internationally recognized award), or **at least three** of the following (8 CFR 204.5(h)(3)):

i. *Documentation of the alien's receipt of lesser nationally or internationally recognized prizes or awards for excellence in the field of endeavor;*
ii. *Documentation of the alien's membership in associations in the field of endeavor, which require outstanding achievements of their members, as, judged by recognized national or international experts in their fields;*
iii. *Published material in professional or major trade publications or major media about the alien and relating to the alien's work in the field of endeavor;*
iv. *Evidence of the alien's participation, either individually or on a panel, as a judge of the work of others in the same or an allied field of specification for which classification is sought;*
v. *Evidence of the alien's original scientific, scholarly, or business contributions of major significance in the field of endeavor;*
vi. *Evidence of alien's authorship of scholarly articles in the field, in professional journals or other major media;*
vii. *Evidence of the display of the alien's work at artistic exhibitions or showcase;*
viii. *Evidence that the alien has performed in a leading or critical role for organizations or establishments that have a distinguished reputation;*
ix. *Evidence that the alien has commanded a high salary or other significantly high remuneration for services, in relation to others in the field; or*
x. *Evidence of commercial successes in the performing arts, as shown by box office receipts or record, cassette, compact disk, or video sales.*

(c) If the above standards do not readily apply to the beneficiary's occupation, the petitioner may submit comparable evidence to establish the beneficiary's eligibility.

This letter serves as a guide for all submitted evidence. Please find enclosed the referred documentation.

The petition is to obtain the immigrant classification on behalf of Mrs. Sousa as a person of extraordinary ability. Mrs. Sousa is an academic professional and has attained a level of expertise indicating she is one of that small percentage of individuals who have risen to the very top of her field, as can be evidenced by (i) the beneficiary's receipt of lesser nationally or internationally recognized prizes or awards for excellence; (iv) her participation as a judge of the work of others in the same or allied field; (v) her original scientific, scholarly, or business contributions of major significance to her field; (vi) authorship of scholarly articles in professional or major trade publications; (vii) display of her work at artistic exhibitions or showcases, **herein submitted as a comparable evidence** (8 CFR 204.5 (h)(4)); and (viii) leading or critical role for organizations or establishments that have a distinguished reputation.

Mrs. Sousa will demonstrate through objective and credible evidence that, by applying the preponderance of evidence standard ("more likely than not"), she meets **at least six** of the regulatory criteria, and when considering the petition in its entirety for the final merits determination, she demonstrates the high level of expertise required for the classification. *(Kazarian v. USCIS*, 596 F.3d 1115 (9th Cir. 2010)).

Moreover, Mrs. Sousa seeks to enter the United States to continue work in the area of extraordinary ability and her entry will substantially benefit the United States in the future, as it will be further demonstrated herein.

A – ELIGIBILITY:

A Brief Note about Mrs. Sousa and her qualification as an Alien of Extraordinary Ability

Mrs. Sousa is an academic professional whose career is grounded in innovative research applied to environmental technology. Her field of specialization focuses on **biochar and activated-carbon–based materials derived from agro-industrial biomass, developed, and characterized for bioenergy and for environmental/industrial chemistry applications, especially adsorption and related processes for contaminant control in water and industrial effluents**. In practical terms, her work sits at the intersection of biomass valorization, carbonaceous materials, and pollution mitigation: converting agricultural and food-processing residues into high-value materials that measurably improve sustainability outcomes.

Her professional trajectory shows a sustained acclaim within this specialization. She earned a B.S. in Forestry Engineering (Federal University of Acre), with focus in Wood Product Technology and emphasis on bioenergy, and during her undergraduate training she was selected for multiple competitive research scholarships such as PIBIC/UFAC and PIBIC/CNPq, **a highly competitive, merit-based federal research award in Brazil that recognizes academic excellence and supports researchers whose work is deemed of strategic importance to the nation's scientific and technological development.**

Mrs. Sousa then completed an M.S. in Forestry Engineering (State University of Santa Catarina), where she investigated **charcoal properties for cooking applications**, aligning technical evaluation of biomass-derived carbon products with real-world energy needs. She is now pursuing a Ph.D. in Technological and Environmental Chemistry (Federal University of Rio Grande), concentrating on **biochar, activated carbon, and pyroligneous extract** produced from **agro-industrial wastes** (e.g., grape and olive pomace, peach pits, rice hulls, corn/soy straw), with attention to quality, applications, and value-added potential.

Her record also reflects the hallmark of extraordinary ability in the sciences: a sustained pattern of scholarly dissemination and peer-recognized research output. Mrs. Sousa has authored peer-reviewed journal articles, including work published in *Scientia Forestalis*, a respected, peer-reviewed forestry journal with international academic circulation (on charcoal produced from Attalea tessmannii fruit waste), and a co-authored article in ACS Omega, a well-regarded international scientific journal recognized for specialized scholarly impact (focused on oil extraction kinetics and physicochemical characterization). She has also contributed a book chapter on charcoal quality produced from wood residues and planted forests, and she has presented a substantial body of work at scientific conferences through full papers and abstracts, demonstrating consistent engagement with the scientific community and the ongoing communication of results for scrutiny and use by other researchers.

In addition to her publications, Mrs. Sousa has produced original, and highly impactful contributions reflected in her role as an inventor on **multiple patent filings** in Brazil. These include, for example, a biochar-based chemically modified voltammetric sensor (rice-husk

biochar) directed at detecting pharmaceuticals (diclofenac), as well as innovations aimed at remediation in aqueous systems (e.g., porous chitosan sponge for removal of used lubricating oil) and biofuel development from biomass-derived oils. This pattern, moving from materials synthesis and characterization to devices and processes, shows her standing to generate protectable, implementation-ready solutions relevant to industrial environmental control and clean production.

Finally, her achievements are reinforced by evidence that she has been entrusted with responsible roles in the scientific enterprise. She has served as a reviewer for scientific journals and participated on an evaluation panel for an academic final project, signaling that her judgment is valued beyond her own research. Her teaching record (course tutoring and multiple teaching internships across forestry engineering, chemistry, and food engineering, including instruction on adsorption) further underscores her standing as a developing expert capable of training others in core concepts central to her specialization.

In summary, Mrs. Sousa's competitive research support, advanced doctoral research in a focused niche, peer-reviewed publications, patented innovations, and scientific reviewing/teaching, presents the type of sustained, documentable scientific achievement and impact that supports classification as a person of extraordinary ability in the sciences, with a credible, well-defined capacity to advance U.S. priorities in waste valorization, industrial sustainability, and water-quality technologies.

Mrs. Sousa will continue working and contributing to the area of Extraordinary Ability in the United States

Under INA 203(b)(1)(A)(ii), to qualify as a person with extraordinary ability, the beneficiary must intend to continue to work in the area of his or her expertise. Mrs. Sousa establishes a clear, credible plan to continue her specialized scientific work in the United States **through postdoctoral research and sustained collaboration with U.S. academia and industry**. She expressly states her intent to pursue postdoctoral opportunities in the U.S. to deepen partnerships and to develop innovative technologies that transform agro-industrial waste into high-value materials. This forward-looking plan is not speculative: it is a direct extension of her current doctoral research in technological and environmental chemistry focused on biochar, activated carbon, and pyroligneous extracts derived from agro-industrial residues.

Her plan further shows that her U.S. contributions will be applied, outcome-oriented, and aligned with persistent national needs, particularly in industrial environmental performance and water quality. She identifies a targeted set of real-world contaminants, pharmaceuticals, pesticides, dyes, fertilizers, and industrial chemicals, and explains that her goal is to develop biochar-based materials and processes for industrial applications and wastewater treatment. **This is persuasive evidence of continued work because it defines a concrete technical direction (pollution control via biochar/activated carbon solutions), a specific deployment context (industrial and wastewater systems), and measurable public benefits (waste reduction, greenhouse gas mitigation, and cleaner production).**

Moreover, Mrs. Sousa seeks to continue her professional work in the United States by applying her expertise to sectors currently under significant pressure to innovate while meeting evolving environmental and regulatory demands, including agriculture, pharmaceuticals, industrial manufacturing, and food processing. She specifically aims to engage with U.S. innovation ecosystems supported by federal agencies such as the Department of Energy (DOE),

Environmental Protection Agency (EPA), and National Science Foundation (NSF). By advancing solutions that reduce operational costs, expand circular-economy practices, and improve industrial efficiency while reinforcing environmental stewardship, Mrs. Sousa establishes a clear and practical national-interest rationale for her continued work in the United States. Her efforts are set to be supported, adopted, and amplified through American research institutions and industry partnerships, ensuring meaningful and sustained benefit to the U.S. economy and environmental objectives.

To demonstrate how Mrs. Sousa proposes to continue working and contributing to the area of Bioenergy & environmental/industrial chemistry Research in the United States, please refer to **Exhibit A**:

A.1. Beneficiary's Personal Statement
A.2. Beneficiary's Resume

Beneficiary's entry to Substantially Benefit the United States in the future

INA 203(b)(1)(A)(iii) establishes that to qualify as a person with extraordinary ability, his/her entry must also substantially benefit the United States in the future. **This interpretation should be broad as neither the statute nor the regulations specifically define the statutory phrase "substantially benefit"**. (*see* U.S. Citizenship & Immigr. Servs., Policy Manual, vol. 6, pt. F, ch. 2, § A.3, https://www.uscis.gov/policy-manual/volume-6-part-f-chapter-2 (last updated Oct. 20, 2021).).

Mrs. Sousa's work is positioned to deliver substantial future benefit to the United States by advancing cost-effective and scalable solutions for industrial water and wastewater treatment, an area of growing national concern as U.S. industries face increasing pressure to manage pharmaceutical residues, agricultural chemicals, and industrial contaminants in water systems. Her specialization in developing biochar and activated-carbon sorbent materials from agro-industrial biomass directly addresses a persistent gap in current treatment technologies, which often rely on expensive, energy-intensive, or imported materials.[1]

In addition, Mrs. Sousa's focus on valorizing agricultural and food-processing residues aligns with current U.S. priorities related to waste reduction, domestic resource utilization, and supply-chain resilience. Repurposing widely available agricultural and food-processing residues, including grape and olive pomace, rice hulls, corn straw, and soybean byproducts, into advanced adsorptive materials advances circular manufacturing frameworks that convert industrial waste into practical environmental solutions. This strategy reduces waste disposal and related environmental impacts while generating new economic uses for agricultural byproducts, reinforcing the sustainability and competitiveness of U.S. farming and agro-industrial operations and contributing to resilient domestic supply chains.

In addition, Mrs. Sousa's research also offers meaningful benefits to sectors under increasing regulatory and environmental scrutiny, including pharmaceuticals, industrial manufacturing, and food processing. Her work targets contaminants such as drugs-related, pesticides, dyes, fertilizers,

[1] https://www.epa.gov/water-research/wastewater-contaminants-research

and industrial chemicals, pollutants that pose documented risks to water quality, ecosystems, and public health.

Importantly, Mrs. Sousa's expertise combines environmental chemistry, bioenergy, and advanced materials development, positioning her to collaborate effectively with U.S. research institutions, clean-technology companies, and industrial partners. Her background in thermochemical biomass conversion and applied adsorption technologies supports innovation pathways that are readily transferable from laboratory research to industrial application. This translational potential increases the likelihood that her work will be adopted, scaled, and integrated into U.S. industrial processes, amplifying its impact beyond academic research and into practical deployment.

Looking forward, Mrs. Sousa's continued work in the United States would strengthen the efforts to modernize industrial water treatment, promote sustainable manufacturing, and advance environmentally responsible innovation using domestic resources. Through Reducing operational costs, improving industrial efficiency, and supporting environmentally sound production across multiple sectors, her contributions offer enduring economic, environmental, and technological benefits.

Mrs. Sousa has earned sustained national and international acclaim related to her work, and her achievements have been recognized in her field, demonstrating that she is "one of that small percentage who have risen to the very top of the field*"* (*see* 8 CFR 204.5(h)(2)) as it will be evidenced throughout this petition along with supporting documentation.

B - EVIDENCE OF EXTRAORDINARY ABILITY – REGULATORY CRITERIA

In the first step examination, Officer should determine whether, **by preponderance of the evidence**, the petitioner objectively meets **at least three** of ten regulatory criteria listed under 8 CFR § 204.5(h), as explained below. Mrs. Sousa meets **at least six** of these criteria, demonstrating her *prima facie* standing as a person of extraordinary ability in the sciences.

Criterion 1. Beneficiary's receipt of lesser nationally or internationally recognized prizes or awards for excellence

To qualify for this regulatory criterion, the beneficiary shall demonstrate whether: 1) the person was the recipient of prizes or awards; 2) the award is a lesser nationally or internationally recognized prize or award which the person received for excellence in the field of endeavor (8 CFR 204.5(h)(3)(i)). **As indicated in the USCIS' policy plain language, this criterion does not require an award or prize to have the same level of recognition and prestige associated with the Nobel Prize or another award that would qualify as a one-time achievement.**

USCIS further clarifies the application of this rule by providing illustrative examples of what may constitute a qualifying award. Specifically, the Policy Manual notes that such awards may include, but are not limited to, **recognition from well-known national institutions or professional associations**, **distinguished doctoral dissertation awards**, and **honors for presentations delivered at nationally or internationally recognized conferences**. This interpretive guidance underscores USCIS's emphasis on the prestige and selectivity of the awarding body, as well as the visibility and impact of the achievement within the petitioner's field of expertise.

Still according to the Federal Agency's guidance:

> While many scholastic awards do not have the requisite level of recognition, there may be some that are nationally or internationally recognized as awards for excellence such that they may satisfy the requirements of this criterion. For example, an award available only to persons within a single locality, employer, or school may have little national or international recognition, **while an award open to members of a well-known national institution (including an R1 or R2 doctoral university) or professional organization may be nationally recognized.** (*See* U.S. Citizenship & Immigr. Servs., Policy Manual, vol. 6, pt. F, ch. 2 (updated Mar. 23, 2023), https://www.uscis.gov/policy-manual/volume-6-part-f-chapter-2.).

The Carnegie Classification of Institutions of Higher Education recognizes R1 and R2 doctoral universities as having **very high or high research activity**, respectively, based on publicly available federal government data regarding the number of doctoral degrees awarded and the amount of total research expenditures.[2]

The CAPES Scholarship – The Brazilian Government's most important scholarship for scientific development

The Coordination for the Improvement of Higher Education Personnel **(**CAPES) scholarship stands as **the most prestigious and competitive public academic awards in Brazil** and serves as a central pillar of the country's national graduate education and research system. CAPES, a federal agency linked to Brazil's Ministry of Education, is responsible for accrediting, evaluating, and funding master's and doctoral programs nationwide, and its scholarships are awarded **exclusively through merit-based, highly selective processes**.

Although Brazil does not utilize the Carnegie Classification system applied in the United States to categorize research universities, CAPES performs an analogous national function by evaluating graduate programs based on research output, faculty quality, doctoral training, and academic impact. In practical terms, CAPES scholarships in Brazil occupy a role **comparable to major U.S. federally supported research awards administered through institutions such as those funded by the National Science Foundation (NSF), the National Institutes of Health (NIH), or competitive federally backed graduate fellowships**. As such, receipt of a CAPES scholarship constitutes nationally recognized academic distinction in Brazil and is widely understood within the international academic community as evidence of research excellence and scholarly merit.

Mrs. Sousa was the recipient of a competitive award – Doctoral (1st place) and Masters (4th place)

The record establishes that Mrs. Sousa was the recipient of a competitive academic award in the form of a CAPES-funded **doctoral scholarship**, granted following a **merit-based selection process**. Official CAPES records confirm that Mrs. Sousa was designated as a doctoral scholarship recipient under the Social Demand Program (DS**)** at the Federal University of Rio Grande (FURG) for the year 2024, **evidencing her status as an awardee of such prestigious federally regulated scholarship program.**

In addition, the results demonstrate that Mrs. Sousa ranked **1st place overall among all candidates competing for doctoral admission and scholarship consideration** in the Program of Graduate Studies in Technological and Environmental Chemistry. The published results expressly list Mrs.

[2] https://carnegieclassifications.acenet.edu/

Sousa as the **top-ranked doctoral candidate**, approved with the **maximum score (10.00)**, and subsequently classified **1st place in the allocation of doctoral CAPES scholarships**, receiving one of the very limited available awards.

Moreover, the official notice confirms that Mrs. Sousa was classified **4th among all evaluated candidates** and was selected as a scholarship recipient for **the master's degree program in forestry engineering**, thereby also satisfying the regulatory requirement that the beneficiary be the recipient of a prize or award.

Importantly, the scholarship was not automatically granted to all applicants or enrolled students, but only to those candidates who achieved the highest rankings following evaluation. Mrs. Sousa's receipt of this award therefore reflects a selective and competitive outcome, not mere participation. Thus, the documents conclusively establish that Mrs. Sousa was the recipient of a competitive prize awarded through an official selection process.

The award is a lesser nationally recognized award granted for excellence in the field

Mrs. Sousa's CAPES doctoral and master's scholarship qualify as a lesser nationally recognized award for excellence in the field**,** as contemplated by 8 C.F.R. § 204.5(h)(3)(i) and USCIS policy guidance. CAPES is a federal agency linked to Brazil's Ministry of Education and serves as the principal national authority responsible for funding, regulating, and evaluating graduate-level research and doctoral training throughout the country. Scholarships awarded under CAPES programs are nationally recognized academic distinctions and are conferred only following rigorous, merit-based evaluation.

While the Manual acknowledges that many scholastic awards may lack sufficient recognition, it expressly provides that awards offered by "a well-known national institution (including an R1 or R2 doctoral university)" may meet the standard of proof. **This recognition is not exhaustive, and other awards conferred by comparably well-known academic institutions may likewise satisfy the applicable standard of proof based on their prestige, selectivity, and national or international recognition**. CAPES operates as **Brazil's primary federal agency for graduate education oversight,** applying uniform national criteria to evaluate programs and allocate competitive scholarships. Awards funded through CAPES therefore represent recognition conferred within a nationally recognized institutional framework, meeting the Policy Manual's emphasis on prestige, selectivity, and evaluative rigor. As such, awards granted by CAPES are inherently distinguished within the national academic community and are widely recognized beyond any single institution. *See* U.S. Citizenship & Immigr. Servs., *Policy Manual*, vol. 6, pt. F, ch. 5, § C(1).[3]

Moreover, the doctoral award at issue was granted through a **highly selective, multi-stage competitive process**, governed by public notices that set forth objective evaluation criteria, expert review, and ranking-based selection. The doctoral selection process included written examinations, research project defense, curriculum analysis, and quantitative scoring, with final rankings determined by a **faculty selection committee composed of subject-matter experts** in chemistry and environmental sciences. **Only candidates achieving the highest cumulative scores advanced**

[3] https://www.uscis.gov/policy-manual/volume-6-part-f-chapter-5.

to final approval, and scholarship allocation was strictly limited to those ranking at the top of the classification list.

Critically, the results confirm that **only one candidate** was awarded a CAPES doctoral scholarship under the open competition category (not quota), and Mrs. Sousa was ranked **first among all competitors**, demonstrating a high level of selectivity and excellence. **This degree of competitiveness strongly supports the conclusion that the award was granted for excellence rather than participation or routine academic progression.**

Lastly, the award was conferred within a **federally recognized doctoral institution**, namely FURG, a Brazilian federal university operating under the national graduate education system regulated and evaluated by CAPES. **USCIS policy expressly recognizes that awards open to members of well-known national institutions, including doctoral universities, may constitute nationally recognized awards when they reflect selective, merit-based recognition** (id.). The institutional standing of CAPES and the doctoral program through which the award was granted therefore further reinforces its excellence standing.

Taken together, the evidence establishes that Mrs. Sousa (1) was the recipient of a prize or award, and (2) that the award constitutes a lesser nationally recognized distinction granted for excellence in her field, satisfying the evidentiary criterion set forth at 8 C.F.R. § 204.5(h)(3)(i). (**Exhibit B)**:

> **B.1.** Official CAPES record confirming award of a federally funded doctoral scholarship to Mrs. Sousa at the Federal University of Rio Grande (FURG), 2024.
> **B.2.** Final doctoral selection results (01/2023; 03/2023) showing Mrs. Sousa ranked first with the highest score in the PPGQTA doctoral program at the Federal University of Rio Grande (FURG), demonstrating that she was the award's recipient.
> **B.3.** Official public notice PPGQTA 01/2023, sections **1.2., 4.1. *Nivel Doutorado* (a)-(j), 5.3.,5.4., 5.5., and 6.1.**, demonstrating that the basis for granting the award was excellence in the field.
> **B.4.** Official CAPES record confirming award of a federally funded master's scholarship to Mrs. Sousa at the State University of Santa Catarina (UDESC), 2022.
> **B.5.** Final results Nº 03/2021/PPGEF/UDESC, masters in forestry engineering, showing Mrs. Sousa ranked 4th place with the UDESC program as a CAPES scholarship awardee, demonstrating that she was the award's recipient.
> **B.6.** Official public notice 03/2021/PPGEF/UDESC, sections **1.4, 1.5, 1.6,** and **3.1.**, demonstrating that the basis for granting the award was excellence in the field.
> **B.7.** Printout *About Us* section from the official Brazilian Government website, noting that CAPES scholarship award is granted based on excellence in research and academic achievement. [Available at: https://www.gov.br/capes/pt-br/acesso-a-informacao/perguntas-frequentes/sobre-a-cap].
> **B.8.** Printout *Yale-CAPES program to prepare Brazil' s next generation of science leaders*, demonstrating that the well-regarded CAPES scholarship is granted based on excellence in sciences [https://news.yale.edu/2018/06/25/yale-capes-program-prepare-brazils-next-generation-science-leaders].

Accordingly, these awards received by Mrs. Sousa qualify as prizes for excellence under the regulations and provide strong evidence of beneficiary's national recognition and distinguished reputation in her area of expertise pursuant to 8 CFR 204.5(h)(3)(i) and USCIS interpretation.

Criterion 4. The Petitioner's participation, either individually or on a panel, as a judge of the work of others in the same or an allied field of specialization for which classification is sought.

To qualify for this eligibility criterion, the regulation determines whether the person has acted as the judge of the work of others in the same or allied field of specialization. The petitioner must show that the person has not only been invited to judge the work of others, but also that the person actually participated in the judging process (8 CFR 204.5(h)(3)(iv)).

Ad hoc reviewer – *Scientia Forestalis* (journal)

Mrs. Sousa was invited, in September 2022, to perform as ***ad hoc*** **reviewer** for the reputable scientific journal *Scientia Florestalis* to evaluate the manuscript **"Wood quality of Eucalyptus clones for the production of plywood panels"**. This study evaluated whether five young eucalyptus tree clones were suitable for manufacturing multilayer plywood panels. The research tested panels made with eucalyptus veneers on the outer layers and commonly used commercial woods in the core, bonded with industrial adhesive. The results showed that eucalyptus clones, particularly *Eucalyptus dunnii*, performed well and met all applicable Brazilian technical standards for strength, durability, moisture control, and structural performance. One specific clone, USP/IPEF 68 (*Eucalyptus dunnii*), demonstrated superior results across all tested properties, confirming its suitability for high-quality plywood production and supporting its potential for commercial and industrial use.

Credible evidence also demonstrates that she actually performed the evaluation work through review submission dated 2022-10-10 at 11:56 PM, by as well a confirmation email sent on October 11, 2022, from PhD Professor Mauro Valdir Schumacher, **Editor in chief of Scientia Forestalis journal** at the time.

The petitioner's service as an *ad hoc* reviewer for this scientific journal squarely satisfies this criterion because it constitutes **peer review of independent researchers' original scholarly work**, a form of judging that USCIS has consistently recognized as classic and **highly probative** evidence under this prong. *See* **U.S. Citizenship & Immigr. Servs., USCIS Policy Manual**, vol. 6, pt. F, ch. 2, § A.4. This role is **inherently selective** and extended based on demonstrated expertise and professional reputation, rather than any institutional obligation or routine academic duty. As a reviewer, the petitioner evaluates the originality, methodological rigor, and scientific merit of submitted manuscripts and provides confidential recommendations that directly influence publication outcomes, placing the petitioner **in a position of authority over the work of other experts in the field.** Such evaluation of original research for publication lies at the very core of "judging the work of others" contemplated by the regulations.

Moreover, *Scientia Forestalis* is a **recognized academic journal from the Brazilian Institute for Forestry Research (IPEF) with national and international reach**, reinforcing the probative value of this reviewing activity. The journal's scope and standing in the field support a finding that the petitioner's assessments **have** meaningful impact beyond a single institution, and that the editorial board relies on the petitioner's **specialized knowledge and professional judgment** to maintain scholarly standards. This evidentiary record may be further corroborated through objective documentation such as editorial invitation emails, reviewer guidelines, acknowledgment letters, and proof of the journal's ISSN, indexing, and disciplinary scope, all of which demonstrate the independence, confidentiality, and significance of the petitioner's role.

Appointment as Examiner for Undergraduate Thesis Committees

In addition to her scholarly peer-review activities, Mrs. Sousa was formally appointed as **Examiner 2** on the Examining Committees for Undergraduate Thesis within the Department of Forest Engineering at the Santa Catarina State University (UDESC), pursuant to Internal Ordinance of CAV No. 159/2021, dated October 8, 2021. This ordinance was issued by the Dean of the Center for Agro-Veterinary Sciences in the lawful exercise of institutional authority and officially published the composition of the examining committees for the first academic semester of 2021.

Mrs. Sousa was named to evaluate the work titled “Analysis of the Behavior of Wood Particle Panels Exposed to Temperature Variation” authored by the student Taís Pitz Barbosa, under the supervision of Professor Martha Andreia Brand.

This appointment reflects institutional recognition of Mrs. Sousa’s subject-matter expertise and professional judgment, **as she was selected to evaluate and assess the final academic work of graduating students**. Her role as an examiner required independent analysis of thesis quality, methodological soundness, and substantive contributions, thereby constituting formal participation in judging the work of others within an accredited higher-education setting at Center for Agro-Veterinary Sciences (CAV).

Official declaration from the State University, dated September 16, 2025, confirms that Mrs. Sousa actually performed the judgement of the work of others in 2021 and that her participation “was of great relevance for the critical analysis and academic enrichment of the work, contributing significantly to the evaluation process and scientific validation of the research presented.” (**Exhibit C).**

Collective, the submitted evidence demonstrates that Mrs. Sousa was invited and actually participated as an ad hoc reviewer for the manuscript "Wood quality of Eucalyptus clones for the production of plywood panels" submitted to the scholarly journal *Sciencia Florestalis* in September 2022 and that she was also invited and contributed to the Santa Catarina State University as a Final Thesis Committee participant in the evaluation of the student’s papers, squarely aligned with the regulation and the USCIS adjudication standards.

To demonstrate the fulfillment of all elements within this criterion, we are submitting the following evidence under **Exhibit C**:

> **C.1.** Invitation email from the Editor-in-Chief of Scientia Forestalis (September 12, 2022) requesting Mrs. Sousa to review the manuscript "Wood quality of Eucalyptus clones for the production of plywood panels," demonstrating that she was invited to participate in the judgment of the work of others in the sciences - Bioenergy & environmental/industrial chemistry.
> **C.2.** Submission confirmation from the Scientia Forestalis editorial system (October 10, 2022) verifying that Mrs. Sousa completed the peer review of research regarding industrial wood quality, demonstrating that she participated in the judgment of the work of others in the sciences - Bioenergy & environmental/industrial chemistry.
> **C.3.** Official Statement from the Editorial Board of Scientia Forestalis (October 11, 2022) acknowledging Mrs. Sousa's contribution to the critical analysis of scientific work, demonstrating that she participated in the judgment of the work of others in the sciences - Bioenergy & environmental/industrial chemistry.

C.4. Internal Ordinance No. 159/2021 from the State University of Santa Catarina (UDESC) appointing Mrs. Sousa to the Examining Committee for a thesis on wood particle panels and temperature variation, demonstrating that she was invited to participate in the judgment of the work of others in the sciences - Bioenergy & environmental/industrial chemistry.
C.5. Declaration from the Department of Forest Engineering at UDESC (September 16, 2025) certifying Mrs. Sousa's service as a formal examiner for the scientific validation of research on wood-based materials, demonstrating that she participated in the judgment of the work of others in the sciences - Bioenergy & environmental/industrial chemistry.
C.6. Letter from Dr. Martha Andreia Brand, Professor at the State University of Santa Catarina (UDESC), confirming that Ms. Sousa was invited to serve in an official capacity as a judge and evaluator of the work of others in her field.
C.7. Editorial profile of Scientia Forestalis detailing the journal's rigorous peer-review standards for original scientific articles in forest and natural resources, demonstrating that Mrs. Sousa was invited and participated in the judgment of the work of others in the sciences - Bioenergy & environmental/industrial chemistry.

Hence, the credible evidence objectively demonstrates that Mrs. Sousa was invited and actually participated as a judge of the work of others in the sciences - sciences - Bioenergy & environmental/industrial chemistry field, pursuant to 8 CFR 204.5(h)(3)(iv) and USCIS guidelines.

Criterion 5. Petitioner's original scientific, scholarly, artistic, athletic, or business-related contributions of major significance in the field.

In evaluating this specific regulatory criterion (8 CFR 204.5(h)(3)(v)), USCIS first determines whether the person has made original scientific, scholarly, artistic, athletic, or business-related contributions to the field. Then, Service determines whether the person's original contributions are considered of major significance to the field.

Evidence of originality and major significance - Mrs. Sousa's patented work is sought at a level indicative of major significance in the field.

Mrs. Sousa is the creator and co-inventor of two officially registered Brazilian patents in the sciences, specifically in her field of specialization, environmental and chemical engineering. The first is titled *"Use of Porous Chitosan Sponge for the Removal of Used Lubricating Oil in an Aqueous System,"* registered under Brazilian patent number BR 102024002786-8 A2, with filing date February 9, 2024, and national publication date October 22, 2024. The second patent is titled *"Process for Obtaining a Chemically Modified Voltammetric Sensor with Rice Husk Biochar for Diclofenac Determination,",* registered under Brazilian patent number BR 102024021199-5 A2, with filing date October 11, 2024, and national publication date June 10, 2025. **These grants, issued by the Brazilian National Institute of Industrial Property (INPI), confirm that her inventions have successfully undergone substantive examination and meet the legal standards of novelty, inventive step, and industrial applicability in the environmental and chemical engineering sciences.**

In addition, Mrs. Sousa has two further patent applications currently pending before INPI, concerning additional original scientific developments in environmental and chemical engineering. Under the Brazilian Industrial Property Statute, No. 9.279/96, the content of such patent applications is protected by confidentiality rules until formal publication by the patent authority.

Therefore, while the full technical details of these pending inventions cannot yet be disclosed, their existence and status as ongoing proceedings before INPI further demonstrate Mrs. Sousa's continuous, research-driven innovation in her specialized field.

USCIS interprets the rule under 8 CFR 204.5(h)(3)(v) stating that patents deriving from the person's work **are example of relevant evidence to demonstrate originality** (*See* **U.S. Citizenship & Immigr. Servs., USCIS Policy Manual**, vol. 6, pt. F, ch. 2, § A.5). Evidence that a beneficiary's work was funded, patented, or published may demonstrate originality; however, such documentation alone does not automatically establish that the contribution is of **major significance to the field**. To meet this higher standard, the record must show that the work has had measurable impact beyond its mere development or dissemination. Persuasive indicators of significance may include substantial scholarly attention, meaningful citation levels relative to others in the discipline, documented reliance by independent researchers, or evidence that a patented technology has attracted commercial adoption or industry implementation. (Id.)

In this analysis, **detailed expert support letters are especially probative.** Well-substantiated letters from recognized authorities that clearly explain the technical substance of the beneficiary's contribution, distinguish it from prior work, and describe its influence on research, practice, or industry provide critical context for evaluating major significance. **Such letters carry greater evidentiary weight when they are specific, independently prepared, and supported by objective documentation**.

Mrs. Sousa is a named inventor on two registered Brazilian patent applications: "Use of Porous Chitosan Sponge for the Removal of Used Lubricating Oil in an Aqueous System", an innovative, biodegradable chitosan-based porous sponge **capable of removing over 99% of used lubricating oil from contaminated water with rapid contact time and reusability, offering a cost-effective and environmentally sustainable solution to a significant source of soil and groundwater pollution** and "Process for Obtaining a Chemically Modified Voltammetric Sensor with Rice Husk Biochar for Diclofenac Determination", a chemically modified electroanalytical sensor utilizing rice husk–derived biochar to achieve highly sensitive detection of diclofenac in water systems, **transforming agricultural waste into a green, low-cost technology for monitoring emerging pharmaceutical contaminants**. Her work clearly meets the first step of the regulatory analysis by demonstrating documented originality through formally filed and published intellectual property within her field of specialization in environmental and electroanalytical chemistry.

The major significance of Mrs. Sousa's original work is further validated by the expert testimony of Professor Guilherme Luiz Dotto, **a world-class authority recognized as a Clarivate Highly Cited Researcher and ranked among the top 2% of scientists globally by Stanford University and Elsevier (Exhibit D.5.)**. Professor Dotto attests that Mrs. Sousa's research in technological and environmental chemistry has "demonstrated both originality and practical relevance," resulting in "technological advances currently protected by intellectual property" that "reflect technical maturity and a clear understanding of how fundamental chemistry can translate into tangible environmental benefits." (Letter from Guilherme Luiz Dotto, Full Professor, Fed. Univ. of Santa Maria (UFSM), to Whom It May Concern (Oct. 28, 2025)). Professor Dotto's evaluation provides **authoritative evidence that Mrs. Sousa's innovations are not merely theoretical but represent a significant advancement in the field of green chemistry with a clear orientation toward sustainable industrial application**.

Moreover, additional detailed expert letters from **recognized authorities in the field** attest that these patented technologies address significant environmental challenges, namely, oil-contaminated water remediation and pharmaceutical pollutant detection **(Exhibits D.5. -D.9.):**

> "In my view, the original contribution registered through the patent BR 102024021199-5 A2 at the Brazilian National Institute of Industrial Property (INPI) . . . provides clear evidence of Ms. Sousa's authorship of a scientifically and professionally relevant contribution of major impact to the electroanalytical chemistry field." Letter from Rodrigo Alejandro Abarza Muñoz, Full Professor of Chemistry, Fed. Univ. of Uberlândia, to U.S. Citizenship and Immigr. Servs. (Dec. 8, 2025).
>
> "Mrs. Sousa's patent co-authorships demonstrate the conversion of low-value residues into higher-value materials, address challenges in environmental monitoring and remediation, and contribute to civic and industrial advancement while protecting the environment." Letter from Ligia Damasceno Ferreira Marczak, Full Professor, Chem. Eng'g Dep't, Fed. Univ. of Rio Grande do Sul, to Whom It May Concern (Nov. 14, 2025).
>
> "This project is having a major impact on Brazilian science, thanks to the numerous patents registered since 2023, for which doctoral student Alice Neri da Silva Sousa's contribution was essential for the execution of laboratory research and related goals." Declaration from Prof. Dr. Luiz Antonio de Almeida Pinto, Dir., Sch. of Chemistry & Food Sci. & Prof. Co-Advisor, Fed. Univ. of Rio Grande, to Whom It May Concern (Sept. 10, 2025).
>
> "The topics [Ms. Sousa] pursues, including residue valorization, functional bio-derived materials, and environmental sensing, are timely, and the innovative approach of her work is a positive indicator of practical orientation. From my perspective, these are areas where scientifically grounded engineering can make a difference in industry and society of the United States." Letter from Christian A. Gusbeth, Dr., Inst. for Pulsed Power & Microwave Tech. (IHM), Karlsruhe Inst. of Tech. (KIT), to Whom It May Concern (Nov. 10, 2025).

In scientific disciplines such as environmental remediation materials and electroanalytical chemistry, work is considered of *major significance* when it demonstrably advances the state of the art and produces measurable impact beyond laboratory novelty. **In these fields, major significance is established when a contribution solves a recognized environmental or technological problem, outperforms prior technologies through objective performance metrics, and shows credible potential for adoption in research, industry, or environmental monitoring**. This standard is particularly relevant where the work addresses globally documented environmental concerns, including used-oil contamination of soil and water resources and the growing presence of pharmaceutical residues such as diclofenac in freshwater ecosystems.[4]

Mrs. Sousa's patented technologies satisfy this standard. Her porous chitosan sponge for oil-contaminated water remediation and her rice-husk-biochar–modified electrochemical sensor for diclofenac detection are not merely original, they introduce objectively improved performance characteristics, including high removal efficiency, reusability, simplified processing, optimized detection sensitivity, and environmentally sustainable design. Independent expert letters further explain how these features materially improve upon prior technologies and address pressing environmental challenges, thereby demonstrating both technical advancement and field-level

[4] https://www.epa.gov/recycle/managing-reusing-and-recycling-used-oil?

relevance. When combined with comparative performance data and documented environmental need, the record establishes that her contributions are of major significance and that she remains an active scientist positioned to implement and expand these technologies within the United States.

To assist in evaluating this criterion, we are submitting the following supporting documents under **Exhibit D:**

D.1. Patent Registration BR 102024002786-8 A2, titled *"Use of Porous Chitosan Sponge for the Removal of Used Lubricating Oil in an Aqueous System,"* issued by the Brazilian National Institute of Industrial Property (INPI)**,** serving as official evidence of an original invention authored by Mrs. Sousa, confirming that the work has undergone substantive examination and meets the legal requirements for novelty and industrial applicability.
D.2. Patent Registration BR 102024021199-5 A2, titled *"Process for Obtaining a Chemically Modified Voltammetric Sensor with Rice Husk Biochar for Diclofenac Determination,"* issued by the Brazilian National Institute of Industrial Property (INPI), demonstrating Mrs. Sousa's authorship of an original technological advancement in the field of electroanalytical chemistry, specifically regarding the sustainable detection of pharmaceutical contaminants.
D.3. Official Patent Application Filing Receipt for the invention titled *"Use of Porous Chitosan Sponge for the Removal of Used Lubricating Oil in an Aqueous System,"* filed with the Brazilian National Institute of Industrial Property (INPI), confirming the creation of a new, original work currently undergoing the formal protection process, further establishing Mrs. Sousa's consistent output of innovative research.
D.4. Official Patent Application Filing Receipt for the invention titled *"Process for Obtaining a Chemically Modified Voltammetric Sensor with Soybean Biochar for the Determination of Tartrazine,"* filed with the Brazilian National Institute of Industrial Property (INPI), providing evidence of Mrs. Sousa's original contribution to the development of sensors for food safety and environmental monitoring, representing a distinct and novel application of her biochar research.
D.5. Expert Letter from Professor Guilherme Luiz Dotto, a Clarivate Highly Cited Researcher and **Top 2% Scientist globally**, attesting to the major significance of Mrs. Sousa's work.
D.6. Expert Letter from Professor Rodrigo Alejandro Abarza Muñoz, Full Professor of Chemistry and member of the Brazilian Academy of Sciences, evaluating the significant impact of Mrs. Sousa's patents.
D.7. Expert Letter from Professor Ligia Damasceno Ferreira Marczak, Full Professor at the Federal University of Rio Grande do Sul (UFRGS), validating the technological progress of Mrs. Sousa's research and the major significance of converting low-value residues into high-value functional materials.
D.8. Declaration from Professor Dr. Luiz Antonio de Almeida Pinto, Director of the School of Chemistry and Food Science at the Federal University of Rio Grande (FURG). This document confirms that Mrs. Sousa's essential contributions to funded innovation projects are "having a major impact on Brazilian science" through the development of a chain of patents and technical reports that advance the national scientific agenda.
D.9. Expert Letter from Dr. Christian A. Gusbeth, Research Scientist at the Karlsruhe Institute of Technology (KIT) in Germany, regarding the international relevance of Mrs. Sousa's innovation that can make a significant difference in the industry and society of the United States.

Based on the submitted evidence, Mrs. Sousa's original work has already demonstrated measurable and field-wide influence and therefore satisfies the regulatory requirement for original scientific contributions of major significance under 8 C.F.R. § 204.5(h)(3)(v).

Criterion 6. Petitioner's authorship of scholarly articles in the field, in professional or major trade publications.

To meet this specific criterion, USCIS requires evidence (1) that the person has authored scholarly articles in the field; (2) whether the venue of the publication qualifies as a professional publication, major trade publication or major media publication (8 CFR 204.5(h)(3)(vi).).

According to the Policy, "[e]xamples of scholarly article authorship include but are not limited to: Publications in professionally relevant peer-reviewed journals; and Published conference presentations at nationally or internationally recognized conferences." (USCIS Policy Manual, vol. 6, pt. F, ch. 2(A)(6).).

Publications in professionally relevant peer-reviewed journals

Mrs. Sousa is the author of scholarly articles in her field in well-known scientific journals with international reach. Notably, she is the author of a scholarly article published at *ACS Omega*, published by the American Chemical Society, **one of the world's most respected scientific organizations**, and maintains rigorous peer-review standards, international circulation, and broad indexing within the global chemistry and environmental sciences communities. Publication in such a venue reflects selection through an independent scientific review process and demonstrates that Mrs. Sousa's research **meets internationally recognized standards of originality, methodological rigor, and relevance**. The placement of her work in this high-visibility journal confirms her active engagement in advanced scientific inquiry and establishes her authorship of scholarly articles in a major professional journal, as contemplated under 8 C.F.R. § 204.5(h)(3)(vi).

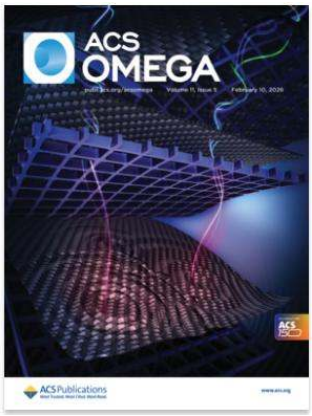
In addition to her publication in *ACS Omega*, Mrs. Sousa has authored scholarly work in other recognized academic venues within her field of environmental and materials sciences. Her research published in *Scientia Forestalis* further demonstrates her continued engagement in peer-reviewed scientific discourse. *Scientia Forestalis* is a specialized academic journal dedicated to forestry and environmental sciences and serves as a professional publication within its discipline. Articles published in this journal undergo editorial and peer review evaluation, ensuring that contributions meet established methodological and scientific standards.

Mrs. Sousa has also published a chapter in the *Open Science Research Journal* (No. VII/2), a scientific volume dedicated to academic research dissemination. As an academic publication with editorial oversight and peer reviewing process, this venue contributes to the body of professional literature in her area of specialization. **Importantly, the book in which Mrs. Sousa appears as the co-author of chapter 7 has been viewed/read over 3.000 times to date by other professionals in the field, demonstrating the relevant field-specific of Mrs. Sousa published article.**

Below is a structured presentation of Mrs. Sousa's qualifying publications:

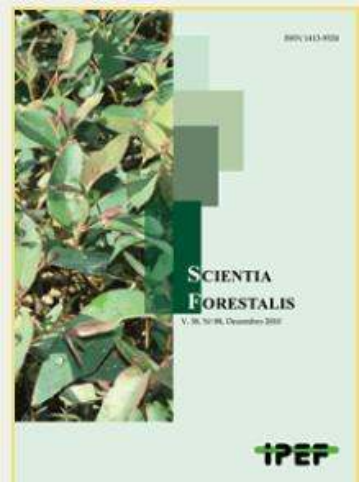
- ***Extraction of Oil from Amazonian Attalea tessmannii Kernels: Kinetics Modeling, Diffusivity Analyses, and Physicochemical Characterization -*** The study analyzed the oil extracted from the seeds of the Amazonian palm tree *Attalea tessmannii* and demonstrated that it contains a high yield of beneficial fatty acids with strong potential for use in food products, pharmaceuticals, and biodiesel production.

  Authors: ANS Sousa et. al.
  Venue: ACS Omega Journal
  Peer Review: Yes – International peer-reviewed journal
  ISSN: 2470-1343
  Publisher: American Chemical Society
  Classification: Professional Journal / Major Scientific Publication (USCIS Policy Manual, Vol. 6, Pt. F, Ch. 2).



- ***Charcoal produced from Attalea tessmannii Burret. fruit wastes –*** This study showed that charcoal made from waste left over after processing Amazon palm fruits can produce high-quality cooking fuel comparable to commercial barbecue charcoal, offering a sustainable way to support traditional forest communities without harming the environment.

  Author(s): Alice Neri da Silva Sousa et. al.
  Venue: *Scientia Florestalis*
  Peer Review: Yes – Academic peer-reviewed journal
  ISSN: 2318-1222/1413-9324
  Publisher: Instituto de Pesquisas e Estudos Florestais
  Classification: Professional Journal (Field-Specific Academic Publication)



- ***Quality of charcoal produced from wood residues and planted forests*** – This study compared the quality of household charcoal produced from Amazonian wood-industry residues to that derived from eucalyptus. Laboratory analysis demonstrated significant differences, with eucalyptus charcoal exhibiting superior quality parameters and more closely meeting Premium Seal standards.

  Author(s): Alice Neri da Silva Sousa et. al.
  Venue: *Open Science Research,* VII edition, Chapter 7.
  Peer Review: Yes – Academic peer-reviewed journal
  ISSN: 978-65-5360-239-7
  Publisher: Digital Scientific Editorial
  Classification: Professional Journal (Field-Specific Academic Publication)

Published conference presentations at nationally or internationally recognized conferences

Mrs. Sousa's work has been published in several national and international conferences in the sciences field, including the Brazilian Congress of Catalysis (CBCat)**,** Brazilian Congress of Food Science and Technology, Brazilian Congress of Wood Science and Technology, and the National Forum of Charcoal. Those conferences represent the largest in Brazil with international reach, squarely aligned with USCIS policy for Published conference presentations at nationally or internationally recognized conferences.

Mrs. Sousa is a contributing author of the scientific work entitled *"Production and Characterization of an Activated Carbon-Based Catalyst from Grape Pomace Impregnated with Iron,"* authored by Alice Neri da Silva Sousa et al., which was selected for presentation at the **Brazilian Congress of Catalysis (CBCat)**, organized by the Brazilian Catalysis Society (SBCat). CBCat is the official national congress of SBCat, the principal professional society for catalysis research in Brazil, **affiliated with the International Association of Catalysis Societies (IACS), reflecting its integration within the global catalysis research community**. The Society was established to promote research dissemination, organize recurring national congresses, and maintain international scientific collaboration, including participation in major international catalysis forums.

Works presented at CBCat are submitted through a structured scientific selection process, **typically requiring abstract submission and technical evaluation prior to acceptance, consistent with standard practices of national scientific congresses organized by professional societies**. The selection of Mrs. Sousa's work for presentation at this nationally recognized congress demonstrates peer-reviewed scientific dissemination within a specialized research community and confirms her active participation in professional scholarly exchange in the field of catalysis.

Furthermore, Mrs. Sousa is also a contributing author of **multiple scientific works accepted for presentation at the 29th Brazilian Congress of Food Science and Technology (CBCTA)**, a nationally recognized scientific congress dedicated to advancing research in food science, technology, and applied biochemical innovation. The congress, held in Florianópolis, Brazil, from October 14–17, 2024, featured peer-reviewed abstract selection and formal certification of accepted works, as evidenced in the attached certificates. Her accepted presentations include *"Evaluation of the Proximate Composition of Attalea tessmannii (Cocão),"* *"Lipid Extraction Kinetics from Cocão Nuts (Attalea tessmannii),"* *"Effect of Solid-State Fermentation by Rhizopus oryzae on the Proximate Composition of Attalea tessmannii (Cocão),"* and *"Fatty Acid Profile Analysis of the Nut Oil from Cocão Fruits (Attalea tessmannii)."*. Selection for presentation at this national congress demonstrates that her research underwent scientific review and was deemed relevant to the broader professional community in food science and applied chemistry. The recurring and nationally organized nature of CBCTA further confirms its status as a professional scientific forum for dissemination of scholarly research.

Mrs. Sousa is also an author of the expanded abstract entitled *"Quality of Charcoal Produced from Wood Residues and Planted Forests,"* authored by Alice Neri da Silva Sousa et al., which was published in the official proceedings of the **V National Forum on Charcoal and the III Seminar on Forest Biomass Energy**. The event was organized and promoted by the Sociedade de Investigações Florestais (SIF) in partnership with the Federal University of Viçosa (UFV), both nationally recognized institutions in forestry and biomass research. The work was accepted for inclusion in the conference annals following scientific evaluation, reflecting structured academic dissemination within a specialized professional forum dedicated to sustainable biomass energy and

forest resource utilization. Publication in the official proceedings confirms peer-reviewed scholarly participation in a nationally organized scientific event focused on renewable energy and environmental sustainability.

Finally, Mrs. Sousa is a contributing author of scientific works accepted at the **VI Brazilian Congress of Science and Technology of Wood (CBCTEM), a nationally recognized technical congress organized by the Brazilian Society of Wood Science and Technology**. Her work entitled *"Energy Potential of Sawmill Wood Residues in Rio Branco, Acre"* was presented in the poster category, and her study *"Immediate Chemical Analysis of Charcoal in Rio Branco, Acre"* was formally published in the official proceedings of the congress. The VI CBCTEM, held from October 16–18, 2024, in Pelotas, Brazil, serves as a professional forum for dissemination of peer-reviewed research in wood science, biomass utilization, and sustainable material technologies. Acceptance and publication in the congress annals reflect submission through structured scientific review and demonstrate Mrs. Sousa's continued participation in nationally organized professional research dissemination within her field of environmental materials and biomass energy.

Mrs. Sousa clearly satisfies the authorship criterion under 8 C.F.R. § 204.5(h)(3)(vi) and the USCIS Policy Manual. The record establishes that she has authored scholarly articles reporting original scientific research within her field of environmental chemistry, biomass materials, and catalysis. Her publication in *ACS Omega*, a peer-reviewed international journal published by the American Chemical Society, reflects the reporting of experimental research involving chemical characterization, extraction kinetics, and material performance analysis, accompanied by structured methodology, data interpretation, and technical references consistent with scholarly publication standards. Likewise, her peer-reviewed publication in *Scientia Forestalis* and her authored chapter in *Open Science Research* demonstrate continued authorship of professionally relevant scientific literature containing formal structure, bibliographic citations, and empirical findings.

In addition, Mrs. Sousa's works published in the proceedings of nationally recognized scientific congresses, including the Brazilian Congress of Catalysis (CBCat), the Brazilian Congress of Food Science and Technology (CBCTA), the Brazilian Congress of Science and Technology of Wood (CBCTEM), and the National Forum on Charcoal, constitute published conference presentations at nationally recognized scientific meetings. **These conferences require abstract submission and technical evaluation prior to acceptance, and the works were formally included in official annals or certified as accepted presentations**. Accordingly, Mrs. Sousa's record squarely aligns with the Policy Manual's examples of scholarly article authorship, including publication in peer-reviewed journals and published conference presentations at nationally recognized conferences.

To demonstrate that Mrs. Sousa meets each requirement for this criterion, we are submitting the following supporting documents under **Exhibit E:**

> **E.1.** Sheraz Ahmad et al., *Extraction of Oil from Amazonian Attalea tessmannii Kernels: Kinetics Modeling, Diffusivity Analyses, and Physicochemical Characterization*, 10 **ACS Omega** 27525 (2025), demonstrating that Mrs. Sousa is the author of scholarly article in her field.
> **E.2.** *ACS Omega – About the Journal* (official webpage describing the journal's peer-review process and publication standards), American Chemical Society, https://pubs.acs.org/page/acsodf/about.html (last visited Feb. 13, 2026), demonstrating that

the venue qualifies as a professional scientific publication undergoing peer review proceedings.

E.3. Alice Neri da Silva Sousa, Keiti Roseani Mendes Pereira, Ananias Francisco Dias Júnior, Matheus Bertotti Floriani, & Martha Andrea Brand, *Charcoal Produced from Attalea tessmannii Burret. Fruit Wastes*, 50 **Scientia Forestalis** e3730 (2022), demonstrating that Mrs. Sousa is the author of scholarly article in her field.

E.4. *Scientia Forestalis – Official Journal Description and Publication Information* (demonstrating its status as a professional scientific journal with editorial and peer-review procedures), Instituto de Pesquisas e Estudos Florestais (IPEF), (last visited Feb. 13, 2026), demonstrating the that the venue is as professional publication that undergoes peer-review proceeding.

E.5. Alice Neri da Silva Sousa et al., *Quality of Charcoal Produced from Wood Residues and Planted Forests*, published in the official proceedings of the **V National Forum on Charcoal & III Seminar on Energy from Forest Biomass** (2019), https://doi.org/10.37886/221010681, demonstrating that Mrs. Sousa is the author of scholarly articles in her field.

E.6. Sousa, Alice Neri da Silva; Freitas, Fernanda Luz de; Alves, Paula Schneid; Roldão, Caroline Pereira; Pinto, Luiz Antonio de Almeida; Jaeschke, Débora Pez; Mortola, Vanessa Bongalhardo; Cadaval Junior, Tito Roberto Sant'Anna. *Production and Characterization of an Activated Carbon-Based Catalyst from Grape Pomace Impregnated with Iron,* presented at the 23rd Brazilian Congress on Catalysis (CBCat), Brazilian Society of Catalysis (SBCat), Brazil.

E.7. Certificate of Presentation issued by the Brazilian Society of Catalysis (SBCat) confirming that Mrs. Alice Neri da Silva Sousa presented the poster entitled *"Production and Characterization of an Activated Carbon-Based Catalyst from Grape Pomace Impregnated with Iron"* at the 23rd Brazilian Congress on Catalysis (CBCat): *Catalysis for a Sustainable Energy Transition*, held September 21–26, 2025, in Natal, Rio Grande do Norte, Brazil, supporting that her research was formally accepted and presented at a national scientific congress and disseminated to the professional scientific community.

E.8. Official documentation from the Brazilian Society of Catalysis (SBCat) and the 23rd Brazilian Congress on Catalysis (CBCat) describing the scientific nature of the congress, its organization by a recognized professional scientific society, and its peer-reviewed abstract selection process, supporting that the presented work was accepted through a formal academic review process and disseminated within a professional scientific forum.

E.9. Certificates issued in October 2024 by the Brazilian Congress of Food Science and Technology (29th edition) confirming that her research was approved and presented in the form of an e-poster at the 29th Brazilian Congress of Food Science and Technology, thereby supporting that her work was formally accepted and publicly presented at a national scientific conference within a professional forum.

E.10. Official *Submissions* page from *Food Science and Technology* confirming that the journal accepts original research and review articles, subject to an anonymous peer-review editorial policy, written in English and prepared according to formal scholarly guidelines, supporting the professional and peer-reviewed nature of the publication venue.

E.11. Certificate issued by the Sociedade de Investigações Florestais (SIF) confirming that her expanded abstract was published in the official proceedings of the V Fórum Nacional sobre Carvão Vegetal and III Seminário de Energia da Biomassa Florestal, held in Belo

Horizonte, Minas Gerais, Brazil, on May 15–16, 2019, thereby supporting that her scholarly work was published in the proceedings of a national scientific conference.
E.12. Certificates issued by the Sociedade Brasileira de Ciência e Tecnologia da Madeira, confirming that her scholarly works were (i) presented in the poster category and (ii) published in the official proceedings of the VI Congresso Brasileiro de Ciência e Tecnologia da Madeira (VI CBCTEM), held October 16–18, 2024, in Pelotas, Brazil, thereby supporting that her research was accepted, publicly presented, and included in the proceedings of a national scientific conference.
E.13. Official guidelines from the VI Congresso Brasileiro de Ciência e Tecnologia da Madeira (CBCTEM), describing the manuscript submission requirements, scientific committee evaluation, and structured review process for acceptance and publication in the conference proceedings, thereby supporting the professional and peer-reviewed nature of the conference and its published works.

Therefore, the evidence establishes that Mrs. Sousa has authored multiple scholarly articles in her field in professional scientific venues and nationally recognized conference proceedings, fully satisfying the authorship criterion under 8 C.F.R. § 204.5(h)(3)(vi) and corresponding USCIS policy guidance.

Criterion 7. Display of the Petitioner's work in the field in Public Exhibitions – submitted as comparable evidence herein.

For the fulfillment of this eligibility criterion, USCIS first determines whether the work that was displayed is the person's work product. Second, USCIS determines whether the venues (virtual or otherwise) were a public showing as per *Merriam-Webster Dictionaries* (*see* 8 CFR 204.5(h)(3)(vii)).

Merriam-Webster's online dictionary defines "exhibition" as a public showing (as of works of art, objects of manufacture, or athletic skill). The policy continues with additional clarifications by stating that "While the dictionary definition includes public showings other than those that are artistic in nature, the plain language of the criterion includes the modifier "artistic" and explicitly requires that the exhibitions or showcases be artistic in nature. **USCIS only considers non-artistic exhibitions or showcases as part of a properly supported claim of comparable evidence**".

According to the USCIS Policy Manual, "petitioners may submit comparable evidence … if the evidentiary criteria **do not readily apply to the person's occupation**." U.S. Citizenship & Immigr. Servs., Policy Manual, vol. 6, pt. F, ch. 5, § B(2). (*See* 8 C.F.R. § 204.5(h)(4)).

Mrs. Sousa's case merits favorable adjudication of this criterion as comparable evidence. This specific regulatory criterion **does not readily apply to her field of endeavor**, scientific research in bioenergy & environmental/industrial chemistry. Criterion (vii) refers to exhibitions or showcases of an alien's work in the arts, but for scientists and medical researchers, the professional equivalent is the **presentation of original research at prestigious scientific congresses and conferences**. Mrs. Sousa's original research has been consistently accepted for presentation and displayed at such prestigious forums, where her findings have been disseminated to and critically evaluated by distinguished experts in biochemistry worldwide. **These presentations constitute a professional equivalent to exhibitions in the arts and therefore serve as valid comparable evidence under the regulation.**

Additionally, while these events are designed primarily for professionals, **they are often open to the public and scientific enthusiasts, thereby serving a similar function of public display and recognition of one's work**. Accordingly, Mrs. Sousa's presentations of her research at these nationally and internationally recognized scientific meetings are directly analogous to the exhibitions contemplated by the regulation. Under USCIS guidance, where a specific criterion does not align with the applicant's field, comparable evidence is permissible, and her consistent selection to present work in these distinguished scientific venues clearly demonstrates recognition of her contributions.

Mrs. Sousa has exhibited her scholarly work, including those identified in **Exhibits E-5 through E-13**, supra, at nationally and internationally recognized scientific congresses. Mrs. Sousa's research has been selected for presentation at major Brazilian scientific forums with international reach, including the Brazilian Congress of Catalysis (CBCat), organized by the Brazilian Catalysis Society (SBCat) and affiliated with the International Association of Catalysis Societies (IACS); the 29th Brazilian Congress of Food Science and Technology (CBCTA), a nationally organized and peer-reviewed scientific congress dedicated to applied biochemical and food innovation; the Brazilian Congress of Wood Science and Technology; and the V National Forum on Charcoal and III Seminar on Forest Biomass Energy, organized by the Sociedade de Investigações Florestais (SIF). **These conferences represent some of the largest and most authoritative professional scientific gatherings in Brazil within their respective disciplines and involve structured abstract submission, technical evaluation, and formal acceptance procedures prior to presentation and publication in official proceedings**.

In addition to such prestigious exhibitions, Mrs. Sousa publicly displayed her scientific work in congresses and conferences regional in nature, namely a **poster presentation** titled *Influence of soaking volume on the electrical conductivity test in cedar seeds (cedrella fissilis – meliaceae)* at the **II Regional Research Congress of the State of Acre and the XXV Scientific Initiation Seminar of the Federal University of Acre – UFAC**, held from October 3 to October 7, 2016. The congress is an annual academic event showcasing undergraduate research across disciplines, where students present oral and poster research outputs developed under faculty supervision, and the program is open for participation by students, faculty, and the general community as *listeners* without prior registration.

Moreover, Mrs. Sousa displayed three distinct scientific works in poster format at the **66th Annual Meeting of SBPC**, held from July 22–27, 2014, at the Federal University of Acre (UFAC), Rio Branco/AC, Brazil. The certified works include: (1) *Erosive Processes in a Permanent Preservation Area of a Stream in Ji-Paraná/RO,* (2) *Socio-Environmental Risk Assessment in a Stream in the City of Ji-Paraná/RO,* and (3) *Identification and Influence of Solid Waste Deposited in the 50 Stream in Ji-Paraná/RO,* each expressly confirmed as having been presented in **poster format** during the nationally organized meeting. The SBPC Annual Meeting is **one of Brazil's most prominent and longstanding multidisciplinary scientific conferences**, organized by the principal national scientific society dedicated to the advancement of science and research dissemination across all academic fields. The event convenes researchers, university faculty, students, and institutional representatives from across Brazil and abroad, serving as a nationally recognized scientific forum for scholarly exchange. The Annual Meeting is publicly accessible for registration by students, academics, and members of the broader community, thereby functioning as a public scientific congress rather than a closed institutional seminar.

Finally, Mrs. Sousa presented her original work entitled *Quality of Charcoal for Domestic Use from a Charcoal Plant in the Municipality of Bujari, Acre* during the XII Forestry Week, organized by the Center for Biological and Natural Sciences and held at UFAC, from September 17 to 21, 2018. The certificate expressly identifies Mrs. Sousa as the presenter of the research, thereby establishing that the exhibited work constitutes her own work product. The XII Forestry Week was an academically organized scientific event hosted by a federal public university, dedicated to research dissemination in forestry, biomass, and environmental sciences.

Under 8 C.F.R. § 204.5(h)(3)(vii), a petitioner may submit "[e]vidence of the display of the alien's work in the field at artistic exhibitions or showcases." As clarified in the USCIS Policy Manual, officers first determine whether the displayed work constitutes the petitioner's own work product. In Mrs. Sousa's case, the certified conference materials confirm that the scientific works presented were authored by her and reflect her original research contributions. Therefore, the threshold requirement that the displayed work be her work product is satisfied.

Second, USCIS evaluates whether the venue qualifies as an "artistic exhibition or showcase." The plain language of the regulation expressly limits this criterion to artistic exhibitions. Mrs. Sousa is a scientist working in the fields of environmental chemistry, biomass, and applied materials science. Scientific congresses and academic conferences are not artistic exhibitions within the meaning of the regulation. Accordingly, the artistic exhibition criterion does not readily apply to her occupation. However, The USCIS Policy Manual expressly permits submission of **comparable evidence** where a criterion does not readily apply to the petitioner's profession. See 8 C.F.R. § 204.5(h)(4); USCIS Policy Manual, Vol. 6, Pt. F, Ch. 2.

The policy clarifies that officers must determine (1) whether the regulatory criterion is readily applicable to the occupation, and (2) whether the submitted evidence is truly comparable in significance. Here, because scientists do not typically exhibit their work in artistic showcases, Mrs. Sousa properly submits evidence of the **presentation and display of her research at nationally recognized scientific conferences** as comparable evidence.

Scientific conferences function as the **professional equivalent** of artistic showcases in academic and research fields. Presentation of peer-reviewed research in poster format at nationally organized scientific congresses constitutes public display of original work before a specialized professional audience or even a general audience and science enthusiasts. In this context, such presentations are directly comparable in evidentiary weight to artistic exhibitions because they demonstrate public dissemination, peer recognition, and professional visibility within the field.

The USCIS Policy Manual explicitly recognizes that, particularly in STEM fields, comparable evidence may include presentations at major trade shows or professional forums when a listed criterion is not easily applicable. Mrs. Sousa's documented poster presentations at nationally organized scientific congresses therefore constitute evidence of comparable significance to the artistic exhibition criterion, as they establish public display of her work product before a recognized professional audience.

Accordingly, because the artistic exhibition criterion does not readily apply to a research scientist, and because the evidence submitted demonstrates competitive, public display of her original scientific work at nationally recognized professional conferences, the regulatory requirements under 8 C.F.R. § 204.5(h)(4) for comparable evidence are satisfied.

For a comprehensive list of congresses and medical conferences where Mrs. Sousa has presented her work, please refer to **Exhibit F**:

> **F.1.** Certificate, 23rd Brazilian Congress on Catalysis (CBCat) (Sept. 21–26, 2025), certifying that Mrs. Sousa and coauthors presented the poster, *Production and Characterization of an Activated Carbon-Based Catalyst from Grape Pomace Impregnated with Iron,* at a scientific conference.
> **F.2.** Certificate, II Regional Research Congress of the State of Acre / XXV Scientific Initiation Seminar of the Federal University of Acre (UFAC) (Oct. 3–7, 2016), demonstrating that Mrs. Sousa presented the poster, *Influence of Soaking Volume on the Electrical Conductivity Test in Cedar Seeds (Cedrella Fissilis – Meliaceae),* at a scientific conference.
> **F.3.** Certificate XII Semana Florestal, Federal University of Acre (UFAC) (Sept. 17–21, 2018), certifying that Mrs**.** Sousa presented the banner, *Quality of Charcoal for Domestic Use from a Charcoal Plant in the Municipality of Bujari, Acre* in the conference.
> **F.4.** Certificates, 66th Annual Meeting of the Brazilian Society for the Advancement of Science (SBPC) (July 22–27, 2014), showing that Mrs. Sousa displayed the posters, *Erosive Processes in a Permanent Preservation Area of a Stream in Ji-Paraná / RO, Socio-Environmental Risk Assessment in a Stream in the City of Ji-Paraná/RO,* and *Identification and Influence of Solid Waste Deposited in the 50 Stream in Ji-Paraná/RO,* at a major scientific conference.
> **F.5.** Printout article, CAPES / Ministry of Education, *SBPC's annual meeting takes place in Acre for the first time* (July 23, 2014), describing the 66th Annual Meeting of the Brazilian Society for the Advancement of Science (SBPC) as a premier national scientific event attended by over 5,400 registered participants, including researchers, professors, and students from across Brazil, and featuring high-level discussions on science, technology, and innovation led by the President of the SBPC and the Minister of Education.

Thus, Mrs. Sousa meets this criterion as the submitted evidence demonstrates her work product was displayed in major scientific events. Although this criterion is not readily applicable to Mrs. Sousa's occupation, we kindly ask the adjudicator to consider it as comparable evidence under 8 C.F.R. § 204.5(h)(4).

Criterion 8. Evidence that the Petitioner has performed in a leading or critical role for organizations or establishments of distinguished reputation.

To demonstrate beneficiary's eligibility under this criterion (8 CFR 204.5(h)(3)(viii) USCIS first evaluates whether the person has performed in a leading or critical role for an organization, establishment, or a division or department of an organization or establishment as well as whether the role is (or was) leading or critical. Second, USCIS determines whether the organization or establishment (department or division) for which the petitioner holds or held a leading or critical role, is of distinguished reputation.

Critical and Leadership Role at UDESC's Wood Technology Laboratory III (State University of Santa Catarina – UDESC)

The submitted evidence establishes that Mrs. Sousa performed a critical and leadership role within the Wood Technology Laboratory III at the State University of Santa Catarina (UDESC), under the coordination of Professor Dr. Martha Andreia Brand. In her letter, Professor Brand expressly affirms that Mrs. Sousa assumed leadership responsibilities within the laboratory, independently supervising undergraduate researchers, coordinating laboratory analyses, verifying experimental quality, organizing research schedules, and serving as a methodological reference point for peers.

Professor Brand specifically concludes that Mrs. Sousa "played a critical and leadership role within our institutional research framework," coordinating fellow researchers and ensuring high experimental standards. USCIS policy makes clear that a role may be considered critical **when the individual contributes in a way that is of significant importance to the organization's outcomes**. Here, Mrs. Sousa's responsibilities directly impacted laboratory productivity, research integrity, and operational efficiency, functions essential to the performance of one of UDESC's most active research units.

Importantly, her role extended beyond routine graduate duties. The letter explains that she implemented structured routines, improved internal communication, enhanced laboratory safety, and elevated research standards. USCIS guidance emphasizes that it is the person's performance, **not title**, that determines whether a role is critical.

Distinguished Reputation of the Organization

The evidence confirms that UDESC and its Wood Technology Laboratory III meet this standard. **UDESC achieved the highest possible score in the Brazilian Ministry of Education's General Course Index (IGC) and ranked 21st among 240 evaluated federal universities and institutes nationwide**. It also ranked 4th among the 38 state universities in Brazil. Such nationally published rankings by Brazil's Ministry of Education demonstrate institutional eminence consistent with Merriam-Webster's definition of "distinguished" as marked by excellence or distinction.

Additionally, the Wood Technology Laboratory III, under Professor Brand's coordination, conducts research and provides technical services impacting the regional economy, including active research contracts and partnerships funded by Fapesc and CNPq and collaborations with major institutions such as Epagri, Embrapa, UFSC, and Uniplac. **The laboratory has also conducted quality control services for major industrial actors, including Klabin, a leading forestry-sector company**. These collaborations, funding sources, and industry engagements further demonstrate the laboratory's recognized professional standing and institutional relevance.

Moreover, the laboratory is led by Professor Dr. Martha Andreia Brand, a CNPq Productivity Fellow and nationally recognized researcher in biomass energy and forestry engineering, further supporting the distinguished nature of the division in which Mrs. Sousa served.

Leading and Critical Role at the Federal University of Rio Grande (FURG), Industrial Technology Laboratory (LTI), School of Chemistry and Food (IEQA)

The evidence also shows that Mrs. Sousa has performed in a leading and critical role within the Industrial Technology Laboratory (LTI) at the Federal University of Rio Grande (FURG), a federally chartered public research university in Brazil. In an original declaration dated October 29, 2025, the Pro-Rector of Research and Graduate Studies at FURG confirms that Mrs. Sousa "played a leading and critical role" within the distinguished research group of the Industrial

Technology Laboratory. The declaration further documents that she supervised undergraduate Scientific Initiation (SI) students, coordinated laboratory analyses, trained junior researchers in laboratory procedures and scientific writing, managed consumables and equipment budgets, and ensured continuity and quality across multiple research lines.

In addition, letter from an Adjunct Professor in FURG's Graduate Programs in Technological and Environmental Chemistry and Chemical Engineering further corroborates that Mrs. Sousa independently identifies experimental issues, proposes and implements technical solutions, coordinates day-to-day scientific initiation activities, safeguards laboratory operations, and plays an indispensable role in maintaining research reliability and productivity. The letter expressly characterizes her function as "critical" to the research organization, emphasizing that her contributions directly affect the success and advancement of projects within a highly productive laboratory environment.

Distinguished Reputation of the Organization – FURG

FURG is a federal public university founded in 1969 and recognized nationally for its research programs, particularly in environmental sciences, oceanography, and engineering. As a federal institution under Brazil's Ministry of Education, FURG participates in nationally competitive research funding systems, including CAPES and CNPq programs, and hosts graduate programs evaluated through Brazil's national academic quality framework.

FURG is also publicly recognized as a federal research university with established graduate programs and nationally evaluated research output. The Industrial Technology Laboratory (LTI), situated within the School of Chemistry and Food, operates within this federally funded research ecosystem. When considered together with the formal declarations from senior university officials and faculty leadership, the record demonstrates that Mrs. Sousa performed in a leading and critical role within a distinguished federal research institution.

Thus, the evidence under **Exhibit G** demonstrates that Mrs. Sousa performed a critical and leadership role within UDESC's Wood Technology Laboratory III by supervising research activities, ensuring methodological rigor, coordinating team operations, and materially contributing to the laboratory's scientific productivity and efficiency. The probative letter from the laboratory coordinator confirms the significance of her role. Furthermore, UDESC's nationally recognized academic ranking, government quality indicators, funded research partnerships, and industrial collaborations establish that both the university and its laboratory division possess a distinguished reputation.

Similarly, Mrs. Sousa's documented research collaboration and leadership functions within the Universidade Regional de Blumenau (FURB) further reinforce satisfaction of this criterion. FURB is a recognized public university in the State of Santa Catarina with established graduate and research programs in engineering and applied sciences, participating in nationally evaluated academic and research systems. Her involvement in laboratory-based research activities, supervision of scientific initiation students, and contribution to ongoing research initiatives within FURB demonstrate that her leadership and critical contributions were not isolated to a single institution but extended across multiple distinguished academic environments. When considered cumulatively, her roles at UDESC and FURB confirm sustained performance in positions of responsibility and impact within reputable research institutions, thereby fully satisfying the regulatory requirements of 8 C.F.R. § 204.5(h)(3)(viii).

G.1. Letter from Dr. Martha Andreia Brand, Professor and Coordinator, Wood Technology Laboratory III, UDESC (Nov. 11, 2025), detailing Mrs. Sousa's leadership and critical role in supervising research activities, coordinating laboratory operations, and maintaining high experimental standards.
G.2. Curriculum Vitae of Dr. Martha Andreia Brand, Professor and Coordinator of Wood Technology Laboratory III at the State University of Santa Catarina (UDESC), reflecting her academic credentials, research leadership, and CNPq Productivity Fellowship (Level 2).
G.3. Profile and Award Recognition of Dr. Martha Andreia Brand, *Energy Technology Research Award* (Global Academic Awards, Mar. 22, 2025), documenting her national and international recognition in biomass energy and forestry engineering.
G.4. News Release, UDESC Lages Wood Technology Laboratory Innovates in Research and Services Focused on Sustainability (Sept. 19, 2025), describing the laboratory's applied research activities, government-funded projects (Fapesc and CNPq), and industrial collaborations, demonstrating that the department has distinguished reputation.
G.5. News Release, UDESC Achieves Top Score in MEC Ranking and Stands Out Among the Best in Brazil (Apr. 14, 2025), reporting UDESC's highest General Course Index (IGC) score and national ranking among Brazilian universities, demonstrating that the organization has distinguished reputation.
G.6. Supporting Documentation of UDESC's Institutional Reputation and Research Partnerships, including evidence of laboratory contracts, collaborations with Embrapa, Epagri, UFSC, and other nationally recognized institutions.
G.7. Printout About Klabin – Corporate Overview and Sustainability Highlights (2024), documenting that Klabin is the largest producer and exporter of packaging paper and sustainable paper packaging solutions in Brazil, operates 22 industrial units (21 in Brazil and one in Argentina), has 126 years of industrial history, and is included in the Dow Jones Best-in-Class Sustainability Indices, thereby corroborating to UDESC's Wood Technology Laboratory III distinguished reputation.
G.8. Declaration of Prof. Ph.D. Daiane Dias, Pro-Rector of Research and Graduate Studies, Federal University of Rio Grande (FURG) (Oct. 29, 2025), affirming that Mrs. Sousa performed a leading and critical role within the Industrial Technology Laboratory (LTI), including supervision of Scientific Initiation students, coordination of laboratory research activities, management of equipment and consumables, and material contributions to the laboratory's scientific productivity.
G.9. Letter from Tito Roberto Sant'Anna Cadaval Jr., Ph.D., Adjunct Professor, Graduate Programs in Technological and Environmental Chemistry and Chemical Engineering, Federal University of Rio Grande (FURG), detailing Mrs. Sousa's independent identification and resolution of experimental challenges, coordination of undergraduate research activities, safeguarding of laboratory operations, and indispensable contributions to the reliability and continuity of the laboratory's research output.
G.10. Printout News Release, *FURG is Among the Seven Brazilian Universities That Have Risen in the World Ranking*, Federal University of Rio Grande (June 2, 2025), reporting FURG's advancement in the CWUR 2025 global ranking, placement among 53 Brazilian universities listed among the best worldwide, and recognition based on academic performance, faculty qualifications, alumni outcomes, and scientific output, demonstrating that the organization has distinguished reputation.

Accordingly, Mrs. Sousa satisfies the regulatory requirements of 8 C.F.R. § 204.5(h)(3)(viii)**.**

TOTALITY OF EVIDENCE - FINAL MERIT DETERMINATION

In *Kazarian v. USCIS,* 596 F.3d 1115 (9th Cir. 2010), the court ruled that USCIS officers should use a two-step analysis to evaluate the evidence submitted with the petition to demonstrate eligibility for classification as a person with extraordinary ability in the sciences, arts, education, business, or athletics **through sustained national or international acclaim** indicating that the person is one of that small percentage who has risen to the very top of the field of endeavor. **The officer applies a preponderance of the evidence standard when making this determination**.

Furthermore, according to the USCIS Manual: "At this step, officers consider **any potentially relevant evidence in the record**, **even if such evidence does not fit one of the above regulatory criteria or was not presented as comparable evidence**. The officers consider all evidence in the totality. Some evidence may weigh more favorably on its own, while other evidence is more persuasive when viewed with other evidence." (Emphasis added). *See* U.S. Citizenship & Immigr. Servs., **Policy Manual**, vol. 6, pt. F, ch. 2, § A(2) (2025), https://www.uscis.gov/policy-manual.

After establishing that Mrs. Sousa clearly meets *prima facie* the minimum eligibility criteria, it is also compelling that she meets the EB-1 **preponderance of evidence standard ("more likely than not")** of extraordinary ability in the field of sciences. The extensive record of her career accomplishments, the relevant awards she has received, her published articles in high-ranking Journals with great impact factor, the high-profile original contributions to academia and groundbreaking research, and her critical roles are sufficient to demonstrate her sustained national and international acclaim.

When evaluated cumulatively, Mrs. Sousa's record clearly satisfies this standard. She has earned nationally competitive federal research scholarships (ranking first at the doctoral level), authored peer-reviewed publications in respected international scientific journals including ACS Omega (American Chemical Society), secured multiple patent registrations and filings for environmentally impactful technologies, served as a peer reviewer and formal academic examiner, and performed in a critical leadership role within a distinguished research laboratory at a nationally ranked university. Her innovations, particularly in biochar-based adsorption systems and electrochemical environmental sensing, have been independently validated by leading experts, including globally ranked researchers, who attest to the originality and major significance of her work. This is not a record of isolated achievement; rather, it reflects a sustained pattern of excellence, competitive recognition, intellectual property generation, and scholarly influence across multiple years.

Moreover, Mrs. Sousa's work lies at the forefront of catalysis and applied environmental chemical engineering, specifically in biomass valorization, carbonaceous functional materials, and contaminant remediation technologies. Her patented technologies address real-world environmental challenges, oil-contaminated water systems, pharmaceutical residues, industrial effluents, using scalable, low-cost, and sustainable materials derived from agroindustrial waste. These contributions reflect both scientific maturity and translational capability. Her profile demonstrates not merely promise, but established authority within her specialization, confirmed through competitive funding, peer-reviewed dissemination, intellectual property protection, invited judging roles, and leadership responsibilities in a high-performing laboratory environment.

In totality, by a preponderance of the evidence, Mrs. Sousa is a scientist who has risen to the pinnacle of her career stage and is recognized as a leading authority within her focused field of catalysis and environmental chemical engineering. Her sustained national acclaim, combined with her continued doctoral research trajectory and innovation pipeline, demonstrates that she is exceptionally well positioned to make substantial, forward-looking contributions to the United States. Her work aligns directly with U.S. priorities in clean manufacturing, water quality protection, waste valorization, renewable materials development, and environmental compliance technologies. The record establishes not only past extraordinary achievement but also a credible and highly probable future of continued scientific impact within the United States.

Accordingly, when viewed under the totality-of-the-evidence framework mandated by *Kazarian*, Mrs. Sousa has demonstrated that she is one of the small percentages who have risen to the very top of her field of endeavor.

To assist the adjudicator in making the final determination on Mrs. Sousa's case, we submit other relevant evidence for the sustained acclaim of Dr. Silva's work on **Exhibit H**:

> **H.1.** Mrs. Sousa's diplomas and transcripts
> **H.2.** Certificates, submission for presentation 30th Chemistry Meeting of the Southern Region

In sum, the breadth of the evidence unequivocally establishes that Mrs. Sousa meets the burden of proof for classification as an alien of extraordinary ability under INA §203(b)(1)(A). Her consistent record of high-level contributions to sciences affirms that she is at the forefront of her profession and whose continuous presence in the United States will be invaluable.

CONCLUSION AND REQUEST FOR FAVORABLE ADJUDICATION

In conclusion, Mrs. Sousa's high-level achievements, and consistent contributions to her field demonstrate that she meets the standard required for the EB-1A visa classification. Her work has left a significant and lasting impact in the scientific community, as evidenced by the several accolades and widespread recognition her projects have received.

In the aggregate, this evidentiary record confirms Mrs. Sousa's extraordinary ability and her eligibility under INA 203(b)(1)(A). She has demonstrated sustained national and international acclaim through her awards, the original research contributions, high-impact publications, elite professional memberships, and globally recognized conferences. The evidentiary portfolio, evaluated under the **preponderance of evidence** standard and in accordance with *Kazarian v. USCIS*, affirms that she belongs to the small percentage of professionals who have risen to the very top of the Sciences – Bioenergy & environmental/industrial chemistry field. Her admission to the United States will not only allow her to continue her pioneering work but will also result in clear and substantial future benefit to the areas of sustainable materials engineering, carbon-based catalysis, industrial wastewater and contaminant remediation, biomass valorization, environmental monitoring technologies, and clean manufacturing processes aligned with U.S. priorities in environmental protection, renewable resources, and circular-economy innovation.

We trust that by the **preponderance of the evidence** the documents presented herein are sufficient to warrant a favorable decision on the request. In totality, Mrs. Sousa has proven her eligibility for classification as a person with extraordinary ability in sciences.

Granting Mrs. Sousa an immigrant visa will enable her to continue making valuable contributions in her field in the United States. We are confident that her extraordinary abilities and promising future will continue to benefit this nation. We kindly request that you consider her application favorably and grant her the opportunity to further her outstanding career in the United States.

Thus, for all the reasons set forth in this letter we respectfully request that the USCIS grants ALICE NERI DA SILVA SOUSA's request for the EB-1A Visa.

Your attention to this case will be deeply appreciated. Thank you for your time and consideration of the request on behalf of Mrs. Sousa.

Sincerely,

Otavio Haverroth Silva
California Bar # 343486

Exhibit list

Exhibits:	Pages:
Exhibit A - Evidence that petitioner will continue working and contributing to the area of Extraordinary Ability	
A.1. Beneficiary’s Personal Statement	1-2
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Exhibit B - Beneficiary’s receipt of lesser nationally or internationally recognized prizes or awards for excellence	
B.1. Official CAPES record confirming award of a federally funded doctoral scholarship to Mrs. Sousa at the Federal University of Rio Grande (FURG), 2024.	11-13
B.2. Final doctoral selection results (01/2023; 03/2023) showing Mrs. Sousa ranked first with the highest score in the PPGQTA doctoral program at the Federal University of Rio Grande (FURG), demonstrating that she was the award’s recipient.	14-19
B.3. Official public notice PPGQTA 01/2023, sections 1.2., 4.1. Nivel Doutorado (a)-(j), 5.3.,5.4., 5.5., and 6.1., demonstrating that the basis for granting the award was excellence in the field.	20-41
B.4. Official CAPES record confirming award of a federally funded master’s scholarship to Mrs. Sousa at the State University of Santa Catarina (UDESC), 2022.	42-44
B.5. Final results Nº 03/2021/PPGEF/UDESC, masters in forestry engineering, showing Mrs. Sousa ranked 4th place with the UDESC program as a CAPES scholarship awardee, demonstrating that she was the award’s recipient.	45-49

Exhibit C - Petitioner’s participation as a judge of the work of other in the same field

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Exhibit E - Petitioner's authorship of scholarly articles in professional or major trade publications or other major media

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Exhibit F - Petitioner's work in public exhibitions

Exhibit G - Petitioner's performance of a leading or critical role in distinguished organizations

recognition in biomass energy and forestry engineering.

G.4. News Release, UDESC Lages Wood Technology Laboratory Innovates in Research and Services Focused on Sustainability (Sept. 19, 2025), describing the laboratory's applied research activities, government-funded projects (Fapesc and CNPq), and industrial collaborations, demonstrating that the department has distinguished reputation. 398-399

G.5. News Release, UDESC Achieves Top Score in MEC Ranking and Stands Out Among the Best in Brazil (Apr. 14, 2025), reporting UDESC's highest General Course Index (IGC) score and national ranking among Brazilian universities, demonstrating that the organization has distinguished reputation. 400-401

G.6. Supporting Documentation of UDESC's Institutional Reputation and Research Partnerships, including evidence of laboratory contracts, collaborations with Embrapa, Epagri, UFSC, and other nationally recognized institutions. 402-413

G.7. Printout About Klabin – Corporate Overview and Sustainability Highlights (2024), documenting that Klabin is the largest producer and exporter of packaging paper and sustainable paper packaging solutions in Brazil, operates 22 industrial units (21 in Brazil and one in Argentina), has 126 years of industrial history, and is included in the Dow Jones Best-in-Class Sustainability Indices, thereby corroborating to UDESC's Wood Technology Laboratory III distinguished reputation. 414-415

G.8. Declaration of Prof. Ph.D. Daiane Dias, Pro-Rector of Research and Graduate Studies, Federal University of Rio Grande (FURG) (Oct. 29, 2025), affirming that Mrs. Sousa performed a leading and critical role within the Industrial Technology Laboratory (LTI), including supervision of Scientific Initiation students, coordination of laboratory research activities, management of equipment and consumables, and material contributions to the laboratory's scientific productivity. 416

Exhibit A - Evidence that petitioner will continue working and contributing to the area of Extraordinary Ability

October 21, 2025

Self-statement

My name is Alice Neri da Silva Sousa, and I have dedicated my academic and professional career to advancing research in bioenergy, biochar, and environmental chemistry. I completed my bachelor's degree in Forestry Engineering from the Federal University of Acre (UFAC) in 2019, focusing on Wood Product Technology and an emphasis on bioenergy.

During my five-year undergraduate studies, I received a research scholarship for three different projects, which allowed me to develop and gain knowledge in scientific research in three distinct areas of forestry engineering: forest seeds, forest ecology, and forest economics. During my undergraduate studies, I also participated in scientific events that improved my communication skills, networking, and research dissemination.

Based on this foundation, I pursued a master's degree in Forestry Engineering at the State University of Santa Catarina (UDESC) between 2020 and 2022. My work investigated the properties of charcoal for cooking applications, contributing to the development of sustainable renewable energy alternatives. During this period, I also participated in the evaluation committee for my final project, leveraging the knowledge I had already acquired throughout my academic career. I also served as a reviewer for a scientific article for a Brazilian peer-reviewed journal.

In 2023, I began my PhD in Technological and Environmental Chemistry at the Federal University of Rio Grande (FURG), where my research focused on biochar, activated carbon, and pyroligneous extract composed of agro-industrial waste, such as grape pomace, olive pomace, peach pits, rice hulls, and corn and soybean straw. This work focuses on the quality, applications, and value-added potential of these materials, addressing critical global challenges such as waste reduction, greenhouse gas mitigation, and sustainable industrial practices. During this period, I have participated in several additional activities within the research group I am part of. I participated as an inventor in four patents already filed, one published peer-reviewed scientific article, and eight scientific papers published at scientific conferences. Participating in all activities beyond my doctoral thesis allows me to add experience and knowledge to my resume, becoming a more competent and prepared professional for the job market.

Looking ahead, I intend to pursue postdoctoral research opportunities in the United States with the goal of deepening collaborations with academic institutions and industry. My plan is to develop innovative technologies that transform agro-industrial waste into high-value materials, especially for industrial applications and wastewater treatment, involving contaminants such as pharmaceuticals, pesticides, dyes, fertilizers, and industrial chemicals. By combining scientific innovation with practical applications, I aim to generate solutions that promote industrial efficiency and environmental sustainability.

I am committed to continuing my academic career as a researcher and educator, contributing to the training of future professionals and the expansion of international research networks. My long-term vision includes working with American universities and

industries to establish projects that improve clean production methods, reduce waste streams, and promote sustainable resource management. These efforts are especially relevant for the United States, where sectors such as agriculture, pharmaceuticals, industrial, and food processing face increasing pressure to adopt more clean technologies and comply with environmental regulations to remain globally competitive.

Furthermore, the US has consistently invested in renewable energy, advanced materials, and environmental technologies—areas directly related to my expertise. With federal initiatives and agencies such as the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the National Science Foundation (NSF) supporting innovation in these areas, my research aligns perfectly with national issues. By applying my expertise to the development of industrial biochar-based solutions for pollution control and sustainable energy, I can contribute to cost reduction, expand the circular economy, and support the US in maintaining its leadership in scientific innovation and environmental stewardship.

Through my work, I will not only continue a strong and impactful scientific career, but I will also help address the US's pressing challenges in industrial productivity, waste management, and climate resilience.

Thank you for your time and consideration of my petition.

Alice N S Sousa

Alice Neri da Silva Sousa

Alice Neri da Silva Sousa

Address to access this CV: http://lattes.cnpq.br/0470062095113640
ID Lattes: **0470062095113640**
Last updated: 30/09/2025

Graduated in Forest Technician at IFRO - Ji-Paraná campus (2014). Bachelor in Forestry Engineering at UFAC - Campus de Rio Branco (2019), working in the area of Forest Energy Resources. Master in Forest Engineering at UDESC - Campus de Lages, with emphasis on Biomass and forest energy. Doctoral student in the Graduate Program in Technological and Environmental Chemistry at FURG - Rio Grande campus, with emphasis on physical chemistry (2023-2027). **(Text informed by the author)**

Personal Information

Name

Alice Neri da Silva Sousa

Bibliographic Citation

SOUSA, A. N. S.;SOUSA, ALICE NERI DA SILVA

Lattes iD

http://lattes.cnpq.br/0470062095113640

Nationality

Brasil

Formal Education/Degree

2023

Ph.D. in progress in Quimica Tecnologica e Ambiental.
Universidade Federal do Rio Grande, FURG, Brasil.
Advisor: Tito Roberto Sant'Anna Cadaval Junior.
Co-advisor: Luiz Antonio de Almeida Pinto e Débora Pez Jaeschke.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: bioenergia; pirólise; Adsorção de contaminantes emergentes.
Major Area: Exact and Earth Sciences
Major Area: Agrarian Sciences / Area: Recursos Florestais e Engenharia Florestal / Subarea: Energia de Biomassa Florestal.
Activity sectors: Pesquisa e desenvolvimento científico.

2020 - 2022

Master in Engenharia Florestal.
Universidade do Estado de Santa Catarina, UDESC, Brasil. Year of degree: 2022.
Advisor: Martha Andreia Brand.
Co-advisor: Keiti Roseani Mendes Pereira.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: biomassa; energia; Resíduos; Produto Florestal não Madeireiro.
Major Area: Agrarian Sciences
Activity sectors: Produção Florestal.

2011 - 2014

Secondary Education.
Instituto Federal de Educação Ciência e Tecnologia de Rondônia, IFRO, Brasil.

2007 - 2010

Elementary Education.
Gonçalves Dias, E.E.E.F.M%20GD, Brasil.

Professional Experience

Florasetec, FT, Brasil.

Contract

2016 - 2017

Type of contract: contrato, Functional Placement: Técnico florestal, Credit Hours: 20

Fundação de Tecnologia do Estado do Acre, FUNTAC, Brasil.

Contract

2019 - 2019

Type of contract: Estágio não remunerado, Functional Placement: Auxiliar de laboratório, Credit Hours: 20

Areas of Expertise

1.

Major Area: Agrarian Sciences / Área: Recursos Florestais e Engenharia Florestal / Subarea: Recursos Florestais e Engenharia florestal.

2.

Major Area: Agrarian Sciences / Área: Recursos Florestais e Engenharia Florestal / Subarea: Técnico em Florestas.

Scientific, Technological, Artistic and Cultural Production

Bibliographical Production

Full articles published in journals

Sort by

Chronological Order

1.

AHMAD, SHERAZ ; **SOUSA, ALICE NERI DA SILVA** ; ARABIDIAN, VIVIANE DE CARVALHO ; PEREIRA, KEITI ROSEANI MENDES ; POHNDORF, RICARDO SCHERER ; CHRIST-RIBEIRO, ANELISE ; NUNES, ISAAC DOS SANTOS ; JAESCHKE, DÉBORA PEZ ; DA SILVEIRA JUNIOR, NAURO ; PINTO, LUIZ ANTONIO DE ALMEIDA ; CADAVAL JUNIOR, TITO ROBERTO SANT?ANNA . Extraction of Oil from Amazonian Attalea tessmannii Kernels: Kinetics Modeling, Diffusivity Analyses, and Physicochemical Characterization. ACS Omega JCR , v. 10, p. 27525-27533, 2025.

2.

SOUSA, A. N. S.; PEREIRA, K. R. M. ; BRAND, M. A. ; FLORIANI, M. B. ; DIAS JUNIOR, A. F. . Charcoal produced from Attalea tessmannii Burret. fruit wastes. Scientia Forestalis JCR, v. 50, p. 1-11, 2022.

Book Published/Organized

1.

SOUSA, A. N. S.; PEREIRA, K. R. M. ; XAVIER, C. N. . Quality of charcoal produced from wood residues and planted forests. 1. ed. Guarujá: Científica Digital, 2022. v. 7. 1533p .

Complete works published in proceedings of conferences

1.

PEREIRA, K. R. M. ; FARRAPO, O. P. B. ; **SOUSA, A. N. S.** ; PINTO, S. P. . Immediate chemical analysis of charcoal in Rio Branco, Acre, 2024, Pelotas - RS. VI CONGRESSO BRASILEIRO DE CIÊNCIA E TECNOLOGIA DA MADEIRA, 2024.

Expanded Summary published in proceedings of conferences

1.

SOUSA, ALICE NERI DA SILVA; PEREIRA, K. R. M. ; PINTO, S. P. ; FARRAPO, O. P. B. . , 2024, PELOTAS. VI CONGRESSO BRASILEIRO DE CIÊNCIA E TECNOLOGIA DA MADEIRA. SÃO PAULO: SOCIEDADE BRASILEIRA DE CIÊNCIA E TECNOLOGIA DA MADEIRA, 2024.

2.

SOUSA, A. N. S.; PEREIRA, K. R. M. ; SILVA, A. A. ; SANTOS, S. K. F. ; XAVIER, C. N. . , 2019, Viçosa. Trabalhos - V Fórum Nacional sobre carvão vegetal e III Seminário de Energia da Biomassa Florestal/2019. Viçosa: UFV, 2019.

Summary published in proceedings of conferences

1.

SOUSA, A. N. S.; PINTO, L. A. A. ; CADAVAL JR, T. R. S. ; JAESCHKE, D. P. ; SILVEIRA JR, N. ; SILVA, K. A. . , 2024, Blumenau. Estrutura Mega Porosa de Quitosana com Nanotubos de Carbono para Determinação do Efeito do pH na Adsorção de Fármaco em Sistema Aquoso, 2024.

2.

SOUSA, A. N. S.; PINTO, L. A. A. ; CADAVAL JR, T. R. S. ; DIAS, D. ; MARIN, G. M. ; LIMA, E. S. A. . , 2024, BLUMENAU. Avaliação do efeito das ativações eletroquímicas em eletrodos de pasta quimicamente modificados com biochar na determinação de ibuprofeno por voltametria, 2024.

3.

GOMES, C. P. W. ; MARQUES, B. ; MARTINS, R. M. ; **SOUSA, A. N. S.** ; JAESCHKE, D. P. ; PINTO, L. A. A. ; CADAVAL JR., T. R. S. ; CHRIST-RIBEIRO, A. . EFFECT OF SOLID-STATE FERMENTATION BY Rhizopus oryzae ON THE PROXIMAL COMPOSITION OF Attalea tessmannii (COCÃO), 2024, FLORIANÓPOLIS. 29 CONGRESSO BRASILEIRO DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS. FLORIANÓPOLIS: SBCTA - SOCIEDADE BRASILEIRA DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS, 2024. v. 1. p. 538-538.

4.

GOMES, C. P. W. ; MARQUES, B. ; MARTINS, R. M. ; **SOUSA, A. N. S.** ; JAESCHKE, D. P. ; PINTO, L. A. A. ; CADAVAL JR., T. R. S. ; CHRIST-RIBEIRO, A. . EVALUATION OF THE PROXIMAL COMPOSITION OF Attalea tessmannii (COCÃO), 2024, FLORIANÓPOLIS. 29 CONGRESSO BRASILEIRO DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS. FLORIANÓPOLIS: SBCTA - SOCIEDADE BRASILEIRA DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS, 2024. v. 1. p. 934-934.

5.

SANTOS, K. ; BRANDAO, P. ; KHAN, S. A. ; HAN, L. H. ; SILVEIRA JR, N. ; JAESCHKE, D. P. ; CHRIST-RIBEIRO, A. ; PINTO, L. A. A. ; CADAVAL JR., T. R. S. ; **SOUSA, A. N. S.** . FATTY ACID PROFILE ANALYSIS OF COCÃO (Attalea tessmannii) ALMOND OIL, 2024, FLORIANÓPOLIS. 29 CONGRESSO BRASILEIRO DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS. FLORIANÓPOLIS: SBCTA - SOCIEDADE BRASILEIRA DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS, 2024. v. 1. p. 958-958.

6.

SANTOS, K. ; BRANDAO, P. ; CHRIST-RIBEIRO, A. ; **SOUSA, A. N. S.** ; JAESCHKE, D. P. ; PINTO, L. A. A. ; CADAVAL JR., T. R. S. ; KHAN, S. A. ; SILVEIRA JR, N. ; PEREIRA, K. R. M. . LIPID EXTRACTION KINETICS FROM COCÃO FRUIT KERNELS (Attalea tessmannii), 2024, FLORIANÓPOLIS. 29 CONGRESSO BRASILEIRO DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS. FLORIANÓPOLIS: SBCTA - SOCIEDADE BRASILEIRA DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS, 2024. p. 1204-1204.

7.

SOUSA, A. N. S.; SILVA, J. A. L. ; PEREIRA, K. R. M. . , 2018, Rio Branco. XII Semana Florestal do Acre - anais, 2018.

8.

SILVA, K. M. F. ; **SOUSA, ALICE NERI DA SILVA** ; CARVALHO, C. . , 2016, RIO BRANCO. II CONGRESSO REGIONAL DE PESQUISA DO ESTADO DO ACRE. RIO BRANCO: UNIVERSIDADE FEDERAL DO ACRE, 2016.

Presentations of Work

1.

CASTELLAN, B. A. ; **SOUSA, A. N. S.** ; TAVARES, L. S. ; FELIX, B. V. ; RODRIGUES JUNIOR, J. C. . IDENTIFICAÇÃO E INFLUÊNCIA DE RESÍDUOS SÓLIDOS DEPOSITADOS NO CÓRREGO 50 EM JI-PARANÁ/RO. 2014. (Presentation/Congress).

2.

FELIX, B. V. ; **SOUSA, A. N. S.** ; CASTELLAN, B. A. ; TAVARES, L. S. ; RODRIGUES JUNIOR, J. C. . AVALIAÇÃO DE RISCOS SOCIOAMBIENTAIS EM UM CÓRREGO NO MUNICÍPIO DE JI-PARANÁ/RO. 2014. (Presentation/Congress).

3.

SOUSA, A. N. S.; FELIX, B. V. ; CASTELLAN, B. A. ; TAVARES, L. S. ; RODRIGUES JUNIOR, J. C. . PROCESSOS EROSIVOS EM ÁREA DE PRESERVAÇÃO PERMANENTE DE UM CÓRREGO EM JI-PARANÁ / RO. 2014. (Presentation/Congress).

Patents and registrations

Patent

Confirmation of the status of a patent application may be requested from the Patent Directorate (DIRPA) by means of a Certificate of acts relating to the processes

1.

SOUSA, A. N. S.; DIAS, D. ; PINTO, L. A. A. ; CADAVAL JR, T. R. S. ; ORESTE, E. Q. ; RIBEIRO, E. S. ; MACIEL, J. V. ; MILER, C. A. , . PROCESSO PARA OBTENÇÃO DE SENSOR VOLTAMÉTRICO QUIMICAMENTE MODIFICADO COM BIOCHAR DE CASCA DE ARROZ PARA DETERMINAÇÃO DE DICLOFENACO. 2024, Brasil.
Patent: Innovation Privilege. Registration number: BR1020240211995, Registration institution: INPI - Instituto Nacional da Propriedade Industrial. Depósito: 11/10/2024

2.

CADAVAL JR., T. R. S. ; PINTO, L. A. A. ; FARIAS, B. S. ; FARIAS, R. ; GERHARDT, R. ; SILVEIRA JR, N. ; ARABIDIAN, V. C. ; RIBEIRO, A. ; RIZZI, F. Z. ; **SOUSA, A. N. S.** . ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO (OLU) EM SISTEMA AQUOSO. 2024, Brasil.
Patent: Innovation Privilege. Registration number: BR1020240027868, Registration institution: INPI - Instituto Nacional da Propriedade Industrial. Depósito: 09/02/2024

3.

SOUSA, A. N. S.; CADAVAL JR., T. R. S. ; PINTO, L. A. A. ; KHAN, S. A. ; ARLINDO, M. Z. F. ; ARABIDIAN, V. C. ; HAN, L. H. ; NUNES, I. ; JAESCHKE, D. P. ; FARIAS, B. S. ; SILVEIRA JR, N. . BIOCOMBUSTÍVEL OBTIDO A PARTIR DO ÓLEO DA SEMENTE DE COCÃO (ATTALEA TASSMANNI). 2024, Brasil.
Patent: Innovation Privilege. Registration number: BR1020240267982, Registration institution: INPI - Instituto Nacional da Propriedade Industrial. Depósito: 19/12/2024

Boards

Participation in course completion works examination boards

Graduation course conclusion paper

1.

SOUSA, A. N. S.; BRAND, M. A.; CUNHA, A. B.. Participation in board of Taís Pitz Barbosa. 2021. Course Conclusion Paper (Graduation in Engenharia Florestal) - Universidade do Estado de Santa Catarina.

Events

Participation in events, congresses, exhibitions and fairs

1.

I SEMINARIO INTEGRADO DE ENSINO, PESQUISA E EXTENSÃO. .ASPECTOS ESTRUTURAIS DO MERCADO DE PORTAS E JANELAS, DE MADEIRA TROPICAL, NA CIDADE DE RIO BRANCO-ACRE, 2018-19. 2019. (Seminary).

2.

. 2017. (Congresses).

3.

. 2016. (Congresses).

4.

FORUM DE ENGENHARIA E DESENVOLVIMENTO SUSTENTÁVEL. 2016. (Outra).

5.

INFUENCIA DO VOLUME DE EMBEBIÇÃO NO TESTE DE CONDUTIVIDADE ELÉTRICA EM SEMENTES DE CEDRO (CEDRELLA FISSILIS - MELIACEAE). 2016. (Congresses).

6.

. 2015. (Congresses).

7.

AVALIAÇÃO DE RISCOS SOCIOAMBIENTAIS EM UM CÓRREGO NO MUNICÍPIO DE JI-PARANÁ/RO. 2014. (Congresses).

Exhibit B - Beneficiary’s receipt of lesser nationally or internationally recognized prizes or awards for excellence

FELLOW INFORMATION

Name: ALICE NERI DA SILVA SOUSA

CPF: ***.358.792-**

Institution: FURG - FEDERAL UNIVERSITY OF RIO GRANDE

Program: SOCIAL DEMAND PROGRAM - DS

Level: DOCTORATE

Year: 2024

11

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

Date: February 6, 2026

Dados do Bolsista

Nome:	ALICE NERI DA SILVA SOUSA
CPF:	***.358.792-**
Instituição:	FURG - UNIVERSIDADE FEDERAL DO RIO GRANDE
Programa:	PROGRAMA DE DEMANDA SOCIAL - DS
Nível:	DOUTORADO
Ano:	2024

Public Notice for the Selection Process for the Award of Master's and Doctoral Fellowships – Notice No. 03/2023

Results

Master's - General Competition

Ranking	Applicant	Status
1st	ANA PAULA DE OLIVEIRA LOPES INÁCIO	Awarded one (01) fellowship quota
2nd	CALEBE DE HEBROM LIVISTOM DA SILVA	Awarded one (01) fellowship quota
3rd	LENON MEDINA FERREIRA	Awarded one (01) fellowship quota
4th	THAIS SCHULTZ CONTER	Awarded one (01) fellowship quota
5th	ANTONIO MIGUEL GOMES LIMA	Awarded one (01) fellowship quota
6th	LUISA REINHEIMER KRECHE	No fellowship quota available
7th	KAIANE DE QUEVEDO RIBEIRO	No fellowship quota available
8th	SIMONE SANTOS SOARES	No fellowship quota available

Doctoral - General Competition

Ranking	Applicant	Status
1st	ALICE NERI DA SILVA SOUSA	Awarded one (01) fellowship quota

There were no candidates registered for the Affirmative Action Program in Graduate Studies (PROAAf-PG).

The results of this Public Notice shall remain valid until the Program conducts a new selection process. In the event of fellowship positions (due to thesis defense or withdrawal), candidates listed in this Public Notice shall be called in ranking order.

Rio Grande, March 17, 2023.

Fellowship Committee

The original document is duly signed.

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

_____ **Date: February 6, 2026**

Edital para Processo Seletivo para Concessão de

Bolsas de Mestrado e Doutorado - Edital 03/2023

Resultado

Mestrado - Ampla concorrência

Classificação	Candidato(a)	Situação
1º	ANA PAULA DE OLIVEIRA LOPES INACIO	Contemplada com 01 cota de bolsa
2º	CALEBE DE HEBROM LIVISTOM DA SILVA	Contemplada com 01 cota de bolsa
3º	LENON MEDINA FERREIRA	Contemplada com 01 cota de bolsa
4º	THAIS SCHULTZ CONTER	Contemplada com 01 cota de bolsa
5º	ANTONIO MIGUEL GOMES LIMA	Contemplada com 01 cota de bolsa
6º	LUISA REINHEIMER KRECHE	Sem cota disponível
7º	KAIANE DE QUEVEDO RIBEIRO	Sem cota disponível
8º	SIMONE SANTOS SOARES	Sem cota disponível

Doutorado - Ampla concorrência

Classificação	Candidato(a)	Situação
1°	ALICE NERI DA SILVA SOUSA	Contemplada com 01 cota de bolsa

Não houveram candidatos inscritos pelo Programa de Ações Afirmativas na Pós-Graduação (PROAAf-PG).

O resultado deste edital é válido até a realização de nova seleção do programa. No caso da vacância de bolsa(s) (defesa/desistência), serão chamados os candidatos deste edital, em ordem de classificação.

Rio Grande, 17 de março de 2023.

Comissão de Bolsas

A via original encontra-se assinada

Selection Public Notice No. 01/2023

Final Result – Doctoral Program

Ranking	Applicant	Application No.	Score	Status
1st	ALICE NERI DA SILVA SOUSA	01	10.00	Approved

Rio Grande, February 15, 2023.

Prof. Dr. Bruno Meira Soares

(Chair of the Selection Committee)

The original document is duly signed.

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

_____ **Date: February 6, 2026**

Edital de Seleção 01/2023

Resultado Final – Doutorado

Classificação	Candidato(a)	Nº inscrição	Pontuação	Situação
1º	ALICE NERI DA SILVA SOUSA	01	10,00	Aprovada

Rio Grande, 15 de fevereiro de 2023.

Prof. Dr. Bruno Meira Soares

(Presidente da Comissão de Seleção)

A via original encontra-se assinada

PUBLIC NOTICE No. 01/2023 – SELECTION OF MASTER'S AND DOCTORAL STUDENTS

The Graduate Studies Program in Technological and Environmental Chemistry (PPGQTA) hereby announces this Selection Notice, which outlines the criteria for the admission of candidates to the Master's and Doctoral programs of the PPGQTA in the fields of Analytical Chemistry, Organic Chemistry, Inorganic Chemistry, and Physical Chemistry.

1. Positions

1.1 A total of 27 Master's positions and 12 Doctoral positions will be offered. Of these, 80% (per program) are allocated to general competition, and 20% (per program) are allocated to the Graduate Studies Affirmative Action Program (PROAAf-PG) for self-declared Black individuals (Black and Brown), transgender individuals (transvestites and transsexuals), Indigenous peoples, quilombola communities, and persons with disabilities, pursuant to CONSUN/FURG Resolution No. 004/2019, as amended by Resolution No. 11/2022 (available at https://propesp.furg.br/RESCONSUN042019), and pursuant to PROPESP/FURG Normative Instruction No. 06/2022 (available at https://propesp.furg.br/INPROPESP062022).

1.2 The positions shall be filled according to the ranking order, based on the criteria described in this Public Notice and the proper completion of the Annexes thereto. Black, transgender, Indigenous, quilombola, and/or persons with disabilities shall compete concurrently for positions, and if classified under general competition, admission shall necessarily occur through general competition, without prejudice to the mechanisms that ensure their continued enrollment.

1.3 If the positions allocated to affirmative action policies are not filled, they shall automatically be reallocated to general competition positions. Candidates approved under affirmative action vacancies shall undergo verification by the Heteroidentification Committee.

1.4 Number of positions offered under this Public Notice:

Field	Positions	
	Master's	Doctorate
Analytical Chemistry	11	6
Organic Chemistry	8	2
Inorganic Chemistry	2	0
Physical Chemistry	6	4

Information regarding the availability and rules for the allocation of scholarships is provided in Annex 11.

2. Committees

2.1 The selection committee for this Public Notice shall be composed of faculty members of the PPGQTA.

2.2 For positions allocated to the Graduate Studies Affirmative Action Program - PROAAf-PG, the Heteroidentification Committee of the School of Chemistry and Food shall be convened.

3. Target Audience

3.1 Master's Level: Holders of a Bachelor's degree diploma or a Certificate of Completion of a Bachelor's degree in Chemistry or related fields.

3.2 Doctoral Level: Holders of a Master's degree diploma or a Certificate of Completion of a Master's degree in Chemistry or related fields, recognized by the Coordination for the Improvement of Higher Education Personnel (CAPES). Submission of a letter from the academic advisor, with the consent of the Coordination of the respective Graduate Studies Program, will also be accepted, informing the scheduled thesis defense date, provided that such date precedes the date of publication of the final results of this selection process.

Note: The above requirements for both levels also apply to diplomas and certificates of completion issued abroad. In such cases, when documents issued abroad are in a language other than Portuguese, they must be accompanied by a sworn translation into Portuguese.

4. Applications

4.1 Applications shall be submitted from 01/09/2023 to 01/31/2023, exclusively through the Graduate Studies Program Application System (SIPOSG), available at siposg.furg.br/mestrado (Master's) and siposg.furg.br/doutorado (Doctorate). The following documents must be scanned and uploaded to the application system, front and back, as applicable:

Master's Level

a) Copy of the Bachelor's degree diploma or a certificate stating expected graduation on a date before the publication of the final results of this selection process, issued by a Higher Education Institution (Required).

b) Copy of a government-issued identification document and Individual Taxpayer Registry (CPF) (Required).

c) For foreign applicants, a copy of the passport number (Required).

d) Updated Lattes Curriculum (Required).

e) Undergraduate academic transcript (Required).

f) Letter of intent for the desired position and motivation for pursuing the Master's degree (Required).

g) Completed scoring table (as per Annex 9), supported by unauthenticated copies of documents, numbered according to the order of the scoring table. Supporting documents must be attached together with the scoring table, following the same scoring order, while observing and respecting the maximum score established. The accuracy of the scoring table and the proper inclusion of sequentially numbered supporting documents are the sole responsibility of the applicant. Any score declared without the respective and proper supporting documentation shall not be analyzed and shall be disregarded. Only the score declared by the applicant shall be considered (Required).

h) Fellowship application form, as per Annex 13, if the applicant wishes to apply for a fellowship under a Fellowship Notice (to be published after the conclusion of this selection process), subject to quota availability and classified according to the results of Notice No. 01/2023.

Note: Only applications submitted with all required documents duly scanned and uploaded to the application system within the deadline established in this Notice shall be approved.

Doctoral Level

a) Copy of the undergraduate and Master's academic transcripts (PDF format) (Required).

b) Copy of the Bachelor's and Master's degree diplomas (or a letter from the academic advisor and the Coordination of the Graduate Studies Program informing the scheduled date of the dissertation defense, which must precede the date of publication of the final results of this selection process) (PDF format) (Required).

c) Copy of a government-issued identification document and Individual Taxpayer Registry (CPF) (Required).

d) For foreign applicants, a copy of the passport number (Required).

e) Updated Lattes Curriculum (http://lattes.cnpq.br) (Required).

f) Scanned digital version of the Doctoral Research Proposal (PDF format) – (Guidelines: maximum of 10 pages; Times New Roman font; size 12; 1.5 line spacing; left and top margins of 3 cm; right and bottom margins of 2 cm) (Required).

g) Scanned digital version of the descriptive academic statement (PDF format) – (Guidelines: maximum of 2 pages; Times New Roman font; size 12; 1.5 line spacing; left and top margins of 3 cm; right and bottom margins of 2 cm) (Required).

h) Letter of intent for the desired position and motivation for pursuing the Doctoral degree (Required).

i) Completed scoring table (as per Annex 10), supported by unauthenticated copies of documents numbered according to the order of the scoring table. Supporting documents must be attached together with the scoring table, following the same scoring order, while observing and respecting the maximum score requested. The accuracy of the scoring table and the inclusion of supporting documents are the sole responsibility of the applicant. Any score declared without the respective and proper supporting documentation shall not be analyzed and shall be disregarded. Only the score declared by the applicant shall be considered (Required).

j) Fellowship application form, as per Annex 11, if the applicant wishes to apply for a fellowship under a Fellowship Notice (to be published after the conclusion of this selection process), subject to quota availability and classified according to the results of Public Notice No. 01/2023.

Note: Only applications submitted with all required documents duly attached to the application system within the deadline established in this Public Notice shall be approved.

4.2 To apply for the positions under the Graduate Studies Affirmative Action Program (PROAAf-PG), the applicant must indicate this option in the self-declaration form contained in Annexes 1, 3, 4, 5, or 6 of this Public Notice and submit the following documentation:

a) Black applicants (Black and Brown): (i) Ethnic-racial self-declaration (Annex 1). The Ethnic-Racial Heteroidentification Committee shall be responsible for verifying and deciding on the legitimacy of the self-declaration (procedure described in Annex 2).

b) Indigenous applicants: (i) Simple copy of the Administrative Indigenous Birth Registration (RANI) issued by the National Foundation for Indigenous Peoples (FUNAI); (ii) Original declaration from a member of the Indigenous Community or Village, issued in the current year and signed by three Community Leaders (Chief + two leaders) (Annex 3).

c) Quilombola applicants: (i) Simple copy of the original declaration issued by the Palmares Cultural Foundation, indicating official recognition of the quilombo to which the applicant belongs; (ii) Original declaration from the quilombola community, issued in the current year, signed by three recognized leaders (President and two leaders), stating that the applicant belongs to that community (Annex 4); (iii)

Proof of residence or declaration of residence in the quilombola community (Annex 5); (iv) For quilombola communities undergoing recognition by the Palmares Cultural Foundation, a document proving the initiation of the recognition process at said Foundation shall be accepted, accompanied by an authenticated copy of the most recent minutes of the meeting of the Quilombola Community members, signed by those present.

d) Transgender applicant: (i) Self-declaration (Annex 6); (ii) Descriptive academic statement (Annex 7); (iii) Full birth certificate (or the protocol number of the administrative process for name/gender record rectification) and/or another document showing the social name. The Transgender Identity Heteroidentification Committee shall be responsible for verifying and deciding on the legitimacy of the self-declaration (procedure described in Annex 8), based on the documentation submitted and the descriptive academic statement.

e) Person with a disability: (i) Medical report (original copy, issued no more than one year prior), containing: a) a descriptive medical opinion prepared by a physician, on official prescription letterhead; b) the disability code pursuant to the International Classification of Diseases (ICD); c) the category of disability pursuant to applicable legislation.

5. Stages of the Selection Process

Master's Level

5.1 First Stage: Written Examination (see subjects and bibliography in Annex 12), corresponding to 70% of the final score, of an eliminatory nature. The examination shall be conducted in person and individually, with a duration of 4 hours, consisting of 12 essay questions (score of 0.83 per question), distributed among the Program's areas. The applicant must bring a blue ballpoint pen and a calculator. Consultation of any bibliographic source shall not be permitted.

Note: Applicants shall be qualified for the second stage (Curriculum Analysis) when the examination score is equal to or greater than 30% of the highest score obtained in the first stage. No applicant shall be qualified if no candidate correctly answers any questions on the Written Examination.

5.2 Second Stage: Curriculum Analysis, corresponding to 30% of the final score, of a classificatory nature, based on the analysis of the applicants' documentation. The Scoring Table (Annex 9) must be completed by the applicant following the guidelines described in item 4.1 of this Public Notice.

Doctoral Level

5.3 First Stage: Written Examination (see subjects and bibliography in Annex 12), corresponding to 70% of the final score, of a classificatory nature. The examination shall be conducted in person and individually, with a duration of 4 hours, consisting of 12 essay questions (score of 0.83 per question), distributed among the Program's areas. The applicant must bring a blue ballpoint pen and a calculator. Consultation of any bibliographic source shall not be permitted.

5.4 Second Stage: Defense of the Research Proposal (to be prepared by the applicant, taking into account suitability to the proposed topic and intended field) and of the Descriptive Academic Statement, both of an eliminatory nature. Applicants who obtain a minimum score of 7 in this stage shall be qualified for the third stage (Curriculum Analysis). The Research Proposal shall have a weight of 7, and the Descriptive Academic Statement shall have a weight of 3.

Note: The Research Proposal presentation shall last 15–20 minutes, and the Descriptive Academic Statement presentation shall last 5–10 minutes. The evaluation and oral examination shall be conducted by faculty members of the Selection Committee after the conclusion of both presentations. The depth of knowledge regarding the project topic and subjects related to the applicant's area of interest shall be assessed.

5.5 Third Stage: Curriculum Analysis, corresponding to 30% of the final score, of a classificatory nature, based on the analysis of the applicants' documentation. The Scoring Table (Annex 10) must be completed by the applicant in accordance with the guidelines described in item 4.1 of this Public Notice.

6. General Considerations on the Selection Process

6.1 The scores for the Written Examination and the Curriculum Evaluation shall be normalized based on the highest score obtained in each stage.

6.2 Scores for all stages shall be expressed with two decimal places.

6.3 In the event of a tie in the final score, the following criteria shall apply: 1st) the applicant with the higher score on the Written Examination; 2nd) if a tie remains in the Written Examination score, age shall be used as the tie-breaking criterion, with older applicants receiving priority in ranking.

6.4 The Written Examination shall be administered at the Auditorium of the School of Chemistry and Food (Carreiros Campus – Rio Grande) and at the Videoconference Room of the UAB Center (Cidade Alta Campus/FURG – Santo Antônio da Patrulha), on the date and time described in the Schedule of this Public Notice. Late arrivals shall not be tolerated.

6.5 The examination may be administered in another city, provided that there is applicant demand and at least one faculty member responsible for administering the examination at their university. In such cases, the faculty member responsible for administering the examination must send an email (within the application period) to the PPGQTA Secretariat (ppgquimica@furg.br), requesting that the examination be administered outside the Carreiros Campus (Rio Grande/RS) or the FURG Campus in Santo Antônio da Patrulha/RS, and informing the location of the examination as well as the name(s) of the applicant(s) registered to take the examination at the respective university. Requests submitted after the deadline shall not be accepted. The PPGQTA Coordination shall send an email to the responsible faculty member upon confirmation of the examination.

6.6 The defenses of the Research Proposal and the Descriptive Academic Statement for the Doctoral level shall be conducted at the Auditorium of the School of Chemistry and Food (Carreiros Campus – Rio Grande) or by videoconference. In the case of applicants residing in Santo Antônio da Patrulha, presentations shall be held in the Videoconference Room of the UAB Center (Cidade Alta Campus/FURG – Santo Antônio da Patrulha), with transmission to the Carreiros Campus.

6.7 Upon request, if the applicant is located in another city, the defenses of the Research Proposal and the Descriptive Academic Statement may be conducted by videoconference, following the same rules outlined in item 6.5 of this Public Notice for administering the examination in another city. The efficiency and reliability of the videoconference system shall be the sole responsibility of the applicant. Late arrivals shall not be tolerated. The order of presentations shall be published together with the list of approved applicants.

6.8 The selection process may be undertaken by applicants who wish to enter the Program and/or by applicants already enrolled who wish to compete for a fellowship quota (pursuant to a Fellowship Notice to be published after this selection process, subject to quota availability).

6.9 In the case of applicants already enrolled in the Doctoral program, it shall not be necessary to carry out the Research Proposal Defense and the Descriptive Academic Statement Defense in order to compete for a scholarship.

7. Enrollment

7.1 Applicants approved in this selection process shall be eligible to enroll in the PPGQTA on a date to be communicated to the approved applicants by email.

7.2 Approved applicants must contact potential academic advisors (see information on the Program's website: ppgqta.furg.br).

7.3 In the event that more than one applicant is interested in the same position, the academic advisor shall determine which applicant will occupy the position, and the tie-breaking criteria shall be established by the advisor.

7.4 The PPGQTA Secretariat shall contact the approved applicants to inform them of the required documentation and enrollment deadlines.

8. Selection Process Schedule

Start of applications	01/09/2023
End of applications	01/31/2023
Publication of the preliminary results of the application approval	02/01/2023
Appeals regarding application approval*	02/02/2023
Final result of application approval	02/03/2023
MASTER'S LEVEL	
First Stage: Written Examination at 8:00 a.m. - Auditorium of the School of Chemistry and Food (Carreiros Campus – Rio Grande) and Videoconference Room of the UAB Center (Cidade Alta Campus/FURG – Santo Antônio da Patrulha)	02/06/2023
Publication of the Preliminary Result of the Written Examination	02/07/2023
Appeals regarding Written Examination scores	02/08/2023
Review of appeals and publication of the Final Result of the Written Examination	02/09/2023
Second Stage: Curriculum Evaluation	02/10/2023
Publication of the Preliminary Results of the Curriculum Evaluation	02/13/2023
Appeals regarding Curriculum Evaluation scores	02/14/2023
Review of appeals and publication of the Final Result of the Curriculum Evaluation	02/15/2023
Final Result	02/15/2023
DOCTORAL LEVEL	
First Stage: Written Examination at 8:00 a.m. - Auditorium of the School of	02/06/2023

Chemistry and Food (Carreiros Campus – Rio Grande) and Videoconference Room of the UAB Center (Cidade Alta Campus/FURG – Santo Antônio da Patrulha)	
Publication of the Preliminary Result of the Written Examination	02/07/2023
Appeals regarding Written Examination scores	02/08/2023
Review of appeals and publication of the Final Result of the Written Examination	02/09/2023
Second Stage: Research Proposal and Descriptive Academic Statement Defense at 2:00 p.m. – Auditorium of the School of Chemistry and Food (Carreiros Campus – Rio Grande) and Videoconference Room of the UAB Center (Cidade Alta Campus/FURG – Santo Antônio da Patrulha)	02/06/2023
Second Stage: Research Proposal and Descriptive Academic Statement Defense at 8:00 AM - Auditorium of the School of Chemistry and Food (Carreiros Campus - Rio Grande) and Videoconference Room of the UAB Center (Cidade Alta/FURG Campus - Santo Antônio da Patrulha)	02/07/2023
Publication of the Preliminary Result of the Research Proposal and Descriptive Academic Statement Defense	02/07/2023
Appeals regarding scores of the Research Proposal and Descriptive Academic Statement Defense	02/08/2023
Review of appeals and publication of the Final Result of the Research Proposal and Descriptive Academic Statement Defense	02/09/2023
Third Stage: Curriculum Evaluation	02/10/2023
Publication of the Preliminary Results of the Curriculum Evaluation	02/13/2023
Appeals regarding Curriculum Evaluation scores	02/14/2023
Review of appeals and publication of the Final Result of the Curriculum Evaluation	02/15/2023
Final Result	02/15/2023

* Appeals must be submitted through the same system used for application submission.

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

_____ **Date: February 6, 2026**

EDITAL 01/2023 - SELEÇÃO DE ALUNOS DE MESTRADO E DOUTORADO

O Programa de Pós-Graduação em Química Tecnológica e Ambiental (PPGQTA) torna público o Edital de Seleção que informa os critérios para o ingresso de candidatos aos cursos de Mestrado e Doutorado do PPGQTA nas áreas de Química Analítica, Química Orgânica, Química Inorgânica e Físico-Química.

1. Vagas

1.1 Serão disponibilizadas 27 vagas de Mestrado e 12 vagas de Doutorado, sendo 80% (por curso) das vagas destinadas à ampla concorrência e 20% (por curso) destinadas ao Programa de Ações Afirmativas na Pós-Graduação (PROAAf-PG) para pessoas auto-declaradas negras (pretas e pardas) ou transgêneros (travestis e transexuais), indígenas, quilombolas e pessoas com deficiência, conforme Resolução n° 004/2019 do CONSUN/FURG, alterada pela Resolução nº 11/2022 (disponível em https://propesp.furg.br/RESCONSUN042019) e conforme IN PROPESP/FURG nº 06/2022 (disponível em https://propesp.furg.br/INPROPESP062022).

1.2 As vagas serão preenchidas de acordo com a ordem classificatória segundo critérios descritos neste edital e com o preenchimento adequado dos Anexos deste edital. Os candidatos negros, transgêneros, indígenas, quilombolas ou com deficiência concorrem às vagas de forma concomitante, e em caso de classificação na ampla concorrência, o ingresso dar-se-á obrigatoriamente pela ampla concorrência, sem prejuízo dos mecanismos para sua permanência.

1.3 Em caso do não preenchimento das vagas destinadas à políticas de ações afirmativas, estas ficarão disponibilizadas automaticamente para as vagas de ampla concorrência. O candidato aprovado, nas vagas vinculadas à política de ações afirmativas, passará por uma averiguação pela comissão de Heteroidentificação.

1.4 Número de vagas ofertadas neste Edital:

Área	Vagas	
	Mestrado	Doutorado
Química Analítica	11	6
Química Orgânica	8	2
Química Inorgânica	2	0
Físico-Química	6	4

As informações sobre disponibilidade e normas para distribuição das bolsas estão no Anexo 11.

2. Comissões

2.1 A comissão de seleção deste Edital será constituída por Docentes do PPGQTA.

2.2 Para as vagas destinadas ao PROAAf-PG, será acionada a comissão de heteroidentificação da Escola de Química e Alimentos.

3. Público alvo

3.1. Nível Mestrado: Portadores de diploma de Graduação ou Certificado de Conclusão de Curso de Graduação em Química ou áreas afins.

3.2. Nível Doutorado: Portadores de diploma de Mestrado ou Certificado de Conclusão de Curso de Mestrado em Química ou áreas afins reconhecido pela Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES). Será admitido ainda a apresentação de carta do orientador com anuência da Coordenação do respectivo Programa de Pós-Graduação informando a data de defesa marcada em data que anteceda a data de divulgação do Resultado final desta seleção.

Observação: As exigências supracitadas para ambos os níveis se aplicam também para o caso de diplomas e certificados de conclusão emitidos no exterior. Nestes casos, quando os documentos emitidos no exterior estiverem em outro idioma, solicita-se ainda que os mesmos sejam acompanhados de tradução juramentada para o português.

4. Inscrições

4.1 As inscrições serão realizadas de 09/01/2023 a 31/01/2023, exclusivamente pelo Sistema de Inscrições dos cursos de Pós-Graduação (SIPOSG), disponível em siposg.furg.br/mestrado (Mestrado) e siposg.furg.br/doutorado (Doutorado). Os documentos a seguir devem ser digitalizados e anexados no sistema de inscrição em frente e verso:

Nível Mestrado

a) Cópia do Diploma de curso superior ou atestado de provável formando em data que anteceda a data do resultado final desta seleção emitido por IES (Obrigatório).
b) Cópia da Carteira de Identidade e Cadastro de Pessoa Física (CPF) (Obrigatório).
c) Para estrangeiros(as), cópia do número do passaporte (Obrigatório).
d) Currículo Lattes atualizado (Obrigatório).
e) Histórico escolar da graduação (Obrigatório).
f) Carta de intenção à vaga pretendida e motivação para a realização do mestrado (Obrigatório).
g) Tabela de pontuação preenchida (conforme Anexo 9) e documentada com cópias não autenticadas e numeradas de acordo com a ordem da tabela de pontuação. Os documentos comprobatórios devem ser anexados junto à tabela seguindo a ordem de pontuação da mesma, observando e respeitando a pontuação máxima solicitada. É de inteira responsabilidade do candidato a pontuação da tabela, bem como a inserção dos documentos comprobatórios numerados sequencialmente, não sendo analisado e sendo desconsiderada a pontuação sem seu respectivo e adequado comprovante. Só será considerada a pontuação declarada pelo candidato (Obrigatório).
h) Formulário de requerimento de bolsa de estudo conforme Anexo 13, caso queira concorrer a bolsa em Edital de Bolsas (o qual será publicado após o término deste processo seletivo), conforme disponibilidade de cota e que terá como critério de classificação o resultado do Edital 01/2023.

Observação: Só serão homologados os inscritos que apresentarem os documentos obrigatórios supracitados digitalizados e anexados ao sistema de inscrição no prazo previsto no edital.

Nível Doutorado

a) Cópia do Histórico Escolar do curso de Graduação e de Mestrado (formato PDF) (Obrigatório).
b) Cópia do Diploma de Curso Superior e de Mestrado (ou carta do orientador e da Coordenação do Programa de Pós-Graduação informando a data de defesa da dissertação que deve anteceder a data do resultado final deste processo seletivo) (formato PDF) (Obrigatório).
c) Cópia da Carteira de Identidade e Cadastro de Pessoa Física (CPF) (Obrigatório).
d) Para estrangeiros(as), cópia do número do passaporte (Obrigatório).
e) Currículo Lattes atualizado (http://lattes.cnpq.br) (Obrigatório).
f) Versão digitalizada do Projeto de Pesquisa para o curso de Doutorado (formato PDF) - (*Normas: máximo de 10 páginas; fonte Times New Roman; tamanho 12; espaço entrelinhas 1,5; margem esquerda e superior contendo 3 cm e direita e inferior contendo 2 cm*) (Obrigatório).
g) Versão digitalizada do memorial descritivo (formato PDF) - (*Normas: máximo 2 páginas; fonte Times New Roman; tamanho 12; espaço entrelinhas 1,5; margem esquerda e superior contendo 3 cm e direita e inferior contendo 2 cm*) (Obrigatório).
h) Carta de intenção à vaga pretendida e motivação para realização do Doutorado (Obrigatório).
i) Tabela de pontuação preenchida (conforme Anexo 10) e documentada com cópias não autenticadas numeradas de acordo com a ordem da tabela de pontuação**.** Os documentos comprobatórios devem ser anexados junto à tabela seguindo a ordem de pontuação da mesma, observando e respeitando a pontuação máxima solicitada. É de inteira responsabilidade do candidato a pontuação da tabela, bem como a inserção dos documentos comprobatórios, não sendo analisado e sendo desconsiderada a pontuação sem seu respectivo e adequado comprovante. Só será considerada a pontuação declarada pelo candidato (Obrigatório).
j) Formulário de requerimento de bolsa de estudo conforme Anexo 11, caso queira concorrer a bolsa em Edital de Bolsas (o qual será publicado após o término deste processo seletivo), conforme disponibilidade de cota e que terá como critério de classificação o resultado do Edital 01/2023.

Observação: Só serão homologados os inscritos que apresentarem os documentos solicitados obrigatórios supracitados e anexados ao sistema de inscrição no prazo previsto neste Edital.

4.2 Para concorrer às vagas do Programa de Ações Afirmativas na Pós-Graduação (PROAAf-PG), o candidato deve assim indicar no formulário de auto declaração que consta nos Anexos 1, 3, 4, 5 ou 6 deste Edital e entregar a seguinte documentação:

a) Negros (pretos e pardos): (*i*) Autodeclaração étnico-racial (Anexo 1). Cabe à Comissão de Heteroidentificação étnico-racial a verificação e decisão sobre a legitimidade da autodeclaração (procedimento descrito no Anexo 2)
b) Indígenas: (*i*) cópia simples do Registro Administrativo de Nascimento de Índio (RANI) expedida pela FUNAI; (*ii*) declaração original de membro pertencente à Comunidade ou Aldeia, expedida no ano vigente e assinada por três Lideranças da Comunidade Indígena (Cacique + duas Lideranças) (Anexo 3)
c) Quilombolas: (*i*) cópia simples da declaração original expedida pela Fundação Cultural Palmares na qual conste o reconhecimento oficial do quilombo ao qual o candidato pertença; (*ii*) declaração original da comunidade quilombola, emitida no ano vigente, com a assinatura de três lideranças reconhecidas (Presidente e duas lideranças) na qual conste que o candidato pertence àquela comunidade (Anexo 4); (*iii*) comprovante de residência ou declaração de

residência em/na comunidade quilombola (Anexo 5); (*iv*) para os quilombos em processo de reconhecimento pela Fundação Cultural Palmares, será aceito um documento que comprove a abertura de processo de reconhecimento nesta Fundação, acompanhado de cópia autenticada da última Ata da reunião dos membros da Comunidade Quilombola assinada pelos presentes no ato da mesma

d) Pessoa transgênero: (*i*) Autodeclaração (Anexo 6); (*ii*) Memorial descritivo (Anexo 7); (*iii*) certidão de nascimento de inteiro teor (ou número de protocolo do processo administrativo para retificação) e/ou outro documento com nome social. Cabe à Comissão de Heteroidentificação de identidade transgênero a verificação e decisão sobre a legitimidade da autodeclaração (procedimento descrito no Anexo 8), tendo como base a documentação e o Memorial descritivo
e) Pessoa com deficiência: (*i*) Laudo médico (via original com no máximo um ano de emissão) que contenha: a) parecer descritivo elaborado pelo médico, em receituário próprio; b) o código da deficiência nos termos da Classificação Internacional de Doenças CID; c) a categoria de deficiência nos termos da legislação vigente.

5. Etapas do processo seletivo

Nível Mestrado

5.1 Primeira Etapa: Prova Escrita (vide assuntos e bibliografia do Anexo 12) correspondendo a 70% da nota final, em caráter eliminatório, a qual será realizada de forma presencial e individual, com duração de 4 horas, contendo 12 questões discursivas (pontuação de 0,83 por questão), distribuídas entre as áreas do Programa. O candidato deve estar munido de caneta esferográfica azul e calculadora. Não será admitido consulta a nenhuma fonte bibliográfica.

Observação: Os candidatos estarão classificados para a segunda etapa (Análise de Currículo) quando a nota da Prova for igual ou superior a 30% da maior nota obtida na primeira etapa. Não haverá candidato classificado se não houver candidato com acertos nas questões da Prova Escrita.

5.2 Segunda Etapa: Análise de Currículo correspondendo a 30% da nota final, em caráter classificatório, a partir da análise da documentação dos candidatos. A Tabela de Pontuação (Anexo 9) deverá ser preenchida pelo candidato, conforme orientações descritas no item 4.1 deste Edital.

Nível Doutorado

5.3 Primeira etapa: Prova Escrita (vide assuntos e bibliografia do Anexo 12) correspondendo a 70% do valor da nota final em caráter classificatório, a qual será realizada de forma presencial e individual, com duração de 4 horas, contendo 12 questões discursivas (pontuação de 0,83 por questão), distribuídas entre as áreas do Programa. O candidato deve estar munido de caneta esferográfica azul e calculadora. Não será admitido consulta a nenhuma fonte bibliográfica.

5.4 Segunda etapa: Defesa do Projeto de Pesquisa (que deverá ser redigido pelo candidato considerando a adequabilidade ao tema e área pretendida) e do Memorial Descritivo, ambos em caráter eliminatório. Os candidatos que obtiverem nota mínima 7 nesta etapa estarão classificados para a terceira etapa (Análise de Currículo). O projeto de Pesquisa terá peso 7 e o Memorial Descritivo terá peso 3.

Observação: A apresentação do Projeto de Pesquisa terá o tempo de 15-20 min e a apresentação do Memorial Descritivo terá o tempo de 5-10 min. A avaliação e arguição será realizada por professores da Comissão de Seleção após o término de ambas as apresentações. Será avaliada a profundidade de conhecimento quanto ao tema do projeto e assuntos relacionados à área de interesse do candidato.

5.5 Terceira etapa: Análise de currículo correspondendo a 30% do valor da nota final, em caráter classificatório, a partir da análise da documentação dos candidatos. A Tabela de Pontuação (Anexo 10) deverá ser preenchida pelo candidato, conforme orientações descritas no item 4.1 deste Edital.

6. Considerações gerais sobre o processo seletivo

6.1 A nota da Prova Escrita e a nota da Avaliação dos Currículos serão normalizadas com base na maior nota de cada etapa.

6.2 As pontuações de todas as etapas serão expressas com duas casas decimais após a vírgula.

6.3 Em caso de empate na nota final, serão utilizados os seguintes critérios: 1º) candidato com maior nota na Prova Escrita; 2º) Caso exista empate na nota na Prova Escrita, o critério de desempate será a idade (o candidato de maior idade terá prioridade na colocação).

6.4 A Prova Escrita será realizada no Auditório da Escola de Química e Alimentos (Campus Carreiros - Rio Grande) e na Sala de Videoconferência do Polo UAB (Campus Cidade Alta/FURG - Santo Antônio da Patrulha) conforme dia e horário descrito no Cronograma deste Edital. Não serão tolerados atrasos.

6.5 A prova poderá ser realizada em outro município desde que exista demanda de candidato e ao menos um docente responsável pela aplicação da Prova em sua Universidade. Neste caso, o docente responsável pela aplicação da prova deverá enviar e-mail (dentro do período de inscrições) para a secretaria do PPGQTA (ppgquimica@furg.br), solicitando a aplicação da prova fora do Campus Carreiros (Rio Grande/RS) ou Campus da FURG em Santo Antônio da Patrulha/RS e informando o local da aplicação assim como o nome do(s) candidato(s) inscrito(s) para realizar a prova na respectiva Universidade. Solicitações fora do prazo não serão aceitas. A coordenação do PPGQTA enviará e-mail ao docente responsável no caso da confirmação da realização da prova.

6.6 As defesas do Projeto de Pesquisa e de Memorial Descritivo para o Doutorado serão realizadas no Auditório da Escola de Química e Alimentos (Campus Carreiros - Rio Grande) ou por videoconferência (no caso de candidatos residentes em Santo Antônio da Patrulha, os quais deverão realizar as apresentações na Sala de Videoconferência do Polo UAB (Campus Cidade Alta/FURG - Santo Antônio da Patrulha), com transmissão para o Campus Carreiros.

6.7 Em caso de solicitação se estiver em outro município, as defesas do Projeto de Pesquisa e de Memorial Descritivo poderão ser realizadas por videoconferência, seguindo as mesmas regras supracitadas no item 6.5 deste Edital para a aplicação de Prova em outro município. É de inteira responsabilidade do candidato a eficiência do sistema de comunicação via videoconferência. Não serão tolerados atrasos. A ordem das apresentações será divulgada juntamente com a lista dos candidatos homologados.

6.8 O processo seletivo poderá ser realizado por candidatos que desejem ingressar no Programa e/ou por candidatos já matriculados que desejem concorrer à cota de bolsa (segundo Edital de bolsas que será publicado após esta seleção, conforme disponibilidade de cotas).

6.9 No caso de candidatos já matriculados no Doutorado, não será necessário realizar a Defesa de Projeto e Memorial Descritivo para concorrer à bolsa.

7. Matrícula

7.1 Os candidatos aprovados neste processo seletivo estarão aptos a efetuar matrícula no PPGQTA em data que será informada por e-mail aos aprovados.

7.2 Os candidatos aprovados devem entrar em contato com os possíveis orientadores (consultar informações no site do programa ppgqta.furg.br).

7.3 No caso de ter mais de um candidato interessado pela mesma vaga, o orientador definirá qual candidato irá ocupar a vaga e os critérios de desempate devem ser estabelecidos pelo orientador.

7.4 A secertaria do PPGQTA entrará em contato com os aprovados para informar a documentação necessária e os prazos para a matrícula.

8. Cronograma do processo seletivo

Início das inscrições	09/01/2023
Término das inscrições	31/01/2023
Divulgação do resultado preliminar da homologação das inscrições	01/02/2023
Recursos da homologação das inscrições*	02/02/2023
Resultado final da homologação das inscrições	03/02/2023
NÍVEL MESTRADO	
Primeira etapa: Prova Escrita às 08:00 - Auditório da Escola de Química e Alimentos (Campus Carreiros - Rio Grande) e Sala de videoconferência do Polo UAB (Campus Cidade Alta/FURG - Santo Antônio da Patrulha)	06/02/2023
Divulgação do Resultado Preliminar da Prova Escrita	07/02/2023
Recursos das notas da Prova Escrita	08/02/2023
Julgamento dos recursos e divulgação do Resultado Final da Prova Escrita	09/02/2023
Segunda etapa: Avaliação de Currículos	10/02/2023
Divulgação do Resultado Preliminar da Avaliação de Currículos	13/02/2023
Recursos das notas da Avaliação de Currículos	14/02/2023
Julgamento dos recursos e divulgação do Resultado Final da Avaliação de Currículos	15/02/2023
Resultado Final	15/02/2023
NÍVEL DOUTORADO	
Primeira etapa: Prova Escrita às 08:00 - Auditório da Escola de Química e	06/02/2023

Alimentos (Campus Carreiros - Rio Grande) e Sala de videoconferência do Polo UAB (Campus Cidade Alta/FURG - Santo Antônio da Patrulha)	
Divulgação do Resultado Preliminar da Prova Escrita	07/02/2023
Recursos das notas da Prova Escrita	08/02/2023
Julgamento dos recursos e divulgação do Resultado Final da Prova Escrita	09/02/2023
Segunda etapa: Defesa de Projeto e Memorial Descritivo às 14:00 - Auditório da Escola de Química e Alimentos (Campus Carreiros - Rio Grande) e Sala de videoconferência do Polo UAB (Campus Cidade Alta/FURG - Santo Antônio da Patrulha)	06/02/2023
Segunda etapa: Defesa de Projeto e Memorial Descritivo às 08:00 - Auditório da Escola de Química e Alimentos (Campus Carreiros - Rio Grande) e Sala de videoconferência do Polo UAB (Campus Cidade Alta/FURG - Santo Antônio da Patrulha)	07/02/2023
Divulgação do Resultado Preliminar da Defesa de Projetos e Memorial descritivo	07/02/2023
Recurso das notas da Defesa de Projeto e Memorial Descritivo	08/02/2023
Julgamento dos recursos e divulgação do Resultado Final da Defesa de Projeto e Memorial Descritivo	09/02/2023
Terceira etapa: Avaliação de currículos	10/02/2023
Divulgação do Resultado Preliminar da Avaliação de Currículos	13/02/2023
Recurso das notas da Avaliação de Currículos	14/02/2023
Julgamento dos recursos e divulgação do Resultado Final da Avaliação de Currículos	15/02/2023
Resultado Final	15/02/2023

* A solicitação de recurso deve ocorrer no sistema que foi efetuada a inscrição.

Public Notice No. 03/2023

Notice for the Selection Process for the Award of Master's and Doctoral Fellowships of the Graduate Studies Program in Technological and Environmental Chemistry

The Coordination of the Graduate Studies Program in Technological and Environmental Chemistry (PPGQTA) of FURG hereby announces the opening of applications for the selection process for the award of 5 Master's fellowships and 5 Doctoral fellowships under the CAPES Social Demand Program (DS). The application period shall run from March 15 to March 16, 2023, and the fellowships shall take effect as of April 2023, governed by the rules outlined herein and conducted by the PPGQTA Fellowship Committee.

I – OBJECT

Article 1 – This Public Notice aims to regulate the selection process for the award of Master's and Doctoral fellowships to students regularly enrolled in the PPGQTA of the Federal University of Rio Grande (FURG) in the year 2023, following the CAPES Social Demand Program.

II – APPLICATIONS

Article 3 – Applications under this Public Notice shall be submitted between 03/15/2023 and 03/16/2023 by submitting the documentation listed below to the Secretariat of the Graduate Studies Program in Technological and Environmental Chemistry (PPGQTA) at the Carreiros Campus of FURG, via the email address ppgquimica@furg.br
.

Article 4 – The following documents are mandatory for the application:

I – Application Form (Annex I to this Notice);
II – CPF and ID;
III – Proof of residence.

Article 5 – The following are conditions for application and rules accepted by the applicant. For the award of a fellowship, the graduate student must:

I – Devote full-time dedication to the activities of the graduate studies program;
II – If holding an employment relationship, be released from professional activities and not receive remuneration;
III – Demonstrate satisfactory academic performance, following the standards defined by the institution offering the program;
IV – Not maintain any employment relationship with the institution offering the Graduate Studies Program;
V – Complete a teaching internship, as established by the Program regulations.

VI – Not be enrolled in a medical residency program;

VII – When a public servant, only those with tenure may be eligible for Master's and Doctoral fellowships, pursuant to Article 318 of Law No. 11,907, of February 2, 2009;

VIII – Public servants who are awarded Master's or Doctoral fellowships must, upon their return, remain in the exercise of their official duties for a period equal to the duration of the leave granted (§ 4, Article 96-A, as amended by Article 318 of Law No. 11,907, of February 2, 2009, which amended Law No. 8,112, of December 11, 1990);

IX – Be approved in the selection process specifically established by the Higher Education Institution where the program is conducted;

X – Establish residence in the city where the program is held;

XI – Not accumulate the fellowship with any other form of financial aid or fellowship from another CAPES program, from any other public funding agency, national or international, or from any public or private entity, except in the following cases:

a) A Master's or Doctoral fellow may receive gross remuneration lower than the value of the respective fellowship arising from an employment relationship with the public basic education system or in the field of collective/public health, provided that the student is fully released from professional activities and, in the latter case, is pursuing graduate studies in the same field;

b) CAPES fellows, enrolled in graduate studies programs in Brazil, who are selected to serve as substitute professors at public higher education institutions, with the formal consent of their academic advisor and authorization from the CAPES/DS Fellowship Committee of the graduate studies program, shall retain their fellowships. However, individuals who are already serving as substitute professors may not be awarded fellowships under the Social Demand Program;

c) As established by Joint Ordinance No. 1 CAPES/CNPq, dated 12/12/2007, CAPES fellows enrolled in graduate studies programs in Brazil may receive a University of Brazil Open University (UAB) fellowship when serving as tutors. With respect to other UAB positions, the accumulation of fellowships is not permitted (pursuant to CAPES Ordinance No. 76/2010);

d) In addition to the criteria outlined above, for the award of fellowships, academic merit shall be assessed based on the ranking in Selection Notice No. 01/2023.

III – SELECTION PROCESS AND RESULTS

Article 6 – The Fellowship Committee shall review the candidates' documentation, and the final result of the selection process shall be published on the Program's official website by March 17, 2023.

IV – SCHOLARSHIP ALLOCATION

Article 7 – The available CAPES/DS fellowships shall be allocated following the order of ranking established in Selection Notice No. 01/2023.

Article 8 – Of the total number of available fellowships, 20% shall be reserved for the affirmative action policy, pursuant to CONSUN/FURG Resolution No. 004/2019, as amended by Resolution No. 11/2022, and

Normative Instruction IN PROPESP/FURG No. 6, of October 27, 2022 (annexed to this Public Notice). These fellowships shall be granted according to the ranking order, based on the criteria described herein. Candidates applying under affirmative action policies shall compete concurrently with the general competition, and if ranked within the general competition, admission shall occur exclusively through the general competition, without prejudice to mechanisms ensuring their continued enrollment. If the positions reserved for affirmative action policies are not filled, they shall be automatically reallocated to the general competition. Candidates approved under affirmative action policies shall be subject to verification by the self-declaration review committee.

IV – TERM AND OTHER PROVISIONS

Article 8 – This Public Notice shall remain in effect until the issuance of the next Selection Notice of the Program.

Article 9 – Any cases not expressly provided for herein shall be resolved by the Program Coordination.

Rio Grande, March 15, 2023.

Prof. Dr. Bruno Meira Soares

Coordinator of the Graduate Studies Program in Technological and Environmental Chemistry.

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

_____ **Date: February 6, 2026**

Edital 03/2023

Edital para Processo Seletivo para Concessão de Bolsas de Mestrado e Doutorado do Programa de Pós-graduação em Química Tecnológica e Ambiental

A Coordenação do Programa de Pós-Graduação em Química Tecnológica e Ambiental (PPGQTA) da FURG torna pública as inscrições para o processo seletivo para a concessão de 5 bolsas de Mestrado e 5 bolsas de Doutorado da CAPES/Demanda Social (DS). O período de inscrições será de 15 a 16 de março de 2022 e a bolsa terá vigência a partir de abril de 2023 e será regida pelas normas a seguir descritas e conduzido pela Comissão de Bolsas do PPGQTA.

I - DO OBJETO

Artigo 1º - Este edital tem como objetivo o processo seletivo para a concessão de bolsas de Mestrado e Doutorado, dos alunos regularmente matriculados no Programa PPGQTA da Universidade Federal do Rio Grande (FURG), no ano de 2023, em conformidade como Programa de Demanda Social da CAPES.

II - DAS INSCRIÇÕES

Artigo 3º - As inscrições de que trata o presente Edital serão realizadas no período de 15/03/2023 a 16/03/2023, através da entrega da documentação listada abaixo na Secretariado Programa de Pós-Graduação em Química Tecnológica e Ambiental (PPGQTA) no Campus Carreiros da FURG, através do endereço de e-mail ppgquimica@furg.br.

Artigo 4º - São documentos indispensáveis para a inscrição:

I - Formulário de Inscrição (Anexo I deste Edital)
II - CPF e RG
III - Comprovante de residência

Artigo 5º - São condições para a inscrição e normas aceitas pelo candidato. Exigir-se-á do pós-graduando, para concessão de bolsa de estudos:

I - Dedicação integral às atividades do programa de pós-graduação;

II - Quando possuir vínculo empregatício, estar liberado das atividades profissionais e sem percepção de vencimentos;

III - Comprovar desempenho acadêmico satisfatório, consoante às normas definidas pela instituição promotora do curso;

IV - Não possuir qualquer relação de trabalho com a instituição promotora doprograma de Pós-Graduação;

V - Realizar estágio de docência de acordo com o estabelecido;

VI - Não ser aluno em programa de residência médica;

VII - Quando servidor público, somente os estáveis poderão ser beneficiados com bolsas de mestrado e doutorado, conforme disposto no art. 318 da Lei 11.907, de 02 de fevereiro de 2009;

VIII- Os servidores públicos beneficiados com bolsas de mestrado e doutorado deverão permanecer no exercício de suas funções, após o seu retorno, por um período igual ao de afastamento concedido (§ 4º, art. 96-A, acrescido pelo Art. 318 da Leinº 11.907, de 02 de fevereiro de 2009 que deu nova redação à Lei 8.112, de 11 de dezembrode 1990);

IX - Ser classificado no processo seletivo especialmente instaurado pela Instituição de Ensino Superior em que se realiza o curso;

X - Fixar residência na cidade onde realiza o curso;

XI - Não acumular a percepção da bolsa com qualquer modalidade de auxílio ou bolsa de outro programa da CAPES, de outra agência de fomento pública, nacional ou internacional, ou empresa pública ou privada, excetuando-se:

a) poderá ser admitido como bolsista de mestrado ou doutorado, o pós-graduando que perceba remuneração bruta inferior ao valor da bolsa da respectiva modalidade, decorrente de vínculo funcional com a rede pública de ensino básico ou na área de saúde coletiva, desde que liberado integralmente da atividade profissional e, nesse último caso, esteja cursando a pós-graduação na respectiva área;

b) Os bolsistas da CAPES, matriculados em programas de pós-graduação no país, selecionados para atuarem como professores substitutos nas instituições públicas de ensino superior, com a devida anuência do seu orientador e autorização da Comissão de Bolsas CAPES/DS do programa de pós-graduação, terão preservadas as bolsas de estudo. No entanto, aqueles que já se encontram atuando como professores substitutos não poderão ser contemplados com bolsas do Programa de Demanda Social;

c) Conforme estabelecido pela Portaria Conjunta Nº. 1 Capes/CNPq, de12/12/2007, os bolsistas CAPES, matriculados em programas de pós-graduação no país, poderão receber bolsa da Universidade Aberta do Brasil - UAB, quando atuarem como tutores. Em relação aos demais agentes da UAB, não será permitido o acúmulo dessas bolsas (Conforme Portaria CAPES Nº 76/2010).

d) Além dos critérios supracitados, para a concessão de bolsa, o mérito acadêmico será avaliado conforme a classificação no Edital de Seleção 01/2023.

III - DA SELEÇÃO E DO RESULTADO

Artigo 6º - A Comissão de Bolsas examinará a documentação dos candidatos e o resultado final da seleção será divulgado na homepage do Programa até o dia 17 de março de 2023.

IV- DA DISTRIBUIÇÃO DAS BOLSAS

Artigo 7º - As bolsas CAPES/DS disponíveis serão distribuídas obedecendo a ordem de classificação do Edital 01/2023.

Artigo 8º - Do total de vagas, 20% serão vinculadas a política de ações afirmativas conforme Resolução n° 004/2019 do CONSUN/FURG, alterada pela Resolução nº 11/2022 e a Instrução Normativa IN

PROPESP/FURG Nº 6, de 27 de outubro de 2022 (Anexo a este edital). As vagas serão preenchidas de acordo com a ordem classificatória segundo critérios descritos neste edital. Os candidatos das políticas de ações afirmativas concorrem às vagas de forma concomitante, e em caso de classificação na ampla concorrência, o ingresso dar-se-á obrigatoriamente pela ampla concorrência, sem prejuízo dos mecanismos para sua permanência. Em caso de não preenchimento das vagas destinadas a política de ações afirmativas, estas ficarão disponibilizadas automaticamente para as vagas de ampla concorrência. O candidato aprovado, nas vagas vinculadas à política de ações afirmativas, passará por averiguação pela comissão de auto declaração.

IV - DA VIGÊNCIA E OUTROS CASOS

Artigo 8º - A vigência deste Edital encerra quando o próximo Edital de Seleção do Programa for realizado.

Artigo 9º - Os casos omissos a estas normas serão resolvidos pela Coordenação.

Rio Grande, 15 de março de 2023.

Prof. Dr. Bruno Meira Soares

Coordenador do Programa de Pós-Graduação em Química Tecnológica e Ambiental

FELLOW INFORMATION

Name: ALICE NERI DA SILVA SOUSA

CPF: ***.358.792-**

Institution: UDESC - STATE UNIVERSITY OF SANTA CATARINA

Program: SOCIAL DEMAND PROGRAM - DS

Level: MASTER'S DEGREE

Year: 2022

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

Date: February 9, 2026

Dados do Bolsista

Nome:	ALICE NERI DA SILVA SOUSA
CPF:	***.358.792-**
Instituição:	UDESC - UNIVERSIDADE DO ESTADO DE SANTA CATARINA
Programa:	PROGRAMA DE DEMANDA SOCIAL - DS
Nível:	MESTRADO
Ano:	2022

FINAL RESULT

FELLOWSHIP NOTICE No. 03/2021/PPGEF/UDESC
SELECTION OF FELLOWS: MASTER'S DEGREE IN FOREST ENGINEERING

Below is the ranking of candidates whose applications were approved under the respective notice.

Candidate	Ranking	Fellowship
Carolina Moraes	1	Capes
Gabriella da Silva França	2	Capes
Huga Gessica Bento de Oliveira	3	Fapesc
Alice Neri da Silva Sousa	4	Capes
Matheus Zanghelini Teixeira	5	Fapesc
Maísa Beatriz Koch Mattos	6	Capes
Marina Cruz	7	Capes
Vitor Hugo Simplicio	8	Promop*
Marina Marly Dalla Betta	9	Promop*
Laryssa Demétrio	10	Promop*
Camila Alves Correa	11	-
Zaro Bortoluzzi Bastos	12	-
Thaila Heberle	13	-
Carolina Rafaela Barroco Soares	14	-
Ângela Silva dos Santos	15	-
Leandro Silva Lemos	16	-
Karen Leticia Wantroba	17	-

* These fellowships have a duration of five (5) months.

- **SELECTION COMMITTEE**

Prof. Marcos Felipe Nicoletti (Chair)
Prof. Rodrigo Figueiredo Terezo
Prof. Thiago Floriani Stepka
Prof. Philipe Ricardo Casemiro Soares

PPGEF PROGRAM COORDINATION

Prof. Martha Andreia Brand

Lages, February 11, 2022.

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

Date: February 10, 2026

RESULTADO FINAL

EDITAL DE BOLSAS Nº 03/2021/PPGEF/UDESC
SELEÇÃO DE BOLSISTAS: MESTRADO EM ENGENHARIA FLORESTAL

Abaixo tem-se a classificação dos candidatos com inscrição homologada no respectivo edital.

Candidato	Ranking	Bolsa
Carolina Moraes	1	Capes
Gabriella da Silva França	2	Capes
Huga Gessica Bento de Oliveira	3	Fapesc
Alice Neri da Silva Sousa	4	Capes
Matheus Zanghelini Teixeira	5	Fapesc
Maísa Beatriz Koch Mattos	6	Capes
Marina Cruz	7	Capes
Vitor Hugo Simplicio	8	Promop*
Marina Marly Dalla Betta	9	Promop*
Laryssa Demétrio	10	Promop*
Camila Alves Correa	11	-
Zaro Bortoluzzi Bastos	12	-
Thaila Heberle	13	-
Carolina Rafaela Barroco Soares	14	-
Ângela Silva dos Santos	15	-
Leandro Silva Lemos	16	-
Karen Leticia Wantroba	17	-

* Essas bolsas possuem 5 (cinco) meses de duração.

- **COMISSÃO DE SELEÇÃO**

Prof. Marcos Felipe Nicoletti (Presidente)
Prof. Rodrigo Figueiredo Terezo
Prof. Thiago Floriani Stepka
Prof. Philipe Ricardo Casemiro Soares

COORDENAÇÃO DO PROGRAMA PPGEF

Profa. Martha Andreia Brand

Lages, 11 de fevereiro de 2022.

FELLOWSHIP SELECTION NOTICE No. 03/2021/PPGEF/UDESC

SELECTION OF FELLOWS: MASTER'S DEGREE IN FOREST ENGINEERING

The Coordinator of the Master's Degree Program in Forest Engineering of the Center for Agricultural and Veterinary Sciences (CAV) of the State University of Santa Catarina (UDESC), following the guidelines outlined in Council for Teaching, Research and Extension (CONSEPE) Resolutions No. 25/2009 and No. 08/2010, University Council (CONSUNI) Resolutions No. 003/2004 and No. 46/2011, Coordination for the Improvement of Higher Education Personnel (CAPES) Ordinances No. 76/2010 and No. 01/2010 (CAPES/CNPq), and Circular Letter No. 0010/2012-CDS/CGSI/DPB/CAPES, hereby publishes this Selection Notice:

1. SELECTION AND AWARD

1.1 The Master's fellowships in Forest Engineering shall be awarded to **regular students** of the Graduate Studies Program in Forest Engineering (PPGEF) **who are enrolled under Selection Notice No. 081/2021/CAV.**

1.2 The number of fellowships available for award under this Selection Notice, as well as their respective implementation for selected candidates, is subject to the release of fellowship quotas by the funding agencies (*CNPq, CAPES, UDESC, *FAPESC, etc.).

1.3 The ranking resulting from this Selection Notice shall be valid during the 2022/1 semester for the award of Master's fellowships arising from quota expansion, program completion, or replacement of fellows.

1.4 The Selection Committee shall review the applications and select the candidates for the Program fellowships based on criteria related to academic production and performance, evaluated through a scoring system as outlined in APPENDIX II, considering only activities and outputs completed by **January 28, 2022.**

1.5 Fellowships shall be awarded in descending order of the scores obtained by the applicants, starting with the highest-ranked candidate.

1.6 The Selection Committee shall determine the funding agency (CNPq, CAPES, FAPESC, UDESC, etc.) for each selected candidate, taking into account the specific requirements of each agency and the interests of the Graduate Studies Program in Forest Engineering.

1.7 If a candidate awarded a fellowship quota is also an applicant for admission under Selection Notice No. 081/2021/CAV and fails to complete enrollment, the fellowship quota shall be reassigned to the remaining candidates, following the ranking order.

1.8 Fellowships shall be awarded for a maximum period of 12 months. After this period, the selected candidate must reapply under a specific selection notice to renew the fellowship.

1.9 Under no circumstances shall FAPESC or *PROMOP fellowships be awarded to students who have an employment relationship. If a student holding this type of fellowship acquires an employment relationship, the fellowship must be relinquished.

1.10 Under no circumstances shall CAPES or CNPq fellowships be awarded to students who have an employment relationship and are earning a salary. If a student holding this type of fellowship acquires an employment relationship after the fellowship has been awarded, the continuation of the fellowship shall be decided by the Fellowship Committee, which shall assess, at a minimum, the following prerequisites:
a) The salary amount must be demonstrably lower than the value of the fellowship granted;
b) Employment relationships of no more than eight (08) hours per week shall be permitted, provided that prior approval is obtained from the student's academic advisor, the program coordinator, and the employer.

*CNPq - National Council for Scientific and Technological Development
*FAPESC - Santa Catarina State Research and Innovation Support Foundation
*PROMOP - Graduate Studies Teaching Assistantship Program

2. CANDIDATE APPLICATION

2.1 **Applications and submission of documentation shall be carried out exclusively online**, from **November 26, 2021, to January 28, 2022** (following the official Brasília/DF time), through the following link: https://www.cav.udesc.br/?idFormulario=309, **all required documentation must be uploaded to the system.**
NOTE – CANDIDATES REGISTERED UNDER THE SELECTION NOTICE (081/2021/CAV) ARE NOT AUTOMATICALLY GUARANTEED PARTICIPATION IN THIS FELLOWSHIP NOTICE. APPLICANTS INTERESTED IN A FELLOWSHIP MUST APPLY SEPARATELY UNDER THIS NOTICE.

2.2 Fellowship applicants must submit the following documents:
2.2.1 Application Form, according to the template provided (APPENDIX I);
2.2.2 Proof of enrollment as a regular student in the program (for regular students);
2.2.3 Scoring Form (APPENDIX II), duly completed and signed by the applicant;
2.2.4 Updated and duly documented Curriculum**, organized following the guidelines outlined in APPENDIX III;

** For online submission, if the documentation supporting the curriculum score exceeds the size limit allowed in the form, a link (in PDF format) must be provided through which the file may be accessed by the Fellowship Committee (OneDrive, Dropbox, Google Drive, etc.).

2.2.5 Undergraduate and/or graduate studies academic transcript(s), including the respective grade point averages or evaluation concepts.

2.3 Applications will be accepted from candidates who meet the following requirements:
2.3.1 Be enrolled as regular students in the Master's Degree Program in Forest Engineering or be applicants under Selection Notice No. 081/2021/CAV;
2.3.2 For regular students, comply with the academic evaluation criteria required by UDESC (semester average equal to or higher than grade B, as evidenced by an updated academic transcript);
2.3.3 Have no employment relationship with the institution offering the Graduate Studies Program;
2.3.4 At the time of fellowship award, require a minimum of ten (10) years of continued employment to be eligible for compulsory retirement;
2.3.5 Not receive a fellowship concurrently with any other type of financial aid or fellowship from another program;
2.3.6 Demonstrate full-time dedication to the activities of the Graduate Studies Program;
2.3.7 Have no employment relationship.

2.4 The information and documents provided in the fellowship application process, as well as their correct completion and submission, are the sole responsibility of the applicant. The Fellowship Committee of the Graduate Studies Program in Forest Engineering at UDESC reserves the right to exclude from the selection process any applicant who fails to complete the application form fully and correctly, or who provides information that is demonstrably false, or who submits links that cannot be accessed for verification of supporting documents.

2.5 The Fellowship Committee of the UDESC Graduate Studies Program shall not be held responsible for applications not received due to technical issues related to computer systems, communication failures, network congestion, or any other technical factors that prevent data transmission.

2.6. Candidates who obtain an employment relationship during the term of the fellowship (after it has been awarded) must immediately inform the Coordination of the Master's Degree Program in Forest Engineering. In such cases, the Fellowship Committee shall decide, based on the applicable legislation, on the continuation of the fellowship award.

2.7. The student's fellowship may be suspended at any time by the Program Coordination in the event of noncompliance by the fellow with any of the requirements outlined in items 2.1 and 2.2 of this Notice.

3. SELECTION CRITERIA

3.1. The available fellowship quotas shall be awarded according to the descending order of scores (APPENDIX II) obtained by candidates enrolled in the Master's Degree Program, starting with the highest-ranked candidate.

3.2. During the selection process, the specific fellowship award rules of each funding agency shall be observed, based on Resolutions No. 25/2009 (CONSEPE), No. 08/2010 (CONSEPE), No. 003/2004 (CONSUNI), No. 33/2009 (CONSUNI); Ordinances No. 76/2010 (CAPES) and No. 01/2010 (CAPES/CNPq); and Circular Letter No. 32/2011 (CDS/CGSI/DPB/CAPES), as well as any other rules that may be established by the funding agencies up to the date of the selection process.

4. PUBLICATION OF RESULTS

4.1. The result of the selection process shall be published by the Selection Committee and approved by the Program Council on the Program's official website (**https://www.udesc.br/cav/ppgef**) by **February 11, 2022.**
4.2. Classified candidates shall be contacted by the Administrative Office of the Graduate Studies Program in Forest Engineering (PPGEF) to submit additional documentation, if necessary, and to sign the specific forms required by each funding agency.

5. GENERAL PROVISIONS

5.1. The award of the fellowship is subject to the release of quotas by the funding agencies and to the submission of all other documents and requirements necessary for the implementation of the fellowship, as required by the funding agencies.

5.2. Any matters not addressed herein shall be resolved by the Council of the Graduate Studies Program in Forest Engineering / UDESC–CAV.

5.3. This Notice shall enter into force on the date of its publication.

Lages, November 29, 2021.

Prof. Martha Andreia Brand
COORDINATOR OF THE MASTER'S DEGREE
PROGRAM IN FOREST ENGINEERING

APPENDIX I

APPLICATION FORM

I, _____, CPF (Brazilian Taxpayer No.): _____, residing at the address: _____, hereby apply for enrollment in **FELLOWSHIP NOTICE NO. 03/2021/PPGEF**. For this purpose, I declare that I have read and agree to all the rules and conditions outlined in the aforementioned Notice.
I further inform that the Selection Committee may, during the selection period, contact me through the following telephone numbers and e-mail addresses to request clarifications or additional documentation for the implementation of any fellowship that may be awarded:
Telephone 1: (____) _____ Telephone 2: (___) _____
E-mail 1: _____ E-mail 2: _____. I declare that I am aware that, should the Fellowship Committee need to contact me and be unable to do so through the telephone numbers or e-mail addresses provided above, there is a risk of disqualification due to insufficient information or documentation.

Place and date

_____
Signature

APPENDIX II

Curriculum scoring spreadsheet (education, academic performance, and scientific and technical publication). Must be completed by the candidate[1].

I – ACADEMIC PERFORMANCE	Criteria	Calculation Method	Total Points
a) Completed Undergraduate Degree (only one undergraduate degree will be scored)[2]			
1. Overall grade point average obtained in the undergraduate program (all courses)	Overall average *5		
b) Completed Specialization Program (only one specialization program will be scored; it must be in the concentration area or related fields)[3]			
1. Overall average obtained in the completed courses	Average *2		
c) Master's or Doctoral courses taken as a special student or regular student in *stricto sensu* Graduate Studies Programs (in the concentration area or related fields)			
1. Overall average obtained in the courses taken, weighted by the total number of credits[4]	Average *4* (no. of credits / 24)		
		Partial I	

II – COMPLEMENTARY ACADEMIC TRAINING ACTIVITIES (in the concentration area or related fields)	Criteria	Calculation Method	Total Points
a) Courses or internships (score a maximum of 10 internships and/or courses)[5]			
1. Extracurricular courses or internships with fewer than 20 in-person hours, or *online* courses with any workload	No. *0,5		
2. Extracurricular courses or internships with 20 to 40 in-person hours	No. *1		
3. Extracurricular courses or internships with 41 to 120 in-person hours	No. *2		
4. Extracurricular courses or internships with 121 to 240 in-person hours	No. *3		
5. Extracurricular courses or internships with more than 240 in-person hours	No. *4		
b) Fellow (score a maximum of 10 semesters of activities)[6]			
1. Experience as a Research Fellow or voluntary Undergraduate Research participant	No. semesters *6		
2. Experience in other fellowship or volunteer modalities (Work, Extension, or Monitoring)	Nº. semesters *3		
c) Participation in academic events (score a maximum of 10 events)			
1. International conferences or similar events	No. events *2		
2. National conferences or similar events	No. events*1,5		
3. Regional or local conferences or similar events	No. events*0,5		
		Partial II	

(1) Scores submitted without the corresponding supporting documentation or with inaccurate completion shall be disregarded. Only certificates related to the scored items must be included among the supporting documents.
(2) If evaluation is issued by letter grades, the following equivalence shall apply: A = 9.0; B = 8.0; C = 7.0; D = 6.0.
(3) If evaluation is issued by letter grades, the following equivalence shall apply: A = 9.0; B = 8.0; C = 7.0; D = 6.0.
(4) One (1) credit equals fifteen (15) classroom hours. If evaluation is issued by letter grades, the following equivalence shall apply: A = 9.0; B = 8.0; C = 7.0; D = 6.0.
(5) Internships or courses without a defined workload shall be considered as eight (8) activity hours per day or forty (40) activity hours per week. Language courses and basic computer courses shall not be scored.
(6) Must be supported by a certificate issued by the educational institution or by the fellowship funding agency.

III – SCIENTIFIC ACTIVITIES (Scientific Production) [7]	Criteria	Calculation Method	Total Points
a) Articles published or accepted in scientific journals			
1. Article published or accepted in a Qualis A1 journal	No. of articles *50		
2. Article published or accepted in a Qualis A2 journal	No. of articles *45		
3. Article published or accepted in a Qualis B1 journal	No. of articles *35		
4. Article published or accepted in a Qualis B2 journal	No. of articles *30		
5. Article published or accepted in a Qualis B3 journal	No. of articles *25		
6. Article published or accepted in a Qualis B4 journal	No. of articles *20		
7. Article published or accepted in a Qualis B5 journal	No. of articles *15		
8. Article published or accepted in a journal without Qualis classification	No. of articles *2,5		
b) Articles submitted to scientific journals currently under review or evaluation[8] (score up to three articles under review)[8]			
1. Article submitted and under review/evaluation in a Qualis A1 journal	No. of articles *15		
2. Article submitted and under review/evaluation in a Qualis A2 journal	No. of articles *13,5		
3. Article submitted and under review/evaluation in a Qualis B1 journal	No. of articles *12		
4. Article submitted and under review/evaluation in a Qualis B2 journal	No. of articles *10,5		
5. Article submitted and under review/evaluation in a Qualis B3 journal	No. of articles *9		
6. Article submitted and under review/evaluation in a Qualis B4 journal	No. of articles *7,5		
7. Article submitted and under review/evaluation in a Qualis B5 journal	No. of articles *6		
8. Article submitted and under review/evaluation in a journal without Qualis classification	No. of articles *0,5		
c) Books and technical bulletins published in the field of knowledge or related areas			
1. Book with ISBN (score up to five books)	No. of books *25		
2. Book chapter with ISBN (score up to five chapters)	No. of chapters *10		
3. Book without ISBN (score up to five books)	No. of books *5		
4. Technical bulletin (score up to five bulletins)	No. of bulletins *10		
d) Full paper published in proceedings of scientific events (minimum of five pages in A4 size. Score a maximum of five full papers in event proceedings)			
1. Full paper presented at an international event	No. of papers *8		
2. Full paper presented at a national event	No. of papers *7		
3. Full paper presented at a regional or local conference	No. of papers *6		
e) Extended abstracts published in proceedings of scientific events (Minimum of two pages in A4 size. Score a maximum of five extended abstracts in conference proceedings)			
1. Extended abstract presented at an international event	No. of abstracts *6		
2. Extended abstract presented at a national event	No. of abstracts *5		
3. Extended abstract presented at a regional or local conference	No. of abstracts *4		
f) Simple abstracts published in conference proceedings (Score a maximum of five simple abstracts in conference proceedings)[9]			
1. Short abstract presented at an international event	No. of abstracts *4		
2. Short abstract presented at a national event	No. of abstracts *3		

(7) All Qualis classifications must be in Agricultural Sciences (Qualis for the 2013–2016 quadrennium).
(8) Articles under review or evaluation are those that have passed the initial editorial screening and have subsequently been sent to peer reviewers. Supporting documentation must indicate that the article is under review or evaluation. Articles must not overlap with those listed in the previous item; each submitted article must be included in only one category, either III-a or III-b. For this item, a printed copy of the submitted article must also be included among the supporting documents.
(9) Each work from the same conference may be scored only once as an abstract (either extended or short).

3. Short abstract presented at a regional or local event	No. of abstracts *2		
g) Articles published in non-scientific newspapers and magazines (Average score of five articles in non-scientific newspapers and magazines)	No. of articles *1		
h) Interviews of a technical or scientific nature published in newspapers and magazines (score a maximum of five interviews published in newspapers and magazines within the field of knowledge)	No. of interviews *0,5		
i) Lectures (score a maximum of five lectures)			
1. Lectures delivered at an international event	No. of lectures *10		
2. Lectures delivered at a national event	No. of lectures *7		
3. Lectures delivered at a regional or local event	No. of lectures *3		
		Partial III	

IV – UNIVERSITY ACTIVITIES	**Criteria**	**Calculation Method**	**Total Points**
a) Length of Service in Higher Education Teaching [10] (score a maximum of five years)			
1. Teaching in Undergraduate Programs	No. of semesters *10		
2. Teaching in Graduate Studies Programs	No. of semesters *15		
b) Extracurricular courses taught in the field of specialization	**No. of courses *2**		
c) Student supervision			
1. Thesis or internships for the completion of undergraduate or *"Lato-Sensu"* specialization programs (score up to five supervisions of thesis or internships for the completion of the programs)	No. of supervisions*3		
2. Scientific Initiation Scholarship (score up to five supervisions of scientific initiation)	No. of supervisions *5		
d) Coordination of research projects (score up to five coordinations)	No. of projects *3		
e) Coordination of extension projects (score up to five coordinations)	No. of projects *2		
f) Participation on examination committees for Final Course Projects, thesis, or public service competitive examinations (score up to five committee participations)	No. of participations *2		
		Partial IV	

V – PROFESSIONAL ACTIVITIES[10] (excluding higher education teaching)	**Criteria**	**Calculation Method**	**Total Points**
a) Teaching in elementary, secondary, or vocational education (score a maximum of five years)	No. of semesters *3		
b) Professional activities with an employment relationship in the field of knowledge (score a maximum of five years)	No. of semesters *2		
c) Supervision of thesis or final internships in vocational/professional programs (score up to five supervisions)	No. of supervisions *1		
d) Participation on examination committees for vocational Program Final Projects (score up to five committee participations)	No. of participat. *0,5		
		Partial V	

VI – OTHER FUNCTIONS AND ACTIVITIES (in the field of knowledge or related areas)	**Criteria**	**Calculation Method**	**Total Points**

(10) The period of service must be documented by means of an employment contract, appointment ordinance, or employment record booklet. The documentation must clearly indicate the start and end dates of the position. In cases where the activity is ongoing, a declaration issued by the competent authority must be attached.

a) Participation in administrative functions in public or private entities (score a maximum of three years)	No. of years *4		
b) Reviewer for academic journals (score a maximum of five reviewed articles)	No. of articles *2		
c) Reviewer of technical/scientific papers at academic events (score a maximum of five events)	No. events *2		
d) Development of software or products (score up to five software programs or products)	No. of patents *5		
e) Product or process patents (score up to five patents)	No. of patents*10		
f) Academic awards, distinctions, and honors (score up to five awards, distinctions, or honors)	No. of awards *2		
g) Organization of scientific events at the national or international level (score up to five event organizations)	No. events *3		
h) Organization of scientific events at the local or regional level (score up to five event organizations)	No. events *1		
i) Membership on academic boards or councils (score up to five activities and up to three years within the period)	No. of semesters *1		
		Partial VI	
		OVERALL TOTAL (Partials I + II + III + IV + V + VI)	

_____, ____ / ____ / _____, _____
Place Date Signature

Note: The final academic scores of the candidates will be weighted by the Selection Committee, assigning a score of 10.0 to the candidate with the highest total score.

APPENDIX III

GUIDELINES FOR THE PREPARATION AND DOCUMENTATION OF THE CURRICULUM

a. For curriculum evaluation, the candidate must submit the following documents:

- APPENDIX II, duly completed;
- Updated Lattes Curriculum, generated online through the Lattes Platform Application, made available free of charge on the CNPq website (www.cnpq.br);
- Supporting documentation substantiating the score obtained, in accordance with APPENDIX II.

b. Guidelines for the preparation and submission of the curriculum

- The completed and signed APPENDIX II, the Lattes Curriculum, and the supporting documents must be compiled, in this order, into a single file.
- All information entered in APPENDIX II must be supported by photocopies (activities and publications without supporting documentation will not be considered).
- Activities not listed in APPENDIX II will not be scored, and therefore, supporting documentation for such activities is not required.
- **IMPORTANT:** Supporting documents corresponding to the entries in APPENDIX II **must be organized sequentially and numbered in the upper-right corner of each copy**, using the numbering that corresponds to the relevant item in APPENDIX II, together with the respective score. **Example:** The supporting document for an expanded abstract published at an International Conference must contain, at the top right corner of the page, the following notation: **III-and-1 / 6 points**

Document Signatures

Verification Code: **3PG34K9Y**

This document was digitally signed by the following signatory(ies) on the dates indicated below:

MARTHA ANDREIA BRAND (CPF: 753.XXX.469-XX) on 11/29/2021, at 11:29:41 a.m.
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To verify the authenticity of this copy, access the link https://portal.sgpe.sea.sc.gov.br/portal-externo/conferencia-documento/VURFU0NfMTIwMjJfMDAwNDg0OThfNDg1OThfMjAyMV8zUEczNEs5WQ== or visit the website https://portal.sgpe.sea.sc.gov.br/portal-externo and enter **UDESC Case No. 00048498/2021** and the Code **3PG34K9Y**, or scan the QR Code displayed on this page to perform the verification.

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

_____ **Date: February 9, 2026**

EDITAL DE BOLSAS Nº 03/2021/PPGEF/UDESC

SELEÇÃO DE BOLSISTAS: MESTRADO EM ENGENHARIA FLORESTAL

A Coordenadora do Curso de Mestrado em Engenharia Florestal do Centro de Ciências Agroveterinárias (CAV) da Universidade do Estado de Santa Catarina (UDESC), em consonância com as orientações emanadas das Resoluções 25/2009 CONSEPE, 08/2010 CONSEPE, 003/2004 CONSUNI, 46/2011 CONSUNI, das Portarias 76/2010 CAPES e 01/2010 CAPES/CNPq e do Ofício Circular Nº 0010 /2012-CDS/CGSI/DPB/CAPES, resolve publicar o presente edital:

1. DA SELEÇÃO E CONCESSÃO

1.1. As bolsas de Mestrado em Engenharia Florestal serão destinadas a **alunos regulares** do PPGEF **e inscritos no edital 081/2021/CAV**.

1.2. O número de Bolsas disponíveis para concessão por meio do presente edital, assim como a respectiva implementação ao candidato selecionado, está sujeito à liberação de quotas pelas agências financiadoras (CNPq, CAPES, UDESC, FAPESC, etc.).

1.3. A classificação decorrente do presente edital será utilizada durante o semestre 2022/1 para concessão de Bolsas de mestrado resultantes da ampliação de quotas, conclusão de curso ou substituição de bolsistas.

1.4. A Comissão de Seleção examinará as solicitações e selecionará os candidatos às Bolsas do Programa mediante critérios baseados na produção e desempenho acadêmico, avaliados por meio de pontuação, conforme previsto no ANEXO II, sendo consideradas somente as atividades e produções concluídas até dia **28 de janeiro de 2022.**

1.5. A concessão das Bolsas será feita de acordo com a ordem decrescente de pontuação obtida pelos candidatos inscritos, iniciando pelo primeiro classificado.

1.6. Ficará a critério da Comissão de Seleção a escolha do órgão financiador (CNPq, CAPES, FAPESC, UDESC, etc.) para cada candidato selecionado, tendo como princípio as exigências particulares de cada órgão e os interesses do Programa de Pós-graduação em Engenharia Florestal.

1.7. Caso o candidato contemplado com quota de bolsa seja candidato a ingresso no curso pelo Edital 081/2021/CAV e não efetive a matrícula, a quota será remanejada aos demais candidatos, seguindo ordem de classificação.

1.8. A concessão das bolsas ocorrerá pelo período máximo de 12 meses; após este período o candidato selecionado deverá concorrer novamente em Edital específico para a renovação da referida bolsa.

1.9. Não será concedida, em hipótese nenhuma, bolsa da FAPESC ou PROMOP a alunos com vínculo empregatício. Se algum aluno com esses tipos de bolsa adquirir vínculo empregatício, deve abdicar da bolsa.

1.10. Não será concedida, em hipótese nenhuma, bolsa da CAPES ou CNPq a alunos com vínculo empregatício e que estejam recebendo salário. Se algum aluno com esses tipos de bolsa adquirir vínculo empregatício após a concessão da bolsa, a manutenção ou não da bolsa será decidida pela comissão de bolsas, que analisará, no mínimo, os seguintes pré-requisitos:

a) O valor do salário deve ser comprovadamente menor do que o valor da bolsa recebida.

b) Serão permitidos vínculos empregatícios de no máximo 08 horas semanais, sendo exigida para isso, a anuência do orientador do aluno, do coordenador do curso e do empregador.

2. DA INSCRIÇÃO DE CANDIDATOS

2.1. **A inscrição e envio de documentação será realizada exclusivamente pela Internet**, de **26 de novembro de 2021 a 28 de janeiro de 2022** (observado o horário oficial de Brasília/DF) no link: https://www.cav.udesc.br/?idFormulario=309 **,toda a documentação deverá ser anexada no sistema.**
OBSERVAÇÃO –CANDIDATOS INSCRITOS NO EDITAL DE SELEÇÃO (081/2021/CAV) NÃO GARANTEM AUTOMATICAMENTE PARTICIPAÇÃO NO EDITAL DE BOLSAS. OS INTERESSADOS EM BOLSA DEVEM SE INSCREVER NO PRESENTE EDITAL.

2.2. Os candidatos à bolsa deverão submeter os seguintes documentos:
2.2.1. Requerimento de Inscrição conforme modelo (ANEXO I);
2.2.2. Atestado de matrícula como aluno regular no curso (para alunos regulares);
2.2.3. Ficha de pontuação (ANEXO II) preenchida e assinada pelo candidato;
2.2.4. Currículo comprovado e atualizado**, organizado conforme orientações constantes no ANEXO III;

**Para envio de documentação on line, caso a comprovação da pontuação do currículo ultrapasse o limite permitido no formulário, deve ser informado um link (em arquivo pdf) onde o arquivo possa ser acessado pela Comissão de Bolsas (One drive, Dropbox, Google drive etc...).

2.2.5. Histórico Escolar de graduação e/ou pós-graduação, com as respectivas médias ou conceitos;

2.3. Serão aceitas inscrições de candidatos que atenderem aos seguintes requisitos:
2.3.1. Estarem matriculados como alunos regulares no Curso de Mestrado em Engenharia Florestal ou inscritos no edital 081/2021/CAV;
2.3.2. Para alunos regulares, estar de acordo com os critérios de avaliação exigidos pela UDESC (média semestral igual ou superior ao conceito B, comprovado por meio do Histórico Escolar atualizado,);
2.3.3. Não possuírem quaisquer relações de trabalho com a instituição promotora do programa de Pós-Graduação;
2.3.4. Carecerem, quando da concessão da bolsa, do exercício laboral por tempo não inferior a dez anos para obtenção de aposentadoria compulsória;
2.3.5. Não acumularem o recebimento da bolsa com qualquer modalidade de auxílio ou bolsa de outro programa;
2.3.6. Possuírem dedicação integral às atividades do programa de pós-graduação;
2.3.7. Não possuírem vínculo empregatício.

2.4. As informações e documentos fornecidos no processo de inscrição para bolsa e o seu correto preenchimento/apresentação são de responsabilidade do candidato, dispondo a Comissão de Bolsas do Programa de Pós-Graduação de Engenharia Florestal da UDESC do direito de excluir do processo de seleção de bolsistas, aquele que não preencher o requerimento de inscrição de forma completa e correta e/ou fornecer dados comprovadamente inverídicos, ou ainda que apresente links com problemas para acesso dos documentos comprobatórios.

2.5. A Comissão de Bolsas do Programa de Pós-Graduação da UDESC não se responsabilizará por inscrições não recebidas por motivos de ordem técnica dos computadores, falhas na comunicação, congestionamento das linhas de comunicação, bem como outros fatores de ordem técnica que impossibilitem a transferência dos dados.

2.6. Candidatos que adquirirem vínculo empregatício durante a vigência da bolsa (após a concessão) devem informar imediatamente à Coordenação do Curso de Mestrado em Engenharia Florestal; neste caso, a Comissão de Bolsas deliberará, com base na legislação vigente, sobre a continuidade da concessão da bolsa.

2.7. A bolsa do aluno será suspensa a qualquer tempo pela Coordenação do Curso em caso de descumprimento por parte do bolsista de qualquer um dos requisitos fixados nos itens 2.1 e 2.2 do presente Edital.

3. DOS CRITÉRIOS DE SELEÇÃO

3.1. A concessão das quotas disponíveis será feita de acordo com a ordem decrescente de pontuação (ANEXO II) obtida pelos candidatos inscritos no curso de Mestrado, iniciando pelo primeiro classificado.
3.2. No processo de seleção, serão respeitadas regras de concessão específicas existentes para cada órgão de fomento, tendo por base as Resoluções 25/2009 CONSEPE, 08/2010 CONSEPE, 003/2004CONSUNI, 33/2009 CONSUNI, das Portarias 76/2010 CAPES e 01/2010 CAPES/CNPq e do Ofício Circular Nº32/2011 CDS/CGSI/DPB/CAPES, além de outras regras que possam ser fixadas pelos órgãos de fomento até a data da realização do processo de seleção.

4. DA PUBLICAÇÃO DOS RESULTADOS

4.1. O resultado da seleção será divulgado pela Comissão de Seleção e homologado pelo Colegiado do Programa, na página de internet do Curso (**https://www.udesc.br/cav/ppgef**) até o **dia 11 de fevereiro de 2022.**
4.2. Os candidatos classificados serão contactados pela Secretaria Administrativa do PPGEF para apresentação de documentos complementares, caso sejam necessários, e para assinatura dos formulários específicos de cada agência financiadora.

5. DAS DISPOSIÇÕES GERAIS

5.1. A concessão da Bolsa será condicionada à liberação das quotas pelas agências financiadoras e à apresentação de todos os demais documentos e providências necessárias à implementação da Bolsa exigidos pelas agências de fomento.
5.2. Os casos omissos serão resolvidos pelo Colegiado do Programa de Pós-Graduação em Engenharia Florestal/UDESC-CAV.
5.3. Este edital entra em vigor na presente data.

Lages, 29 de novembro de 2021.

Profa. Martha Andreia Brand
COORDENADORA DO CURSO DE MESTRADO EM
ENGENHARIA FLORESTAL

ANEXO I

REQUERIMENTO DE INSCRIÇÃO

Eu, _____, CPF:_____, domiciliado no endereço:_____ _____ _____,venho através deste REQUERER inscrição no **EDITAL DE BOLSAS Nº 03/2021/PPGEF**. Para tal, declaro que li e aceito todas as normas contidas no referido edital.
Informo que a Comissão de Seleção pode, durante o período de seleção, contatar-me através dos seguintes números de telefone e endereços de e-mail a fim de solicitar esclarecimentos ou documentação complementar para a implementação de eventual bolsa concedida:
Telefone 1: (___)_____, Telefone 2 (___)_____, e-mail 1: _____, e-mail 2: _____ . Declaro estar ciente de que se a Comissão de Bolsas necessitar e não conseguir contato pelos telefones e e-mails acima, há risco de desclassificação por insuficiência de informações ou documentação.

Local e data

_____

Assinatura

ANEXO II

Planilha para pontuação do currículo (formação, desempenho acadêmico e produção científica e técnica). Preenchimento obrigatório pelo candidato[1].

I – DESEMPENHO ACADÊMICO	Critério	Memorial de cálculo	Total Pontos
a) Curso de Graduação concluído (será pontuado somente um curso de graduação)[2]			
1. Média geral obtida na graduação (todas as disciplinas)	Média geral*5		
b) Curso de Especialização concluído (será pontuado apensas um curso de especialização, sendo que este deverá ser na área de concentração ou afins)[3]			
1. Média geral obtida nas disciplinas cursadas	Média*2		
c) Disciplinas de mestrado ou doutorado cursadas como aluno especial ou aluno regular em Programas de Pós-Graduação Strictu sensu (na área de concentração ou afins)			
1. Média geral obtida nas disciplinas cursadas ponderada com o total de créditos do curso[4]	Média*4* (nºcréditos/24)		
		Total parcial I	

II – ATIVIDADES DE FORMAÇÃO COMPLEMENTAR (na área de concentração ou afins)	Critério	Memorial de cálculo	Total Pontos
a) Cursos ou estágios (pontuar, no máximo, 10 estágios e/ou cursos)[5]			
1. Cursos ou estágios extracurriculares com menos de 20 horas presenciais ou *on line* com qualquer carga horária.	Nº *0,5		
2. Cursos ou estágios extracurriculares com 20 a 40 horas presenciais	Nº *1		
3. Cursos ou estágios extracurriculares com 41 a 120 horas presenciais	Nº *2		
4. Cursos ou estágios extracurriculares com 121 a 240 horas presenciais	Nº *3		
5. Cursos ou estágios extracurriculares com mais que 240 horas presenciais	Nº *4		
b) Bolsista (pontuar, no máximo, até 10 semestres de atividades)[6]			
1. Atuação como Bolsista de Pesquisa ou Iniciação Científica voluntária	Nº semestres*6		
2. Atuação em outras modalidades de Bolsista ou voluntariado (Trabalho, Extensão ou Monitoria)	Nº semestres*3		
c) Participação em eventos (pontuar, no máximo, até 10 eventos)			
1. Congressos ou similares de âmbito internacional	Nº eventos*2		
2. Congressos ou similares de âmbito nacional	Nº eventos*1,5		
3. Congressos ou similares de âmbito regional ou local	Nº eventos*0,5		
		Total parcial II	

[1] As pontuações sem os respectivos comprovantes ou com preenchimento distorcido serão desconsideradas. Inserir nos documentos comprobatórios somente os certificados dos itens pontuados.
[2] Caso a avaliação seja emitida por conceitos, considerar a seguinte correlação: A = 9,0; B = 8,0; C = 7,0; D = 6,0.
[3] Caso a avaliação seja emitida por conceitos, considerar a seguinte correlação: A = 9,0; B = 8,0; C = 7,0; D = 6,0.
[4] 1 crédito = 15 horas aula. Caso a avaliação seja emitida por conceitos, considerar a seguinte correlação: A = 9,0; B = 8,0; C = 7,0; D = 6,0.
[5] Estágios ou cursos sem carga horária definida são considerados como 8 horas-atividade/dia ou 40 horas-atividade/semana. Cursos de línguas e informática básica não serão pontuados.
[6] Com certificado expedido pela instituição de ensino ou pelo órgão de financiamento da bolsa.

Av. Luiz de Camões, 2090 – B. Conta Dinheiro – Lages/SC – CEP 88520-000
Telefone: (0**49) 3289-9241 / (0**49) 3289-9249
Home-page: http://ppgef.cav.udesc.br – E-mail: jackson.theiss@udesc.br; martha.brand@udesc.br

III – ATIVIDADES CIENTÍFICAS (Produção Científica) [7]	Critério	Memórial de cálculo	Total Pontos
a) Artigos publicados ou aceitos em periódicos científicos			
1. Artigo publicado ou aceito em periódico Qualis A1	Nº artigos*50		
2. Artigo publicado ou aceito em periódico Qualis A2	Nº artigos*45		
3. Artigo publicado ou aceito em periódico Qualis B1	Nº artigos*35		
4. Artigo publicado ou aceito em periódico Qualis B2	Nº artigos*30		
5. Artigo publicado ou aceito em periódico Qualis B3	Nº artigos*25		
6. Artigo publicado ou aceito em periódico Qualis B4	Nº artigos*20		
7. Artigo publicado ou aceito em periódico Qualis B5	Nº artigos*15		
8. Artigo publicado ou aceito em periódico sem Qualis	Nº artigos*2,5		
b) Artigos submetidos a periódicos científicos, que se encontram em fase de revisão ou avaliação[8] (pontuar até três artigos em fase de revisão)[8]			
1. Artigo submetido em fase de revisão/avaliação a periódico Qualis A1	Nº artigos*15		
2. Artigo submetido em fase de revisão/avaliação a periódico Qualis A2	Nº artigos*13,5		
3. Artigo submetido em fase de revisão/avaliação a periódico Qualis B1	Nº artigos*12		
4. Artigo submetido em fase de revisão/avaliação a periódico Qualis B2	Nº artigos*10,5		
5. Artigo submetido em fase de revisão/avaliação a periódico Qualis B3	Nº artigos*9		
6. Artigo submetido em fase de revisão/avaliação a periódico Qualis B4	Nº artigos*7,5		
7. Artigo submetido em fase de revisão/avaliação a periódico Qualis B5	Nº artigos*6		
8. Artigo submetido em fase de revisão/avaliação a periódico sem Qualis	Nº artigos*0,5		
c) Livros e boletins técnicos publicados na área de conhecimento ou afins			
1. Livro com ISBN (pontuar até cinco livros)	Nº livros* 25		
2. Capítulo de livro com ISBN (pontuar até cinco capítulos)	Nº capítulos* 10		
3. Livro sem ISBN (pontuar até cinco livros)	Nº livro*5		
4. Boletim técnico (pontuar até cinco boletins)	Nº boletins*10		
d) Trabalho completo publicado em anais de eventos científicos (mínimo de cinco páginas em tamanho A4. Pontuar, no máximo, cinco trabalhos completos em anais de eventos)			
1. Trabalho completo em evento internacional	Nº de trabalhos*8		
2. Trabalho completo em evento nacional	Nº de trabalhos*7		
3. Trabalho completo em congresso regional ou local	Nº de trabalhos*6		
e) Resumos expandidos publicados em anais de eventos científicos (mínimo de duas páginas em tamanho A4. Pontuar, no máximo, cinco resumos expandidos em anais de eventos)			
1. Resumo expandido em evento internacional	Nº de resumos*6		
2. Resumo expandido em evento nacional	Nº de resumos*5		
3. Resumo expandido em congresso regional ou local	Nº de resumos*4		
f) Resumos simples publicados em anais de eventos científicos (Pontuar, no máximo, cinco resumos simples em anais de eventos)[9]			
1. Resumo simples em evento internacional	Nº de resumos*4		
2. Resumo simples em evento nacional	Nº de resumos*3		

[7] Todos os Qualis deverão ser em Ciências Agrárias (Qualis do quadriênio 2013 – 2016).
[8] Entende-se como artigos em revisão ou avaliação aqueles que já passaram pela pré-seleção editorial e, após essa fase inicial, foi encaminhado para revisores. Nos documentos comprobatórios deve estar indicado que o artigo se encontra em revisão ou avaliação. Não sobrepor artigos com aqueles inseridos no item anterior, o artigo submetido deve ser inserido em somente um dos itens, III-b ou III-c. Nesse item, também é necessário inserir o artigo impresso submetido, entre os documentos comprobatórios.
[9] Cada trabalho de um mesmo congresso somente poderá ser pontuado uma vez como resumo (expandido ou simples).

3. Resumo simples em evento de âmbito regional ou local	Nº de resumos*2		
g) Artigos em jornais e revistas não científicas (Pontuar, no máximo, cinco artigos em jornais e revistas não científicas)	Nº de artigos*1		
h) Entrevistas com caráter técnico ou científico para jornais e revistas (Pontuar, no máximo, cinco entrevistas em jornais e revistas na área de conhecimento)	Nº de entrevistas*0,5		
i) Palestras (pontuar até cinco palestras)			
1. Palestras proferidas em evento internacional	Nº palestras*10		
2. Palestras proferidas em evento nacional	Nº palestras*7		
3. Palestras proferidas em evento regional ou local	Nº palestras*3		
		Total parcial III	

IV - ATIVIDADES UNIVERSITÁRIAS	**Critério**	**Memórial de cálculo**	**Total Pontos**
a) Tempo de Magistério Superior [10] (pontuar, no máximo, cinco anos)			
1. Docência em Cursos de Graduação	Nºsemestres*10		
2. Docência em Cursos de Pós-Graduação	Nºsemestres*15		
b) Cursos extracurriculares ministrados na especialidade	**Nºcursos*2**		
c) Orientação de alunos			
1. Monografia ou estágios de conclusão de Cursos de graduação ou especialização "Lato-Sensu" (pontuar até cinco orientações de monografia ou estágio de conclusão de curso)	Nº de orient.*3		
2. Bolsista de Iniciação científica (pontuar até cinco orientações de iniciação científica)	Nº de orient.*5		
d) Coordenação de projetos de pesquisa (pontuar até cinco coordenações)	Nº projetos*3		
e) Coordenação de projetos de extensão (pontuar até cinco coordenações)	Nº projetos*2		
f) Participação em bancas de Trabalhos de Conclusão de Curso, monografias e banca de concurso público (pontuar até cinco participações em bancas)	Nº particip.*2		
		Total parcial IV	

V - ATIVIDADES PROFISSIONAIS[10] (exceto magistério em ensino superior)	**Critério**	**Memórial de cálculo**	**Total Pontos**
a) Magistério em ensino fundamental, médio ou profissionalizante (pontuar, no máximo, cinco anos)	Nº semestres*3		
b) Atividades profissionais com vínculo empregatício na área de conhecimento (pontuar, no máximo, cinco anos)	Nº semestres*2		
c) Orientação de monografia ou estágios de conclusão de curso profissionalizante (pontuar até cinco orientações)	Nº orient.*1		
d) Participação em bancas de Trabalhos de Conclusão de Curso profissionalizante (pontuar até cinco participações em bancas)	Nº partic.*0,5		
		Total parcial V	

VI -OUTRAS FUNÇÕES E ATIVIDADES (na área de conhecimento ou afins)	**Critério**	**Memórial de cálculo**	**Total Pontos**

[10] O período deverá ser comprovado, por meio de contrato de trabalho, portaria de nomeação ou carteira de trabalho. Deve ficar explicitado a data de início no cargo e data de término. Em caso de atividade ainda em exercício, anexar declaração da autoridade competente.

a) Participação em funções administrativas em entidades públicas ou privadas (pontuar, no máximo, três anos)	Nº anos*4		
b) Revisor de periódicos (pontuar, no máximo, cinco artigos revisados)	Nº artigos*2		
c) Revisor de trabalhos técnico/científicos em eventos (pontuar, no máximo, cinco eventos)	Nº eventos*2		
d) Desenvolvimento de softwares ou produtos (pontuar até cinco softwares ou produtos)	Nº produtos*5		
e) Patente de produto ou processo (pontuar até cinco patentes)	Nº patentes*10		
f) Prêmios, distinções e láureas acadêmicas (pontuar até cinco prêmios, distinções ou láureas)	Nº prêmios*2		
g) Organização de eventos científicos em nível nacional e internacional (pontuar até cinco organizações)	Nº eventos*3		
h) Organização de eventos científicos em nível local ou regional (pontuar até cinco organizações)	Nº eventos*1		
i) Membros de colegiados ou conselhos (pontuar até cinco atividades e três anos no período)	Nºsemestres*1		
		Total parcial VI	
		TOTAL GERAL (Parciais I + II + III + IV + V + VI)	

_____ , __ / ___ / _____, _____

Local Data Assinatura

Obs. As notas finais de títulos dos candidatos serão ponderadas pela Comissão de Seleção, atribuindo-se nota 10,0 para o candidato com maior pontuação.

ANEXO III

ORIENTAÇÕES PARA A ELABORAÇÃO E COMPROVAÇÃO DO CURRÍCULO

a. Para avaliação do currículo, o candidato deve submeter os seguintes documentos:

- ANEXO II preenchido;
- Currículo Lattes atualizado gerado *online* pelo Aplicativo Plataforma Lattes, disponibilizado gratuitamente no *site* do CNPq (www.cnpq.br)
- Documentos comprobatórios da pontuação obtida conforme o ANEXO II.

b. Orientações para elaboração e apresentação do currículo:

- O ANEXO II preenchido e assinado, o Currículo Lattes, e os documentos comprobatórios deverão ser reunidos, **nesta ordem**, em um único arquivo.
- Todas as informações registradas no ANEXO II deverão ser comprovadas por meio de fotocópias (não serão consideradas as atividades e publicações que não estiverem acompanhadas de comprovação).
- Atividades que não constam no ANEXO II não serão pontuadas, não sendo necessário anexar comprovantes dessas outras atividades.
- **IMPORTANTE:** As comprovações dos registros no ANEXO II **deverão estar sequencialmente organizadas e numeradas no canto superior direito da cópia**, com a numeração correspondente ao item do ANEXO II a que se referem e a pontuação referente. **Exemplo:** o comprovante de um resumo expandido publicado em Congresso Internacional deverá conter, no alto da página e a direita, a seguinte anotação: **III-e-1/6 pontos**.

Av. Luiz de Camões, 2090 – B. Conta Dinheiro – Lages/SC – CEP 88520-000
Telefone: (0**49) 3289-9241 / (0**49) 3289-9249
Home-page: http://ppgef.cav.udesc.br – E-mail: jackson.theiss@udesc.br; martha.brand@udesc.br

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CAPES **Evidence supporting the fact that CAPES is a well-known national institution**

About CAPES

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What is CAPES?

The Coordination for the Improvement of Higher Education Personnel (CAPES) (https://www.gov.br/capes/pt-br/acesso-a-informacao/institucional/historia-e-missao) is a Foundation of the Ministry of Education (MEC) (https://www.gov.br/mec/pt-br) that plays a fundamental role in the expansion and consolidation of *stricto sensu* postgraduate studies (master's and doctoral degrees) in all states of the Federation. In 2007, the training of basic education teachers was included in its activities, expanding the scope of its actions in the training of qualified personnel in Brazil and abroad. CAPES' functions can be grouped into the following lines of action, each developed by a structured set of Programs:

- *evaluation of stricto sensu* postgraduate programs
- access and dissemination of scientific production
- Investments in the training of highly skilled resources both domestically and abroad.
- promoting international scientific cooperation
- Promoting and fostering initial and continuing teacher training for basic education in both face-to-face and distance learning formats.

advancement of knowledge and the demands of society require.

The evaluation system, which is continuously improved, serves as an instrument for the university community in the pursuit of a standard of academic excellence for national master's and doctoral programs. The evaluation results serve as a basis for the formulation of policies for the postgraduate area, as well as for the sizing of support actions (scholarships, grants, and other support).

Press relations

To submit any request, we advise journalists to access the Customer Service Centers - Communication area , located in the menu at https://www.gov.br/capes/pt-br/canais_atendimento .

Ordinances

An ordinance is an instrument that regulates the internal rules of the agency. It contains important information about the objectives of the Programs, the granting of scholarships, basic requirements, and other matters. Questions about ordinances can be clarified at: http://cad.capes.gov.br/ato-administrativo .

CAPES address

North Banking Sector, Block 2, Lot 06, Postal Code 70040-020 - Brasília, DF

What activities are carried out by the Evaluation Directorate?

The Evaluation Directorate (DAV) (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/avaliacao) is the CAPES unit responsible for the evaluation processes for the entry of new courses and the continuation of *stricto sensu* postgraduate p

evaluation coordinators. In addition, the DAV monitors these programs by providing support and guidance to the academic community (vice-rectors, program coordinators, secretaries, professors, and postgraduate students), supporting visits and induction activities that lead to the improvement or creation of postgraduate courses that contribute to reducing regional disparities.

What activities are carried out by the Scholarship Program Directorate in the country?

The Directorate of Programs and Scholarships in the Country (DPB) (https://www.gov.br/capes/pt-br/composicao/diretoria-de-programas-e-bolsas-no-pais) operates in three central areas:

- institutional actions
- strategic actions
- dissemination and access to information

As an institutional action, one of the directorate's missions is to promote postgraduate studies in the country through the granting of scholarships and financial resources to stimulate the training of qualified personnel at the higher education level and to meet the growth of the National Postgraduate System (SNPG), thus promoting the quality of Brazilian postgraduate education. Strategically, the DPB manages a set of actions focused on stimulating research and the training of human resources in areas strategic to national development, contributing to the reduction of regional asymmetries and creating cooperation networks that provide for the consolidation of inter-institutional partnerships and the exchange of knowledge.

Finally, the Directorate's activities include the dissemination of and access to scientific information, provided by offering the best of national and international scientific production on the Periodicals Portal (https://www-periodicos-capes-gov-br.ezl.periodicos.capes.gov.br/index.php), and by supporting the organization of scientific and technological events in the country.

What activities are carried out by the Directorate of International Relations?

informacao/acoes-e-programas/bolsas/bolsas-e-auxilios-internacionais/) works to promote and foster international scientific cooperation, coordinating mobility programs, establishing partnerships with institutions abroad, whether they are institutions of excellence in education or research funding agencies, always seeking the internationalization of Brazilian postgraduate studies and research and the formation of international networks of excellence in research.

What activities are carried out by the Directorate of Basic Education?

The main activities of the Directorate for Teacher Training in Basic Education (DEB) (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/educacao-basica) are:

a) To promote initial and continuing training programs for teaching professionals in basic education;

b) to coordinate policies for the training of basic education teachers at all levels of government, based on a collaborative framework;

c) to develop sectoral or regional action programs in order to meet the social demand for basic education teaching professionals;

d) to maintain exchange with other public administration bodies in the country, with international organizations and with national or foreign private entities,

with a view to promoting cooperation for the development of initial and continuing teacher training, through the signing of agreements, contracts and arrangements that may be necessary to achieve its objectives.

The Distance Education Directorate (DED) (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/educacao-a-distancia) is responsible for operationalizing the actions of articulation, approval, implementation, coordination, promotion and monitoring of higher education programs and courses in Distance Education - EaD, taught by Public Higher Education Institutions - IPES, in face-to-face support centers, through the Open University of Brazil System – UAB (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/educacao-a-distancia/uab/universidade-aberta-do-brasil). In addition to coordinating the UAB System, DED is responsible for managing the Professional Master's Programs for the Qualification of Teachers in the Public Basic Education Network – ProEB (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/educacao-a-distancia/proeb).

What activities are carried out by the Information Technology Directorate?

The Information Technology Directorate (DTI) (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/tecnologia-da-informacao) carries out activities inherent to the Information Technology Resources Management System (SISP) (https://www.gov.br/governodigital/pt-br/sisp), namely:

a) To provide and manage Information and Communications Technology (ICT) and information security (IS) resources;

b) to guide internal committees on planning, standardization of use, standardization and process improvement involving ICT&IS;

c) contribute to the personnel training plan (PDP), for the preparation of the institutional staff in relation to the use of ICT&IS resources;

CAPES

What is a *stricto sensu* postgraduate degree ?

This refers to a period of post-graduation training, of an academic and research nature, with the main objective of deepening scientific training, being an integral part of higher education and necessary for the achievement of essential university goals. It can be carried out through master's or doctoral courses, which grant diplomas and academic degrees in the form of master's or doctoral titles.

What is a *lato sensu* postgraduate degree ?

This refers to a period of post-graduation training, primarily practical and professional, which may be occasional in nature, with the aim of promoting technical specialization or training in the components of a professional or scientific field. These courses only offer a certificate of proficiency or achievement that qualifies one to practice a professional specialty, and which may even be obtained from non-university institutions.

What is the difference between lato sensu **and** *stricto sensu* **postgraduate programs ?**

Postgraduate *lato sensu* programs comprise specialization programs and include courses designated as MBA (*Master of Business Administration*). With a minimum duration of 360 hours, upon completion the student will receive a certificate, not a diploma. Furthermore, they are open to candidates with undergraduate degrees who meet the requirements of the educational institutions. Postgraduate *stricto sensu* programs comprise master's and doctoral programs open to candidates with undergraduate degrees who meet the requirements of the educational institutions and the student selection process. Upon completion of the course, the student will receive an academic degree and a diploma.

What is CAPES' role in lato sensu **postgraduate programs ?**

CAPES has no jurisdiction over lato sensu postgraduate courses (specialization). Such cour

distance learning modality; and by state systems, in the case of courses offered by state and municipal institutions.

What is CAPES' role in stricto sensu **postgraduate programs ?**

CAPES is responsible for evaluating, monitoring, promoting, and encouraging stricto sensu postgraduate courses . Therefore, for the regular operation of master's and doctoral programs in Brazil and for the issuance of diplomas valid throughout the national territory, a positive evaluation by CAPES, recognition by the National Education Council, and approval by the Ministry of Education are necessary for each course applied for. The list of all regular courses in Brazil is available on the Sucupira Platform , accessible at:

https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/programa/listaPrograma.jsf .

What is a master's degree? How does it work?

It is a stricto sensu postgraduate course , whose objective is to deepen the training obtained in undergraduate studies, granting an academic degree. It may constitute a preliminary step in obtaining a doctoral degree or as a final degree. It must have a minimum duration of one year and, in addition to preparing the dissertation or final work defined in institutional regulations, the candidate must study a certain number of subjects related to their area of concentration and related fields, as well as undergo partial and general examinations.

What is the difference between an academic master's degree and a professional master's degree?

The academic master's degree primarily aims to prepare professionals for work in higher education teaching and academic research. The professional master's degree is geared towards training professionals in various fields of knowledge through the study of techniques, processes, or themes that meet a demand in the job market.

master's degree should consult the regular *stricto sensu postgraduate programs on the* Sucupira Platform , available at https://sucupira.capes.gov.br/sucupira/ , and contact the secretariat of the program of interest to learn about the selection criteria.

What is a doctorate? How does it work?

It is a stricto sensu postgraduate course that grants an academic degree awarded by a university-level higher education institution, certifying a person's ability to conduct research in a specific area of science. Doctoral courses must have a minimum duration of two years and, in addition to preparing the thesis or final work defined in institutional regulations, the candidate must study a certain number of subjects related to their area of concentration and related fields, as well as undergo partial and general examinations.

I want to pursue a doctorate, what are the prerequisites?

The basic requirement is a bachelor's degree. From there, those interested in pursuing a doctorate should consult the regular *stricto sensu postgraduate programs on the* Sucupira Platform , available at https://sucupira.capes.gov.br/sucupira/ , and contact the secretariat of the program of interest to learn about the selection criteria.

What is a postdoctoral fellowship?

It is an internship undertaken after obtaining a doctoral degree, aimed at improving and deepening studies and knowledge in a specific subject of interest to the researcher, for which a certificate of completion is issued. It does not confer an academic degree or title.

I want to pursue a postdoctoral degree; what are the prerequisites?

Those interested should contact the institution of interest to check if there are postdoctoral internships available and what the admission criteria are.

A postdoctoral fellowship is a period of study for updating the knowledge of a professional who holds the highest academic degree (doctorate), and is not part of the formal higher education system. Therefore, only a certificate of completion is obtained.

What is a thesis?

This constitutes the final work of the doctoral course, demonstrating originality in the approach to the topic during research on a specific object with a defined theoretical approach, and its structure may be defined in the regulations of the stricto sensu postgraduate program (monograph, report, collection of articles, portfolio, among others).

What is a dissertation?

This constitutes the final work of the master's course, contributing reflections and analyses on a specific theme, without necessarily being an original approach to the subject, but seeking to offer new interpretations of it. Its structure may be defined in the regulations of the *stricto sensu* postgraduate program (dissertation, report, collection of articles, portfolio, among others).

What is the difference between a thesis and a dissertation?

The thesis, being the final work of a doctoral course, is characterized by the originality of its approach and the theoretical depth of the subject under study.

What is the CAPES Thesis Catalog?

The CAPES Thesis and Dissertation Database (http://catalogodeteses.capes.gov.br/catalogo-teses/#!/) is a platform designed to facilitate access to information about theses and dissertations defended in *stricto sensu* postgraduate programs in Brazil, as well as providing statistical information about this type of intellectual production.

The validity of master's and doctoral degrees in Brazil depends on the accreditation of the stricto sensu postgraduate programs that offered these courses. A list of recommended and recognized courses can be found on the Sucupira Platform , available at:

https://sucupira.capes.gov.br/sucupira/ .

Will my diploma be valid even if, during my studies, the course loses its recognition in a new evaluation conducted by CAPES?

If the diploma is issued while the graduate program *(stricto sensu)* was in good standing, the diplomas issued by it do not lose their validity. If the loss of recognition occurs before the end of the course, students will have the right to complete it and receive a diploma valid in the national territory.

What are the stricto sensu **postgraduate courses (master's and doctoral degrees), in the blended learning format, authorized to operate in Brazil?**

Currently, the only blended learning courses recommended by CAPES and recognized by the MEC are part of the Professional Master's Program for the Qualification of Teachers in the Public Basic Education Network (ProEB) (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/educacao-a-distancia/proeb), intended for teachers in public basic education networks who are currently employed.

Master's and doctoral distance learning programs were regulated by CAPES Ordinances No. 90, of April 24, 2019, and No. 70, of June 5, 2020, available at https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/avaliacao/sobre-a-avaliacao/avaliacao-o-que-e/sobre-a-avaliacao-conceitos-processos-e-normas/legislacao-especifica , however, to date, no proposals submitted to CAPES have been approved.

Is a master's degree program offered by a Brazilian institution in partnership with a foreign institution recognized by CAPES?

CAPES, yes. The current legislation related to stricto sensu postgraduate studies can be consulted at https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/avaliacao/sobre-a-avaliacao/avaliacao-o-que-e/sobre-a-avaliacao-conceitos-processos-e-normas - menu "Specific Legislation".

How can I get a master's or doctoral degree earned abroad recognized in Brazil?

The process of recognizing/revalidating foreign diplomas is not the responsibility of CAPES. Higher Education Institutions (HEIs) themselves have the freedom to decide whether or not to grant the request, according to the regulations of the National Education Council and the Ministry of Education. Degrees issued by foreign institutions are not valid nationally until they are revalidated/recognized. Master's and doctoral degrees issued by universities in other countries can only be recognized by universities that have postgraduate courses recognized and evaluated by CAPES, in the same area of knowledge and at an equivalent or higher level.

Once in possession of a degree issued by a foreign institution, the interested party must seek out a higher education institution (HEI) that has a program evaluated by CAPES (Coordination for the Improvement of Higher Education Personnel) with a research focus and curriculum compatible with the master's or doctoral degree pursued.

The list of all courses recommended by CAPES is available on the Sucupira Platform: https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/programa/listaPrograma.jsf .

The Carolina Bori Platform (http://carolinabori.mec.gov.br/) of the Ministry of Education guides the process of revalidating or recognizing foreign diplomas.

Does CAPES offer scholarships for master's degrees abroad?

CAPES stopped offering scholarships for master's degrees abroad since Brazil offers excellent courses in this modality and fulfills goal 14 of the National Education Plan (PNE) (https://novaescola.org.br/guias/18/pne), which establishes the number of master's degrees to be awarded annually in Brazil (GOAL 14 - Gradually increase the number of enrollments in

in goal 14 of the PNE.

How can I get a CAPES scholarship in Brazil?

CAPES, through its institutional programs, grants master's and doctoral scholarships directly to national institutions that have stricto sensu graduate programs evaluated with a grade equal to or higher than 3. These scholarships are institutional, meaning they are distributed to Higher Education Institutions, which then pass them on to students through internal selection processes. Those interested in a scholarship should contact the coordinator of the graduate program they intend to enroll in (see Recommended Courses https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/programa/listaPrograma.jsf) and inquire about the procedures and requirements necessary to obtain it.

Within the scope of strategic actions, CAPES grants scholarships to projects in areas that are strategic for the country, which are selected through published calls for proposals available consultation on its institutional *website . These scholarships are the responsibility of the researcher, a professor affiliated with a CAPES-recommended stricto sensu* graduate program , who submitted a project to one of the strategic calls for proposals and was selected. Those interested in these scholarships should monitor the CAPES *website* to verify if the projects funded by the Agency's calls for proposals are in research areas of their interest.

How can I get a CAPES scholarship to study abroad?

CAPES grants scholarships that promote international mobility in the following modalities: full doctorate, sandwich doctorate, doctoral internship, and postdoctoral internship. All scholarships are granted based on public calls widely publicized on the CAPES website and its partners. To learn about the calls for proposals that promote the international mobility of students and researchers, visit: DRI/CAPES . (https://www.gov.br/capes/pt-br/acesso-a-informacao/acoes-e-programas/bolsas/bolsas-e-auxilios-internacionais/)

scholarships in Brazil. To do so, you need to follow the guidelines provided in the answer to the question, "How to obtain a CAPES scholarship in Brazil?". If you are a professor affiliated with a graduate program, your research may be supported through strategic actions managed by the Directorate of Programs and Scholarships in Brazil, and presented on its institutional *website* . These actions aim to support research projects in strategic areas for the country, stimulating the training of highly qualified graduate personnel.

Services you accessed

YaleNews

Evidence supporting that CAPES is a well-known national institution

International

Yale-CAPES program to prepare Brazil's next generation of science leaders

A newly launched program will bring top Brazilian students to study in Yale's Combined Program in Biological and Biomedical Sciences.

Jun 25, 2018

2 min read

Yale University and The Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) are launching a joint program to recruit top graduates from institutions in Brazil to attend Yale's Combined Program in Biological and Biomedical Sciences (BBS).

Students will be supported with funding from both CAPES and Yale. Only students from Brazil who are both admitted by Yale University, and approved for a scholarship from CAPES are eligible.

Yale's BBS program is a comprehensive, interdisciplinary graduate program with eight tracks:

- Biochemistry, quantitative biology, biophysics and structural biology
- Computational biology and bioinformatics
- Immunology
- Microbiology
- Molecular cell biology, genetics, and development
- Molecular medicine, pharmacology, and physiology
- Neuroscience
- Plant molecular biology

The goal of BBS is to prepare the scholars to become the next generation of scientific leaders.

For this program, CAPES participating students will be introduced to the critical practices, strategies, and conventions necessary to become future leaders in biological and biomedical research. For example, students will meet with faculty to gain insights on how to succeed in a variety of pursuits including graduate school, running a successful research lab, or translating basic biomedical discoveries into clinical advancements.

The BBS program has no departmental or geographical boundaries so participating students gain access to courses, seminars, and faculty labs across Yale. In addition, Yale's main campus and medical school are within walking distance of one another, enabling students to easily participate in research activities and courses on the main campus as well as at the Yale School of Medicine and Yale's West Campus.

The program lasts for up to six years, a format that is different from Brazilian graduate programs. In their first year at Yale, students will study two to three subjects per semester and complete two to four laboratory rotations. They then will select a thesis adviser in the laboratory in which their doctoral research will be conducted.

Application to the program takes place in two stages, with different deadlines. First, the candidate must submit a proposal on the CAPES website by Aug. 31, 2018. The agency will release the preliminary results on Oct. 10. Those approved must then apply to Yale by Nov. 10. Yale will announce final selections by February 2019, and activities at Yale will begin in August 2019.

Send email to yale@capes.gov.br with questions or for more information.

Topics International Science & Technology

International →

TEACHING AND LEARNING

'Revolutionary Barcelona': in the archives, history comes to life

MANAGEMENT IN PRACTICE

Building a for-profit health model that reaches the poorest

Exhibit C - Petitioner’s participation as a judge of the work of other in the same field

Gmail

Alice Neri < nneri.alice@gmail.com>

Subject: [SF] The journal Scientia Forestalis requests article review

1 message

Mauro Schumacher <scientia.forestalis@ipef.br> September 12, 2022 at 12:14 PM
To: ALICE NERI DA SILVA SOUSA nneri.alice@gmail.com

ALICE NERI DA SILVA SOUSA,

I believe your knowledge will be fundamental in reviewing the manuscript "Wood quality of Eucalyptus clones for the production of plywood panels" submitted to Scientia Forestalis. Information about the submission is below, and I hope you will consider assuming this important responsibility.

Access the system by 2022-09-19 to inform whether you will be available or not to carry out the review, as well as to access the complete submission data and register your review and recommendations, through the URL https://www.editora.ipef.br/ojs/index.php/scientia
.
The deadline for delivery of the review is 2022-10-10.

Submission URL: https://www.editora.ipef.br/ojs/index.php/scientia/reviewer/submission?submissionId=3926&reviewId=9891&key=xGEXu6
The submission URL provides direct access, eliminating the need to enter a login and password, which are required to access other areas.

The declaration of the article review will be issued after submission of the opinion.

Thanking you in advance for your attention,

Mauro Schumacher
editorchefe@ipef.br

Submission data

Title:
"Wood quality of Eucalyptus clones for the production of plywood panels"

Abstract

Abstract:

This study was conducted to evaluate the potential of five *Eucalyptus* clones, 48 months old, for producing multilayer plywood panels. Veneers of four clones of *E. dunnii* and one of *E. saligna* were used as facing of the plywood panels, while the plywood core consisted of veneers of *Pinus* and *Virola*. The adhesive used in the panel production was resorcinol-formaldehyde with a grammage of 320 g/m². The results revealed that the clones of *E. dunnii* presented great potential for the production of multilayer plywood panels, since the physical and mechanical properties of these plywood panels were within the range described as adequate in the standards: NBR 9484 (moisture content), NBR 9485 (basic panel density), NBR 12466 (shear strength), and NBR 9533 (static bending). The clone that presented the best performance in all physico-mechanical analyses was USP/IPEF 68 - *Eucalyptus dunnii*.

_____ Scientia Forestalis http://editora.ipef.br/ojs/index.php/scientia

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that I have performed the professional translation of this document from Portuguese to English, as a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

Date: September 30, 2025.

Gmail **Alice Neri <nneri.alice@gmail.com>**

[SF] A revista Scientia Forestalis solicita avaliação de artigo

1 mensagem

Mauro Schumacher <scientia.forestalis@ipef.br> 12 de setembro de 2022 às 12:14
Para: ALICE NERI DA SILVA SOUSA <nneri.alice@gmail.com>

ALICE NERI DA SILVA SOUSA,

Acredito que seu conhecimento será fundamental para realizar a avaliação do manuscrito "Qualidade da madeira de clones de Eucalyptus para a produção de painéis de compensado" submetido a Scientia Forestalis. Informações sobre a submissão encontram-se abaixo, e espero que considere assumir esta importante responsabilidade.

Acesse o sistema até 2022-09-19 para informar se estará disponível ou não para realizar a avaliação, bem como acessar os dados completos da submissão e registrar sua avaliação e recomendações, através da URL https://www.editora.ipef.br/ojs/index.php/scientia.

O prazo para a entrega da avaliação é 2022-10-10.

URL da Submissão: https://www.editora.ipef.br/ojs/index.php/scientia/reviewer/submission?submissionId=3926&reviewId=9891&key=xGEXu6
A URL da submissão permite acesso direto, sem a necessidade de informar login e senha, que serão necessários para acessar outras áreas.

A declaração de avaliação do artigo será emitida após o envio do parecer.

Agradecendo desde já a atenção dispensada,

Mauro Schumacher
editorchefe@ipef.br

Dados da submissão

Título:
"Qualidade da madeira de clones de Eucalyptus para a produção de painéis de compensado"

Resumo

Resumo:

Este estudo foi conduzido com o objetivo de avaliar o potencial de cinco clones de *Eucalyptus,* com 48 meses de idade, para a confecção de painéis multilaminados de contraplacado. Foram utilizadas lâminas de quatro clones de *E. dunnii* e um de *E. saligna* como revestimento dos painéis de compensado, enquanto o núcleo de compensado consistiu em lâminas de *Pinus* e *Virola* . O adesivo utilizado na produção do painel foi o resorcinol-formaldeído com gramatura de 320 g/m ^{2} . Os resultados revelaram que os clones de *E. dunnii* apresentaram grande potencial para a produção de painéis multilaminados de compensado, uma vez que as propriedades físicas e mecânicas desses painéis de compensado estavam dentro da faixa descrita como adequada nas normas: NBR 9484 (teor de umidade), NBR 9485 (densidade do painel básico), NBR 12466 (resistência ao cisalhamento) e NBR 9533 (flexão estática). O clone que apresentou melhor desempenho em todas as análises físico-mecânicas foi o USP/IPEF 68 - *Eucalyptus dunnii* .

_____ Scientia Forestalis http://editora.ipef.br/ojs/index.php/scientia

Review: *Wood quality of Eucalyptus clones for the production of plywood panels*

Review Submitted

Thank you for completing the review of the submission. Your opinion has been successfully submitted. We appreciate your contribution to the quality of the work we publish. The editor may contact you again for more information if necessary.

Review Discussion

Add comments

Name	From	Last reply	Replies	Closed
Comments on the review	aliceneri – 2022-10-10 11:56 PM	-	0	

I, Marina Viana Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Marina Viana

Date: September 30, 2025.

Avaliação: ***Qualidade da madeira de clones de Eucalyptus para a produção de painéis de compensado***

Avaliação Enviada

Obrigado por completar a avaliação da submissão. Seu parecer foi submetido com êxito. Agradecemos a sua contribuição para a qualidade do trabalho que publicamos. O editor pode contatá-lo novamente para obter mais informações se for necessário.

Discussão da avaliação Adicionar comentários

Nome	De	Última resposta	Respostas	Fechado
comentários sobre a revisão	aliceneri 2022-10-10 11:56 PM	-	0	☐

Gmail

Alice Neri <nneri.alice@gmail.com>

[SF] Review Acknowledgement

1 menssage

Mauro Schumacher <scientia.forestalis@ipef.br>
To: ALICE NERI DA SILVA SOUSA <nneri.alice@gmail.com>

October 11, 2022 at 8:39 AM

Piracicaba, October 11, 2022.

STATEMENT

Herewith we state that ALICE NERI DA SILVA SOUSA in the year 2022 contributed as a partner of the article ID 3926, submitted to the Journal **Scientia Forestalis**.

The Editorial Board of the Journal is very thankful for the cooperation given with the critical analysis of this work. It must be pointed out that the participation of the reviewer is a very important part of the process of the quality improvement of the articles published by the Journal, Qualis **B1** in the area of agricultural sciences.

Scientia Forestalis is also included in the database ISI Web of Knowledge - Thomson Scientific (USA): Science Citation Index Expanded (SciSearch); JCR – Journal Citation Reports / Scientific Edition and Scopus.

Sincerely, Prof. Dr. Mauro Valdir Schumacher

Editor in chief of **Scientia Forestalis (ISSN 1413-9324)**

IPEF - Institute of Forestry Studies and Research, Piracicaba, SP, Brazil

Phone (19) 2105-8618 - Fax (19) 2105-8603

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_____ Scientia Forestalis http://editora.ipef.br/ojs/index.php/scientia

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Marina Viana

Date: September 30, 2025.

Gmail

Alice Neri <nneri.alice@gmail.com>

[SF] Review Acknowledgement

1 mensagem

Mauro Schumacher <scientia.forestalis@ipef.br> 11 de outubro de 2022 às 08:39
Para: ALICE NERI DA SILVA SOUSA <nneri.alice@gmail.com>

Piracicaba, October 11, 2022.

STATEMENT

Herewith we state that ALICE NERI DA SILVA SOUSA in the year 2022 contributed as a partner of the article ID 3926, submitted to the Journal **Scientia Forestalis**.

The Editorial Board of the Journal is very thankful for the cooperation given with the critical analysis of this work.

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Sincerely,

Prof. Dr. Mauro Valdir Schumacher

Editor in chief of **Scientia Forestalis (ISSN 1413-9324)**

IPEF - Instituto de Pesquisas e Estudos Florestais, Piracicaba, SP, Brazil

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UDESC
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INTERNAL ORDINANCE OF CAV
No. 159/2021, dated 08/10/2021

APPOINTS EXAMINING COMMITTEES FOR THE UNDERGRADUATE THESIS – TCC – DEPARTMENT OF FOREST ENGINEERING.

The Dean of the Center for Agro-Veterinary Sciences, in the exercise of his/her duties,

RESOLVES:

1. To publish the composition of the Examining Committees for the Undergraduate Thesis – TCC, of the Department of Forest Engineering, for the 1st Semester of 2021, as attached to this Ordinance.

Prof. Clóvis Eliseu Gewehr
Dean
CAV/UDESC

UDESC STATE UNIVERSITY OF SANTA CATARINA | LAGES · CAV CENTER FOR AGRO-VETERINARY SCIENCES

Order	Student	Undergraduate Thesis Title	Advisor	Examiner 1	Examiner 2
1	Carolina Schneider Macedo	Application of Remote Sensing Techniques to Assess Logging Scars in an Area Located in the Amazon	Veraldo Liesenberg	Jessica da Silva Costa	Marcos Benedito Schimalski
2	Geórgia Levorse Oliveira	Characterization and Biometric Modeling of Dicksonia sellowiana Presl. (Hooker) in Upper-Montane Mixed Ombrophilous Forest	Thiago Floriani Stepka	Amanda Krüger	Marcos Felipe Nicoletti
3	Iara Francisco Floriani	Assessment of Palms (Arecaceae) in Urban Landscaping of the Palmas Neighborhood, in Governador Celso Ramos, SC	Maria Raquel Kanieski	Gabriel Mancini Antunes da Silva	Marcos Felipe Nicoletti
4	Jéssica Amaral de Souza	Monitoring of Conduct Adjustment Activities in Permanent Preservation Areas in Commercial Forests/Reforestation Using RapidEye and PlanetScope Images	Veraldo Liesenberg	Michel Tadeu Rodrigues Nolasco de Omena	Marcos Benedito Schimalski
5	Laryssa Demétrio	Dendrochronology and Its Relationship with the Production of Androsporophylls, Shape, and Size of Araucaria angustifolia (Bertol.) Kuntze in the Municipality of Lages, SC	André Felipe Hess	Thiago Floriani Stepka	Geedre Adriano Borsoi
6	Letícia Rodrigues da Silva	Quantitative-qualitative analysis and spacialization of urban arborization of the coral neighborhood, in Lages-sc	Maria Raquel Kanieski	Gabriel Mancini Antunes da Silva	Charles Costa Coelho
7	Lucas Denega	Evaluation of Sampling Methods in Managed Pinus taeda L. Plantations in Santa Catarina	Thiago Floriani Stepka	Geedre Adriano Borsoi	Norton Machado
8	Marcia Aparecida Simonete	Spatial Structure of Pioneer Species in Areas with Different Periods of Natural Regeneration Following the Removal of Pinus spp. Stands in Bocaina do Sul, SC	Maria Raquel Kanieski	Charline Zangalli	Lúcio Fonseca Rech
9	Maurício Jean Freisleben	Analysis of Dendro/Morphometric and Climatic Relationships with the Production of Androsporophylls of Araucaria angustifolia (Bertol.) Kuntze in Southern Brazil	André Felipe Hess	Thiago Floriani Stepka	Geedre Adriano Borsoi
10	Murilo Rosa Frederico	Determination of Species-Area Curve in Tropical Forest	Veraldo Liesenberg	Thiago Floriani Stepka	Matheus Morais Ziembowicz
11	Roni Ermínio Pavarin	Monitoring of Fire Scars in the Southern Plateau of Santa Catarina Using Planet Constellation Data	Veraldo Liesenberg	Michel Tadeu Rodrigues Nolasco de Omena	Marcos Benedito Schimalski
12	Taís Pitz Barbosa	Analysis of the Behavior of Wood Particle Panels Exposed to Temperature Variation	Martha Andreia Brand	Alexsandro Bayestorff da Cunha	Alice Neri da Silva Sousa
13	Thaila Heberle	Evaluation of Sampling Methods for Undistributed Pinus taeda L. Plantations in Santa Catarina	Thiago Floriani Stepka	Marcos Felipe Nicoletti	Norton Machado

Document Signatures

Verification Code: **5AA8ML94**

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_____ **Date: October 1, 2025.**

UDESC UNIVERSIDADE DO ESTADO DE SANTA CATARINA | LAGES · CAV CENTRO DE CIÊNCIAS AGROVETERINÁRIAS

PORTARIA INTERNA DO CAV
Nº 159/2021, de 10/08/2021

DESIGNA BANCAS DE AVALIAÇÃO DO TRABALHO DE CONCLUSÃO DO CURSO – TCC – DEPARTAMENTO DE ENGENHARIA FLORESTAL.

O Diretor Geral do Centro de Ciências Agroveterinárias, no uso de suas atribuições,

RESOLVE:

1. Publicar a composição das Bancas de Avaliação do Trabalho de Conclusão do Curso – TCC, do Departamento de Engenharia Florestal, referente ao 1º Semestre de 2021, que acompanha a presente Portaria.

Prof. Clóvis Eliseu Gewehr
Diretor Geral
CAV/UDESC

UDESC UNIVERSIDADE DO ESTADO DE SANTA CATARINA | LAGES · CAV CENTRO DE CIÊNCIAS AGROVETERINÁRIAS

Ord.	Aluno	Título do TCC	Orientador	Avaliador 1	Avaliador 2
1	Carolina Schneider Macedo	Aplicação de técnicas de sensoriamento remoto para avaliar cicatrizes de exploração florestal em uma área situada na Amazônia	Veraldo Liesenberg	Jessica da Silva Costa	Marcos Benedito Schimalski
2	Geórgia Levorse Oliveira	caracterização e modelagem biométrica de *Dicksonia sellowiana* Presl. (Hooker) em Floresta Ombrófila Mista Alto-Montana	Thiago Floriani Stepka	Amanda Krüger	Marcos Felipe Nicoletti
3	Iara Francisco Floriani	Avaliação das Palmeiras (Arecaceae) na arborização urbana do bairro de palmas, Em Governador Celso Ramos, SC	Maria Raquel Kanieski	Gabriel Mancini Antunes da Silva	Marcos Felipe Nicoletti
4	Jéssica Amaral de Souza	Acompanhamento das atividades de ajustamento de conduta em áreas de preservação permanente em florestas comerciais/reflorestamentos utilizando imagens *RapidEye* E *PlanetScope*	Veraldo Liesenberg	Michel Tadeu Rodrigues Nolasco de Omena	Marcos Benedito Schimalski
5	Laryssa Demétrio	Dendrocronologia e relações com a produção de androstróbilos, forma e dimensão de *Araucaria angustifolia* (Bertol.) Kuntze no Município de Lages, SC.	André Felipe Hess	Thiago Floriani Stepka	Geedre Adriano Borsoi
6	Letícia Rodrigues da Silva	Quantitative-qualitative analysis and spacialization of urban arborization of the coral neighborhood, in Lages-sc	Maria Raquel Kanieski	Gabriel Mancini Antunes da Silva	Charles Costa Coelho
7	Lucas Denega	Avaliação de métodos de amostragem em plantio manejado de *Pinus taeda*. L. em Santa Catarina	Thiago Floriani Stepka	Geedre Adriano Borsoi	Norton Machado
8	Marcia Aparecida Simonete	Estrutura espacial de espécies pioneiras em áreas com diferentes períodos de restauração natural após supressão do povoamento de *Pinus spp*. em Bocaina Do Sul, SC.	Maria Raquel Kanieski	Charline Zangalli	Lúcio Fonseca Rech
9	Maurício Jean Freisleben	Análise das relações dendro/morfométricas e climáticas com a produção de androstróbilos de *Araucaria angustifolia* (Bertol.) Kuntze no sul do Brasil	André Felipe Hess	Thiago Floriani Stepka	Geedre Adriano Borsoi
10	Murilo Rosa Frederico	Determinação de curva espécie-área em florestal tropical	Veraldo Liesenberg	Thiago Floriani Stepka	Matheus Morais Ziembowicz
11	Roni Ermínio Pavarin	Monitoramento de cicatrizes de queimada no planalto sul catarinense com dados da constelação planet	Veraldo Liesenberg	Michel Tadeu Rodrigues Nolasco de Omena	Marcos Benedito Schimalski
12	Taís Pitz Barbosa	Análise do Comportamento de Painéis Particulados de Madeira Expostos à Variação de Temperatura	Martha Andreia Brand	Alexsandro Bayestorff da Cunha	Alice Neri da Silva Sousa
13	Thaila Heberle	Avaliação de métodos de amostragem para plantio de *Pinus taeda*. L. sem desbaste em Santa Catarina	Thiago Floriani Stepka	Marcos Felipe Nicoletti	Norton Machado

Assinaturas do documento

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ENGENHARIA FLORESTAL
CAV-UDESC

State University of Santa Catarina
Center for Agro-Veterinary Sciences
Adress: 2090, Avenue Luiz de Camões, Conta Dinheiro, Lages/SC, Brazil.
telephone: +55 49 3289 9250
E-Mail: comunicação.cav@udesc.br
Web: https://www.udesc.br/cav
Date: 16 september 2025

DECLARATION

I, Professor. Dra. **Martha Andreia Brand**, faculty member of the Bachelor's Degree Program in Forest Engineering at **forestry engineering department** in my capacity as the advisor of the Undergraduate Thesis of the student **Taís Pitz Barbosa**, entitled **"Análise do Comportamento de Painéis Particulados de Madeira Expostos à Variação de Temperatura"**, hereby declare that M.Sc. Alice Neri da Silva Sousa was formally invited and served as a member of the examining committee for the evaluation of the aforementioned thesis, defended in the second semester of 2021.

The participation of M.Sc. Alice Neri da Silva Sousa was of great relevance for the critical analysis and academic enrichment of the work, contributing significantly to the evaluation process and scientific validation of the research presented.

In witness whereof, I issue this declaration for all due purposes.

Lages, Santa Catarina, september 16th, 2025.

Prof. Dra. Martha Andreia Brand
Professor in the department of forestry engineering

UDESC
UNIVERSIDADE
DO ESTADO DE
SANTA CATARINA

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AGROVETERINÁRIAS

Martha Andreia Brand, Ph.D.
Professor (Associate IX)
State University of Santa Catarina (UDESC)
Center for Agroveterinary Sciences
Lages, SC, Brazil
Email: martha.brand@udesc.br
Phone: +55 (49) 3289-9279

Dear Immigration Officer,

My name is Dr. Martha Andreia Brand, Professor (Associate IX) at the State University of Santa Catarina (UDESC), Department of Forest Engineering, where I have served as faculty member since 2007 and I have coordinated the Graduate Program in Forest Engineering and Laboratory of Technology III. I am writing in support of Ms. Alice Neri da Silva Sousa EB-1 visa application.

Ms. Sousa was invited and participated in an academic board for the evaluation of a final project for the undergraduate course in Forest Engineering at the State University of Santa Catarina, Brazil. The recommended individual was a member of the evaluating board, which took place on August 27, 2021. In the occasion, I served as the President of the Board.

At our institution, participation on evaluation boards is extended to graduate students who demonstrate strong research performance and alignment with the topic under review, qualifications that Ms. Sousa clearly demonstrates. Ms. Sousa evaluated the the research paper titled *"Analysis of the behavior of wood particle panels exposed to temperature variation."* which served as the basis for a later, more in-depth study and the publication of a scientific article titled "*Effect of raw material and adhesive on thermal degradation of particle boards,*" available at: https://doi.org/10.1590/s1678-86212025000100886.

My invitation to Ms. Sousa was based on the alignment of her research experience with the subject of the project and on her demonstrated analytical performance in my graduate courses and research activities. During the defense, Ms. Sousa's review focused on the scientific rigor and interpretation of the experimental results. She emphasized the need to clearly describe the temperature ranges observed during the material's heating process, to differentiate the effects of the raw materials and the adhesives on the panels' thermal stability, and to highlight the practical implications of the research for fire-safety performance. Her feedback was incorporated into the final version of the project, improving its clarity and scientific accuracy.

Based on her technically sound analysis and constructive feedback, Ms. Sousa fulfilled the responsibilities expected of a formal evaluator in our department. Documentation exists to confirm her service on this board. In line with academic norms, broader examining roles often require greater seniority; upon completion of her doctorate, Ms. Sousa will be eligible to serve on higher-level academic committees.

In view of the above, I confirm that Ms. Sousa acted in an official capacity as a judge and evaluator of others' work at our university, within a setting that carries formal academic responsibility and standards.

If you need more information, please contact me by email of phone.

Sincerely,

Martha Andreia Brand.

Martha Andreia Brand

Address to access this CV: http://lattes.cnpq.br/0920058820470751
ID Lattes: **0920058820470751**
Last updated: 01/09/2025

bachelor's at Forest Resources and Forest Engineering from Universidade Federal do Paraná (1997), master's at Forest Resources and Forest Engineering from Universidade Federal do Paraná (2000) and doctorate at Forest Resources and Forest Engineering from Universidade Federal do Paraná (2007). Has experience in Forest Resources and Forest Engineering, acting on the following subjects: biomassa florestal, pinus taeda, qualidade da madeira, indústria madeireira and resíduos industriais. **(Text informed by the author)**

Personal Information

Name

Martha Andreia Brand

Bibliographic Citation

BRAND, M. A.;BRAND, M.A.;BRAND, MARTHA ANDREIA;Brand, Martha Andrea;ANDREIA BRAND, MARTHA

Lattes iD

http://lattes.cnpq.br/0920058820470751

Nationality

Brasil

Address

Professional Address

Universidade do Estado de Santa Catarina, Centro Agroveterinário, Departamento de Engenharia Florestal.
Avenida Luiz de Camões - de 1371/1372 a 2445/2446
Conta Dinheiro
88520000 - Lages, SC - Brasil
Telephone: (49) 4932899279
Fax: (49) 32899279
Homepage URL: http://www.cav.udesc.br

Formal Education/Degree

2003 - 2007

Ph.D. in Engenharia Florestal.
Universidade Federal do Paraná, UFPR, Brasil. ,
Year of degree: 2007.
Advisor: Graciela Ines Bolzon de Muniz.
Keywords: cogeração; resíduos madeiráveis; energia de biomassa.
Major Area: Agrarian Sciences
Major Area: Agrarian Sciences / Area: Forest

Resources and Forest Engineering / Subarea: Energia de Biomassa Florestal.

1998 - 2000

Master in Engenharia Florestal.
Universidade Federal do Paraná, UFPR, Brasil.
Year of degree: 2000.
Advisor: Graciela Inês Bolzon de Muñiz.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: Balanço de materiais; Serraria; Laminadora; Manufatura de painéis; Balanço energético.
Major Area: Agrarian Sciences
Major Area: Agrarian Sciences / Area: Forest Resources and Forest Engineering / Subarea: Tecnologia e Utilização de Produtos Florestais / Specialty: Processamento Mecânico da Madeira.
Activity sectors: Energy; Quality and Productivity.

1993 - 1997

Graduation in Engenharia Florestal.
Universidade Federal do Paraná, UFPR, Brasil.
Advisor: Graciela Inês Bolzon de Muñiz.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.

1988 - 1990

Curso técnico/profissionalizante in Técnico em Agropecuária.
Colégio Agrícola Vidal Ramos, COLÉGIO AGRICOLA, Brasil.

Complementary Education

2002 - 2002

Disciplina de Metodologia da Pesquisa.
Universidade do Planalto Catarinense, UNIPLAC, Brasil.

2002 - 2002

Disciplina de Metodologia do Ensino Superior.
Universidade do Planalto Catarinense, UNIPLAC, Brasil.

Professional Experience

Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, EPAGRI, Brasil.

Contract

2017 - Present

Type of contract: Pesquisador em projeto em rede, Functional Placement: sem vinculo

Universidade Federal de Santa Catarina, UFSC, Brasil.

Contract

2014 - 2017

Type of contract: Pesquisador de projeto em rede, Functional Placement: pesquisador

Universidade do Estado de Santa Catarina, UDESC, Brasil.

Contract

2007 - Present

Type of contract: Professor, Functional Placement: Professor Associado, nível VII, Credit Hours: 40, Regime: Exclusive Dedication.

Activities

05/2024 - Atual

Councils, Commissions and Consulting, Centro Agroveterinário.

Position or Function
Comissão de Extensão do CAV.

01/2019 - Atual

Manager and Administrative Positions, Centro Agroveterinário, Departamento de Engenharia Florestal.

Position or Function
Coordenadora do Laboratório de Tecnologia da Madeira III.

07/2014 - Atual

Councils, Commissions and Consulting, Comissão Editorial da Revista de Ciências Agroveterinárias.

Position or Function
Representante do Departamento de Engenharia Florestal.

03/2012 - Atual

Teaching, Engenharia Florestal, Degree: Pos-Graduation

Disciplines Taught
Energia e Desenvolvimento
Engenharia do Ambiente na Indústria Florestal
Metodologia Científica e da Pesquisa
Qualidade da Madeira e Produtos Florestais
Tópicos especiais em caracterização da madeira e processos industriais
Transformação da Madeira e Produtos Florestais

01/2012 - Atual

Teaching, Engenharia Florestal, Degree: Graduation

Disciplines Taught
Anatomia e Identificação de Madeiras
Celulose e Papel
Energia de Biomassa Florestal
Metodologia científica
Preservação e Secagem da Madeira
Química de Madeira

07/2007 - Atual

Research and Development, Grupo de Pesquisa Qualidade e Utilização de Recursos Florestais-Ambientais.

Research Fields
Qualidade da Madeira
Energia de Biomassa Florestal
Extração e transformação de materiais

02/2021 - 12/2022

Manager and Administrative Positions, Curso de Mestrado em Engenharia Florestal.

Position or Function
Coordenador do Curso de Mestrado em Engenharia Florestal.

03/2017 - 03/2020

Councils, Commissions and Consulting, Centro Agroveterinário.

Position or Function
Presidente da Comissão de Pesquisa do Departamento de Engenharia Florestal.

03/2014 - 03/2018

07/1995 - 07/1995

Trainee Activities , Divisâo Madeira.

Trainee Activities
Acompanhamento das atividades da divisão Florestal do IPT-SP.

Research line

1.

Qualidade da Madeira

Objective: Qualificar, analisar e desenvolver a matéria-prima e produtos de base florestal.
Major Area: Agrarian Sciences
Keywords: qualidade da madeira.

2.

Energia de Biomassa Florestal

Objective: Quantificar e qualificar a Biomassa Florestal e Industrial para o uso na Geração de Energia.
Major Area: Agrarian Sciences
Keywords: biomassa florestal.

3.

Extração e transformação de materiais

Research projects

2022 - Current

Desenvolvimento da cadeia produtiva de pellets no Brasil nos últimos 10 anos e análise prospectiva do crescimento para a próxima década

Situation: In progress; Nature: Research.
Participant students: Graduation: (2) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Flávio José Simioni - Member / Djeison Felipe Voos - Member.

2021 - Current

Emprego de redutores de emissão de formaldeído na produção de painéis de fibra de média densidade (MDF)

Project certified by the coordinator Alexsandro Bayestorff da Cunha in 08/08/2023.

Description: Número de autorização na UDESC NPP2015010003792, execução de 01/09/2021 a 31/07/2024.
Situation: In progress; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Coordinator / Polliana D'Angelo Rios - Member.

2020 - 2022

Estudo de adsorção dos metais Cu(II) e Zn(II) em solução aquosa utilizando biochar obtido a combustão de biomassa de Pinus sp. em termelétrica

Description: Número de autorização na UDESC NPP2015010003503, Execução de 01/08/2020 a 31/07/2022.
Situation: Completed; Nature: Research.

Members: Martha Andreia Brand - Member / SCHEIN, VIVIANE APARECIDA SPINELLI - Coordinator.

2020 - 2021

Qualidade da madeira de árvores de Pinus taeda com lenho anormal de compressão

Project certified by the coordinator Alexsandro Bayestorff da Cunha in 08/08/2023.

Description: Número de autorização na UDESC NPP2015020002824, Execução de 01/08/2020 a 31/07/2021.
Situation: Completed; Nature: Research.

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Coordinator / Polliana D'Angelo Rios - Member.

2020 - Current

Sistema de medição para indicação do nível de biomassa em gaseificador do tipo contracorrente

Description: Autorização institucional: NPP2015010003907.
Situation: In progress; Nature: Research.
Participant students: Graduation: (2) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Matheus Fontanelle Pereira - Member / Thiago Henrique Mombach - Member.

S, T & A Production Rate: 1

2020 - Current

Desenvolvimento de protótipo para torrefação de biomassa na geração de energia

Description: Número do registro institucional (UDESC): NPP2015010003906.
Situation: In progress; Nature: Research.
Participant students: Graduation: (2) / Academic master's degree: (2) .

Members: Martha Andreia Brand - Coordinator / Matheus Fontanelle Pereira - Member / Ariton Araldi - Member / Marlon Filippe Santos da Silva - Member.

S, T & A Production Rate: 2

2020 - Current

POTENCIAL ENERGÉTICO DOS FRUTOS E DO BIOCARVÃO VEGETAL DA ESPÉCIE Attalea tessmannii (COCÃO) EXPLORADO E PRODUZIDO NO ESTADO DO ACRE, BRASIL

Description: Número do registro institucional (UDESC): NPP2015010003904.
Situation: In progress; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Alice Neri da Silva Sousa - Member / Keiti Roseani Mendes Pereira - Member / Ananias F. Dias Júnior - Member.

2019 - 2023

Qualidade da madeira de Eucalyptus benthamii de rotação longa nos processos de desdobro e secagem

Project certified by the coordinator Alexsandro Bayestorff da Cunha in 08/08/2023.

Description: Número de autorização na UDESC - NPP2015 2000301. 01/08/2019 a 31/07/2023.
Situation: Completed; Nature: Research.
Participant students: Graduation: (2) .

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Coordinator / Polliana D'Angelo Rios - Member.

2019 - 2021

Viabilidade técnica e econômica da produção de carvão de briquetes produzidos com misturas de resíduo de abatedouro de aves e maravalha de Pinus spp.

Description: Número de autorização na UDESC NPP2015010003250, Execução de 01/07/2019 a 31/07/2021.
Situation: Completed; Nature: Research.
Participant students: Academic master's degree: (1) .

Members: Martha Andreia Brand - Member / Philipe Ricardo Casemiro Soares - Coordinator.

2019 - 2021

Nanocritais de celulose com qualidade morfológica e química para reforço estrutural de papel

Project certified by the coordinator Polliana D`Angelo Rios in 08/08/2023.

Description: Número de autorização na UDESC NPP2015010003263, Execução de 01/08/2019 a 31/07/2021.
Situation: Completed; Nature: Research.

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Member / Polliana D'Angelo Rios - Coordinator.

2019 - 2020

Efeito da composição da biomassa nos parâmetros de processo em peletizadora de matriz plana e na qualidade de pellets para uso energético

Description: buscando aumentar o potencial de utilização múltipla da madeira por meio do seu uso energético em forma de pellet, este projeto tem como objetivo de analisar a qualidade dos pellets produzidos a partir de diferentes misturas contendo madeira de Pinus e de Eucalyptus, a fim de estabelecer a qualidade das diferentes misturas nos parâmetros de peletização, com base nos critérios de qualidade da norma ISO 17225-2..
Situation: Completed; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Alexsandro Bayestorff da Cunha - Member / Aline Lima de Sena - Member.

S, T & A Production Rate: 1

2018 - 2021

Aplicação do biochar obtido a partir da combustão de biomassa de Pinus sp. em termelétrica na adsorção de metais para remediação ambiental

Description: O objetivo deste projeto será avaliar as características do biochar residual da combustão de biomassa de Pinus sp. e sua eficiência como adsorvente de metais pesados em água resisual e solos contaminados com estéril de mina de carvão. Número do registro institucional (UDESC): NPP2015010002983.
Situation: Completed; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) / Doctorate: (1) .

Members: Martha Andreia Brand - Coordinator / Alexsandro Bayestorff da Cunha - Member / Viviane Spinelli Schein - Member / Polliana D'Angelo Rios - Member / Reny Aldo Henne - Member / Mari Lucia Campos - Member /

e entorno de onde o projeto da co-geradora. Para tanto foram realizadas análises da fauna, flora, comunidade humana, condições climáticas, edáficas e hidrícas. Deste levantamento originou-se um Relatório de Impacto ambiental e recomendações para mitigação dos efeitos negativos e maximização dos efeitos positivos do empreendimento. Como resultado houve a implantação da co-geradora obedecendo todos os pressupostos do relatório..
Situation: Completed; Nature: Development.

Members: Martha Andreia Brand - Coordinator / Estelamaris Agostini - Member.
Financier(s): Universidade do Planalto Catarinense - Cooperation / Tractebel Energia S.A. - Grant.

Other Projects

2006 - 2007

Estudo da variação das propriedades físicas da madeira relacionadas ao processo de secagem controlada e co-geração de energia

Description: Este projeto foi aprovado na Chamada pública 07/2006 - Apoio a Pesquisa Científica Básica - Linha I, lançado pela Fundação de Apoio à Pesquisa do Estado de Santa Catarina. Fez parte deste projeto o plano de expansão dos Laboratórios de Sacegem da Madeira e Energia da Madeira do Centro de Ciências e Tecnológicas da UNIPLAC..
Situation: Completed; Nature: Other.
Participant students: Graduation: (1) .

Members: Martha Andreia Brand - Member / Valdeci José da Costa - Coordinator.
Financier(s): Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina - Grant / Universidade do Planalto Catarinense - Cooperation.

Member of editorial board

2025 - Present

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2021 - 2023

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2019 - 2021

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2017 - 2019

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2014 - 2016

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINARIAS

Member of advisory committee

2019 - Present

Development agency: Associação Brasileira de Normas Técnicas

Scientific journal referee

2001 - Present

Journal: Floresta (UFPR)

2011 - Present

Journal: Ambiência (UNICENTRO)

2012 - Present

Journal: British Journal of Applied Science & Technology

2008 - Present

Journal: Pesquisa Florestal Brasileira (Impresso)

2012 - Present

Journal: Energia na Agricultura (UNESP. Botucatú. CD-Rom)

2013 - Present

Journal: Ciência Rural (UFSM. Impresso)

2014 - Present

Journal: Ciência da Madeira

2014 - Present

Journal: Bosque (Valdivia. Impresa)

2014 - Present

Journal: FLORAM - Revista Floresta e Ambiente

2014 - Present

Journal: Scientia Forestalis (IPEF)

2014 - Present

Journal: Wood Material Science and Engineering

2014 - Present

Journal: Ciência Florestal (UFSM. Impresso)

2016 - Present

Journal: Biomass and bioenergy

2016 - Present

Journal: Anais da Academia Brasileira de Ciências (Online)

2016 - Present

Journal: Revista Brasileira de Engenharia Agrícola e Ambiental (Online)

2016 - Present

Journal: Energy and Fuel

2017 - Present

Journal: Journal of Power and Energy

2018 - Present

Journal: Revista Árvore (on-line)

2016 - Present

Journal: ENERGY

2018 - Present

Journal: Journal of Renewable and Sustainable Energy

2019 - Present

Journal: Philippine Journal of Science

2020 - Present

Journal: FUEL

2012 - Present

Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2020 - Present

Journal: Songklanakarin Journal of Science and Technology

2019 - Present

Journal: Journal of Waste Resources and Reprocessing

2019 - Present

Journal: RENEWABLE & SUSTAINABLE ENERGY REVIEWS

2022 - Present

Journal: AMBIENTE & SOCIEDADE (ONLINE)

2022 - Present

Journal: AMBIENTE & SOCIEDADE (ONLINE)

2022 - Present

Journal: BioResources

2022 - Present

Journal: BioResources

2023 - Present

Journal: Cerne

2025 - Present

Journal: Journal of Renewable Materials

Funding project reviewer

2018 - Present

Development agency: Universidade Federal do Rio Grande do Norte

2018 - Present

Development agency: Conselho Nacional de Desenvolvimento Científico e Tecnológico

Areas of Expertise

1.

Major Area: Agrarian Sciences / Área: Forest Resources and Forest Engineering / Subarea: Energia de Biomassa Florestal.

2.

Major Area: Engineering / Área: Material and Metallurgical Engineering / Subarea: Materiais Não-Metálicos/Specialty: Extração e Transformação de Materiais.

Languages

English

Comprehends Reasonably, Speaks Reasonably, Reads Well, Writes Reasonably.

Spanish

Comprehends Well, Speaks Well, Reads Well, Writes Reasonably.

Scientific, Technological, Artistic and Cultural Production

Bibliographical Production

Citations

Web of Science

Total of articles: 40 Total of citations: 353 Date: 06/09/2023

Brand, M.A.

SCOPUS

Total of articles: 57 Total of citations: 498 Date: 06/09/2023

Brand, M.A.

Full articles published in journals

Sort by

Chronological Order

1.

RODRIGUES, T.M. ; **BRAND, M. A.** ; RECH, T.D. ; BALSISSERA, T.C. ; PINTO, C.E. ; GARAGORRY, F.C. ; CUNHA, A. B. ; RIOS, P. D. ; TEREZO, R.F. ; SOUZA, G. DE O. ; RIBEIRO, L.DE l. . Biomass of South Brazilian highland grassland under management with burning and mowing: Characterization of vegetation and feedstock for energy. Biomass & Bioenergy JCR, v. 197, p. 01-10, 2025.

2.

SOUZA, G. DE O. ; **BRAND, M. A.** ; CUNHA, A. B. ; RIOS, P. D. ; TEREZO, R.F. ; BORTOLETTO JUNIOR, G. ; RODRIGUES, T.M. ; RIBEIRO, L.DE l. ; SURDI, P.G. ; BRITO, F.M.S. . Efeito da matéria-prima e do adesivo na degradação térmica de painéis de partículas. AMBIENTE CONSTRUÍDO (ONLINE), v. 25, p. 01-15, 2025.

3.

ALVES CORRÊA, CAMILA ; BAYESTORFF DA CUNHA, ALEXSANDRO ; VIEIRA, HELENA CRISTINA ; TEIXEIRA, MATHEUS ZANGHELINI ; DE CAMARGO, TARCISIO FRANSCISCO ; MELO, NATALIA DURIGON ; **BRAND, MARTHA ANDREIA** ; D?ANGELO RIOS, POLLIANA ; FIGUEIREDO TEREZO, RODRIGO . Technical feasibility of medium-density fibreboard (MDF) produced with oversized Pinus spp. fibres and partial incorporation of low-pressure melamine laminate residues. Wood Material Science and Engineering JCR, v. 1, p. 1-11, 2025.

4.

SILVA DA SILVA, WASHINGTON DUARTE ; SANTOS, JOIELAN XIPAIA DOS ; NISGOSKI, SILVANA ; NAIDE ACOSTA, TAWANI LORENA ; VIEIRA, HELENA CRISTINA ; SOUZA, DEIVISON VENICIO ; DALLA CORTE, ANA PAULA ; **BRAND, MARTHA ANDREIA** ; MUÑIZ, GRACIELA INES BOLZON DE . Density, chemistry and energy potential of wood waste from five least explored Amazonian species: contribution to a circular bioeconomy. Wood Material Science and Engineering JCR, v. 1, p. 1-9, 2025.

5.

, BAYESTORFF DA CUNHA, ALEXSANDRO ; CALINE DE MELLO, DÉBORA ; LIMA FERREIRA, JOELSON ; **BRAND, MARTHA ANDREIA** ; D´ANGELO RIOS, POLLIANA ; ALVES CORRÊA, CAMILA ; COSTA DE LIZ, GEFFERSON . Industrial boiler ash as an alternative for reducing formaldehyde emissions in medium-density fiberboards. WOOD MATERIAL SCIENCE AND ENGINEERING JCR, v. 19, p. 1-10, 2024.

6.

SOUSA, ALICE NERI DA SILVA ; PEREIRA, KEITI ROSEANI MENDES ; DIAS JUNIOR, ANANIAS FRANCISCO ; FLORIANI, MATHEUS BERTOTTI ; **BRAND, MARTHA ANDREIA** . Charcoal produced from Attalea tessmannii Burret. fruit wastes. SCIENTIA FORESTALIS JCR, v. 50, p. 1-11, 2022. **Citações:** WEB OF SCIENCE 1

7.

KREFTA, S.C. ; CUNHA, A. B. ; **BRAND, M.A.** . Influência do revestimento nas propriedades de painéis compensados não-estruturais de uso exterior submetidos a câmara de intemperismo acelerado. Scientia Forestalis JCR, v. 50, p. e3849, 2022. **Citações:** WEB OF SCIENCE 1

8.

SIMIONI, FLÁVIO JOSÉ ; **BRAND, MARTHA ANDREIA** ; BIANCHINI, DEBORA CRISTINA . Energy viability of industrial drying of wood chips. Biofuels JCR, v. 14, p. 259-266, 2022.

9.

BRAND, M.A.; RODRIGUES, T.M. ; SILVA, J.P. DA ; OLIVEIRA, J. . Recovery of agricultural and wood wastes: The effect of biomass blends on the quality of pellets. FUEL JCR, v. 284, p. 118881-118887, 2021. **Citações:** WEB OF SCIENCE 32 | SCOPUS 34

10.

BRAND, M.A.; BALDUINO JUNIOR, A. ; FRIEDERICHS, G. ; CUNHA, A. B. . ENERGETIC POTENTIAL OF Phyllostachys bambusoides AS AN ALTERNATIVE SOURCE OF BIOMASS. FLORESTA (ONLINE) (CURITIBA), v. 51, p. 201-210, 2021.

11.

RODRIGUES, T.M. ; RECH, T.D. ; BALSISSERA, T.C. ; PINTO, C.E. ; GARAGORRY, F.C. ; **BRAND, M.A.** . IMPACT OF WEATHER CONDITIONS ONTHE ENERGETICQUALITY OF ACICULATED DRY BRANCHES OF Araucaria angustifolia(Bertol.) Kuntze PRODUCED THROUGHOUT AYEAR. FLORESTA (ONLINE) (CURITIBA), v. 51, p. 785-793, 2021.

12.

DORS, PRISCILLA ; CAMPOS, MARI LUCIA ; **BRAND, MARTHA ANDREIA** ; MIQUELLUTI, DAVID JOSÉ . Biochar and its adsorbent power. How are scientific publications about this issue?. RESEARCH, SOCIETY AND DEVELOPMENT, v. 10, p. e61101018520, 2021.

13.

BRAND, M. A.; Henne, R.A. ; SCHEIN, VIVIANE APARECIDA SPINELLI ; PEREIRA, E.R. . Mapeamento dos problemas associados à geração e tratamento das cinzas na combustão da biomassa florestal em caldeira. CIÊNCIA FLORESTAL (ONLINE)JCR, v. 31, p. 1167-1192, 2021. **Citações:** WEB OF SCIENCE 3 | SCOPUS 3

14.

SILVA, JULIO PERETTI DA ; **BRAND, MARTHA ANDREIA** ; SOARES, PHILIPE RICARDO CASEMIRO ; SALAMON, MATHEUS DE LIZ ; RODRIGUES, TAISE MARIANO ; GÜTTLER, GERMANO . Compaction as a sustainable alternative to dried sludge from poultry slaughterhouse wastewater for energy generation. CIÊNCIA RURALJCR, v. 51, p. 1-9, 2021. **Citações:** WEB OF SCIENCE 1

15.

TOMIO, GUSTAVO FAGGIANI ; CUNHA, ALEXSANDRO BAYESTORFF DA ; **BRAND, MARTHA ANDREIA** ; CORDOVA, ULISSES DE ARRUDA . Rendimento e qualidade da madeira de Eucalyptus benthamii Maiden et Cambage de rotação longa no processo de desdobro. Scientia ForestalisJCR, v. 49, p. 1-11, 2021. **Citações:** WEB OF SCIENCE 2 | SCOPUS 1

16.

Henne, R.A. ; **BRAND, M.A.** ; SCHEIN, V. S. ; PEREIRA, E.R. ; SCHVEITZER, BIANCA . CHARACTERIZATION OF ASHES FROM FOREST BIOMASS COMBUSTION IN BOILERS: A SYSTEMIC VIEW OF POTENTIAL APPLICATIONS. FLORESTA (ONLINE) (CURITIBA), v. 50, p. 1073-1082, 2020.

17.

BRAND, MARTHA ANDREIA; JACINTO, RODOLFO CARDOSO . Apple pruning residues: Potential for burning in boiler systems and pellet production. RENEWABLE ENERGYJCR, v. 152, p. 458-466, 2020. **Citações:** WEB OF SCIENCE 29 | SCOPUS 25

18.

BRAND, MARTHA ANDREIA; GAA, ANGELA ZAKOSTELSKY NEVES ; BALDUINO JUNIOR, AILTON LEONEL ; CUNHA, ALEXSANDRO BAYESTORFF DA ; RIOS, POLLIANA D'ANGELO . Potencial do uso de quatro espécies de bambu para a produção de carvão vegetal para uso doméstico. CIÊNCIA FLORESTAL (ONLINE)JCR, v. 30, p. 60-71, 2020. **Citações:** WEB OF SCIENCE 3 | SCOPUS 2

19.

CARVALHO, ADRIEL FURTADO DE ; **BRAND, MARTHA ANDREIA** ; HIGUCHI, PEDRO ; SILVA, ANA CAROLINA DA . Qualidade do carvão vegetal obtido a partir da espécie Cecropia glaziovii Sneth. produzido na agricultura familiar em Santa Catarina. REVISTA DE CIÊNCIAS AGROVETERINÁRIAS, v. 19, p. 132-138, 2020. **Citações:** SCOPUS 1

20.

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26.

Evidence supporting the nature of professional publication

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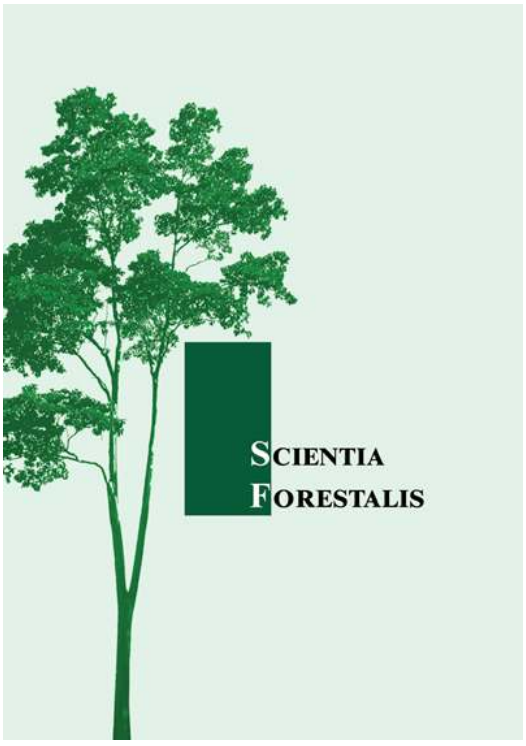

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Exhibit D - Petitioner’s original scientific, scholarly, artistic, or business-related contributions of major significance in the field

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PROITI/OCEANTEC - OFFICE OF INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER

DECLARATION No. 4, OF SEPTEMBER 17, 2025

I hereby declare, at the request of the interested party, that patent application No. **BR 10 2024 026798 2**, owned by the Federal University of Rio Grande - FURG, was filed with the National Institute of Industrial Property - INPI on December 19, 2024, through petition No. 870240108721, and is currently under the confidentiality period (Article 30 of Law No. 9,279/1996).

The inventors of the aforementioned patent application are: Tito Roberto Sant'Anna Cadaval Junior, Sheraz Ahmad, Viviane de Carvalho Arabidian, Alice Neri da Silva Sousa, Isaac Santos Nunes, Luiz Henrique Han, Maurício Zimmer Ferreira Arlindo, Bruna Silva de Farias, Débora Pez Jaeschke, Luiz Antônio de Almeida Pinto, Nauro da Silveira Junior.

Rio Grande, date of electronic signature.

Dr. Eduardo Pitrez de Aguiar Correa
Coordinator of the Office of Intellectual Property and Technology Transfer
(PROITI/OCEANTEC/EPITT)

Document electronically signed by **Eduardo Pitrez de Aguiar Correa**, **Public Servant**, on 09/18/2025, at 12:12 p.m., Brasília official time, pursuant to Article 6, §1, of Decree No. 8,539, of October 8, 2015.

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Reference: If responding to this Declaration, indicate Process No. 23116.016896/2024-22 SEI No. 0480740

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.


_____ Date: October 22, 2025.

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PROITI/OCEANTEC - ESCRITÓRIO DE PROPRIEDADE INTELECTUAL E TRANSFERÊNCIA DE TECNOLOGIA

DECLARAÇÃO N° 4, DE 17 DE SETEMBRO DE 2025

Declaro, a pedido da parte interessada, que o pedido de patente n.º **BR 10 2024 026798 2**, de titularidade da Universidade Federal do Rio Grande - FURG, foi depositado no Instituto Nacional da Propriedade Industrial - INPI em 19 de dezembro de 2024, por meio da petição n.º 870240108721, o qual se encontra, no momento, em período de sigilo (art. 30 da Lei n.º 9.279/1996).

São inventores do referido pedido de patente: Tito Roberto Sant'Anna Cadaval Junior, Sheraz Ahmad, Viviane de Carvalho Arabidian, Alice Neri da Silva Sousa, Isaac Santos Nunes, Luiz Henrique Han, Maurício Zimmer Ferreira Arlindo, Bruna Silva de Farias, Débora Pez Jaeschke, Luiz Antônio de Almeida Pinto, Nauro da Silveira Junior.

Rio Grande, data da assinatura eletrônica.

Dr. Eduardo Pitrez de Aguiar Correa
Coordenador do Escritório de Propriedade Intelectual e Transferência de Tecnologia (PROITI/OCEANTEC/EPITT)

Documento assinado eletronicamente por **Eduardo Pitrez de Aguiar Correa**, **Servidor(a)**, em 18/09/2025, às 12:12, conforme horário oficial de Brasília, com fundamento no art. 6º, § 1º, do Decreto nº 8.539, de 8 de outubro de 2015.

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DECLARATION No. 7, OF NOVEMBER 3, 2025

I hereby declare, at the request of the interested party, that patent application No. **BR 10 2025 023822 5**, owned by the Federal University of Rio Grande - FURG, was filed with the National Institute of Industrial Property - INPI on October 31, 2025, through petition No. 870250099954, and is currently under the confidentiality period (Article 30 of Law No. 9,279/1996). According to the aforementioned legal provision, the patent application shall be kept confidential for 18 (eighteen) months from the filing date or from the earliest priority date, if any, after which it shall be published, except in the case provided for in Article 75 (a patent application originating in Brazil whose subject matter is of interest to national defense).

The inventors of the aforementioned patent application are: Daiane Dias, Gabriel Moraes Marin, Eduardo Silveira Ribeiro, Enedina Sena Alves de Lima, Juliane Froncheti de Moura, Alice Neri da Silva Sousa, Eliézer Quadro Oreste, Tito Roberto Sant'Anna Cadaval Junior, Luiz Antonio de Almeida Pinto.

Rio Grande, date of electronic signature.

Paula Fagundes Marques Shinzato

Administrative Assistant

Office of Intellectual Property and Technology Transfer
(PROITI/OCEANTEC/EPITT)

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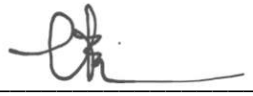
Reference: If responding to this Declaration, indicate Process No. 23116.016914/2025-57 SEI No. 0505295

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.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DECLARAÇÃO N° 7, DE 03 DE NOVEMBRO DE 2025

Declaro, a pedido da parte interessada, que o pedido de patente n.º **BR 10 2025 023822 5**, de titularidade da Universidade Federal do Rio Grande - FURG, foi depositado no Instituto Nacional da Propriedade Industrial - INPI em 31 de outubro de 2025, por meio da petição n.º 870250099954, o qual se encontra, no momento, em período de sigilo (art. 30 da Lei n.º 9.279/1996). De acordo com o aludido dispositivo legal, o pedido de patente será mantido em sigilo durante 18 (dezoito) meses contados da data de depósito ou da prioridade mais antiga, quando houver, após o que será publicado, à exceção do caso previsto no art. 75 (pedido de patente originário do Brasil cujo objeto interesse à defesa nacional).

São inventores do referido pedido de patente: Daiane Dias, Gabriel Moraes Marin, Eduardo Silveira Ribeiro, Enedina Sena Alves de Lima, Juliane Froncheti de Moura, Alice Neri da Silva Sousa, Eliézer Quadro Oreste, Tito Roberto Sant'Anna Cadaval Junior, Luiz Antonio de Almeida Pinto.

Rio Grande, data da assinatura eletrônica.

Paula Fagundes Marques Shinzato

Assistente em Administração

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Federative Republic of Brazil

Ministry of Development, Industry, Commerce and Services

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(54) Title: USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AQUEOUS SYSTEM

(51) Int. Cl.: B01J 20/24; C02F 101/32; B01J 20/22; C08B 37/08; C02F 1/28; (...).

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(71) Applicant(s): FEDERAL UNIVERSITY OF RIO GRANDE - FURG.

(72) Inventor(s): TITO ROBERTO SANT'ANNA CADAVAL JUNIOR; LUIZ ANTONIO DE ALMEIDA PINTO; NAURO DA SILVEIRA JUNIOR; ROMULO HENRIQUE BATISTA DE FARIAS; BRUNA SILVA DE FARIAS; RAFAEL GERHARDT; VIVIANE DE CARVALHO ARABIDIAN; ALICE NERI DA SILVA SOUSA; ARIANE BORGES RIBEIRO; FRANCISCA ZUCHOSKI RIZZI.

(57) Abstract: USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AQUEOUS SYSTEM. Awareness of the problems caused by used lubricating oils is essential to promote positive changes in how these wastes are managed. When these oils are dumped into the soil, their chemical substances contaminate the upper layers and eventually infiltrate groundwater. This contamination poses a serious threat to the quality of drinking water, as the toxic components present in the oils can compromise human health and aquatic life. Furthermore, when lubricating oils are discharged directly into bodies of water, such as rivers and lakes, immediate pollution occurs. During the burning of used lubricating oils, toxic substances such as heavy metals, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) are released. To mitigate the problems related to atmospheric emissions from used lubricating oils, it becomes essential to adopt proper waste management practices. In this context, the present patent application aims to improve and/or solve the problem caused by leaks or improper disposal of used lubricating oil in water, presenting an alternative with fewer processing steps, thus becoming a lower-cost and viable option for the removal of this (...).

USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL (ULO) IN AQUEOUS SYSTEM

Field of the Invention

[001] The invention relates to the use of a natural polymer (chitosan) in the form of a porous sponge, produced through simple manufacturing processes with few steps and reactions, aimed at removing used lubricating oil from aqueous systems.

[002] The present invention brings the benefits of using a polymer derived from a natural source, which is extremely efficient in removing used lubricating oil from aqueous systems. The distinguishing feature of this material lies in the fact that, in addition to its excellent removal rate, it also offers the possibility of reuse with minimal loss of capacity, setting it apart from others due to the reduced number of operations involved, the short contact time, and the ease of desorption.

Foundations of the Invention

[003] Lubricating oils play an essential role in the proper functioning of machines and equipment, reducing friction and wear of moving parts. However, when these oils are used and disposed of improperly, they can cause serious damage to the environment and human health. Awareness of the problems caused by used lubricating oils is crucial to promote positive changes in how these wastes are managed. The implementation of proper management practices, such as collection, recycling, and correct disposal of these oils and, in cases where these measures are not properly carried out, the recovery of degraded areas is essential to minimize negative impacts on the environment and public health.

[004] Soil and water pollution is one of the main problems resulting from the improper disposal of used lubricating oils. When these oils are dumped onto the soil, their chemical substances contaminate the upper layers and eventually, they infiltrate into the

groundwater. This contamination poses a serious threat to the quality of drinking water, as the toxic components present in the oils can compromise human health and aquatic life. Furthermore, when lubricating oils are discharged directly into bodies of water, such as rivers and lakes, immediate pollution occurs. The oil forms a surface layer that blocks sunlight penetration, affecting photosynthesis and harming aquatic life. Fish, birds, and other species may suffer from asphyxiation due to the lack of dissolved oxygen, in addition to being exposed to harmful chemical substances present in the oil.

[005] This contamination has significant impacts on aquatic ecosystems. Aquatic plant species may be suppressed, leading to reduced biodiversity and decreased oxygen production. Marine life, including fish, crustaceans, and mollusks, can be negatively affected, resulting in population declines and ecological imbalances. Therefore, it is crucial to implement measures to prevent soil and water pollution caused by the improper disposal of used lubricating oils, and research into equipment and processes for damage mitigation is of utmost importance.

[006] Atmospheric emissions from the burning of used lubricating oils constitute one of the main environmental problems associated with these wastes. The improper burning of these oils releases pollutant gases and particles into the atmosphere, contributing to air pollution and its harmful effects on human health. During the burning of used lubricating oils, toxic substances such as heavy metals, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) are released. These substances can disperse into the atmosphere and become widely distributed, posing a risk to air quality in urban and industrial areas.

[007] Heavy metals, such as lead, cadmium, and mercury, are known to be highly toxic and bioaccumulative. Their release into the atmosphere contributes to air and soil contamination and poses a threat to natural ecosystems. Inhalation of these metals can lead to respiratory problems, damage to the central nervous system, and even cancer. PAHs are chemical compounds formed during the incomplete combustion of organic

materials, such as lubricating oils as oils. These substances are associated with adverse health effects, including respiratory diseases, damage to the immune system, and an increased risk of developing cancer. Furthermore, PAHs contribute to the formation of smog and acid rain, which have negative impacts on air quality and biodiversity.

[008] VOCs are volatile chemical compounds that easily evaporate under normal temperature and pressure conditions. During the burning of used lubricating oils, these compounds are released into the atmosphere, contributing to the formation of secondary pollutants, such as tropospheric ozone, which is harmful to human health. Exposure to these pollutants can cause respiratory irritation, cardiovascular problems, and exacerbate existing respiratory conditions, such as asthma.

[009] To mitigate problems related to atmospheric emissions from used lubricating oils, it is essential to adopt proper waste management practices. Implementing collection and recycling systems for used lubricating oils is a crucial measure to prevent their improper burning and, thereby, reduce the release of pollutant gases and particles. Additionally, it is necessary to raise awareness about the risks associated with atmospheric emissions from used lubricating oils, encouraging responsible actions by industries and end users of these products.

[010] Used lubricating oils pose significant risks to human health, both for those who have direct contact with these products and for those exposed to their smoke or vapors. Prolonged exposure to these oils can result in a variety of health problems, ranging from skin irritation to neurological damage and an increased risk of developing cancer. When there is direct contact with used lubricating oils, whether through the skin or inhalation, they can cause irritations and allergic reactions. Many lubricating oils contain chemical additives that can be toxic and irritating to the skin, leading to dermatitis and other skin conditions. Furthermore, inhalation of the vapors from these oils can result in respiratory irritation, coughing, difficulty breathing, and even long-term lung damage.

[011] Used lubricating oils may also contain harmful substances, such as heavy metals, solvents, and aromatic compounds, which pose risks to human health. Exposure to these substances can lead to damage to the central nervous system, neurological disorders, hormonal changes, and immune system dysfunctions. Additionally, some of the compounds present in these oils, such as polycyclic aromatic hydrocarbons (PAHs), are known to be carcinogenic and can increase the long-term risk of developing cancer.

[012] Therefore, it is essential to adopt protective and preventive measures to reduce the human health risks associated with used lubricating oils. This includes the use of personal protective equipment (PPE), such as gloves, safety goggles, and respiratory masks, when handling these products. Additionally, it is necessary to raise awareness about the dangers of these oils and provide proper training to workers involved in their handling so that they can adopt appropriate safety measures. Contamination by used lubricating oils has a significant impact on biodiversity, negatively affecting terrestrial and aquatic ecosystems. Even small amounts of oil can cause significant damage to living organisms and the biological processes essential for sustaining ecosystems. When used lubricating oils are improperly disposed of in the environment, they can infiltrate the soil and affect plant life. The presence of these oils in the soil impedes the proper exchange of gases and moisture between the soil and the atmosphere, interfering with plant respiration and photosynthesis. As a result, oxygen production decreases, negatively impacting the entire food chain and the diversity of plant and animal species that depend on these plants for food and shelter.

[013] In aquatic ecosystems, contamination by used lubricating oils is particularly concerning. When discharged directly into bodies of water, the oil forms a surface film, blocking sunlight and impairing the photosynthesis of aquatic plants. These plants play a crucial role in oxygen production and in maintaining water quality. The reduction in the quantity and diversity of aquatic plants negatively impacts the aquatic food chain,

affecting fish, waterfowl, and other animals that rely on these plants for food and shelter.

[014] Furthermore, contamination by used lubricating oils directly affects aquatic fauna. Marine animals can suffer poisoning from chemical substances present in the oils, compromising their growth, reproduction, and survival. Fish and aquatic organisms can accumulate these substances in their tissues, which can lead to cascading adverse effects throughout the entire food chain.

[015] Contamination by used lubricating oils also has negative impacts on terrestrial ecosystems, affecting wildlife. Terrestrial fauna, such as birds, mammals, and reptiles, can be affected by direct exposure to the oils, whether through physical contact or accidental ingestion. The oil can affect the animals' feathers or fur, impairing their ability to maintain thermal insulation and protection against predators. Additionally, ingestion of these oils can lead to internal damage, compromising the health and survival of these animals. In short, contamination by used lubricating oils represents a significant threat to biodiversity and ecosystem health. It is essential to adopt proper and sustainable management practices to minimize contamination, such as collection, recycling, and proper disposal of these oils. Awareness of the negative impacts of these residues.

[016] Chitosan is a naturally derived biopolymer obtained from chitin, a polysaccharide abundantly found in the exoskeletons of crustaceans, such as shrimp, crabs, and lobsters, as well as in some fungal cell walls. Chitosan is widely used in various sectors due to its biocompatible, biodegradable, non-toxic properties and high-water retention capacity. Chitosan can be obtained through different processes involving extraction, purification, and deacetylation of chitin. The main methods of obtaining chitosan are acidic, alkaline, and enzymatic extraction. In the acidic method, chitin is extracted from crustacean exoskeletons through treatment with diluted hydrochloric acid. The acid demineralizes the chitin by removing the inorganic salts present and also helps to solubilize and separate the chitin from insoluble organic components. Next, the chitin is purified and subjected to a deacetylation process, usually using sodium hydroxide, to convert the chitin into chitosan.

In the alkaline method, chitin is extracted from crustacean exoskeletons through treatment with an alkaline solution, usually sodium hydroxide. The alkaline solution removes inorganic salts and solubilizes the chitin, allowing its separation from insoluble organic components. After purification, the chitin is deacetylated to produce chitosan. In the enzymatic method, enzymes such as chitinase are used to hydrolyze the chitin present in the crustacean exoskeletons and produce chitosan. The enzyme breaks the bonds between the glucose residues of the chitin, resulting in the formation of chitosan. This process is generally carried out under mild conditions, preventing damage to the chitosan structure.

[017] In addition to being obtained from crustaceans, chitosan can also be produced from other sources, such as filamentous fungi and fishery industry residues. In all production methods, the resulting chitosan is subsequently purified, if necessary, and can be transformed into different forms, such as powder, flakes, films, or hydrogels, depending on the desired application. Chitosan has a wide range of applications, including in the pharmaceutical, food, cosmetic, textile, and agricultural industries. Its use is associated with properties such as film-forming ability, heavy metal adsorption capacity, antimicrobial activity, controlled release of active substances, among other benefits. Its production from renewable sources and its biodegradability.

[018] Chitosan is widely recognized for its exceptional adsorption capacity, making it a prominent material in various processes for the removal and recovery of unwanted substances. This property is related to its unique chemical structure and the interactions it establishes with different compounds. Due to the presence of amino and hydroxyl functional groups in its structure, chitosan exhibits an affinity for ions, organic molecules, and even heavy metals. This affinity is mainly attributed to the formation of electrostatic interactions, hydrogen bonds, and coordination interactions between chitosan’s functional groups and the target molecules.

[019] The adsorption capacity of chitosan has been explored in various fields, including wastewater treatment, purification of industrial effluents, and the removal of dyes and

heavy metals, among others. For example, in textile dye removal processes, chitosan can be used as an efficient adsorbent to retain dyes, contributing to the reduction of water pollution. In the case of heavy metals, chitosan demonstrates excellent adsorption capacity due to the presence of amino groups in its structure. These groups have a high affinity for metal ions, allowing for the efficient removal of these contaminants from water. Chitosan has been successfully used to remove heavy metals such as lead, copper, cadmium, and mercury.

[020] The adsorption capacity of chitosan can also be enhanced through chemical modifications, such as the introduction of specific functional groups into its structure. These modifications allow for the selective adjustment of chitosan's affinity for different substances and optimize its efficiency in adsorption processes. In addition to adsorbing undesirable substances, chitosan can also be used for the recovery of valuable compounds. For example, in the adsorption of bioactive compounds, such as polyphenols and flavonoids, chitosan can be employed to extract and concentrate these compounds from plant matrices, contributing to the production of higher value-added products.

[021] The invention is based on the discovery of the use of the natural polymer chitosan, in a porous sponge form, for the treatment of water contaminated with used lubricating oil (ULO). The invention will also demonstrate its removal capability. Its lipophilic affinity (adsorption of oils and fats) and various structural forms have been shown in several publications, such as document CN109485911 and document CN104629079. Both deal with the adsorption capacity of flexible chitosan sponges. However, they involve other compounds and several processes (in greater quantity) different from those presented here for obtaining the sponge. In the first material, the chitosan sponge is prepared using the vacuum freeze-drying method, with iron (Fe) modified and zinc oxide nanoparticles supported within the three-dimensional porous structure of the chitosan-based sponge. In the second document, to obtain the chitosan sponge, it first undergoes a process of dissolution in acetic acid, followed by treatment with an aqueous solution of sodium tripolyphosphate. After being lyophilized, the solution needs to be transferred to another

solution of aldehyde ethanol, heated, and then immersed in absolute ethanol to remove the aldehydes. During the research of similar materials, records such as CN113731372 were also found, entitled Peat adsorbent for treating oil spill polluted soil and treatment method, which discloses a peat adsorbent for treating soil contaminated by oil spills. The peat adsorbent comprises chitosan-modified reticulated sphagnum peat and expanded vermiculite. A micron-sized pore structure of the expanded vermiculite is fully utilized to introduce the chitosan-modified reticulated sphagnum peat into a macroporous structure of the expanded vermiculite in a semi-interpenetrating manner, so that a hydrophobic and lipophilic composite adsorbent is prepared. There is also record PH22016000037 (Calcium carbonate composite for oil spill remediation), which refers to sorbent composite materials comprising chitosan and calcium carbonate, in which the chitosan component contains calcium carbonate and the calcium carbonate component is surface-treated with stearic acid and NaOH. As a removal system, record CN109027209 (Oil spill recovery device for high-vanadium-titanium steel rolling line) describes an oil spill recovery device for a high-vanadium-titanium steel rolling line, capable of effectively recovering and filtering spilled oil, thereby reducing abnormal oil consumption. Its production cost is also reduced. When considering research at INPI, record PI0601854-8 (use of chitosan films and membranes in the removal of water pollutants) targets the use of films and membranes developed in various compositions for treating waters contaminated with petroleum and its residues. It is also aimed at adsorbing heavy metals from industrial wastewater across multiple sectors due to the composition of these films and membranes. It is different in the format and preparation of the material responsible for removal. Finally, the record PI0404309-0 (use of chitin, chitosan, and their derivatives in the removal of petroleum and its residues from water) targets the uses of the natural polymers chitin and chitosan and their derivatives, in various forms including microspheres, magnetic microspheres, and chitosomes, in the treatment of water contaminated with petroleum-derived residues. It is therefore possible to state that in this invention, an interaction between chitosan and glutaraldehyde can be observed, which is responsible for improving the structural strength through cross-linking.

Thus, providing the chitosan sponge with a greater ability to maintain its structure and prevent dissolution. As a result, it exhibits a structure different from all the others mentioned, with its shape and formulation also varying. The short contact time and, especially, the reduced number of processes are unique features of this invention.

Objects of the invention

[022] The present patent application aims at the development of sponges made from chitosan crosslinked with glutaraldehyde, followed by a freeze-drying process, in order to adsorb used lubricating oil (ULO) in an aqueous system. The use of chitosan in adsorption processes offers a promising and sustainable alternative for wastewater treatment, being effective for various applications in environmental and industrial fields.

Summary of the Invention

[023] A new system has been developed for the adsorption of used lubricating oil (ULO). This system consists of a chitosan sponge crosslinked with glutaraldehyde for application in the adsorption of used lubricating oil (ULO) dispersed in an aqueous medium.

[024] For the purposes of this invention, the process describes the methods for extracting chitin from shrimp waste (*Penaeus brasiliensis*) and producing chitosan. Additionally, it describes the preparation of chitosan sponges crosslinked with glutaraldehyde.

[025] For the preparation of chitosan, it is first necessary to obtain chitin, generally extracted through the following chemical sequences: demineralization, deproteinization, and deodorization. In demineralization, HCl solutions (2.5%) are used, followed by deproteinization, in which proteins are removed using a NaOH solution (5%) under mild conditions to avoid hydrolysis of the acetamide groups of chitin and depolymerization of this polymer. Deodorization occurs with the addition of NaClO (0.36%).

[026] For the fabrication of the chitosan sponge, a 4% m v^{-1} concentration of chitosan is used, dissolved in a 1% (1%, v v^{-1}) acetic acid solution, and then glutaraldehyde

(1,5%, v v-¹) is added for the crosslinking of the adsorbents. The mixture is subjected to a freeze-drying process, in which it is first frozen in an ultra-freezer for 24 hours at -80°C. After this step, the samples are placed in a freeze-dryer for sublimation drying, remaining for 48 hours at -54°C under a vacuum of 44 μmHg until the complete evaporation of the solvents. As a final result, the sponges are cut and standardized into 1 g pieces for subsequent use.

[027] For the application of the chitosan sponge in the adsorption of used lubricating oil (ULO), the optimized chitosan sponge: used lubricating oil ratio is 1:2.5 (g g^{-1}), while the optimized used lubricating oil: water ratio is 1:20 (g mL^{-1}). After using the sponge to adsorb the oil, the desorption process can be carried out to allow the sponge to be reused. For this, after the sponges are saturated during the ULO adsorption step, the contaminants are eluted using a nonpolar solvent, such as hexane.

CLAIMS

USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM

1. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, characterized by the process of removing ULO from an aqueous system using a biomaterial based on the natural polymer chitosan.

2. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, according to claim 1, characterized by the origin of the chitosan, being obtained from the alkaline deacetylation reaction of chitin, which was extracted from crustacean shells.

3. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1, characterized by the use of the biopolymer chitosan in the form of a porous sponge.

4. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1, characterized by dissolving the chitosan in an acetic acid solution, followed by crosslinking with glutaraldehyde and freeze-drying.

5. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1, characterized by the physical separation of the water and the sponge containing adsorbed ULO without the addition of any further components.

6. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1,

characterized by the speed of the process, being carried out in just 10 minutes of contact.

7. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1, characterized by the reusability of the sponge.

8. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1, characterized by a removal rate higher than 99% upon first contact between the sponge and the pollutant.

9. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1, characterized by a removal rate higher than 95% during the first 7 reuses when the mass-to-mass ratio between the sponge and the pollutant is 40%.

10. USE OF POROUS CHITOSAN SPONGE FOR THE REMOVAL OF USED LUBRICATING OIL IN AN AQUEOUS SYSTEM, process according to claim 1, characterized by a removal rate higher than 92% during the first 7 reuses when the mass-to-mass ratio between the sponge and the pollutant is 20%.

ABSTRACT

Use of porous chitosan sponge for the removal of used lubricating oil in an aqueous system

Awareness of the problems caused by used lubricating oils is essential to promote positive changes in the way these wastes are managed. When these oils are dumped into the soil, their chemical substances contaminate the upper layers and can eventually infiltrate groundwater. This contamination poses a serious threat to drinking water quality, as the toxic components present in the oils can compromise human health and aquatic life. Furthermore, when used lubricating oils are directly discharged into water bodies, such as rivers and lakes, immediate pollution occurs. During the burning of used lubricating oils, toxic substances such as heavy metals, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) are released. To mitigate problems related to the atmospheric emissions of used lubricating oils, it is essential to adopt proper waste management practices. In this context, the present patent application aims to improve and/or solve the problem caused by leaks or irregular disposal of used lubricating oil in water, offering an alternative with fewer processing steps, thus becoming a lower-cost and viable option for the removal of this pollutant in aqueous systems. The present invention seeks to develop a new process for the removal of used lubricating oil using a chitosan sponge as the adsorbent material. To obtain the sponge, chitosan is dissolved in acetic acid, followed by crosslinking with glutaraldehyde and subsequent lyophilization. Afterwards, the chitosan sponges can be applied to adsorb used lubricating oil dispersed in an aqueous system. All operational parameters have been optimized to develop a specific system for the adsorption of used lubricating oil.

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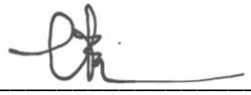
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(57) Resumo: USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO. A conscientização sobre os problemas causados pelos óleos lubrificantes usados é fundamental para promover mudanças positivas na forma como esses resíduos são gerenciados. Quando esses óleos são despejados no solo, suas substâncias químicas contaminam as camadas superiores e, eventualmente, se infiltram nos lençóis freáticos. Essa contaminação representa uma séria ameaça à qualidade da água potável, pois os componentes tóxicos presentes nos óleos podem comprometer a saúde humana e a vida aquática. Além disso, quando os óleos lubrificantes são lançados diretamente em corpos d'água, como rios e lagos, ocorre uma poluição imediata. Durante a queima dos óleos lubrificantes usados, substâncias tóxicas como metais pesados, hidrocarbonetos aromáticos policíclicos (HAPs) e compostos orgânicos voláteis (COVs) são liberadas. Para mitigar os problemas relacionados às emissões atmosféricas dos óleos lubrificantes usados torna-se fundamental adotar práticas adequadas de gerenciamento desses resíduos. Neste contexto, presente pedido de patente de invenção visa melhorar e/ou solucionar o problema causado por vazamentos ou descartes irregulares de óleo lubrificante usado em águas, apresentando uma alternativa com menor número de processos, tornando-se assim uma opção de menor custo e viável na remoção desse (...).

USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO (OLU) EM SISTEMA AQUOSO

Campo da invenção

[001] A invenção se refere ao uso de um polímero natural (quitosana) utilizado na forma de esponja porosa, com processos de fabricação simples, com poucas intervenções e reações, com objetivo de remover óleo lubrificante usado em sistemas aquosos.

[002] A atual invenção trás os benefícios do uso de um polímero proveniente de fonte natural, que é extremamente eficiente para a remoção de óleo lubrificante usado em sistemas aquosos. O diferencial no uso deste material está o fato de que, além da excelente taxa de remoção, o mesmo apresenta também a possibilidade do reuso sem muita perda de capacidade, se diferenciando dos outros justamente pelo número reduzido de operações envolvidas, pelo tempo de contato e pela facilidade da dessorção.

Fundamentos da invenção

[003] Os óleos lubrificantes desempenham um papel essencial no funcionamento adequado de máquinas e equipamentos, reduzindo o atrito e o desgaste das peças móveis. No entanto, quando esses óleos são utilizados e descartados de forma inadequada, podem causar sérios danos ao meio ambiente e à saúde humana. A conscientização sobre os problemas causados pelos óleos lubrificantes usados é fundamental para promover mudanças positivas na forma como esses resíduos são gerenciados. A implementação de práticas de manejo adequadas, como a coleta, reciclagem, disposição correta desses óleos e em casos que tudo isso não ocorra da forma correta; uma recuperação de áreas degradadas, é essencial para minimizar os impactos negativos no meio ambiente e na saúde pública.

[004] A poluição do solo e da água é um dos principais problemas decorrentes do descarte inadequado dos óleos lubrificantes usados. Quando esses óleos são despejados no solo, suas substâncias químicas contaminam as camadas superiores e,

eventualmente, se infiltram nos lençóis freáticos. Essa contaminação representa uma séria ameaça à qualidade da água potável, pois os componentes tóxicos presentes nos óleos podem comprometer a saúde humana e a vida aquática. Além disso, quando os óleos lubrificantes são lançados diretamente em corpos d'água, como rios e lagos, ocorre uma poluição imediata. O óleo forma uma camada superficial que bloqueia a penetração de luz solar, afetando a fotossíntese e prejudicando a vida aquática. Peixes, aves e outras espécies podem sofrer asfixia devido à falta de oxigênio dissolvido, além de serem expostos a substâncias químicas prejudiciais presentes no óleo.

[005] Essa contaminação tem impactos significativos nos ecossistemas aquáticos. As espécies de plantas aquáticas podem ser suprimidas, levando à redução da biodiversidade e à diminuição da produção de oxigênio. A vida marinha, incluindo peixes, crustáceos e moluscos, pode ser afetada negativamente, levando a declínios populacionais e desequilíbrios ecológicos. Portanto, é crucial implementar medidas para evitar a poluição do solo e da água causada pelo descarte inadequado dos óleos lubrificantes usados e de suma importância a pesquisa de equipamentos e processos para mitigação de danos.

[006] As emissões atmosféricas provenientes da queima de óleos lubrificantes usados constituem um dos principais problemas ambientais relacionados a esses resíduos. A queima inadequada desses óleos libera gases e partículas poluentes na atmosfera, contribuindo para a poluição do ar e seus efeitos prejudiciais à saúde humana. Durante a queima dos óleos lubrificantes usados, substâncias tóxicas como metais pesados, hidrocarbonetos aromáticos policíclicos (HAPs) e compostos orgânicos voláteis (COVs) são liberadas. Essas substâncias têm a capacidade de se dispersar na atmosfera e se tornar amplamente distribuídas, representando um risco para a qualidade do ar em áreas urbanas e industriais.

[007] Os metais pesados, como chumbo, cádmio e mercúrio, são conhecidos por serem altamente tóxicos e bioacumulativos. Sua liberação na atmosfera contribui para a contaminação do ar e do solo, além de representar um perigo para os ecossistemas naturais. A inalação desses metais pode levar a problemas respiratórios, danos ao sistema nervoso central e até mesmo câncer. Os HAPs são compostos químicos formados durante a combustão incompleta de materiais orgânicos, como os óleos

lubrificantes. Essas substâncias estão associadas a efeitos adversos à saúde, incluindo doenças respiratórias, danos ao sistema imunológico e aumento do risco de desenvolvimento de câncer. Além disso, os HAPs contribuem para a formação de smog e chuva ácida, que têm impactos negativos sobre a qualidade do ar e a biodiversidade.

[008] Os COVs são compostos químicos voláteis que evaporam facilmente em condições normais de temperatura e pressão. Durante a queima dos óleos lubrificantes usados, esses compostos são liberados para a atmosfera, contribuindo para a formação de poluentes secundários, como ozônio troposférico, que é prejudicial à saúde humana. A exposição a esses poluentes pode causar irritação respiratória, problemas cardiovasculares e agravar condições respiratórias existentes, como asma.

[009] Para mitigar os problemas relacionados às emissões atmosféricas dos óleos lubrificantes usados, é fundamental adotar práticas adequadas de gerenciamento desses resíduos. A implementação de sistemas de recolhimento e reciclagem dos óleos lubrificantes usados é uma medida essencial para evitar sua queima inadequada e, assim, reduzir a liberação de gases e partículas poluentes. Além disso, é necessário promover a conscientização sobre os riscos associados às emissões atmosféricas dos óleos lubrificantes usados, incentivando ações responsáveis por parte das indústrias e dos usuários finais desses produtos.

[010] Os óleos lubrificantes usados apresentam riscos significativos à saúde humana, tanto para aqueles que têm contato direto com esses produtos quanto para aqueles expostos à sua fumaça ou vapores. A exposição prolongada a esses óleos pode resultar em uma variedade de problemas de saúde, desde irritações cutâneas até danos neurológicos e riscos aumentados de desenvolvimento de câncer. Quando há contato direto com óleos lubrificantes usados, seja através da pele ou por inalação, eles podem causar irritações e reações alérgicas. Muitos óleos lubrificantes contêm aditivos químicos que podem ser tóxicos e irritantes para a pele, levando a dermatites e outras condições cutâneas. Além disso, a inalação dos vapores desses óleos pode resultar em irritação das vias respiratórias, tosse, dificuldade respiratória e até mesmo danos pulmonares a longo prazo.

[011] Os óleos lubrificantes usados também podem conter substâncias nocivas, como metais pesados, solventes e compostos aromáticos, que representam riscos à saúde humana. A exposição a essas substâncias pode levar a danos no sistema nervoso central, distúrbios neurológicos, alterações hormonais e disfunções do sistema imunológico. Além disso, alguns dos compostos presentes nesses óleos, como os hidrocarbonetos aromáticos policíclicos (HAPs), são conhecidos por serem cancerígenos e podem aumentar o risco de desenvolvimento de câncer em longo prazo.

[012] Portanto, é fundamental adotar medidas de proteção e prevenção para reduzir os riscos à saúde humana associados aos óleos lubrificantes usados. Isso inclui o uso de equipamentos de proteção individual (EPIs), como luvas, óculos de proteção e máscaras respiratórias, ao lidar com esses produtos. Além disso, é necessário promover a conscientização sobre os perigos desses óleos e fornecer treinamento adequado aos trabalhadores envolvidos em seu manuseio, para que possam adotar medidas de segurança adequadas. A contaminação por óleos lubrificantes usados tem um impacto significativo na biodiversidade, afetando negativamente os ecossistemas terrestres e aquáticos. Pequenas quantidades de óleo podem causar danos significativos aos organismos vivos e aos processos biológicos essenciais para a sustentação dos ecossistemas. Quando os óleos lubrificantes usados são descartados inadequadamente no ambiente, eles podem se infiltrar no solo e afetar a vida vegetal. A presença desses óleos no solo impede a troca adequada de gases e umidade entre o solo e a atmosfera, interferindo nos processos de respiração e fotossíntese das plantas. Como resultado, a produção de oxigênio diminui, afetando negativamente toda a cadeia alimentar e a diversidade de espécies vegetais e animais que dependem dessas plantas como fonte de alimento e abrigo.

[013] Nos ecossistemas aquáticos, a contaminação por óleos lubrificantes usados é especialmente preocupante. Quando lançados diretamente em corpos d'água, o óleo forma uma película na superfície, bloqueando a entrada de luz solar e prejudicando a fotossíntese das plantas aquáticas. Essas plantas desempenham um papel crucial na produção de oxigênio e na manutenção da qualidade da água. A redução da quantidade e diversidade de plantas aquáticas impacta negativamente a cadeia alimentar aquática,

afetando peixes, aves aquáticas e outros animais que dependem dessas plantas como fonte de alimento e abrigo.

[014] Além disso, a contaminação por óleos lubrificantes usados afeta diretamente a fauna aquática. Os animais marinhos podem sofrer intoxicação por substâncias químicas presentes nos óleos, comprometendo seu crescimento, reprodução e sobrevivência. Peixes e organismos aquáticos podem acumular essas substâncias em seus tecidos, o que pode levar a efeitos adversos em cascata em toda a cadeia alimentar.

[015] A contaminação por óleos lubrificantes usados também tem impactos negativos nos ecossistemas terrestres, afetando a vida selvagem. A fauna terrestre, como aves, mamíferos e répteis, pode ser afetada pela exposição direta aos óleos, seja por contato físico ou ingestão acidental. O óleo pode afetar a plumagem ou o pelo dos animais, prejudicando sua capacidade de isolamento térmico e proteção contra predadores. Além disso, a ingestão desses óleos pode levar a danos internos e comprometer a saúde e a sobrevivência desses animais. Em suma, a contaminação por óleos lubrificantes usados representa uma ameaça significativa à biodiversidade e à saúde dos ecossistemas. É essencial adotar práticas de manejo adequadas e sustentáveis para minimizar a contaminação, como a coleta, reciclagem e disposição correta desses óleos. A conscientização sobre os impactos negativos desses resíduos.

[016] A quitosana é um biopolímero de origem natural derivado da quitina, um polissacarídeo encontrado em abundância em exoesqueletos de crustáceos, como camarões, caranguejos e lagostas, bem como em algumas paredes celulares de fungos. A quitosana é amplamente utilizada em diversos setores devido às suas propriedades biocompatíveis, biodegradáveis, não tóxicas e de alta capacidade de retenção de água. A obtenção da quitosana pode ser feita por meio de diferentes processos, que envolvem etapas de extração, purificação e desacetilação da quitina. As principais formas de obtenção da quitosana consiste na extração ácida, alcalina e enzimática. No método ácido, a quitina é extraída a partir dos exoesqueletos dos crustáceos por meio de tratamento com ácido clorídrico diluído. O ácido desmineraliza a quitina, removendo os sais inorgânicos presentes, e também ajuda a solubilizar e separar a quitina dos componentes orgânicos insolúveis. Em seguida, a quitina é purificada e submetida ao processo de desacetilação, geralmente usando hidróxido de sódio, para converter a

quitina em quitosana. No método alcalino, a quitina é extraída a partir dos exoesqueletos dos crustáceos por meio de tratamento com uma solução alcalina, geralmente hidróxido de sódio. A solução alcalina promove a remoção dos sais inorgânicos e solubiliza a quitina, permitindo sua separação dos componentes orgânicos insolúveis. Após a purificação, a quitina é desacetilada para produzir a quitosana. No método enzimático utiliza-se enzimas, como a quitinase, para hidrolisar a quitina presente nos exoesqueletos dos crustáceos e produzir a quitosana. A enzima quebra as ligações entre os resíduos de glicose da quitina, resultando na formação da quitosana. Esse processo é geralmente realizado em condições suaves, evitando danos à estrutura da quitosana.

[017] Além da obtenção a partir de crustáceos, a quitosana também pode ser produzida a partir de outras fontes, como fungos filamentosos e resíduos da indústria de pescados. Em todos os métodos de obtenção, a quitosana resultante é posteriormente purificada, se necessário, e pode ser transformada em diferentes formas, como pó, flocos, filmes ou hidrogéis, dependendo da aplicação desejada. A quitosana tem uma ampla gama de aplicações, incluindo na indústria farmacêutica, alimentícia, cosmética, têxtil e agrícola. Seu uso está relacionado a propriedades como capacidade de formação de filmes, capacidade de adsorção de metais pesados, atividade antimicrobiana, capacidade de liberação controlada de substâncias ativas, entre outros benefícios. Sua obtenção a partir de fontes renováveis e sua biodegradação.

[018] A quitosana é amplamente reconhecida por sua excepcional capacidade de adsorção, o que a torna um material de destaque em diversos processos de remoção e recuperação de substâncias indesejáveis. Essa propriedade está relacionada à sua estrutura química única e às interações que ela estabelece com diferentes compostos. Devido à presença de grupos funcionais de amina e hidroxila na sua estrutura, a quitosana apresenta afinidade por íons, moléculas orgânicas e até mesmo metais pesados. Essa afinidade é atribuída principalmente à formação de interações eletrostáticas, ligações de hidrogênio e interações de coordenação entre os grupos funcionais da quitosana e as moléculas alvo.

[19] A capacidade de adsorção da quitosana tem sido explorada em várias áreas, incluindo tratamento de águas residuais, purificação de efluentes industriais, remoção de

corantes e metais pesados, entre outros. Por exemplo, em processos de remoção de corantes têxteis, a quitosana pode ser utilizada como adsorvente eficiente para a retenção dos corantes, contribuindo para a redução da poluição da água. No caso de metais pesados, a quitosana demonstra excelente capacidade de adsorção devido à presença de grupos amino em sua estrutura. Esses grupos possuem alta afinidade por íons metálicos, permitindo a remoção eficiente desses contaminantes da água. A quitosana tem sido utilizada com sucesso na remoção de metais pesados como chumbo, cobre, cádmio e mercúrio.

[020] A capacidade de adsorção da quitosana também pode ser ampliada por meio de modificações químicas, como a introdução de grupos funcionais específicos na sua estrutura. Essas modificações permitem ajustar seletivamente a afinidade da quitosana por diferentes substâncias e otimizar sua eficiência em processos de adsorção. Além da adsorção de substâncias indesejáveis, a quitosana também pode ser usada para a recuperação de substâncias valiosas. Por exemplo, em processos de adsorção de compostos bioativos, como polifenóis e flavonoides, a quitosana pode ser empregada para extrair e concentrar esses compostos a partir de matrizes vegetais, contribuindo para a obtenção de produtos de maior valor agregado.

[021] A invenção está baseada na descoberta do uso do polímero natural quitosana, em uma forma de esponja porosa, no tratamento de águas contaminadas com OLU. A invenção também apresentará a capacidade de remoção da mesma. A afinidade lipofílica (adsorção de óleos e gorduras) da quitosana e suas diferentes estruturas está demonstradas em diversas publicações como por exemplo o documento CN109485911 e também o documento CN104629079. Ambos versam sobre a capacidade de adsorção de esponjas flexíveis de quitosana. Porém, as mesmas apresentam outros compostos e diversos processos (em maior quantidade) diferentes deste aqui apresentado, para a aquisição da esponja. No primeiro material, a esponja de quitosana é preparada usando o método de liofilização a vácuo; tendo o Fe modificado e com nano granulado de óxido de zinco suportados na estrutura porosa tridimensional da esponja à base de quitosana. No segundo documento, para a obtenção da esponja de quitosana, a mesma passa pelo processo inicial com dissolução em ácido acético, depois por uma solução aquosa de tripolifosfato de sódio. Depois de liofilizada, a solução precisa ir para outra solução de

etanol de aldeídos, aquecida e depois mergulhado etanol absoluto para a retirada dos aldeídos. Durante a pesquisa de materiais similares foi encontrado ainda registros como CN113731372, intitulado Peat adsorbent for treating oil spill polluted soil and treatment method na qual revela um adsorvente de turfa para tratamento de solo contaminado por derramamento de óleo. O adsorvente de turfa compreende turfa de esfagno reticulada de quitosana modificada e vermiculita expandida. Uma estrutura de poros de tamanho mícron de vermiculita expandida é totalmente utilizada para introduzir turfa de esfagno reticulada de quitosana modificada em uma estrutura macroporosa da vermiculita expandida de uma maneira semi-interpenetrante, de modo que o adsorvente composto hidrofóbico e lipofílico seja preparado. Há também o registro PH22016000037 (calcium carbonate composite for oil spill remediation) que se refere a materiais compósitos sorventes compreendendo quitosana e carbonato de cálcio, em que o componente de quitosana contém carbonato de cálcio e o componente de carbonato de cálcio é tratado superficialmente com ácido esteárico e NaOH. Como sistema de remoção o registro CN109027209 (Oil spill recovery device for high-vanadium-titanium steel rolling line) descreve um dispositivo de recuperação de derramamento de óleo para uma linha de laminação de aço com alto teor de vanádio-titânio, podendo efetivamente recuperar e filtrar o óleo vazado, de modo que o consumo anormal de óleo seja reduzido. Seu custo de produção é reduzido. Quando levado em consideração pesquisa no INPI, o registro PI0601854-8 (uso de filmes e membranas de quitosana e derivados na remoção de poluentes de águas) visa o uso de filmes e membranas desenvolvidos em suas várias composições, no tratamento de águas contaminadas com petróleo e seus resíduos. Como também na adsorção de metais pesados oriundos de águas residuais das industriais de diversos segmentos em função de sua composição. Sendo diferente no formato e no preparo do material responsável pela remoção. E por último o registro PI 0404309-0 (uso de quitina, quitosana e seus derivados na remoção de petróleo e seus resíduos de águas) visa as utilizações dos polímeros naturais quitina e quitosana e seus derivados, em várias formas inclusive microesferas, microesferas magnéticas e Quitossomas no tratamento de águas contaminadas com resíduos derivados do petróleo. É possível então, afirmar que nessa invenção, podemos verificar uma interação entre a quitosana e o glutaraldeído, sendo assim responsável por melhora a resistência da estrutura através de uma reticulação. Dando assim uma maior capacidade para a

esponja de quitosana manter sua estrutura e evitar a dissolução. Como resultado, verifica-se uma estrutura diferente de todas as outras citadas, tendo forma e formulação também variando. O diminuto tempo de contato e principalmente o reduzido número de processos é característica única dessa invenção.

Objetivo da invenção

[022] O presente pedido de patente de invenção visa o desenvolvimento de esponjas a partir de quitosana reticulada com glutaraldeído, seguida da operação de secagem por liofilização, a fim de adsorver óleo lubrificante usado (olu) em sistema aquoso. O uso de quitosana em processos de adsorção oferece uma alternativa promissora e sustentável para o tratamento de efluentes, sendo eficaz para várias aplicações na área ambiental e industrial.

Sumário da Invenção

[023] Um novo sistema foi desenvolvido para a adsorção de óleo lubrificante usado (olu). Este sistema é constituído por esponja de quitosana reticulada com glutaraldeído para aplicação na operação de adsorção de óleo lubrificante usado (olu) disperso em meio aquoso.

[024] Para fins desta invenção, o processo descreve os métodos para a extração quitina a partir de resíduos de camarão (*Penaeus brasiliensis*) e produção de quitosana. Além disso, descreve o preparo das esponjas de quitosana reticulada com glutaraldeído.

[025] Para o preparo da quitosana é preciso primeiro adquirir a quitina, geralmente extraída a partir de sequências químicas: desmineralização, desproteinização e desodorização. Na desmineralização são utilizadas soluções de HCl (2,5%), seguida da desproteinização, em que as proteínas são removidas através de uma solução de NaOH (5%) sob condições suaves para evitar a hidrólise dos grupos acetamida da quitina e a despolimerização deste polímero. A desodorização ocorre com a adição de NaClO (0,36%).

[026] Para a confecção da esponja de quitosana utiliza-se uma concentração de 4% m v^{-1} de quitosana, dissolvida em uma solução de ácido acético (1%, v v^{-1}) e, após

adiciona-se o glutaraldeído (1,5%, v v^{-1}) para a reticulação dos adsorventes. A mistura é submetida ao processo de liofilização, em que, primeiramente ocorre um congelamento, no ultrafreezer por 24h à -80°C. Após essa etapa, as amostras são colocadas em um liofilizador para a secagem por sublimação e, dessa forma, as amostras permanecem por 48h à -54°C, sob vácuo de 44 μmHg, até a evaporação completa dos solventes. Como resultado final, as esponjas são cortadas e padronizadas em pedaços com 1g para posterior utilização.

[027] Para aplicação da esponja de quitosana na adsorção de óleo lubrificante usado (OLU), a proporção de esponja de quitosana:óleo lubrificante usado na condição otimizada corresponde ao valor de 1:2,5 (g g^{-1}). Em que a proporção de óleo lubrificante usado:água na condição otimizada corresponde ao valor de 1:20 (g mL^{-1}). Após a utilização da esponja na adsorção do óleo lubrificante, pode-se realizar o processo de dessorção do poluente, a fim de permitir o reuso da esponja. Para isso, após a saturação das esponjas na etapa de adsorção do OLU, realiza-se a eluição dos contaminantes utilizando um solvente apolar, como o hexano.

REIVINDICAÇÕES

USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO

1. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, caracterizado pelo processo de remoção de OLU de sistema aquoso com o uso de biomaterial à base do polímero natural quitosana.

2. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, de acordo com a reivindicação 1, caracterizado pela origem da quitosana, sendo obtida a partir da reação de desacetilação alcalina da quitina, a qual foi extraída de carapaças de crustáceos.

3. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a reinvindicação 1, caracterizado pelo uso do biopolímero quitosana na forma de esponja porosa.

4. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a reinvindicação 1, caracterizado pela dissolução da quitosana em solução de ácido acético, seguida da reticulação com glutaraldeído e secagem por liofilização.

5. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a reinvindicação 1 caracterizado pela separação física da água e da esponja contendo OLU adsorvido sem a adição de mais nenhum componente.

6. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a

reinvindicação 1 caracterizado pela rapidez do processo. Sendo esse realizado em apenas 10 minutos de contato.

7. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a reinvindicação 1 caracterizado pela capacidade de reuso da esponja.

8. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a reinvindicação 1 caracterizado pela taxa de remoção superior a 99% no primeiro contato entre a esponja e o poluente.

9. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a reinvindicação 1 caracterizado pela taxa de remoção superior aos 95% nos primeiros 7 reusos quando a relação massa-massa entre esponja e poluente é de 40%.

10. USO DE ESPONJA POROSA DE QUITOSANA PARA REMOÇÃO DE ÓLEO LUBRIFICANTE USADO EM SISTEMA AQUOSO, processo de acordo com a reinvindicação 1 caracterizado pela taxa de remoção superior aos 92% nos primeiros 7 reusos quando a relação massa-massa entre esponja e poluente é de 20%.

RESUMO

Uso de esponja porosa de quitosana para remoção de óleo lubrificante usado em sistema aquoso

A conscientização sobre os problemas causados pelos óleos lubrificantes usados é fundamental para promover mudanças positivas na forma como esses resíduos são gerenciados. Quando esses óleos são despejados no solo, suas substâncias químicas contaminam as camadas superiores e, eventualmente, se infiltram nos lençóis freáticos. Essa contaminação representa uma séria ameaça à qualidade da água potável, pois os componentes tóxicos presentes nos óleos podem comprometer a saúde humana e a vida aquática. Além disso, quando os óleos lubrificantes são lançados diretamente em corpos d'água, como rios e lagos, ocorre uma poluição imediata. Durante a queima dos óleos lubrificantes usados, substâncias tóxicas como metais pesados, hidrocarbonetos aromáticos policíclicos (HAPs) e compostos orgânicos voláteis (COVs) são liberadas. Para mitigar os problemas relacionados às emissões atmosféricas dos óleos lubrificantes usados torna-se fundamental adotar práticas adequadas de gerenciamento desses resíduos. Neste contexto, presente pedido de patente de invenção visa melhorar e/ou solucionar o problema causado por vazamentos ou descartes irregulares de óleo lubrificante usado em águas, apresentando uma alternativa com menor número de processos, tornando-se assim uma opção de menor custo e viável na remoção desse poluente em sistemas aquosos. O presente pedido de patente de invenção visa o desenvolvimento de um novo processo para a remoção de óleo lubrificante usado, utilizando esponja de quitosana como material adsorvente. Para a obtenção da esponja, realiza-se a dissolução da quitosana em ácido acético, seguida da reticulação com glutaraldeído e, posterior, secagem por liofilização. Posteriormente, as esponjas de quitosana podem ser aplicadas na adsorção do óleo lubrificante usado disperso em sistema aquoso. Todos os parâmetros operacionais foram otimizados, com intuito de desenvolver um sistema específico para a adsorção de óleo lubrificante usado.

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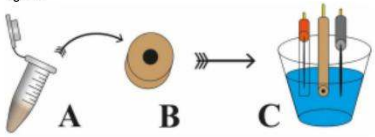
(54) Abstract: PROCESS FOR OBTAINING A CHEMICALLY MODIFIED VOLTAMMETRIC SENSOR WITH RICE HUSK BIOCHAR FOR DICLOFENAC DETERMINATION.

The present patent application aims at the development of a new electroanalytical sensor based on the use of a glassy carbon electrode modified with a biochar film obtained from the pyrolysis of rice husk for the determination of diclofenac. The proposed method stands out for its environmental relevance, aiming to meet the principles of green analytical chemistry, while adding technological value to rice husk, an agricultural residue in need of disposal alternatives. For the development of the film to be applied, the pyrolysis conditions of the rice husk, such as time and temperature, were optimized. For the development of the sensor, the parameters related to the square-wave voltammetry method, such as deposition time and potential, frequency, amplitude, and step potential (Estep), were optimized. Likewise, the conditions of the working cell were optimized with respect to different buffers and their respective concentrations and pH levels. In this context, this invention shows promise for industrial application, as well as potential for innovation in electroanalytical studies, encouraging its use for the determination of other types of analytes in different types of (...).

Figure 1.



PROCESS FOR THE PREPARATION OF A VOLTAMMETRIC SENSOR CHEMICALLY MODIFIED WITH RICE HUSK BIOCHAR FOR DETERMINATION OF DICLOFENAC

Field of the Invention

[001] The present invention relates to the field of electroanalytical chemistry, with potential for industrial application, as well as innovation potential in electroanalytical studies, encouraging its use for the determination of other types of analytes in different types of samples. The innovation of this invention concerns the process of modifying the surface of a glassy carbon electrode using a film-forming solution containing rice husk *biochar* for the determination of diclofenac using the square-wave voltammetry technique, thereby increasing the detection levels and sensitivity of this process for the analyte in question. In this way, the present invention also provides a use for rice husks, which constitute an important agro-industrial residue.

Foundations of the Invention

[002] Diclofenac is an important drug with anti-inflammatory and analgesic action. Due to its indiscriminate use, this pharmaceutical becomes a significant pollutant that needs monitoring. Studies indicate that diclofenac and its metabolites have already been found in different regions of the world, and even at low concentrations, it has been able to cause adverse effects on aquatic organisms, leading to infertility, increased mortality, sexual ambiguity, among other comorbidities (Hanif et al. 2020). Similarly, the occurrence of pharmaceuticals in nature, which has been increasing due to population growth, has also been reported to cause various comorbidities in the general population, affecting life expectancy, fertility, infant mortality, among others (Hejna et al. 2022). Therefore, environmental monitoring of this drug becomes extremely relevant.

[003] Among the available methods, voltammetric techniques stand out due to their operational simplicity and low cost. Regardless of the chosen technique, the result is expressed as a potential *versus* current curve. However, the choice of technique takes

into account several factors, depending on the objective to be achieved and the experimental conditions. For this purpose, it becomes necessary to optimize various parameters related to the technique, such as deposition requirements, scan rate, analyte concentration, resolution of voltammetric peaks, among others.

[004] The identification of the analyte, and consequently the ability to measure it, occurs through its interaction with the electrode surface, which in this case is modified by the deposition of a film containing *biochar* derived from rice husk. *Biochar* is an adsorbent material made from a renewable source. It is characterized as a charcoal obtained through the pyrolysis reaction under different time and temperature conditions (Almeida et al. 2020). Depending on the raw material source used and the different process conditions, a final product is obtained with varying characteristics that will influence a lower or higher degree of interaction between this compound and the analyte to be measured on the electrode surface.

[005] Among the available raw material options for obtaining *biochar*, rice husk stands out as an agro-industrial residue with a high production rate. Therefore, given this high availability, it becomes essential to pursue ecological environmental strategies, as well as the study and development of new technologies aimed at a greater utilization of this abundant biomass.

[006] The present patent application proposes the development of a new electroanalytical sensor, based on the modification of the surface of a glassy carbon electrode using *biochar* derived from rice husk for the determination of diclofenac. To highlight the novelty of this invention, a prior art search was conducted in various patent databases (both national and international). Thus, the searches were conducted at the National Institute of Industrial Property (INPI), *Canadian Intellectual Property Office* (CIPO), *United States Patent* and *Trademark Office* (USPTO), ESPACENET, LATIPAT, PATENTSCOPE, and GOOGLE PATENTS. For this purpose, the keywords used were: "*biochar*" or "*charcoal*," "*sensor*" or "*electrode*," and "*rice*".

[007] In the consulted databases, no references were found regarding the production/application of rice husk biochar for the chemical modification of a glassy carbon electrode and its use in the determination of diclofenac. The document

BR102023015006A2 was the only one to describe the development of an electrochemical sensor using rice husk *biochar*. However, a carbon paste electrode was used instead of glassy carbon for its modification, and differential pulse voltammetry was employed instead of square wave voltammetry, resulting in a completely different optimization of the technique's parameters compared to the present invention, as well as the use of a different electrolyte. Finally, the cited document describes the development and optimization of the sensor for the determination of tartrazine, unlike the present invention, which optimized all sensor parameters for the determination of diclofenac.

[008] The document CN000111122676A describes the development of an electrochemical sensor using wheat flour *biochar*, which requires activation with KOH and calcination for its application. Furthermore, the document also reports the need to incorporate a platinum-gold nanometallic alloy into the *biochar* to modify a carbon paste electrode for the subsequent determination of quercetin in ginkgo leaves. This differs from the present invention, which aims to modify a different type of electrode using another raw material (rice husk) for the determination of a different analyte (diclofenac).

[009] The document CN000114577872A describes the process of modifying an electrode using *biochar* made from bagasse as the raw material, which needs to be ground in a ball mill and dissolved in deionized water for its application. Subsequently, the document also mentions the need to apply L-cysteine for using the sensor in the determination of metals, unlike the present invention, which used rice husk as the raw material for the *biochar* and optimized all technique parameters for the determination of diclofenac.

[0010] The document CN109187693B describes the process of modifying the surface of a glassy carbon electrode through a combination of components, among which stand out *carbon black*, ferrocene, rice, and specific aptamers for the detection of the analyte vanillin. Additionally, the method also describes immersing this surface in chloroauric acid and subsequently depositing gold nanoparticles for detecting the analyte in question using the cyclic voltammetry technique. This document differs from the present invention, which uses only rice husk as the source of raw material and processes this residue for

application in the form of *biochar*, without requiring the combination of all the other constituents mentioned in the above document. Furthermore, the technique used for process optimization in the present invention was square-wave voltammetry instead of cyclic voltammetry, aiming at the determination of diclofenac, unlike the analyte addressed in the document.

[0011] The document CN000111141798A reports the development of an electrochemical sensor for the detection of baicalein. For this purpose, *biochar* derived from Musa basjoo-based biomass was used, which still required an alkaline activation process and had to be mixed with multi-walled carbon nanotubes. Subsequently, this *biochar* was used to modify the surface of a glassy carbon electrode, and cyclic voltammetry was applied for the determination of the analyte in question. However, in the present invention, a different raw material (rice husk) was used to obtain the *biochar*, without the need for an alkaline activation process or the incorporation of carbon nanotubes. Furthermore, the voltammetric technique used also differs from the present invention, which employed square wave voltammetry aimed at determining a different analyte (diclofenac).

[0012] The document CN117191895A reports a method for detecting polybrominated diphenyl ether in an aqueous solution using an electrochemical sensor modified with *biochar*. The cited document, in addition to having a different application from the present invention, also does not describe the raw material used in the production of the *biochar*.

[0013] The document CN112345611B describes a method for preparing an electrochemical sensor using a composite made from *biochar* derived from loofah sponge, undergoing carbonization and activation with potassium hydroxide, and carbon/poly(3,4-ethylenedioxythiophene)-gold. The document in question claims the method for preparing the composite and its application in an electrochemical sensor, without specifying its particular use. The present invention differs from the cited document by using *biochar* derived from rice husk to modify a glassy carbon electrode, optimizing all parameters related to the square wave voltammetry technique for the determination of diclofenac.

[0014] The document CN116519763A describes the modification of an electrode surface using *biochar* and silver/phosphorene nanoparticles for the detection of baicalein. The

document in question differs from the present invention by using a different raw material to obtain the *biochar*, without the need for applying various nanoparticles, and by targeting a different analyte.

[0015] The document CN113311043A describes the preparation process for an electrochemical sensor used for the detection of Hg^{2+} and Pb^{2+} ions, unlike the present invention, which targets the determination of diclofenac. Furthermore, the process involves the modification of the surface of a glassy carbon electrode through the application of *biochar* and metal-organic structures (also known as MOFs, Metal Organic Frameworks), without specifying the raw material used for the production of the *biochar*. This document differs from the present invention, which aims to use rice husk for the production of *biochar*, without requiring the insertion of metal-organic structures, for the determination of diclofenac instead of the ions mentioned in the cited document.

[0016] The document CN116448745A reports the development of a multichannel colorimetric sensor, using *biochar* derived from seaweed for the differentiation and recognition of various pesticides. This patent differs from the present invention by using a different raw material for the preparation of the *biochar*, employing a colorimetric method instead of a voltammetric one, and targeting a different type of analyte.

[0017] Considering the search conducted across different patent databases, no inventions were found that use rice husk biochar for the production of a chemically modified voltammetric sensor applied to the determination of diclofenac, as proposed in the present patent application. This highlights the significance of the invention and the importance of its filing at both national and international levels.

Description of the Images

[0018] The following images illustrate the process of obtaining and applying the chemically modified sensor with rice husk *biochar* proposed in the present patent application.

Image 1 - Representative scheme of the development of the chemically modified voltammetric sensor with rice husk *biochar* for the determination of diclofenac.

“A” represents the film-forming solution composed of rice husk *biochar* (1 mg mL^{-1}) obtained under different time conditions (60 and 120 minutes) and temperatures (400 and 700 °C), graphite powder (1 mg mL^{-1}), and alginate (1 mg mL^{-1}), using ultrapure water as the solvent. “B” represents the deposition of 6 µL of this solution onto the surface of a glassy carbon electrode, allowing 12 hours for complete solvent evaporation. “C” represents the application of this chemically modified electrode in conjunction with a reference electrode (Ag/AgCl (KCl 3 mol L^{-1})) and an auxiliary electrode (platinum) for the determination of diclofenac.

Image 2 - Comparative graph of current responses for 1 mg L^{-1} diclofenac using rice husk *biochars* obtained under different parameters. The Control group represents the response obtained using the dispersion containing only graphite powder (1 mg mL^{-1}), alginate (1 mg mL^{-1}), and ultrapure water as the solvent. The other groups used the same constituents at the same concentrations, supplemented with *biochars* obtained at 400 °C for 60 minutes (1 mg mL^{-1} *Biochar*-1), 400 °C for 120 minutes (1 mg mL^{-1} *Biochar*-2), 700 °C for 60 minutes (1 mg mL^{-1} *Biochar*-3), and 700 °C for 120 minutes (1 mg mL^{-1} *Biochar*-4).

Image 3 - Analytical curve for the determination of diclofenac obtained from the currents generated by different concentrations of the analyte using the square-wave voltammetry technique.

Description of the Invention

[0019] The present patent application covers the production of *biochar* from the agro-industrial waste of rice husk, through a process known as pyrolysis, and its application in the chemical modification of the surface of a glassy carbon electrode for the voltammetric determination of diclofenac.

[0020] The selected agro-industrial waste was rice husk due to the worldwide consumption of this food. However, this high consumption results in the generation of a large amount of waste, in this case, rice husk, which can be applied on a large scale due to the volume produced globally. The proper utilization of this waste aims to add value to

the final product, as well as provide an environmentally responsible destination for this industrial residue. In addition to the carbon source, the conditions applied during pyrolysis, such as temperature, heating rate, and duration, will result in distinct properties of the final product (Tomczyk et al. 2020). Thus, various combinations of these parameters are possible to obtain a product that meets the desired requirements, depending on its intended application.

[0021] As a platform, a glassy carbon electrode was used, and the chemical modification was carried out on its surface, which is responsible for measuring the current. To perform the modification, a solution was prepared consisting of *biochar* obtained from rice husk (for its interaction with the analyte), graphite powder (for its conductivity), alginate (for its film-forming ability), and ultrapure water as the solvent. The modification process was carried out using the "*drop casting*" technique, which involved depositing 6 µL of the solution onto the electrode surface and waiting 12 hours for the complete evaporation of the solvent.

[0022] The characterization of the developed electrochemical sensor can be carried out using various voltammetric techniques, producing as a response graph of current as a function of potential. The selection of the most appropriate technique depends on both the desired objectives and the experimental conditions. Among them, the most notable techniques are cyclic voltammetry, differential pulse voltammetry, square-wave voltammetry, among others (Nguyen et al. 2023). For this invention, the square-wave voltammetry method was used, optimizing all its parameters according to the analyte in question, namely: deposition time and potential, frequency, amplitude, and E_{step}.

[0023] In this approach, three electrodes were used: a reference electrode (Ag/AgCl (KCl 3 mol L^{-1})), an auxiliary electrode (platinum), and a working electrode, which is the glassy carbon electrode with its surface modified by the incorporation of *biochar* derived from rice husk. The system operates in an aqueous medium, and the working cell needs to be filled with the ideal electrolyte to allow for greater current flow. Among the tested options, the one that showed the highest current response for the studied analyte was phosphate buffer at a concentration of 0.05 mol L^{-1} and pH 5.0. It is important to highlight that the

instrumentation possibilities for both these electrodes and the system are not limited to those presented in the embodiment example of the present invention, allowing for the incorporation of other components.

[0024] Thus, the present invention application proposes a method for the development and application of an electroanalytical sensor modified with *biochar* made from rice husk. The relevance of the topic is highlighted, as well as the use of abundant agro-industrial residues in the development of higher-value products and their application in the monitoring of diclofenac. Furthermore, complementary studies may indicate different aspects and parameters to be employed in the developed electroanalytical sensor, aiming at its application for the determination of other analytes of interest.

Example of embodiment of the invention

[0025] The present invention proposes the production of *biochar* from the agro-industrial residue of rice husk and its application in the chemical modification of the surface of a glassy carbon electrode for the voltammetric determination of diclofenac.

[0026] For the preparation of the *biochar*, 20 g of rice husk (previously ground and sieved with 425 and 250 µm sieves) was used with a heating rate of 25 °C min^{-1}. Pyrolysis conditions of 400 and 700 °C were tested, with durations ranging from 60 to 120 minutes. For the determination of diclofenac, this study showed that the harsher conditions, using 700 °C and 120 minutes, resulted in higher electric current responses for the analyte in question.

[0027] The modification of the glassy carbon electrode surface consisted of depositing 6 µL of a solution containing the produced *biochar* (1 mg mL^{-1}), graphite powder (1 mg mL^{-1}), and alginate (1 mg mL^{-1}), using ultrapure water as the solvent. After depositing the solution, the solvent was allowed to evaporate for 12 hours.

[0028] For the determination of diclofenac, the square wave voltammetry technique was used with the following parameters: $E_{initial}$: 0.6 V; E_{final}: 1.1 V; E_{step}: 0.01 V; $E_{deposition}$: 0.65 V; Amplitude: 0.04 V; Frequency: 90 Hz and Deposition time: 40 s. For this, an Ag/AgCl (KCl 3 mol L^{-1}) reference electrode, a platinum wire as counter electrode,

and 40 mL of 0.05 mol L^{-1} phosphate buffer (pH 5.0) were used, with measurements performed in triplicate.

[0029] The performance of the sensor was evaluated based on electroanalytical measurements obtained using different diclofenac concentrations, ranging from 0.25 to 1.25 mg L^{-1}, to generate the analytical curve. The calibration equation showed a linear relationship between the generated current and the analyte concentration, with a correlation coefficient (R^2) of 0.99, represented by the line corresponding to the equation $y = 3.78\times10^{-7}X + 5.21\times10^{-9}$. The detection and quantification limits for the instrument were calculated as 5.79 and 17.6 µg L^{-1}, respectively.

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CLAIMS

1. PROCESS FOR OBTAINING A CHEMICALLY MODIFIED SENSOR WITH RICE HUSK BIOCHAR FOR VOLTAMMETRIC DETERMINATION OF DICLOFENAC, characterized by a process for obtaining a new device through the following steps:

(a) Obtaining biochar through pyrolysis of rice husk;

(b) Preparing a solution by combining graphite powder, biochar, alginate, and ultrapure water as solvent;

(c) Modifying a glassy carbon electrode with the film-forming solution;

(d) Using a voltammetric cell containing the glassy carbon electrode modified with rice husk biochar as the working electrode, Ag/AgCl in 3.0 mol L^{-1} KCl as the reference electrode, and a platinum wire as the counter electrode;

(e) Employing square-wave voltammetry for the determination of the analyte.

2. PROCESS FOR OBTAINING A CHEMICALLY MODIFIED SENSOR, according to claim 1, characterized by obtaining biochar from the pyrolysis of rice husk under different time (60 and 120 minutes) and temperature (400 and 700 °C) conditions.

3. PROCESS FOR OBTAINING A CHEMICALLY MODIFIED SENSOR, according to claim 1, characterized by the preparation of a film-forming solution composed of alginate, rice husk *biochar*, and graphite powder in equal proportions, as well as the use of ultrapure water as a solvent.

4. PROCESS FOR OBTAINING A CHEMICALLY MODIFIED SENSOR, according to claim 1, characterized by the modification of the electrode through the immobilization of 6 µL of the film-forming solution on the surface of the glassy carbon electrode via *drop casting*, followed by solvent evaporation for at least 12 hours.

5. PROCESS FOR OBTAINING A CHEMICALLY MODIFIED SENSOR, according to claim 1, characterized by using diclofenac as the analyte;

6. PROCESS FOR OBTAINING A CHEMICALLY MODIFIED SENSOR, according to claim 1, characterized by using an initial potential of 0.6 V, a final potential of 1.1 V, a step potential of 0.01 V; a deposition potential of 0.65 V, an amplitude of 0.04 V, a frequency of 90 Hz, and a deposition time of 40 s.

Drawings

Image 1.

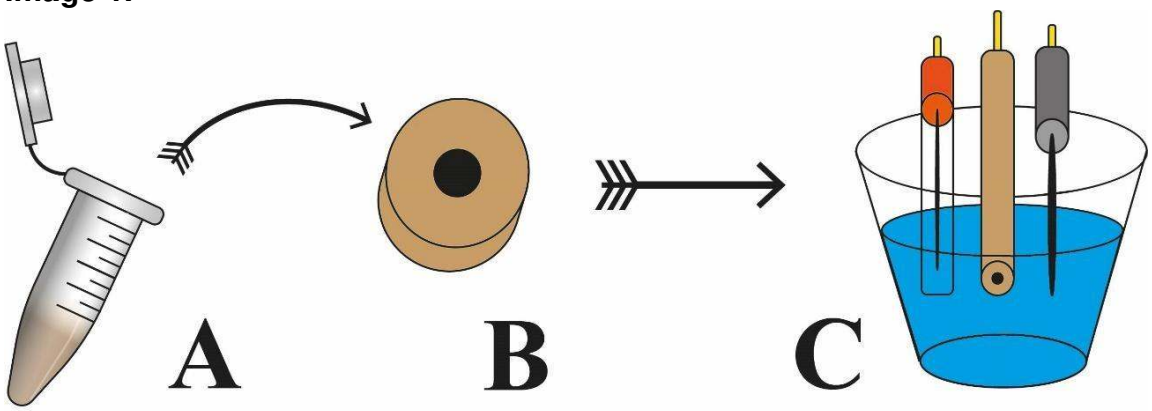


Image 2.

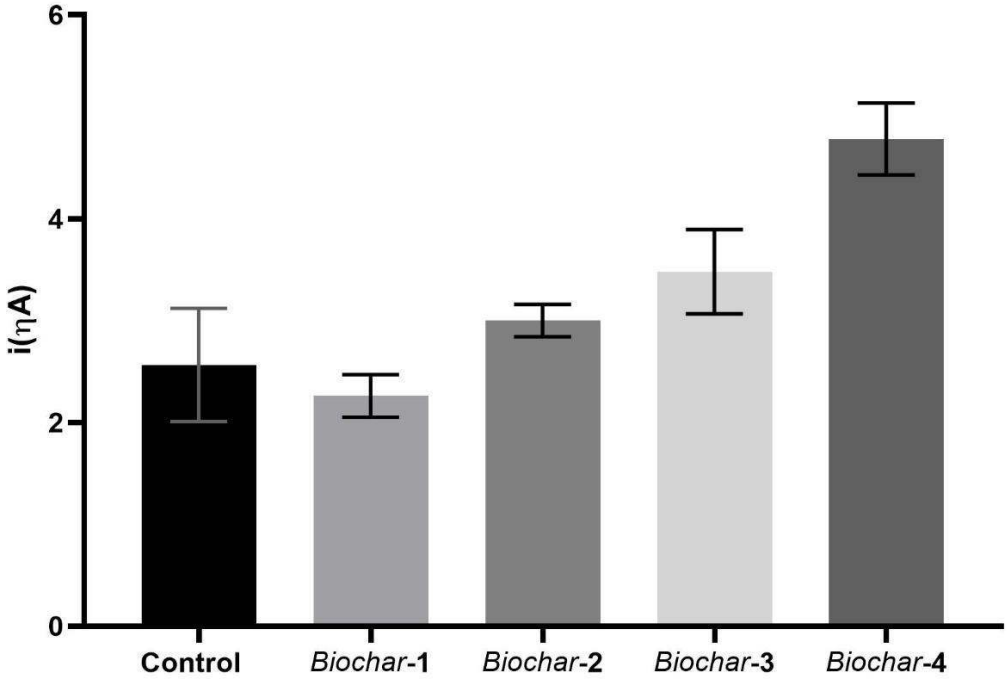
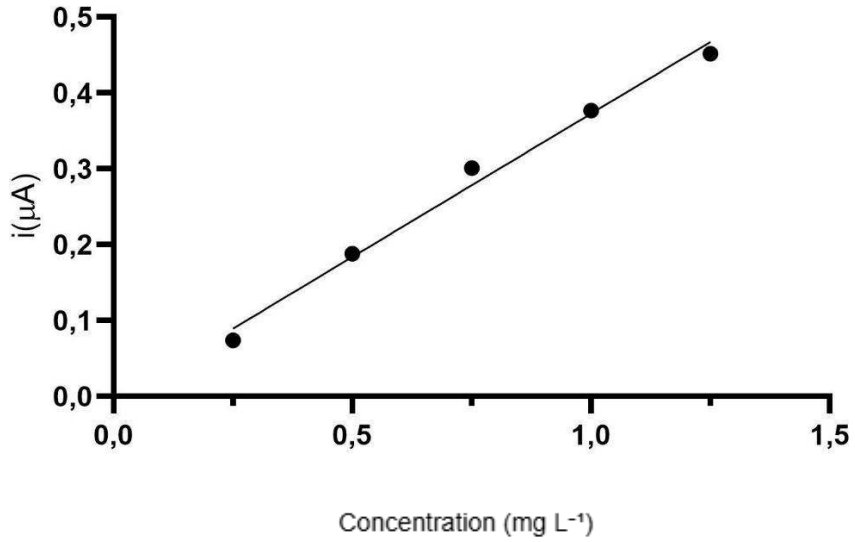


Image 3.



ABSTRACT

PROCESS FOR OBTAINING A VOLTAMMETRIC SENSOR CHEMICALLY MODIFIED WITH RICE HUSK BIOCHAR FOR DICLOFENAC DETERMINATION

The present patent application aims at the development of a new electroanalytical sensor, based on the use of a glassy carbon electrode modified with a *biochar* film obtained from the pyrolysis of rice husk for the determination of diclofenac. The proposed method stands out for its environmental importance, aiming to comply with the principles of green analytical chemistry, enabling the addition of technological value to rice husk, an agricultural residue that requires alternatives for its disposal. For the development of the film to be applied, the pyrolysis conditions of the rice husk, such as time and temperature, were optimized. For the development of the sensor, the parameters related to the square wave voltammetry method were optimized, such as deposition time and potential, frequency, amplitude, and E_{step}. Similarly, the conditions of the working cell were optimized using different buffers and their respective concentrations and pH levels. In this context, this invention proves to be promising for industrial application, as well as having innovative potential in electroanalytical studies, encouraging its use for the determination of other types of analytes in different types of samples. Furthermore, the developed electroanalytical sensor features ease of fabrication and handling, as well as low cost.

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.


_____ Date: October 27, 2025.

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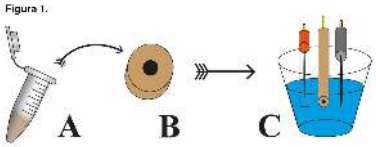
(57) Resumo: PROCESSO PARA OBTENÇÃO DE SENSOR VOLTAMÉTRICO QUIMICAMENTE MODIFICADO COM BIOCHAR DE CASCA DE ARROZ PARA DETERMINAÇÃO DE DICLOFENACO. O presente pedido de patente de invenção visa o desenvolvimento de um novo sensor eletroanalítico, baseado na utilização de eletrodo de carbono vítreo modificado com filme de biochar resultante da pirólise de casca de arroz para determinação de diclofenaco. O método proposto se destaca pela sua importância ambiental, visando atender aos princípios da química analítica verde, possibilitando agregar valor tecnológico à casa de arroz, um resíduo agrícola com necessidade de alternativas para seu destino. Para o desenvolvimento do filme a ser aplicado, foram otimizadas as condições de pirólise referentes à casca de arroz, como o tempo e temperatura. Para o desenvolvimento do sensor foram otimizados os parâmetros referentes ao método de voltametria de onda quadrada, como o tempo e potencial de deposição, frequência, amplitude e Estep. Da mesma forma, foram otimizadas as condições da célula de trabalho frente a diferentes tampões e suas respectivas concentrações e níveis de pH. Nesse contexto, esta invenção apresenta-se promissora para sua aplicação industrial, assim como potencial de inovação em estudos eletroanalíticos, motivando seu uso para determinação de outros tipos de (...).

Figura 1.



PROCESSO PARA OBTENÇÃO DE SENSOR VOLTAMÉTRICO QUIMICAMENTE MODIFICADO COM BIOCHAR DE CASCA DE ARROZ PARA DETERMINAÇÃO DE DICLOFENACO

Campo da invenção

[001] A presente invenção refere-se ao setor de química eletroanalítica, com possibilidade de aplicação industrial, assim como potencial de inovação em estudos eletroanalíticos, motivando seu uso para determinação de outros tipos de analitos em diferentes tipos de amostras. A inovação dessa invenção refere-se ao processo de modificação da superfície um eletrodo de carbono vítreo utilizando uma solução formadora de filme contendo *biochar* de casca de arroz para a determinação de diclofenaco a partir da técnica de voltametria de onda quadrada, aumentando assim os níveis de detecção e sensibilidade desse processo para o analito em questão. Dessa forma, a presente invenção também apresenta um destino para a casca de arroz, a qual consiste em um importante resíduo agroindustrial.

Fundamentos da invenção

[002] O diclofenaco é um importante medicamento com ação anti-inflamatória e analgésica. Devido ao seu uso indiscriminado, esse fármaco acaba se tornando um importante poluente a ser monitorado. Estudos indicam que o diclofenaco e seus metabólitos já foram encontrados em regiões distintas do mundo, e mesmo em pequenas concentrações foi capaz de causar efeitos adversos nos organismos aquáticos presentes, acarretando infertilidade, aumento da mortalidade, indefinição sexual, entre outras comorbidades (Hanif et al. 2020). Do mesmo modo, a ocorrência de fármacos na natureza, que vêm aumentando devido ao aumento populacional, também já foi descrita por causar diversas comorbidades na população em geral, afetando expectativa de vida, fecundidade, mortalidade infantil, entre outros (Hejna et al. 2022). Dessa forma, torna-se de extrema relevância o monitoramento ambiental desse fármaco.

[003] Dentre os métodos disponíveis, os voltamétricos se destacam devido a sua simplicidade de operação e baixo custo . Independente da técnica escolhida, o resultado é expresso em curva de potencial *versus* corrente. Entretanto, a escolha da

técnica leva em consideração diversos fatores, dependendo do objetivo a ser alcançado e das condições experimentais. Para tal, torna-se necessária a otimização de diversos parâmetros referentes à técnica, como necessidade de deposição, velocidade de varredura, concentração do analito, resolução dos picos voltamétricos, entre outros.

[004] A identificação do analito, e por consequência a capacidade de mensurá-lo, ocorre a partir da sua interação com a superfície do eletrodo, que nesse caso está modificada pela deposição do filme contendo *biochar* proveniente da casca de arroz. O *biochar* é um material adsorvente confeccionado a partir de uma fonte renovável. Ele é caracterizado como um carvão vegetal obtido através da reação de pirólise em diferentes condições de tempo e temperatura (Almeida et al. 2020). Dependendo da fonte de matéria-prima utilizada e das diferentes condições de processo, se obtêm um produto final com diferentes características que irão influir em um menor ou maior grau de interação entre esse composto e o analito a ser mensurado, na superfície do eletrodo.

[005] Dentre as opções disponíveis de matéria-prima para a obtenção do *biochar*, a casa de arroz se destaca por ser um resíduo agroindustrial com alta taxa de produção. Logo, frente a essa alta demanda, torna-se imprescindível a busca por estratégias ambientais ecológicas, assim como o estudo/desenvolvimento de novas tecnologias visando um maior aproveitamento dessa biomassa abundante.

[006] O presente pedido de patente propõe o desenvolvimento de um novo sensor eletroanalítico, a partir da modificação da superfície de um eletrodo de carbono vítreo utilizando *biochar* proveniente de casca de arroz para a determinação de diclofenaco. Visando expor o ineditismo da presente invenção, uma busca de antecedentes foi realizada em diferentes bases de patentes (nacionais e internacionais). Desse modo, as pesquisas foram realizadas no Instituto Nacional de Propriedade Intelectual (INPI), *Canadian Intelectual Property Office* (CIPO), *United States Patent and Trademark Office* (USPTO), ESPACENET, LATIPAT, PATENTSCOPE e GOOGLE PATENTS. Para tal, foram utilizadas as palavras-chave: "*biochar*" ou "*charcoal*", "*sensor*" ou "*electrode*" e "*rice"*.

[007] Nas bases de dados consultadas não foram encontradas referências sobre a obtenção/aplicação de *biochar* de casca de arroz para a modificação química de um eletrodo de carbono vítreo e sua aplicação na determinação de diclofenaco. O

documento BR102023015006A2 foi o único a descrever o desenvolvimento de um sensor eletroquímico utilizando *biochar* de casca de arroz. Entretanto, foi utilizado um eletrodo de pasta de carbono ao invés de carbono vítreo para a sua modificação, também foi utilizado a técnica de voltametria por pulso diferencial ao invés de onda quadrada, acarretando uma otimização dos parâmetros da técnica totalmente diferente da presente invenção, assim como a utilização de um eletrólito distinto. Por fim, o documento citado descreve o desenvolvimento e otimização do sensor para a determinação de tartrazina, diferente da presente invenção que otimizou todos os parâmetros do sensor para a determinação de diclofenaco.

[008] O documento CN000111122676A descreve o desenvolvimento de um sensor eletroquímico utilizando *biochar* de farinha de trigo, o qual necessita de ativação com KOH e ser calcinado para sua aplicação. Além disso, o documento ainda relata sobre a necessidade de inserção de uma liga nanometálica de platina e ouro no *biochar* para a modificação de um eletrodo de pasta de carbono para posteriormente determinação de quercetina em folha de gingko. Diferente da presente invenção que visa a modificação de um outro tipo de eletrodo, utilizando outra matéria-prima (casca de arroz), para a determinação de outro analito (diclofenaco).

[009] O documento CN000114577872A descreve o processo de modificação de um eletrodo a partir da aplicação de *biochar* utilizando bagaço como matéria-prima, que necessita ser moído em um moinho de bolas e dissolvido em água deionizada para a sua aplicação. Posteriormente, o documento ainda relata da necessidade de aplicação de L-cisteína para a utilização do sensor na determinação de metais, diferente da presente invenção que utilizou casca de arroz como fonte de matéria-prima do *biochar*, e otimizou todos os parâmetros da técnica para a determinação de diclofenaco.

[0010] O documento CN109187693B descreve o processo de modificação da superfície de um eletrodo de carbono vítreo através de uma combinação de componentes, dentre eles, destacam-se o *carbon black*, ferroceno, arroz e aptâmeros específicos para a detecção do analito vanilina. Além disso, o método ainda descreve a imersão dessa superfície em ácido cloroáurico e a posterior deposição de nanopartículas de ouro para a detecção do analito em questão através da técnica de voltametria cíclica. Esse documento difere da presente invenção que utiliza apenas a casca de arroz como fonte de matéria-prima e ainda faz o processamento desse resíduo para sua aplicação na

forma de *biochar*, não necessitando da combinação de todos os outros constituintes mencionados no documento acima. Além disso, a técnica utilizada para a otimização do processo na presente invenção foi de voltametria por onda quadrada ao invés de voltametria cíclica, visando a determinação de diclofenaco, diferente do analito exposto no documento.

[0011] O documento CN000111141798A relata o desenvolvimento de um sensor eletroquímico para a detecção de baicaleína. Para tal, foi utilizado *biochar* proveniente de biomassa à base de Musa basjoo, o qual ainda necessitou passar por um processo de ativação alcalina e ser misturado com nanotubos de carbono de paredes múltiplas. Posteriormente, esse *biochar* foi utilizado na modificação da superfície de um eletrodo de carbono vítreo e aplicada a técnica de voltametria cíclica para a determinação do analito em questão. Porém, na presente invenção utilizou-se de uma matéria-prima diferente (casca de arroz) para a obtenção do *biochar*, sem necessitar passar por um processo de ativação alcalina ou inserção de nanotubos de carbono. Além disso, a técnica voltamétrica utilizada também difere da presente invenção, que utilizou voltametria de onda quadrada visando também a determinação de outro analito (diclofenaco).

[0012] O documento CN117191895A relata um método para a detecção de éter difenil polibromado em solução aquosa através de um sensor eletroquímico modificado com *biochar*. O documento citado além de possuir uma aplicação distinta da presente invenção também não descreve a matéria-prima utilizada na fabricação do *biochar*.

[0013] O documento CN112345611B expõem o método de preparo de um sensor eletroquímico a partir da utilização de um compósito formado por *biochar* proveniente de esponja loofah, passando pelas etapas de carbonização e ativação com hidróxido de potássio, e carbono/poli 3, 4-etilenodioxitiofeno-ouro. O documento em questão reivindica o método de preparo do compósito em questão e sua aplicação em um sensor eletroquímico, sem especificar sua aplicação. A presente invenção difere-se do documento exposto por utilizar um *biochar* proveniente de casca de arroz na modificação de um eletrodo de carbono vítreo, otimizando todos os parâmetros referente a técnica de voltametria de onda quadrada para a determinação de diclofenaco.

[0014] O documento CN116519763A relata a modificação da superfície de um eletrodo utilizando *biochar* e nanopartículas de prata/fosforeno para a detecção de baicaleína. O

documento em questão difere-se da presente invenção pela utilização de outra matéria-prima na obtenção do *biochar*, sem necessidade de aplicação de diferentes nanopartículas, e por possuir um analito distinto.

[0015] O documento CN113311043A descreve o processo de preparo para um sensor eletroquímico utilizado na detecção de íons Hg^{2+} e Pb^{2+}, diferente da presente invenção que visa a determinação de diclofenaco. Além disso, o processo consiste na modificação da superfície de um eletrodo de carbono vítreo a partir da aplicação de *biochar* e estruturas metálicas orgânicas (também conhecidas como MOFs, do inglês Metal Organic Frameworks), sem especificar a matéria-prima utilizada na confecção do *biochar*. Esse documento difere da presente invenção que visa a utilização de casca de arroz para a confecção do *biochar*, sem necessitar da inserção de estruturas metálicas orgânicas, para a determinação de diclofenaco, ao invés dos íons citados pelo documento em questão.

[0016] O documento CN116448745A relata o desenvolvimento de um sensor colorimétrico multicanais, utilizando *biochar* proveniente de algas marinhas para a diferenciação e reconhecimento de diversos pesticidas. Esta patente difere-se da presente invenção pela utilização de uma matéria prima diferente para a confecção do *biochar*, a utilização de um método colorimétrico e não voltamétrico, assim como sua aplicação para outro tipo de analito.

[0017] Considerando a pesquisa realizada nas diferentes bases de patentes, não foram encontradas invenções que utilizem biochar de casca de arroz para obtenção de sensor voltamétrico quimicamente modificado aplicado à determinação diclofenado, como é proposto no presente pedido de patente. Isso mostra a relevância da invenção e a importância do seu pedido de depósito em nível nacional e internacional.

Descrição das figuras

[0018] A seguir, estão descritas as figuras que mostram o processo de obtenção e aplicação do sensor quimicamente modificado com *biochar* de casca de arroz proposto no presente pedido de patente.

Figure 1 - Esquema representativo do desenvolvimento do sensor voltamétrico quimicamente modificado com *biochar* de casca de arroz para determinação de

diclofenaco. “A” representa a solução formadora de filme composta pelo *biochar* de casca de arroz (1 mg mL^{-1}) obtido sob diferentes condições de tempo (60 e 120 minutos) e temperatura (400 e 700 °C), pó de grafite (1 mg mL^{-1}) e alginato (1 mg mL^{-1}), utilizando-se água ultrapura como solvente. “B” representa a deposição de 6 µL dessa solução sob a superfície de um eletrodo de carbono vítreo, aguardando-se 12 horas para a completa evaporação do solvente. “C” representa a aplicação desse eletrodo quimicamente modificado utilizando em conjunto um eletrodo de referência (Ag/AgCl (KCl 3 mol L^{-1})) e um eletrodo auxiliar (platina) para a determinação do diclofenaco.

Figura 2 - Gráfico comparativo das respostas de corrente para 1 mg L^{-1} de diclofenaco para *biochars* de casca de arroz obtidos utilizando diferentes parâmetros. O grupo Controle representa a resposta obtida utilizando a dispersão contendo apenas pó de grafite (1 mg mL^{-1}), alginato (1 mg mL^{-1}) e água ultra pura como solvente, os outros grupos utilizaram os mesmos constituintes nas mesmas concentrações acrescidos dos *biochars* obtido a 400 °C durante 60 minutos (1 mg mL^{-1} de *Biochar*-1), 400 °C durante 120 minutos (1 mg mL^{-1} de *Biochar*-2), 700 °C durante 60 minutos (1 mg mL^{-1} de *Biochar*-3) e 700 °C durante 120 minutos (1 mg mL^{-1} de *Biochar*-4).

Figura 3 - Curva analítica para a determinação de diclofenaco obtida a partir das correntes geradas pelas diferentes concentrações do analito na técnica de voltametria de onda quadrada.

Descrição da invenção

[0019] O presente pedido de patente de invenção abrange a obtenção do *biochar* a partir do resíduo agroindustrial de casca de arroz, através de um processo conhecido como pirólise, e sua aplicação na modificação química da superfície de um eletrodo de carbono vítreo para a determinação voltamétrica de diclofenaco.

[0020] O resíduo agroindustrial escolhido foi a casca de arroz devido ao consumo em escala mundial desse alimento. Entretanto, esse alto consumo tem por consequência a enorme geração de resíduo, nesse caso, a casca de arroz, a qual pode ser aplicada em larga escala devido ao volume gerado mundialmente. A correta aplicação desse resíduo

visa agregar valor ao produto final, além de dar um destino ecologicamente correto para esse resíduo industrial. Além da fonte de carbono, as condições aplicadas à pirólise, como temperatura, taxa e tempo de aquecimento acarretarão propriedades distintas do produto final (Tomczyk et al. 2020). Dessa maneira, diversas combinações desses parâmetros são possíveis para a obtenção de um produto que atenda às necessidades desejadas, dependendo de sua aplicação.

[0021] Como plataforma foi utilizado um eletrodo de carbono vítreo e a modificação química foi realizada sob a sua superfície, a qual realiza as medições de corrente. Para realizar a modificação utilizou-se uma solução composta por *biochar* obtido a partir da casca de arroz (devido a sua interação com o analito), pó de grafite (devido a sua condutividade), alginato (pela sua capacidade formadora de filme) e água ultra pura como solvente. O processo de modificação foi realizado pela técnica de *"drop casting"* que consistiu na deposição de 6 µL da solução sob a superfície do eletrodo e aguardou-se 12 h para a completa evaporação do solvente.

[0022] A caracterização do sensor eletroquímico desenvolvido pode ocorrer através de diversas técnicas voltamétricas, obtendo-se como resposta gráficos de corrente em função do potencial. A seleção da técnica mais apropriada depende tanto dos objetivos desejados quanto das condições experimentais. Dentre elas, destacam-se as técnicas de voltametria cíclica, de pulso diferencial, de onda quadrada, entre outras (Nguyen et al. 2023). Para esta invenção utilizou-se o método de voltametria de onda quadrada, otimizando todos os seus parâmetros em função do analito em questão, sendo eles: tempo e potencial de deposição, frequência, amplitude e E_{step}.

[0023] Nesta abordagem utilizou-se três eletrodos. Um eletrodo de referência (Ag/AgCl (KCl 3 mol L^{-1})), um eletrodo auxiliar (platina) e um eletrodo de trabalho que é o eletrodo de carbono vítreo com sua superfície modificada pela inserção do *biochar* oriundo da casca de arroz. O sistema opera em meio aquoso e a célula de trabalho necessita ser preenchida com o eletrólito ideal para permitir uma maior passagem de corrente. Dentre as opções testadas, o que apresentou uma maior corrente de resposta frente ao analito estudado foi o tampão fosfato na concentração de 0,05 mol L^{-1} e pH 5,0. É importante destacar que as possibilidades de instrumentação tanto desses eletrodos como do

sistema não se restringem às apresentadas no exemplo de concretização da presente invenção, permitindo a incorporação de outros componentes.

[0024] Desse modo, o presente pedido de invenção propõe um método para o desenvolvimento e aplicação de um sensor eletroanalítico modificado com *biochar* confeccionado a partir da casca de arroz. Destaca-se a relevância do tema, a aplicação de resíduos agroindustriais abundantes no desenvolvimento de produtos de maior valor agregado e a sua aplicação no monitoramento de diclofenaco. Além disso, estudos complementares poderão indicar diferentes aspectos a parâmetros para serem empregados no sensor eletroanalítico desenvolvido visando sua aplicação na determinação de outros analitos de interesse.

Exemplo de concretização da invenção

[0025] A presente invenção propõe a obtenção do *biochar* a partir do resíduo agroindustrial de casca de arroz e sua aplicação na modificação química da superfície de um eletrodo de carbono vítreo para a determinação voltamétrica de diclofenaco.

[0026] Para a confecção do *biochar* utilizou-se 20 g de casca de arroz (previamente triturado e peneirado com peneiras de 425 e 250 mm) com taxa de aquecimento de 25 °C min^{-1}. Foram testadas condições de pirólise utilizando-se 400 e 700 °C de temperatura, com tempos que variaram de 60 a 120 minutos. Para a determinação de diclofenaco, esse estudo mostrou que as condições mais severas, utilizando 700 °C e 120 minutos acarretam em maiores resultados de corrente elétrica para o analito em questão.

[0027] A modificação da superfície do eletrodo de carbono vítreo consistiu na deposição de 6 µL de uma solução contenção o *biochar* produzido (1 mg mL^{-1}), pó de grafite (1 mg mL^{-1}) e alginato (1 mg mL^{-1}), utilizando-se água ultra pura como solvente. Após a deposição da solução aguardou-se a evaporação do solvente durante 12 h.

[0028] Para a determinação de diclofenaco utilizou-se a técnica de voltametria por onda quadrada, utilizando os seguintes parâmetros: $E_{inicial}$: 0,6 V; E_{final}: 1,1 V; E_{step}: 0,01 V; $E_{deposição}$: 0,65 V; amplitude: 0,04 V, frequência: 90 Hz e tempo de deposição: 40 s. Para tal, utilizou-se o eletrodo de referência Ag/AgCl (KCl 3 mol L^{-1}), fio de platina como contra

eletrodo e 40 mL de eletrólito tampão fosfato 0,05 mol L^{-1} (pH 5,0), com leituras realizadas em triplicata.

[0029] O desempenho do sensor foi avaliado a partir das medidas eletroanalíticas obtidas utilizando-se diferentes concentrações de diclofenaco, que variaram de 0,25 até 1,25 mg L^{-1} para a geração da curva analítica. A equação de calibração apresentou relação linear entre a corrente gerada e a concentração do analito, com coeficiente de correlação (R^2) de 0,99 expressa pela reta correspondente a equação $y = 3{,}78\times10^{-7}X + 5{,}21\times10^{-9}$. Os limites de detecção e quantificação para o instrumento foram calculados como 5,79 e 17,6 µg L^{-1}, respectivamente.

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REIVINDICAÇÕES

1. PROCESSO PARA OBTENÇÃO DE SENSOR QUIMICAMENTE MODIFICADO COM BIOCHAR DE CASCA DE ARROZ PARA DETERMINAÇÃO VOLTAMÉTRICA DE DICLOFENACO, caracterizado por um processo para obter um novo dispositivo a partir das seguintes etapas:

(a) Obtenção de biochar pela pirólise da casca de arroz;

(b) Preparo de uma solução pela combinação de pós de grafite, biochar, alginato e água ultrapura como solvente;

(c) Modificação de um eletrodo de carbono vítreo com solução formadora de filme;

(d) Uso de célula voltamétrica contendo eletrodo de carbono vítreo modificado com biochar de casca de arroz como eletrodo de trabalho, Ag/AgCl em KCl 3,0 mol L^{-1} como eletrodo de referência e fio de platina como eletrodo indicador;

(e) Uso da técnica de voltametria de onda quadrada para determinação do analito.

2. PROCESSO PARA OBTENÇÃO DE SENSOR QUIMICAMENTE MODIFICADO, de acordo com a reivindicação 1, caracterizado pela obtenção do *biochar* a partir da pirólise de casca de arroz em diferentes condições de tempo (60 e 120 minutos) e temperatura (400 e 700 °C).

3. PROCESSO PARA OBTENÇÃO DE SENSOR QUIMICAMENTE MODIFICADO, de acordo com a reivindicação 1, caracterizado pela obtenção de uma solução formadora de filme composto por alginato, *biochar* de casca de arroz e pó de grafite em proporções iguais, além do uso de água ultrapura como solvente.

4. PROCESSO PARA OBTENÇÃO DE SENSOR QUIMICAMENTE MODIFICADO, de acordo com a reivindicação 1, caracterizado pela modificação do eletrodo a partir da imobilização de 6 µL da solução formadora de filme na superfície do eletrodo de carbono vítreo via *drop casting*, seguido da evaporação do solvente por no mínimo 12 h.

5. PROCESSO PARA OBTENÇÃO DE SENSOR QUIMICAMENTE MODIFICADO, de acordo com a reivindicação 1, caracterizado por utilizar diclofenaco como analito;

6. PROCESSO PARA OBTENÇÃO DE SENSOR QUIMICAMENTE MODIFICADO, de acordo com a reivindicação 1, caracterizado por utilizar potencial inicial de 0,6 V, potencial final de 1,1 V, potencial step de 0,01 V; potencial de deposição de 0,65 V, amplitude de 0,04 V, frequência de 90 Hz e tempo de deposição de 40 s.

Desenhos

Figura 1.

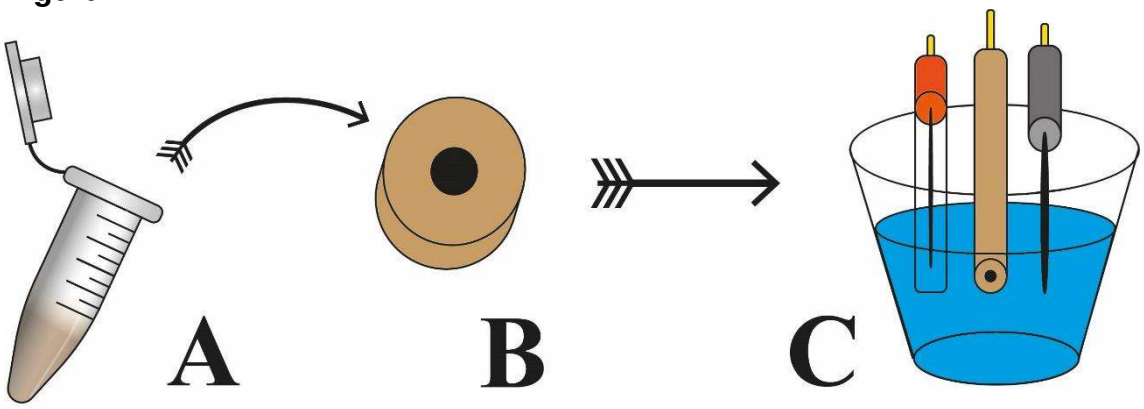


Figura 2.

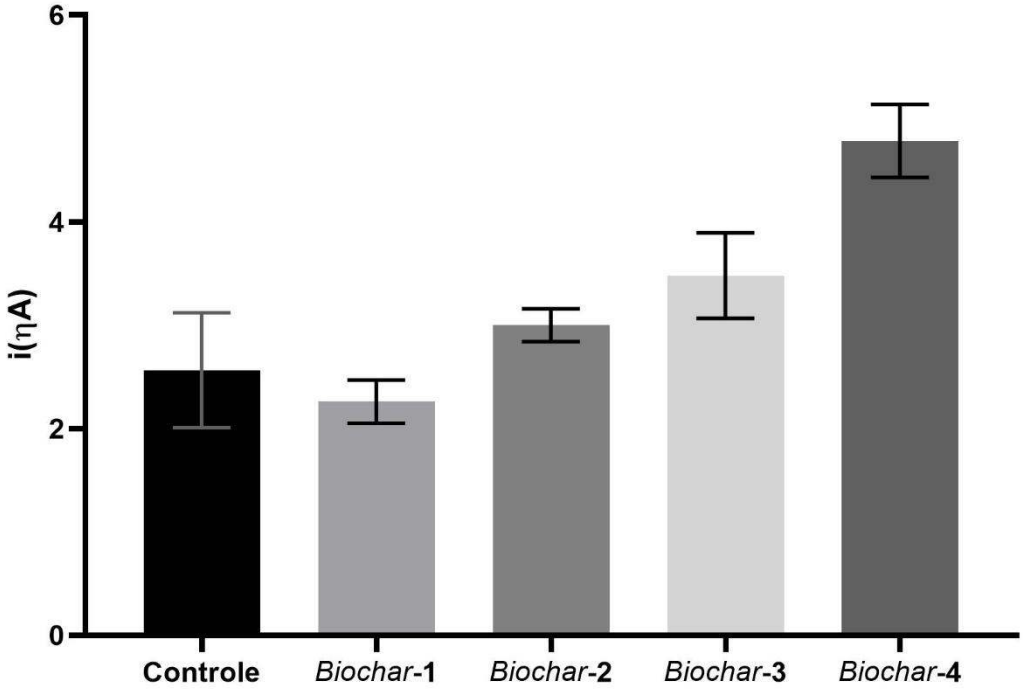
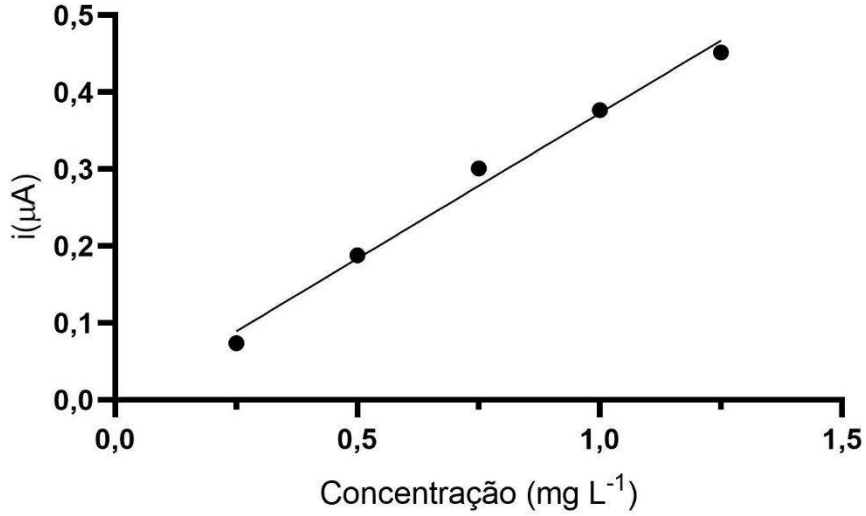


Figura 3.



RESUMO

PROCESSO PARA OBTENÇÃO DE SENSOR VOLTAMÉTRICO QUIMICAMENTE MODIFICADO COM BIOCHAR DE CASCA DE ARROZ PARA DETERMINAÇÃO DE DICLOFENACO

O presente pedido de patente de invenção visa o desenvolvimento de um novo sensor eletroanalítico, baseado na utilização de eletrodo de carbono vítreo modificado com filme de *biochar* resultante da pirólise de casca de arroz para determinação de diclofenaco. O método proposto se destaca pela sua importância ambiental, visando atender aos princípios da química analítica verde, possibilitando agregar valor tecnológico à casa de arroz, um resíduo agrícola com necessidade de alternativas para seu destino. Para o desenvolvimento do filme a ser aplicado, foram otimizadas as condições de pirólise referentes à casca de arroz, como o tempo e temperatura. Para o desenvolvimento do sensor foram otimizados os parâmetros referentes ao método de voltametria de onda quadrada, como o tempo e potencial de deposição, frequência, amplitude e E_{step}. Da mesma forma, foram otimizadas as condições da célula de trabalho frente a diferentes tampões e suas respectivas concentrações e níveis de pH. Nesse contexto, esta invenção apresenta-se promissora para sua aplicação industrial, assim como potencial de inovação em estudos eletroanalíticos, motivando seu uso para determinação de outros tipos de analitos em diferentes tipos de amostras. Além disso, o sensor eletroanalítico desenvolvido apresenta como características a sua simplicidade de obtenção e manuseio e baixo custo.

October, 28 of 2025

To whom it may concern,

My name is Guilherme Luiz Dotto, a Professor and senior researcher at the Federal University of Santa Maria (UFSM). I hold a Ph.D. in Chemical Engineering and have over 15 years of experience at the intersection of chemical engineering and environmental technologies, with recognized expertise in adsorption, catalysis, and advanced wastewater treatment. I have authored over 300 papers in high-impact journals and serve on the editorial boards of leading outlets (e.g., Case Studies in Chemical and Environmental Engineering; Chemical Engineering Journal Advances), with distinctions including Clarivate Highly Cited Researcher (Cross-Field) and Stanford/Elsevier Top 2% Scientist. My work advances scalable solutions for pollution mitigation and the valorization of industrial and agricultural residues within the circular economy.

In this context, I have had the opportunity to follow the scientific trajectory of Ms. Alice Neri da Silva Sousa, a researcher who stands out for her technical depth and ability to integrate different areas of knowledge. I became acquainted with her work through academic collaboration with her doctoral advisor, Professor Dr. Tito Cadaval Jr., with whom I have maintained a long-standing professional relationship. Since then, I have followed her research in technological and environmental chemistry, which has demonstrated both originality and practical relevance.

Ms. Sousa has a strong and interdisciplinary academic background. Initially trained in Forestry Engineering, she redirected her career toward Technological and Environmental Chemistry, focusing on the transformation of agricultural and forest residues into high-value products, such as adsorbent materials and renewable biofuels. This transition demonstrates intellectual versatility and a genuine commitment to developing solutions that contribute to environmental protection and the sustainable use of natural resources.

During her doctoral studies, she developed innovative procedures that integrate biomass pyrolysis with the design of functional materials aimed at contaminant removal and environmental monitoring. These studies have already resulted in technological advances currently protected by intellectual property, including the development of biochar-based voltammetric sensors for detecting pharmaceutical contaminants and porous chitosan sponges for cleaning oily wastewater. These achievements reflect technical maturity and a clear understanding of how fundamental chemistry can translate into tangible environmental benefits.

What distinguishes Ms. Sousa's work is her ability to connect fundamental scientific knowledge to real-world challenges. The materials and processes she has developed provide solutions for water purification, industrial waste treatment, and clean energy generation, which are central themes in current discussions on sustainability and the circular economy. Her contributions strengthen the field of green chemistry and demonstrate the potential of scalable technologies that help reduce environmental impacts while promoting more responsible production practices.

Ms. Sousa represents a new generation of researchers committed to scientific innovation and positive environmental impact. Her work combines independence, creativity, and purpose, contributing meaningfully to the advancement of sustainable chemical solutions that align technological progress with ecological balance.

Sincerely,

Guilherme Luiz Dotto
Full Professor, Federal University of Santa Maria (UFSM)
Ph.D. in Chemical Engineering
guilherme_dotto@yahoo.com.br

GUILHERME LUIZ DOTTO

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December 8, 2025

To USCIS,

My name is Rodrigo Alejandro Abarza Muñoz, and I serve as a Full Professor of Chemistry at the Federal University of Uberlândia in Brazil. I graduated in Chemistry from the University of São Paulo and obtained my Ph.D. in Analytical Chemistry from the same institution, including a doctoral internship at the University of Oxford. I completed postdoctoral research at Arizona State University in the United States and at the University of São Paulo. Over my career, I have authored more than 350 research papers, with an h-index of 55 in ISI Web of Science and 65 in Google Scholar, and approximately 15,000 citations. I have coordinated the Graduate Program in Chemistry at the Federal University of Uberlândia, served as Director and Treasurer of the Division of Electrochemistry and Electroanalysis of the Brazilian Chemical Society, been Associate Editor of the Journal of the Brazilian Chemical Society, and currently sit on the Advisory Editorial Board of Microchimica Acta. I am also an affiliate member of the Brazilian Academy of Sciences and a CNPq research fellow at the 1B level, and I have received awards such as the Jacob Palis Award and the Hans Viertler pAward for distinguished research.

I was invited to provide a technical evaluation of the work of Alice Neri da Silva Sousa as a professional at another institution that does not have a direct connection through published works, patents, or conference papers. I am not related to Ms. Sousa's patent, entitled "Process for Obtaining a Chemically Modified Voltammetric Sensor with Rice Husk Biochar for the Determination of Diclofenac," and my analysis is based exclusively on the technical content of this patent and on my experience in electroanalytical chemistry, electrochemical sensors, advanced materials, and related areas.

The patent BR 102024021199-5 A2, entitled "Process for Obtaining a Chemically Modified Voltammetric Sensor with Rice Husk Biochar for the Determination of Diclofenac", addresses a well-known limitation in electroanalytical chemistry, which is the branch of chemistry that uses electrical signals to measure chemical substances. In practical terms, there is a persistent difficulty in developing sensors that are at the same time low-cost, stable, environmentally sustainable, and capable of detecting pharmaceutical compounds such as diclofenac at very low concentrations. Traditional materials used to modify electrodes for this purpose are often expensive, generate significant chemical waste, or require many preparation steps, which limits their use in routine analytical laboratories.

To address this limitation, Ms. Sousa developed a process to obtain biochar from rice husk. This abundant agro-industrial residue usually has limited higher-value applications and can be used as a chemical modifier of glassy carbon electrodes, which are standard components in electrochemical sensors. In simple terms, she transforms an agricultural waste material into a functional material that improves the performance of the sensor. The patent documents how this biochar is produced by controlled pyrolysis and how it is incorporated into the electrode surface, creating a sensor with enhanced electrochemical behavior for the determination of diclofenac.

The technical effects documented for this sensor are directly relevant to specialists in electroanalytical chemistry, and they have clear practical implications for the field. Compared with unmodified glassy carbon electrodes, the electrode modified with rice husk biochar shows higher sensitivity, which means that smaller amounts of diclofenac can be detected more

clearly and reliably. It also presents improved signal stability, which means that the measurements remain consistent over the course of the analysis, and lower detection limits, which means that the sensor can measure diclofenac at concentrations that are relevant for environmental monitoring. Together, these characteristics facilitate the determination of diclofenac at environmentally relevant levels and support more trustworthy data in studies of contamination.

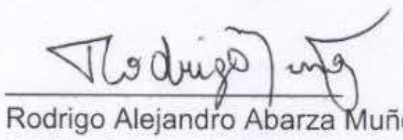
At the same time, the use of rice husk biochar reduces analytical costs by replacing conventional high-cost modifiers with a low-cost residue. The fabrication process is described as simple, does not require specialized equipment, and is aligned with the principles of green analytical chemistry, since it allows analyses with lower waste generation, shorter preparation time, and greater reproducibility. In practice, this combination of low cost, simplicity, and green chemistry is essential for electroanalytical chemistry because it makes the methodology more accessible to laboratories with limited resources, favors routine implementation, and responds to current demands for sustainable analytical procedures.

These combined characteristics, all described in the patent, address several key needs in our area: sensitivity at low concentrations, reliability of measurements over time, reduction of operational costs, and reduction of environmental impact associated with analytical work. From the perspective of a specialist, it is particularly relevant that Ms. Sousa's work connects the valorization of an agricultural residue with the development of an electrochemical sensor for a pharmaceutical contaminant such as diclofenac, creating a documented route for integrating waste materials into analytical technology in a way that is technically robust and aligned with contemporary trends in the field.

In my view, the original contribution registered through the patent BR 102024021199-5 A2 at the Brazilian National Institute of Industrial Property (INPI), together with the technical advances described above, provides clear evidence of Ms. Sousa's authorship of a scientifically and professionally relevant contribution of major impact to the electroanalytical chemistry field.

I fully support this petition and remain available to provide any further technical clarification that may be required.

Sincerely,



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DEQUI
DEPARTAMENTO DE ENGENHARIA QUÍMICA

Porto Alegre, Brazil.

To whom it may concern,

I am Professor Ligia Damasceno Ferreira Marczak, Full Professor in the Chemical Engineering Department at the Federal University of Rio Grande do Sul (UFRGS), where I have worked since 1989. I hold a Bachelor degree in Chemical Engineering from the Pontifical Catholic University of Rio Grande do Sul (PUCRS, 1984), a Master's and a Ph.D. in Mechanical Engineering from the Federal University of Santa Catarina (UFSC, 1987 and 1993).

Although I have not worked directly with Ms. Alice Neri da Silva Sousa, I have reviewed her CV carefully. My background and experience as a professor and researcher in Chemical Engineering provides a technical basis to evaluate her. She currently holds four co-authored patents, three of them from 2024: (1) a biochar-modified voltammetric sensor for detecting diclofenac in water; (2) a porous chitosan sponge for removing used lubricating oil from water; and (3) a third 2024 invention that remains under confidentiality. There is also a fourth patent, from 2025, that is under a confidentiality period. Because two of these patents have not yet been disclosed, I cannot comment on them; therefore, my assessment focuses on the two publicly described patents. These two outcomes demonstrate the conversion of low-value residues into higher-value materials, address challenges in environmental monitoring and remediation, and contribute to civic and industrial advancement while protecting the environment. Moreover, the set of four patent co-authorships indicates consistent, recent technological progress.

Moreover, Ms. Sousa has contributed to the publication of articles in peer-reviewed international journals and in conferences, as well as participating in graduate-level projects. Converting agro-industrial residues into higher-value

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products, engineering bio-derived sorbents, aligning with ongoing agendas in sustainability.

Ms. Sousa's profile and trajectory is marked by steady progress in graduate research wich indicates potential to contribute in competitive laboratories and innovation programs in the United States.

Respectfully,

Ligia Damasceno Ferreira Marczak
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Phone: +55 (51) 3308-2143 / 3308-2308

Porto Alegre, Brazil, November 14th, 2025.

Ligia Damasceno Ferreira Marczak

Scholarship Research Productivity holder CNPq - Level 1B

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Last updated: 28/07/2025

graduation at Engenharia Quimica from Pontifícia Universidade Católica do Rio Grande do Sul (1984), master's at Mechanical Engineering from Universidade Federal de Santa Catarina (1987) and doctorate at Mechanical Engineering from Universidade Federal de Santa Catarina (1993). Has experience in Chemical Engineering, acting on the following subjects: transferência de calor e massa, meios porosos, transferência de calor, secagem and aquecimento ôhmico. **(Text informed by the author)**

Personal Information

Name

Ligia Damasceno Ferreira Marczak

Bibliographic Citation

MARCZAK, L. D. F;Damasceno-Ferreira, L.S.;Ferreira, L.S.D.;MARCZAK, LIGIA DAMASCENO FERREIRA;Marczak, L.D.F.;Marczak, Lígia D.F.;Ferreira Marczak, Ligia Damasceno;MARCZAK, Lígia D. F.;Marczak, Lígia Damasceno Ferreira;MARCZAK, LIGIA D.F.;MARCZAK, L.D.F;DAMASCENO FERREIRA MARCZAK, LIGIA;Marzack, L. D.F.;MARZACK, L,D.F.;MARCZAK, LIGIA;FERREIRA MARCZAK, LIGIA DAMASCENO;Ferreira, Marczak Ligia Damasceno;marckzak, ligia damasceno ferreira;MARCZAK, LIGIA DAMASCENO FERREIRA

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Nationality

Brasil

Address

Professional Address

Universidade Federal do Rio Grande do Sul, Escola de Engenharia, Departamento de Engenharia Química.
Rua Ramiro Barcelos, 2777
Rio Branco
90035007 - Porto Alegre, RS - Brasil
Telephone: (51) 33084122
Homepage URL: http://www.enq.ufrgs.br

Formal Education/Degree

1987 - 1993

Ph.D. in Engenharia Mecânica.
Universidade Federal de Santa Catarina, UFSC, Brasil. , Year of degree: 1993.
Advisor: Alvaro Toubes Prata.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: meios porosos; secagem de solos; aterramento de cabos; transferência de calor e massa.
Major Area: Engineering
Activity sectors: Other sectors.

1985 - 1987

Master in Engenharia Mecânica.
Universidade Federal de Santa Catarina, UFSC, Brasil. Year of degree: 1987.
Advisor: Alvaro Toubes Prata.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: meios porosos; transfeência de calor e massa; migração de umidade.
Major Area: Engineering
Activity sectors: Other sectors.

1979 - 1984

Graduation in Engenharia Quimica.
Pontifícia Universidade Católica do Rio Grande do Sul, PUCRS, Brasil.

Postdoctorate

2009 - 2010

Postdoctorate.
The State University of New Jersey - New Brunswick, RUTGERS, Estados Unidos.
Major Area: Engineering
Major Area: Agrarian Sciences / Area: Science and Technology of the Food.

Professional Experience

Universidade Federal do Rio Grande do Sul, UFRGS, Brasil.

Contract

1989 - Present

Type of contract: Government Employee, Functional Placement: Titular Professor, Credit Hours: 40, Regime: Exclusive Dedication.

Activities

09/2021 - Atual

Manager and Administrative Positions, Escola de Engenharia.

Position or Function
Chefe do Departamento de Engenharia Química.

3/2002 - Atual

Research and Development, Escola de Engenharia, Departamento de Engenharia Química.

Research Fields
Estudo Teórico Experimental da Secagem de Soja Texturizada
Análise dos Processos de Secagem e Obtenção de Propriedades Térmicas e Difusivas de Produtos Alimentícios
Estudo Teórico e Experimental do Processo de Micro Filtração
Análise da Planta de Tratamento de Efluentes de uma Indústria Alimentícia

3/1995 - Atual

Teaching, Engenharia Química, Degree: Pos-Graduation

Disciplines Taught
Fenômenos de Transporte
Fenômenos de Transporte Computacional
Transferência de Calor e Massa em Meios Porosos
Fenômenos de Transporte Aplicado ao Processamento de Alimentos

8/1992 - Atual

Teaching, Engenharia Química, Degree: Graduation

Disciplines Taught
Fenômenos de Transporte Computacional
Fenômenos de Transporte II (Trans. de Calor)
Fenômenos de Transporte III (Transf. de Massa)
Introdução aos Fenômenos de Transporte
Introdução às Operações Unitárias
Laboratório de Fenômenos de Transporte
Transferência de Calor e Massa I
Transferência de Calor e Massa II
Tópicos Especiais em Processamento de Alimentos

8/1992 - Atual

Councils, Commissions and Consulting, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Membro de colegiado superior.

11/2017 - 01/2022

Manager and Administrative Positions, Escola de Engenharia.

Position or Function
Membro representante docente no Conselho da Escola de Engenharia.

07/2015 - 07/2017

Manager and Administrative Positions, Escola de Engenharia.

Position or Function
Head of Department.

01/2011 - 12/2012

Manager and Administrative Positions, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Coordenador de Programa de Pós Graduação.

6/2006 - 6/2008

Councils, Commissions and Consulting, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Membro do Conselho Universitário.

7/2003 - 7/2007

Manager and Administrative Positions, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Head of Department.

7/2003 - 7/2007

Councils, Commissions and Consulting, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Membro de conselho de unidade.

2/2003 - 1/2006

Research and Development, Escola de Engenharia, Departamento de Engenharia Química.

Research Fields
Estudo do Processo de Produção de Tofu

1/1999 - 12/2003

Councils, Commissions and Consulting, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Membro da Comissão de Graduação do Curso de Engenharia Química.

7/1999 - 6/2001

Councils, Commissions and Consulting, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Membro do Conselho da Escola de Engenharia.

6/1999 - 6/2001

Manager and Administrative Positions, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Head of Department.

3/1995 - 6/2000

Councils, Commissions and Consulting, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Membro da Comissão de Graduação do Curso de Engenharia de Alimentos.

3/1995 - 3/1999

Councils, Commissions and Consulting, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Membro da Com[illegible]o Coordenadora do Curso

de Pós-Graduação em Engenharia Química.

1/1995 - 6/1997

Manager and Administrative Positions, Escola de Engenharia, Departamento de Engenharia Química.

Position or Function
Course Co-ordinator.

Research line

1.

Estudo do Processo de Produção de Tofu

2.

Estudo Teórico Experimental da Secagem de Soja Texturizada

3.

Análise dos Processos de Secagem e Obtenção de Propriedades Térmicas e Difusivas de Produtos Alimentícios

4.

Estudo Teórico e Experimental do Processo de Micro Filtração

5.

Análise da Planta de Tratamento de Efluentes de uma Indústria Alimentícia

Research projects

2024 - Current

Desenvolvimento de um sistema para crescimento de microalgas assistido por campo elétrico moderado

Description: Microalgas são microrganismos que sintetizam produtos de interesse comercial, como pigmentos e lipídeos, que têm potencial aplicação nas indústrias de alimentos, farmacêutica e química. O crescimento de microalgas, contudo, é um processo que ainda possui custos elevados de produção, tornando-se pouco competitivo, se comparado a outras fontes desses produtos de interesse. Nesse sentido, estudos que objetivam aumentar a produtividade, tanto da biomassa, quanto dos compostos de interesse, vêm sendo explorados nos últimos anos. A tecnologia de campo elétrico moderado (MEF, do inglês moderate electric field) pode ser empregada durante o crescimento de microrganismos para induzir condições de estresse, estimulando a síntese de determinados compostos. A aplicação de MEF promove mudanças na estrutura celular, alterando rotas metabólicas de absorção de nutrientes e de síntese de compostos. No

entanto, é necessário avaliar a influência dos parâmetros de processo (intensidade, frequência e tempo de aplicação do MEF), uma vez que condições muito intensas podem levar à morte das células. No presente projeto está sendo proposto a aplicação da tecnologia de MEF durante o cultivo de microalgas para estimular a produção de biomassa, carotenoides e lipídeos. Os resultados obtidos com esse projeto irão contribuir para avanços no uso das tecnologias elétricas na área de biotecnologia..
Situation: In progress; Nature: Research.
Participant students: Graduation: (1) .

Members: Ligia Damasceno Ferreira Marczak - Coordinator / Débora Pez Jaeschke - Member / Suelen Suelen Goettems Kuntzler - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.

2021 - Current

Crescimento de microalgas assistido por campo elétrico moderado e ultrassom

Description: As microalgas sintetizam produtos de interesse comercial, como pigmentos, lipídeos, proteínas e carboidratos, que podem ser aplicados pela indústria de alimentos, farmacêutica e química. No entanto, os cultivos de microalgas ainda possuem custos elevados de produção, o que torna esses microrganismos pouco competitivos. Nesse sentido, estudos visando o aumento da produtividade, tanto de biomassa, quanto dos compostos sintetizados pelas microalgas vem sendo realizados. Nesse contexto, as tecnologias emergentes de ultrassom (US) e campo elétrico moderado (MEF, do inglês moderate electric field) podem ser empregadas durante o crescimento de microrganismos com o objetivo de induzir condições de estresse, promovendo a síntese de compostos de interesse. Acredita-se que essas tecnologias possam induzir mudanças na estrutura celular, podendo promover alterações nas rotas metabólitas de absorção de nutrientes. No entanto, é necessário entender os parâmetros de processo que devem ser utilizados para esse fim, uma vez que condições muito intensas podem levar à morte das células. Dessa forma, neste trabalho é proposta a aplicação das tecnologias de US e MEF durante o cultivo da microalga Chlorella zofingiensis para estimular a produção de carotenoides, lipídeos e de biomassa. Essa microalga foi escolhida porque sintetiza quantidades significativas de carotenoides secundários, como astaxantina, que possui alto valor agregado. Os resultados obtidos com esse projeto irão contribuir para o desenvolvimento de novas tecnologias, contribuindo para avanços no uso das tecnologias de ultrassom e elétricas para o estímulo ao crescimento de microrganismos e síntese de metabólitos..
Situation: In progress; Nature: Research.
Participant students: Academic master's degree: (1) Doctorate: (1) .

Members: Ligia Damasceno Ferreira Marczak - Coordinator / Júlia Ribeiro Sarkis - Member / Débora Pez Jaeschke - Member / Naira Poerner Rodrigues - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.

2018 - 2024

Aplicação de campo elétrico moderado na extração de compostos e no crescimento de microalgas

Description: Os métodos tradicionais de extração de compostos intracelulares a partir de microalgas são dispendiosos e têm se mostrado pouco eficientes. Desta forma, o desenvolvimento de métodos de extração com maior rendimento, com aumento da pureza dos extratos e com minimização da energia utilizada se torna essencial para viabilizar a produção em grande escala de produtos derivados das microalgas. Nesse contexto, as tecnologias emergentes podem ser empregadas na biotecnologia e no processamento de alimentos em diferentes operações unitárias tornando os processos mais eficientes e menos agressivos ao meio ambiente. Neste trabalho é proposta a utilização de campo elétrico moderado (MEF) como pré-tratamento para a extração de ficocianinas e proteínas da microalga Spirulina platensis. As ficocianinas são pigmentos azuis com capacidade antioxidante, com aplicação em alimentos e cosméticos, e as proteínas sintetizadas por microalgas possuem aplicação na indústria de alimentos, inclusive como fonte vegana desse composto. Devido aos efeitos não térmicos de eletroporação e permeabilização das células, o MEF pode ser também aplicado durante o crescimento de microrganismos com o objetivo de induzir condições de estresse, promovendo a síntese de compostos de interesse. Assim, este trabalho também tem como objetivo avaliar a aplicação da tecnologia de MEF durante o cultivo da microalga Haematococcus pluvialis para estimular a produção de astaxantina e de biomassa. Os resultados obtidos com esse projeto irão contribuir para o desenvolvimento de novas tecnologias de processamento, visando fornecer à indústria novas técnicas de extração de compostos intracelulares e contribuindo para avanços no uso de tecnologias elétricas para o estímulo ao crescimento de microrganismos e síntese de metabólitos..
Situation: Completed; Nature: Research.
Participant students: Graduation: (3) / Academic master's degree: (3) / Doctorate: (2) .

Members: Ligia Damasceno Ferreira Marczak - Coordinator / Débora Pez Jaeschke - Member / DOMENEGHINI MERCALI, GIOVANA - Member / Renata Nunes Pereira - Member.
Financier(s): Conselho Nacional de Desenvolvimento Científico e Tecnológico - Grant.

2017 - 2021

Avalição do uso da tecnologia de ultrassom no processamento de alimentos

Description: A tecnologia de alimentos encontra-se em constante desenvolvimento e aprimoramento a fim de melhorar a qualidade e a segurança dos produtos, preservar as características sensoriais e nutricionais dos alimentos, minimizar gastos energéticos e geração de resíduos que contribuam para problemas ambientais e reduzir custos de processo. Diante disso, destaca-se o ultrassom que é uma tecnologia emergente conhecida por

ser amiga do ambiente, devido a eficiência em tempos curtos de processo, por envolver menores gasto de água e energia e, também, devido à baixa geração de efluentes e produtos tóxicos, quando comparadas com os métodos convencionais de processamento de alimentos. O presente projeto tem como objetivo utilizar a tecnologia de ultrassom para o processo de amaciamento da carne. A carne é um alimento altamente consumido devido às suas características sensoriais e devido ao seu elevado conteúdo proteico de alto valor biológico. No contexto econômico mundial, a indústria de carnes é uma das principais no setor de alimentos, uma vez que gera grande volume de empregos e recursos. As características sensoriais como o sabor, o aroma, a aparência e a suculência são parâmetros que determinam a qualidade da carne. No entanto, a maciez é conhecida como um dos atributos mais importantes que influencia grandemente na aceitabilidade da carne pelo consumidor. Até o presente momento, métodos mecânicos, químicos, bioquímicos, físicos e enzimáticos têm sido empregados pela indústria para a obtenção de carnes e produtos cárneos com maciez desejável. No entanto, o principal método utilizado consiste na aplicação de enzimas proteolíticas, tais como a papaína, a bromelina e a ficina. A aplicação de enzimas proteolíticas é um método eficiente para contribuir com o aumento da maciez da carne; no entanto, um problema comumente associado a este método é encontrar uma maneira eficaz de aumentar a difusão enzimática na carne. Vários procedimentos foram desenvolvidos para introduzir enzimas proteolíticas em cortes de carne. Estes incluem os métodos secos, tais como a aplicação de pó, e os úmidos, tais como imersão e a injeção de solução enzimática na carne. Os métodos secos e úmidos consomem tempo e a injeção de uma solução enzimática na carne provoca danos da agulha no tecido cárneo. Diante disso, surge a necessidade de explorar novos métodos não destrutivos para acelerar a amaciamento da carne e diminuir a danificação do tecido. A tecnologia de ultrassom pode ser uma alternativa, e vem recebendo destaque como sendo uma técnica inovadora e eficaz para o amaciamento de tecidos cárneos. O ultrassom pode atuar de diferentes maneiras no tecido cárneo, como promovendo a modificação da integridade das células musculares e/ou intensificando reações enzimáticas. Diante do exposto, o presente projeto visa explorar o uso de uma tecnologia emergente para promover o amaciamento de tecidos cárneos que apresentem relativo grau de dureza. Neste contexto, serão avaliadas diferentes intensidades de potência do ultrassom, assim como diferentes tempos de processo para promover o rompimento das proteínas miofibrilares e, consequentemente, aumentar a maciez dos tecidos. Além disso, será investigada a combinação do uso da tecnologia de ultrassom com enzimas proteolíticas, como a papaína, a fim de aumentar o processo de difusão das enzimas para o interior dos tecidos..
Situation: Completed; Nature: Research.
Participant students: Academic master's degree: (1) .

Members: Ligia Damasceno Ferreira Marczak - Coordinator / Giovana Meneguini Mercali - Member / Lucas Fallavena - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.
S, T & A Production Rate: 1

2017 - 2018

Extração de compostos antinutricionais das tortas de canola e girassol assistida por ultrassom

Description: O Brasil tem grande e diversificada produção de óleos e gorduras vegetais, sendo utilizados como óleos comestíveis e para inúmeras outras finalidades industriais. A produção de óleos tem como consequência a geração de subprodutos; esses subprodutos podem ser interessantes comercialmente por possuírem alto valor calórico e por serem ricos em proteínas e em componentes minoritários que podem ser fracionados e comercializados. Em função da qualidade destes resíduos, o seu aproveitamento para obtenção de um produto com maior valor agregado é de grande importância para aumentar os ganhos financeiros na indústria de óleos. Dentre as diversas plantas oleaginosas existentes, neste trabalho serão abordadas as culturas da canola e do girassol, que têm valor de mercado equiparado com o da soja e cultivos em crescente expansão, principalmente no sul do Brasil. O propósito deste estudo está ligado, principalmente, à presença de determinadas substâncias nos grãos dessas culturas. Essas substâncias, pertencentes à classe dos compostos fenólicos, são consideradas antinutricionais para a alimentação animal, quando mantidas misturadas ao farelo, porém de grande interesse para a indústria de alimentos, fármacos e cosméticos quando isoladas. Neste contexto, o objetivo deste projeto é avaliar o uso de ultrassom na extração de compostos antinutrionais das tortas de canola e girassol com vistas ao aumento de ser valor agregado..
Situation: Completed; Nature: Research.
Participant students: Academic master's degree: (1) .

Members: Ligia Damasceno Ferreira Marczak - Coordinator / Cibele Freitas Oliveira - Member.
Financier(s): Bunge Alimentos - Gaspar - Cooperation.

2014 - Current

USO DE CAMPO ELETRICO NA EXTRACAO DE COMPOSTOS BIO-ATIVOS NATURAIS DE ALIMENTOS E SUA ESTABILIDADE POR MICROENCAPSULACAO

Description: A pesquisa para identificar fontes alternativas e baratas de ativos ricos em compostos antioxidantes é um tema importante que tem ganhado relevância em tecnologia de alimentos. Entre estas fontes, destacam-se os subprodutos agrícolas da fabricação de sucos e derivados de frutas (uva, morango, amora, mirtilo, framboesa, ameixa, laranja, manga, abacaxi, entre outras) e também da produção de óleos a partir de sementes como castanha do pará, abóbora, linhaça e gergelim. Entre os compostos antioxidantes presentes no bagaço de frutas e sementes estão os carotenóides, as vitamina C e E, e uma variedade de antioxidantes fitoquímicos como compostos fenólicos simples, glicosídeos, flavonóides e fitoesteróis. A extração com solventes tem sido o método mais empregado na extração de pigmentos contidos em frutas e também na extração de óleos e compostos antioxidantes presentes no mesmo; no entanto, o resíduo de

meio ambiente externo. Desta forma, a umidade presente nos espaços vazios do solo começa a migrar na forma de vapor, diminuindo gradativamente o conteúdo de umidade no solo próximo ao cabo, e aumentando consideravelmente a resistividade térmica do solo. Como conseqüência, o solo, que deveria atuar como um dissipador de calor, passa a atuar como um isolante térmico. A temperatura superficial do cabo atinge, assim, elevados valores que eventualmente podem ocasionar o rompimento do isolamento do cabo. Este projeto tem por onjetivo desenvolver uma metodologia capaz de prever os processos de transferência de calor e umidade e a conseqüente secagem dos solos que envolvem cabos de potência aterrados..
Situation: Completed; Nature: Research.
Participant students: Graduation: (2) / Specialization: (0) / Academic master's degree: (0) / Professional master's degree: (0) / Doctorate: (0) .

Members: Ligia Damasceno Ferreira Marczak - Coordinator / Simone Sebben - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.
S, T & A Production Rate: 9

Member of advisory committee

2015 - Present

Development agency: FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL

Scientific journal referee

2006 - Present

Journal: Journal of Porous Media

2006 - Present

Journal: Brazilian Journal of Chemical Engineering

2007 - Present

Journal: International Journal of Thermal Sciences

2010 - Present

Journal: Canadian Journal of Chemical Engineering

2007 - Present

Journal: Journal of Food Engineering

Funding project reviewer

2020 - Present

Development agency: Fundação de Amparo à Pesquisa do Estado de São Paulo

2011 - Present

Development agency: Conselho Nacional de Desenvolvimento Científico e Tecnológico

2010 - Present

Development agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

Areas of Expertise

1.

Major Area: Engineering / Área: Chemical Engineering / Subarea: Fenômenos de Transporte/Specialty: Transferência de Calor e Massa.

2.

Major Area: Agrarian Sciences / Área: Science and Technology of the Food / Subarea: Engenharia de Alimentos.

3.

Major Area: Engineering / Área: Mechanical Engineering / Subarea: Fenômenos de Transporte.

Languages

English

Comprehends Well, Speaks Well, Reads Well, Writes Well.

French

Comprehends Reasonably, Speaks Reasonably, Reads Well, Writes Little.

Awards and Titles

2023

Paraninfa da Turma de Formandos do Curso de Engenharia Química 2023/1, UFRGS.

2022

Professora Homenageada da Turma de Formandos do Curso de Engenharia Química 2022/1, UFRGS.

2022

Professora Homenageada da Turma de Formandos do Curso de Engenharia Química 2022/2, UFRGS.

2021

Professora Homenageada da Turma de Formandos do Curso de Engenharia Química 2021/1, UFRGS.

2020

Professora Homenageada da Turma de Formandos do Curso de Engenharia Química 2020/1, UFRGS.

2019

Professora Homenageada da Turma de Formandos do Curso de Engenharia Química 2019/1, UFRGS.

2019

Professora Homenageada da Turma de Formandos do Curso de Engenharia Química 2019/2, UFRGS.

2018

Paraninfa da turma de Formandos do Curso de Engenharia Química 2018/1, UFRGS.

2017

Paraninfa da turma de Formandos do Curso de Engenharia Química 2017/1, UFRGS.

2016

Docente Destaque do ano de 2015 da Escola de Engenharia da UFRGS, Escola de Engenharia da UFRGS.

2015

Orientadora da Tese de Doutorado escolhida como melhor Tese na área das Engenharias do Prêmio UFRGS de Tese 2015, Pro Reitoria de Pós Graduação - UFRGS.

2015

Professora Homenageada da Turma de Formandos do Curso de Engenharia Química da UFRGS 2015/2, UFRGS.

2014

Professora Homenageada da Turma de Formandos do Curso de Engenharia de Alimentos da UFRGS 2014/2, UFRGS.

2013

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2013/2, UFRGS.

2012

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 2012/1, UFRGS.

2012

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2012/2, UFRGS.

2010

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2010/1, UFRGS.

2010

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 2010/2, UFRGS.

2008

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2008/2, UFRGS.

2008

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 2008/1, UFRGS.

2006

Professora Homenageada da turma de formandos do curso de Engenharia de Alimentos do semestre 2006/2, UFRGS.

2006

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2006/1, UFRGS.

2006

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 2006/2, UFRGS.

2005

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2005/2, UFRGS.

2005

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2005/1, UFRGS.

2004

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2004/1, UFRGS.

2004

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 2004/2, UFRGS.

2003

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2003/2, UFRGS.

2003

Professora Homenageada da turma de formandos do curso de Engenharia de Alimentos do semestre 2003/1, UFRGS.

2002

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 2002/2, UFRGS.

2002

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 2002/1, UFRGS.

2001

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 2001/2, UFRGS.

2000

Professora Homenageada da turma de formandos do curso de Engenharia de Alimentos do semestre 2000/2, UFRGS.

1999

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 1999/2, UFRGS.

1999

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 1999/1, UFRGS.

1997

Paraninfa da turma de formandos do Curso de Engenharia Química da UFRGS do semestre 1997/1, UFRGS.

1996

Professora Homenageada da turma de formandos do Curso de Química - ênfase Industrial no semestre 1996/2, UFRGS.

1995

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestren 1995/2, UFRGS.

1995

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 1995/1, UFRGS.

1994

Professora Homenageada da turma de formandos do curso de Engenharia Química do semestre 1994/2, UFRGS.

1993

Professora Homenageada da turma de formandos do Curso de Química - ênfase Industrial no semestre 1993/2, UFRGS.

Scientific, Technological, Artistic and Cultural Production

Bibliographical Production

Citations

Web of Science

Total of articles: 85 Total of citations: 838 Date: 05/09/2018

Ligia Marczak; Marczak, L.D.F.; Marczak LDF

SciELO

Total of articles: 73 Total of citations: 1486 Date: 05/07/2022

Marczak, Ligia Damasceno Ferreira

SCOPUS

Total of articles: 108 Total of citations: 2769 Date: 05/07/2022

Marczak, Ligia Damasceno Ferreira

Full articles published in journals

Sort by

Chronological Order

1.

TEIXEIRA, INGRID ROCHA ; Mercali, Giovana Domeneghini ; Jaeschke, Débora Pez ; **MARCZAK, LIGIA DAMASCENO FERREIRA** . Effective and low-cost method to obtain purified C-phycocyanins from Arthrospira platensis. BRAZILIAN JOURNAL OF CHEMICAL ENGINEERING (ONLINE)JCR, v. 1, p. 1, 2025. **Citações:** WEB OF SCIENCE 2 | SCOPUS 1

2.

RIÉFFEL, ROBERTA COUGO ; AGOSTINI, LUCAS ; RODRIGUES, NAIRA POENER ; BERLITZ, SIMONE JACOBUS ; **Marczak, Lígia Damasceno Ferreira** ; KÜLKAMP-GUERREIRO, IRENE CLEMES .

Sustainable Olive Pomace Extracts for Skin Barrier Support. PHARMACEUTICS JCR, v. 17, p. 962, 2025.

3.

TEIXEIRA, INGRID ROCHA ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; Mercali, Giovana Domeneghini ; Jaeschke, Débora Pez . Saline extraction assisted by ultrasound: a method to obtain purified phycocyanin. JOURNAL OF BIOTECHNOLOGY JCR, v. 384, p. 38-44, 2024. **Citações:** WEB OF SCIENCE 10 | SCOPUS 3

4.

PEREIRA, RENATA NUNES ; Jaeschke, Débora Pez ; rech, rosane ; Mercali, Giovana Domeneghini ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; PUEYO, JAVIER RASO . Pulsed electric field-assisted extraction of carotenoids from Chlorella zofingiensis. Algal Research-Biomass Biofuels and Bioproducts JCR, v. 79, p. 103472, 2024. **Citações:** WEB OF SCIENCE 8 | SCOPUS 6

5.

MÜLLER, WAGNER AUGUSTO ; Sarkis, Júlia Ribeiro ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; MUNIZ, ANDRÉ RODRIGUES . Computational analysis of the simultaneous application of ultrasound and electric fields in a lipid bilayer. BIOCHIMICA ET BIOPHYSICA ACTA-BIOMEMBRANES JCR, v. 1866, p. 184364, 2024.

6.

ALVES, ISRAEL LUNA ; MARTINS, CAROLINE CARBONI ; CACCIATORE, FABÍOLA AYRES ; DA SILVA MALHEIROS, PATRÍCIA ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; FLÔRES, SIMONE HICKMANN ; MERCALI, GIOVANA DOMENEGHINI . Ultrasound-Assisted Extraction of Bioactive Compounds From Sucupira (Pterodon pubescens) Fruit: Chemical Characterization and Antimicrobial Activity. JOURNAL OF FOOD PROCESS ENGINEERING JCR, v. 47, p. 1, 2024.

7.

PEREIRA, RENATA NUNES ; Jaeschke, Débora Pez ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; rech, rosane ; Mercali, Giovana Domeneghini . Effect of ultrasound on Pseudoneochloris marina and Chlorella zofingiensis growth. BIORESOURCE TECHNOLOGY JCR, v. 373, p. 128741, 2023. **Citações:** WEB OF SCIENCE 4 | SCOPUS 2

8.

SILVA, PAULO RICARDO SANTOS DA ; MANN, MICHELE BERTONI ; TESSARO, Isabel Cristina ; **MARCZAK, LIGIA DAMASCENO FERREIRA** . Proposal of a generic model to predict the time to reject low acid fruit pulps contaminated by Byssochlamys fulva. The Journal of Engineering and Exact Sciences, v. 9, p. 15609-01e, 2023.

9.

DE VARGAS, VICTÓRIA HERMES ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; FLÔRES, SIMONE HICKMANN ; Mercali, Giovana Domeneghini . Morphology and functional properties of

gelatin-based films modified by UV radiation and bacterial cellulose nanofibers. JOURNAL OF FOOD PROCESS ENGINEERING JCR, v. v, p. xx, 2023. **Citações:** WEB OF SCIENCE 9 | SCOPUS 8

10.

MÜLLER, WAGNER AUGUSTO ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; Sarkis, Júlia Ribeiro . Thermal and kinetic integrated models applied for Aspergillus fumigatus inactivation during ohmic and conventional juice pasteurization. JOURNAL OF FOOD ENGINEERING JCR , v. 319, p. 110907, 2022. **Citações:** WEB OF SCIENCE 3 | SCOPUS 3

11.

MÜLLER, WAGNER AUGUSTO ; Sarkis, Júlia Ribeiro ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; MUNIZ, ANDRÉ RODRIGUES . Molecular dynamics study of the effects of static and oscillating electric fields in ovalbumin. Innovative Food Science & Emerging Technologies JCR, v. 75, p. 102911, 2022. **Citações:** WEB OF SCIENCE 18 | SCOPUS 15

12.

DE VARGAS, VICTORIA HERMES ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; FLÔRES, SIMONE HICKMANN ; Mercali, Giovana Domeneghini . Advanced Technologies Applied to Enhance Properties and Structure of Films and Coatings: a Review. Food and Bioprocess Technology JCR, v. 15, p. 1224-1247, 2022. **Citações:** WEB OF SCIENCE 35 | SCOPUS 33

13.

VARGAS, VICTORIA HERMES ; FLÔRES, SIMONE HICKMANN ; Mercali, Giovana Domeneghini ; **MARCZAK, LIGIA DAMASCENO FERREIRA** . Effect of OHMIC heating and ultrasound on functional properties of biodegradable gelatin¿based films. POLYMER ENGINEERING AND SCIENCE JCR, v. 62, p. 1890-1906, 2022. **Citações:** WEB OF SCIENCE 3 | SCOPUS 3

14.

PRESTES FALLAVENA, LUCAS ; POERNER RODRIGUES, NAIRA ; **DAMASCENO FERREIRA MARCZAK, LIGIA** ; DOMENEGHINI MERCALI, GIOVANA . Formation of advanced glycation end products by novel food processing technologies: A review. FOOD CHEMISTRY JCR, v. 393, p. 133338, 2022. **Citações:** WEB OF SCIENCE 31 | SCOPUS 25

15.

MÜLLER, WAGNER AUGUSTO ; Sarkis, Júlia Ribeiro ; **MARCZAK, LIGIA DAMASCENO FERREIRA** ; MUNIZ, ANDRÉ RODRIGUES . Molecular dynamics insights on temperature and pressure effects on electroporation. BIOCHIMICA ET BIOPHYSICA ACTA-BIOMEMBRANES JCR, v. 1864, p. 184049, 2022. **Citações:** WEB OF SCIENCE 7 | SCOPUS 4

16.

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1.

MARCZAK, L. D. F; WADA, Keiko (Org.) . . Porto Alegre: , 1998. v. 1. 152p .

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1.

Luchese, C. L. ; Gurak, P.D. ; **MARCZAK, LIGIA DAMASCENO FERREIRA** . . In: Catarina Pedro Pássaro Carvalho, Diego A. Moreno. (Org.). 1ed.Alicante, Espanha: LIMENCOP S.L, 2014, v. , p. 161-180.

2.

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1.

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2.

Daudt, R. M. ; Külkamp, I. ; CLADERA-OLIVERA, FLORENCIA ; Thys, Roberta Cruz Silveira ; **Marczak, L.D.F.** . , 2012, Búzios, RJ. Anais do XIX Congresso Brasiliero de Engenharia Química - COBEQ 2012. Rio de Janeiro, 2012.

3.

Staudt, P.B. ; Kechinski, Carolina P. ; Soares, R.de P. ; TESSARO, Isabel Cristina ; **Marczak, L.D.F.** ; Cardozo, Nilo S.M. . , 2012, Búzios, RJ. Anais do XIX Congresso Brasiliero de Engenharia Química - COBEQ 2012. Rio de Janeiro, 2012.

4.

BALDASSO, Camila ; **MARCZAK, L. D. F** ; TESSARO, Isabel Cristina . , 2012, b. Anais do XIX Congresso Brasiliero de Engenharia Química - COBEQ 2012, 2012.

5.

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6.

KECHINSKI, Carolina Pereira ; TESSARO, Isabel Cristina ; MARCZAK, L. D. F. . , 2010, Foz do Iguaçu. Anais do XVIII COBEQ - Congresso Brasileiro de Engenharia Química, 2010., 2010.

7.

KECHINSKI, Carolina Pereira ; TESSARO, Isabel Cristina ; Souza, A.C.P. ; **MARCZAK, L. D. F** . , 2010, Foz do Iguaçu. Anais do XVIII COBEQ - Congresso Brasileiro de Engenharia Química,, 2010.

8.

Mercali, Giovana Domeneghini ; Sarkis, Júlia Ribeiro ; **Marczak, Lígia Damasceno Ferreira** ; TESSARO, Isabel Cristina . , 2010, Foz do Iguaçu. Anais do XIII Congresso Brasileiro de Engenharia Química - COBEQ, 2010.

9.

MERCALI, G. M. ; TESSARO, Isabel Cristina ; **MARCZAK, LIGIA DAMASCENO FERREIRA** . , 2009, Concordia. Anais do Congreso Argentino de Ciencia y Tecnologia de Alimentos, 2009. v. 1. p. 1-2.

10.

MERCALI, G. M. ; TESSARO, Isabel Cristina ; **MARCZAK, LIGIA DAMASCENO FERREIRA** . , 2009, Concórdia. Anais do Congreso Argentino de Ciencia y Tecnologia de Alimentos, 2009. v. 1. p. 1-2.

11.

KECHINSKI, Carolina Pereira ; TESSARO, Isabel Cristina ; CARDOZO, N. S. M. ; **MARCZAK, LIGIA DAMASCENO FERREIRA** . , 2009, Concordia. Anais do Congreso Argentino de Ciencia y Tecnologia de Alimentos, 2009. v. 1. p. 1-2.

12.

KECHINSKI, Carolina Pereira ; **MARCZAK, L. D. F** ; NOREÑA, Caciano Pelayo Zapatã . , 2008, Recife, Pe. XVII COBEQ - Congresso Brasileiro de Engenharia Química, 2008.

13.

KECHINSKI, Carolina Pereira ; **MARCZAK, L. D. F** ; NOREÑA, Caciano Pelayo Zapatã . , 2008, Recife, PE. Anais do XVII COBEQ -Congresso Brasileiro de Engenharia Química, 2008.

14.

OLIVEIRA, Florência Cladera ; NOREÑA, Caciano Pelayo Zapatã ; MARCZAK, L. D. F. . , 2008, Recife, Pe. Anais do XVII COBEQ - Congresso Brasileiro de Engenharia Química, 2008.

15.

CASSINI, Aline Schilling ; TESSARO, Isabel Cristina ; **MARCZAK, L. D. F** ; PERTILE, C. . , 2008, Recife, PE. Anais do XVII COBEQ - Congresso Brasileiro de Engenharia Química, 2008.

16.

SOUZA, Daiana de ; **MARCZAK, L. D. F** ; TESSARO, Isabel Cristina ; Bolzan, T.G. . , 2008, Recife, PE. Anais do XVII COBEQ - Congresso Brasileiro de Engenharia Química, 2008.

17.

PROCIÚNCULA, Cleiton Bittencourt da ; TESSARO, Isabel Cristina ; **MARCZAK, L. D. F** . , 2006, Santos, SP. Anais do XVI Congresso Brasileiro de Engenharia Química, 2006. v. 1.

18.

OLIVERA, Florência Cladera ; PETTERMANN, Ana Carolina ; NOREÑA, Caciano Pelayo Zapatã ; WADA, Keiko ; **MARCZAK, L. D. F** . , 2006, Santos, SP. Anais do XVI Congresso Brasileiro de Engenharia Química, 2006. v. 1.

19.

MARCZAK, L. D. F; MARCINKOWSKI, Emmanuelle ; NOREÑA, Caciano Pelayo Zapatã . , 2006, Santos, SP. Anais do XVI Congresso Brasileiro de Engenharia Química, 2006. v. 1.

20.

MARCZAK, L. D. F; TESSARO, Isabel Cristina ; GOMES, Marina da Silveira . , 2006, Santos, SP. Anais do XVI Congresso Brasileiro de Engenharia Química, 2006. v. 1.

21.

MARCZAK, L. D. F; RODRIGUEZ, Hugo Ariel Lombardi . , 2006, Belém, Pa. Anais do XXVII Cilamce - Congresso Ibero Latino Americano de Métodos Computacionais em Engenharia, 2006. v. 1.

22.

CASSINI, Aline Schilling ; TESSARO, Isabel Cristina ; **MARCZAK, L. D. F** . , 2006, Buenos Aires. Anais do XXII Interamerican Congress of Chemical Engineering and V Argentinean Congress of Chemical Engineering, 2006. v. 1. p. 1-1.

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Date: 10 september 2025

DECLARATION

I, Prof. Dr. **Luiz Antonio de Almeida Pinto**, Director of the School of Chemistry and Food Science and Professor co-advisor at the Federal University of Rio Grande, hereby declare, for all intents and purposes, that doctoral student **Alice Neri da Silva Sousa** actively participated in the project approved in FAPERGS/SICT Notice No. 06/2022 – INOVA AGRO, funded by the FAPERGS development agency.

Her contribution was essential for the execution of laboratory research involving the production of biochar and pyrolytic extract, the preparation of technical reports, and the supervision of activities related to the goals established in the project, always under my direct guidance.

This project is having a major impact on Brazilian science, thanks to the numerous patents registered since 2023, which are:

(1) Registration number: BR1020230150063, title: "DEVELOPMENT OF A CHEMICALLY MODIFIED SENSOR WITH RICE HUSK BIOCHAR FOR VOLTAMMETRIC DETERMINATION OF TARTRAZINE," Registration institution: INPI - National Institute of Industrial Property. Filing date: 07/26/2023; Grant date: 12/10/2024. **(2)** Registration number: BR1020240028597, title: "DEVELOPMENT OF CHEMICALLY MODIFIED FILM ELECTRODE WITH SOYBEAN BIOCHAR APPLIED TO VOLTAMMETRIC DETERMINATION OF CAFFEINE," Registration institution: INPI - National Institute of Industrial Property. Filing date: February 14, 2024. **(3)** Registration number: BR1020240112210, title: "OBTAINING A CHEMICALLY MODIFIED SENSOR WITH SOYBEAN BIOCHAR FOR THE DETERMINATION OF TARTRAZINE," Registration institution: INPI - National Institute of Industrial Property. Filing date: 06/04/2024. **(4)** Registration number: BR1020240188284, title: "DETERMINATION OF CHLORAMPHENICOL USING CHEMICALLY MODIFIED SENSOR WITH SOY BIOCHAR," Registration institution: INPI - National Institute of Industrial Property. Filing date: 09/12/2024. **(5)** Registration number: BR1020250091356, title: "PROCESS FOR MANUFACTURING A VOLTAMMETRIC SENSOR USING A CARBON PASTE ELECTRODE MODIFIED WITH RICE HUSK BIOCHAR FOR DETERMINING DICLOFENAC",

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Works at events: **(1)** "SOYBEAN RESIDUES APPLIED IN THE DEVELOPMENT OF VOLTAMMETRIC SENSORS FOR CAFFEINE DETERMINATION." In: 22nd University Production Exhibition (MPU), 2023, Rio Grande, RS. **(2)** "ELECTROANALYTICAL SENSOR DEVELOPED FROM SOYBEAN RESIDUES APPLIED TO CAFFEINE DETERMINATION." In: Brazilian Symposium on Electrochemistry and Electroanalytics, 2023, Porto Alegre. Proceedings of the XXIV Brazilian Symposium on Electrochemistry and Electroanalytics 1st edition Lajeado/RS, 2023. **(3)** "Film electrode made from soybean biochar for caffeine determination by voltammetry." In: 29th SBQ Sul, 2023, Pelotas. A look to the future, 2023.

It should also be noted that proof of her effective participation is recorded in patent application number BR1020240211995, entitled "Process for obtaining a chemically modified voltammetric sensor with rice husk biochar for the determination of diclofenac," filed with the National Institute of Industrial Property (INPI). And also, the work at the Southern Region Chemistry Meeting - SBQ Sul (2024), entitled "Evaluation of the effect of electrochemical activations on chemically modified paste electrodes with biochar in the determination of ibuprofen by voltammetry.

Rio Grande, Rio Grande do Sul, september 16th, 2025.

Prof. Dr. Luiz Antonio de Almeida Pinto
Professor in the School of Chemistry and Food Science

Luiz Antonio de Almeida Pinto

Scholarship Research Productivity holder CNPq - Level 1B

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Last updated: 31/08/2025

He has degree in Industrial-Chemical Engineering from the Federal University of Rio Grande (1977), a master's degree in Chemical Engineering from the Federal University of São Carlos (1992) and a Ph.D. in Chemical Engineering from the Federal University of São Carlos (1996). Full Professor at the Federal University of Rio Grande, and has experience in the areas of Chemical Engineering and Food Engineering, with an emphasis on Industrial Food Production and Separation and Mixing Processes, working mainly on the following topics: food drying, adsorption, utilization of tailings, transport phenomena, effluent treatment, statistical modeling and nanotechnology. **(Text informed by the author)**

Personal Information

Name

Luiz Antonio de Almeida Pinto

Bibliographic Citation

PINTO, L. A. A.;Luiz Antonio de Almeida Pinto;L.A.A. Pinto;Luiz A. A. Pinto;Pinto, L.A.A.;Pinto, Luiz Antônio de Almeida.;PINTO, LUIZ ANTONIO DE ALMEIDA;Pinto, Luiz A.A.;DE ALMEIDA PINTO, LUIZ ANTONIO;PINTO, LUIZ A. A.;ANTONIO A. PINTO, LUIZ;PINTO, LUIZ ANTONIO A.;Luiz A.A. Pinto;PINTO, L.A.A;L. A. de A. PINTO;DE A. PINTO, L. A.;PINTO, L. A. DE A.;PINTO, LUIZ;PINTO, L. A. A;DE ALMEIDA PINTO, LUIZ ANTONIO;PINTO, L. A.A.;ANTONIO DE ALMEIDA PINTO, LUIZ;PINTO, LUIZ A. DE A.;PINTO, LUIZ A. DE ALMEIDA;PINTO, LUIZ ANTONIO;PINTO, LUIZ A.;ALMEIDA PINTO, LUIZ ANTONIO;PINTOA, LUIZ ANTONIO DE ALMEIDA;ALMEIDA PINTO, LUIZ ANTONIO DE

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Formal Education/Degree

1992 - 1996

Ph.D. in Engenharia Química.
Universidade Federal de São Carlos, UFSCAR, Brasil. , Year of degree: 1996.
Advisor: Satoshi Tobinaga.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: Secagem de alimentos fibrosos; Cinética da Secagem; Modelo Difusivo com Encolhimento.
Major Area: Engineering
Major Area: Engineering / Area: Chemical Engineering / Subarea: Tecnologia Química / Specialty: Alimentos.
Activity sectors: Manufacture of Chemicals ; Nutrition and feeding; Fishing, aquaculture and seaculture.

1990 - 1992

Master in Engenharia Química.
Universidade Federal de São Carlos, UFSCAR, Brasil. Year of degree: 1992.
Advisor: Satoshi Tobinaga.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: Secagem de Materiais Fibrosos; Processamento de Pescado; Secador de Pratos.
Major Area: Engineering
Major Area: Engineering / Area: Chemical Engineering / Subarea: Tecnologia Química / Specialty: Alimentos.
Activity sectors: Manufacture of Chemicals ; Fishing, aquaculture and seaculture; Nutrition and feeding.

1973 - 1977

Graduation in Engenharia Industrial - Química.
Universidade Federal do Rio Grande, FURG, Brasil.

Complementary Education

1999 - 1999

Capacitação Para Gerentes Acadêmicos. (Credit hours: 160h).
Universidade Federal do Rio Grande, FURG, Brasil.

Professional Experience

Universidade Federal do Rio Grande, FURG, Brasil.

Contract

1977 - Present

Type of contract: Government Employee, Functional Placement: Titular Professor, Credit Hours: 40, Regime: Exclusive Dedication.

Activities

01/2025 - Atual

Manager and Administrative Positions, Escola de Química e Alimentos.

Position or Function
Diretor.

01/2025 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Conselheiro.

01/2025 - Atual

Councils, Commissions and Consulting, Conselho de Ensino, Pesquisa, Extensão e Administração (COEPEA).

Position or Function
Conselheiro.

03/2018 - Atual

Teaching, Engenharia Quimica, Degree: Pos-Graduation

Disciplines Taught
Fenômenos de Transporte
Termofluidodinâmica de Sistemas Particulados

03/2014 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

Disciplines Taught
Físico-Química Avançada II

03/2012 - Atual

Teaching, Química-Bacharelado, Degree: Graduation

Disciplines Taught
Operações Unitárias

01/2012 - Atual

Councils, Commissions and Consulting, Comisão de Curso de Engenharia, Engenharia Bioquímica/Escola de Química e Alimentos.

Position or Function
Membro do Núcleo Docente Estruturante (NDE) do curso de graduação de Engenharia Bioquímica..

03/2010 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

Disciplines Taught
Estágio de Docência
Fisico-Química Avançada I
Operações Unitárias
Tópicos Especiais em Fisico-Química

03/2008 - Atual

Councils, Commissions and Consulting, Reitoria, Pró-Reitoria de Pesquisa e Pós-Graduação.

Position or Function
Membro do Comitê Assessor para Seleções de Bolsas de Iniciação Científicas (PIBIC-FURG)..

1/2001 - Atual

Other Technical-Scientific Activities , Departamento de Química, Departamento de Química.

Accomplished Activity
Membro do Comitê Editorial da Revista VETOR - ISSN 0102-7352.

03/1996 - Atual

Research and Development, Escola de Química e Alimentos, Laboratório de Secagem.

Research Fields
Secagem de Pastas e Suspensões

3/1996 - Atual

Teaching, Engenharia e Ciência de Alimentos, Degree: Pos-Graduation

Disciplines Taught
Fenômenos de Transporte aplicados e Engenharia de Alimentos

2024 - Current

Extração supercrítica de concentrados de óleo de resíduos de atum-bonito e seu nanoencapsulamento utilizando colágeno de pele de atum-bonito como material de parede.

Description: O óleo de atum apresenta elevada quantidade de ácidos graxos poli-insaturados (AGPI) da família ômega-3, principalmente eicosapentaenóico (EPA) e docosahexaenóico (DHA), os quais trazem diversos benefícios à saúde humana e podem ser inseridos na formulação de produtos. O óleo de pescado obtido via extração por fluido supercrítica (EFS), torna-se uma alternativa interessante, pois a operação é seletiva, ocorre em baixas temperaturas evitando a oxidação do óleo, e não utiliza solventes tóxicos, sendo atrativa para as indústrias dos setores farmacêutico e alimentício para formulação de produtos contendo os concentrados de AGPI. O nanoencapsulamento tem como função evitar a oxidação do óleo, aumentando a vida útil do produto e impedindo perda do seu valor nutricional. O colágeno é a principal proteína dos vertebrados, e pode ser incorporado em produtos fármacos e alimentícios devido as suas propriedades moleculares, tornando-se uma opção como material de parede das nanocápsulas. Este trabalho tem como objetivo extrair concentrados de AGPI de óleo de resíduos de atum-bonito (Katsuwonus pelamis) via extração supercrítica, e realizar o nanoencapsulamento destes concentrados, utilizando o colágeno de resíduos de atum-bonito (Katsuwonus pelamis) como material de revestimento. Para a obtenção do óleo de atum concentrado em AGPI, serão otimizadas as condições de extração com fluido supercrítico. O colágeno será extraído das peles do atum e caracterizado. Para avaliar a obtenção das nanoemulsões contendo os concentrados em AGPI será realizado um delineamento experimental fatorial 23 contendo 3 pontos centrais, que terá como variáveis de estudo o percentual de colágeno e a taxa de agitação. As nanoemulsões serão caracterizadas com relação a estabilidade físico-química conforme o tamanho de partícula, o índice de polidispersão e o potencial zeta. A estabilidade oxidativa será determinada pelo índice de peróxido. As nanoemulsões serão secas por liofilização, a fim de obter as nanoestruturas. A bioacessibilidade, perfil de liberação e atividade antioxidante dos AGPI de óleo de atum serão investigados durante a digestão in vitro. Por fim será realizado um estudo de viabilidade técnica e econômica da implantação de uma unidade de produção do nanocápsulas de concentrados de AGPI de óleo de resíduos de atum-bonito, utilizando o colágeno de resíduos de atum-bonito como material de parede..
Situation: In progress; Nature: Research.

Members: Luiz Antonio de Almeida Pinto - Member / Tito Roberto Sant'Anna Cadaval Jr - Coordinator / NAURO SILVEIRA JR - Member / Jorge Luiz Marques Junior - Member / RIZZI, FRANCISCA ZUCHOSKI - Member / Bruna Silva de Farias - Member / ANDREI VALLERAO IGANSI - Member / RAFAEL LIPINSKI PAES - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.

2023 - Current

Valorização de subprodutos agroindustriais da produção das oliveiras a partir de tecnologias limpas: desenvolvimento de produtos cosméticos e alimentícios inovadores.

Description: O presente projeto visa a agregar valor aos resíduos agroindustriais da olivicultura, extrair compostos bioativos a partir de folhas de oliveira e bagaço de oliva, desenvolver formulações nanotecnológicas a partir dos extratos, e aplicá-las em produtos alimentícios e cosméticos. O estado do Rio Grande do Sul concentra mais de 90 da produção de azeite de oliva do Brasil, gerando uma quantidade significativa de resíduos. Assim, estudar formas de reaproveitar esses resíduos poderá ter impactos econômico, ambiental e social positivos. Os compostos bioativos presentes nesses resíduos apresentam grande potencial de aplicação em produtos alimentícios e cosméticos. Como estratégia de desenvolvimento da pesquisa, serão avaliados, inicialmente, métodos de secagem das matérias-primas com o objetivo de preservar os compostos bioativos presentes nos resíduos. Os processos de extração dos compostos de interesse serão investigados utilizando as tecnologias de ultrassom e extração com fluido supercrítico. Destaca-se que essas tecnologias são consideradas ambientalmente amigáveis, uma vez que a sua aplicação não requer o uso de solventes tóxicos. Para identificar de forma adequada os compostos potenciais a serem utilizados nas formulações alimentícias e cosméticas, eles serão analisados pela técnica de metabolômica. A partir dos compostos de interesse obtidos, serão desenvolvidas nanoformulações, que serão avaliadas quanto a suas atividades biológicas e toxicidade. As nanoformulações com maiores potencialidades de aplicação serão selecionadas para o desenvolvimento de produtos alimentícios e cosméticos. A partir da constatação das atividades antifúngica e antioxidante, o potencial das nanoformulações desenvolvidas para aplicação em produtos cosméticos e alimentícios será avaliado. Para consolidação dos resultados alcançados, será realizada a viabilidade econômica da introdução dos produtos desenvolvidos nos mercados brasileiro e mexicano..
Situation: In progress; Nature: Research.

Members: Luiz Antonio de Almeida Pinto - Coordinator / MERY LUIZA GARCIA VIEIRA - Member / Ligia Damasceno Ferreira Marczak - Member / Bruna Silva de Farias - Member / Débora Pez Jaeschke - Member / ANELISE CHRIST RIBEIRO - Member / Miriam Anders Apel - Member / Irene Guerreiro - Member / Simone Jacobus Berlitz - Member / Roberta Cougo Riéffel - Member.
Financier(s): Conselho Nacional de Desenvolvimento Científico e Tecnológico - Grant.

2023 - Current

Instituto Nacional de Ciência e Tecnologia em Tribologia Verde Voltada à Transição Energética

Description: Esta proposta cria uma rede nacional integrada e multidisciplinar que utilize a tribologia como ferramenta para contribuir para a solução dos enormes desafios associados à transição energética. Este

ecossistema de geração de conhecimento engloba os mais eminentes grupos de tribologia, do extremo sul ao nordeste do país, congregando pesquisadores em tribologia, ciência dos materiais, física, química, bioquímica e meio ambiente para fomentar forte interação com o setor produtivo. Será fundamental o desenvolvimento de novas soluções em lubrificantes, materiais e engenharia de superfícies para a mobilidade e a energia do futuro. Propõe-se identificar e atuar nos principais desafios tribológicos decorrentes das tecnologias atuais, que irão guiar as pesquisas para otimização tribológica das novas soluções sustentáveis..
Situation: In progress; Nature: Research.

Members: Luiz Antonio de Almeida Pinto - Member / JORGE ALBERTO VIEIRA COSTA - Member / Tito Roberto Sant'Anna Cadaval Jr - Member / MICHELE GREQUE DE MORAIS - Member / Felipe Kessler - Member / DIAS, DAIANE - Member / Bruno Meira - Member / HENARA LILLIAN COSTA MURRAY - Coordinator / ALEX FABIANI CLARO FLORES - Member / DINALVA AIRES DE SALES - Member / JORGE LUIS BRAZ MEDEIROS - Member / JOSE HENRIQUE ALANO - Member / LUCIANO VOLCANOGLO BIEHL - Member.

2022 - Current

Biomassas aplicadas na obtenção de produtos agrícolas de valor agregado

Description: Esta proposta envolve a utilização de resíduos agrícolas aplicados a obtenção de biocarvão e de extrato pirolenhoso que serão aplicados como regulador de crescimento, bioherbicida, biofertilizante, antioxidante e antibactericida. Dessa forma, esses resíduos que normalmente são descartados de forma incorreta, poderão ser utilizados na sua totalidade na obtenção destes materiais que possuem valor agregado. É importante enfatizar que essa proposta envolve pesquisadores de diferentes EIS (FURG, UFSM, UFPEL), assim como a Empresa SEMINARE (Algaagro Soluções Agrícolas Ltda) que possui estrutura física adequada para a realização dos testes agronômicos e a EMATER/RS que auxiliará na mobilização dos agricultores que receberão cursos de capacitação para a obtenção dos produtos de valor agregado. Destaca-se que esse projeto atua na fronteira do conhecimento no que tange estudos relacionados a química dos materias, química analítica, agronomia, controle de qualidade de produtos e química ambiental, apresentando desta forma elevada capacidade de inovação científica uma vez que engloba formação de recursos humanos, diferentes áreas e expertises; bem como inovação tecnológica uma vez que possibilita a geração de produtos e métodos simples e de baixo custo. Destaca-se também que esta proposta apresenta elevado impacto social uma vez que faz uso de tecnologias que envolvem materiais ambientalmente corretos, de fácil acesso e que muitas vezes são resíduos ambientais. Desta forma, a aprovação e execução desta proposta contribuirá para o equilíbrio entre desenvolvimento econômico, social e preservação ambiental assim como para a melhoria da oferta de produtos e serviços essenciais para uma parcela significativa da população brasileira..
Situation: In progress; Nature: Research.

Members: Luiz Antonio de Almeida Pinto -

Coordinator / Tito Roberto Sant'Anna Cadaval Júnior - Member / DIAS, DAIANE - Member / Guilherme L Dotto - Member / RAFAEL LIPINSKI PAES - Member / Carlos Roberto de Menezes Peixoto - Member / Marcia Foster Mesko - Member / Renato Zanella - Member / Martha Bohrer Adaime - Member / Osmar Damian Prestes - Member / Filipe Fagan Donato - Member / Juliano Ricardo Farias - Member / Juliana Vilela Maciel - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.

2020 - 2023

Laboratório NanoSul

Description: Em virtude de sua localização geográfica e antecedentes históricos, a FURG tem vocação Institucional direcionada ao reconhecimento, por meio da criação e difusão do conhecimento, da importância dos Sistemas Costeiros e oceânicos, já que nestes sistemas é onde ocorre uma das maiores produções naturais de matéria orgânica do nosso planeta. Neste cenário de grandes possibilidades de desenvolvimento industrial, social e ambiental, a presente proposta visa apresenta o ?cluster? de laboratórios da Instituição com atuação na área de nanotecnologia, com ênfase nas áreas de Química Multidisciplinar, Farmácia e Farmacologia, e Toxicologia. O histórico da Instituição na prospecção de compostos bioativos e de aplicação tecnológica no ambiente marinho tem propiciado um grande potencial de transferência de tecnologia na área nano e a oferta de prestação de serviços à sociedade pelo uso de sua estrutura e pela capacidade técnica instalada. A atuação do Laboratório NanoSul está de acordo com Instrução Normativa MCTIC N 11 de 02 de agosto de 2019 e será no âmbito da FURG, a qual conta com um projeto de desenvolvimento Institucional cadastrado no sistema da Universidade, SISPROJ, a partir de um convênio com a FAURG (Fundação de Apoio à Universidade do Rio Grande), o que possibilita à FAURG emitir nota fiscal e pagamentos pelos serviços, em especial os externos. Neste sentido, todos os centros e as restantes instalações possuem características multi-usuários, sendo rotineiramente utilizados por pesquisadores da FURG e de outras instituições públicas e privadas nacionais e estrangeiras. Na Instituição existem competências bem desenvolvidas pelos integrantes da proposta na área de alimentos e materiais da indústria alimentícia, utilizando polímeros obtidos de fontes naturais (ex: quitosana, pectina, alginato). Desta forma, a utilização de matéria prima oriunda do mar possibilitou gerar suplementos nanoencapsulados visando seu uso na saúde humana e, também, na Aquacultura, sendo priorizadas ações que visam o uso seguro dos nanomateriais através da aplicação de testes de toxicidade padronizados. Neste último ponto cabe salientar que integrantes da proposta têm participado na iniciativa europeia NanoReg, que teve como objetivo padronizar os ensaios para avaliação da toxicidade potencial de diferentes tipos de nanomateriais. Este exercício de intercalibração internacional permitiu o desenvolvimento de habilidades para executar ensaios de toxicidade em condições aceitas internacionalmente, o que gera confiabilidade dos dados toxicológicos obtidos, permitindo uma avaliação precisa do potencial risco ambiental do nanomateriais. Na área da saúde

têm se buscado o desenvolvimento de novas formas farmacêuticas para tratamento de doenças neurodegenerativas (Alzheimer e doença de Parkinson), doenças negligenciadas (Tuberculose), AVC hemorrágico, problemas de pele, como melhora na cicatrização e o tratamento de queimaduras, entre outros. Além disso, nos últimos anos têm surgido na Instituição algumas áreas emergentes em nanotecnologia, como para a avaliação de propriedades mecânicas de nanomateriais. Neste sentido, trabalhos envolvendo a avaliação de revestimentos e modificações superficiais, com especial ênfase em aplicações envolvendo corrosão ou tribologia têm sido realizados. Finalmente, é importante salientar que a atuação conjunta e integrada das equipes do Laboratório NanoSul têm gerado informação científica e produtos tecnológicos com características diferenciadas, onde o foco principal está no uso de matérias-primas de origem natural, o que está propiciando a colaboração e a prestação de serviços não somente no país mas também no exterior, este último ponto favorecido pelas cooperações internacionais que a Instituição tem estabelecido em área de atuação como a Química Multidisciplinar, Farmácia e Farmacologia, e Toxicologia..
Situation: Completed; Nature: Research.

Members: Luiz Antonio de Almeida Pinto - Member / Tito Roberto Sant'Anna Cadaval Jr - Member / JOSÉ MARIA MONSERRAT - Coordinator / PRIMEL, EDNEI G. - Member / DIAS, DAIANE - Member / KESSLER, FELIPE - Member / M. A. GELESKY - Member / Bruno Meira - Member.
Financier(s): Conselho Nacional de Desenvolvimento Científico e Tecnológico - Grant.

2010 - 2014

Produção de biopolímeros de alto valor agregado a partir de microorganismos e resíduos marinhos oriundos do extremo sul do Brasil

Description: Produzir biopolímeros de alto valor agregado a partir de microrganismos e resíduos marinhos, com ênfase na produção de hidrogéis, filmes nanocompostos, polímeros a partir de microalgas, filmes de quitosana com óleo de pescado, e outros biopolímeros a partir de efluentes do pólo pesqueiro do Rio Grande.
Situation: Completed; Nature: Research.
Participant students: Graduation: (4) / Academic master's degree: (4) / Doctorate: (4) .

Members: Luiz Antonio de Almeida Pinto - Member / JORGE ALBERTO VIEIRA COSTA - Member / CARLOS PRENTICE HERNANDEZ - Coordinator / MYRIAM DE LAS MERCEDES SALAS MELLADO - Member / Eliana B FURLONG - Member / Fabrício Butierres Santana - Member / Christiane Saraiva Ogrodowski - Member / Charles Crapo - Member.
Financier(s): Conselho Nacional de Desenvolvimento Científico e Tecnológico - Grant.

2009 - 2013

Rede Nanofotobiotec - Rede Integradora de Nanotecnologia e Biotecnologia Microalgal para

Spanish

Comprehends Well, Speaks Well, Reads Well, Writes Well.

English

Comprehends Well, Speaks Reasonably, Reads Well, Writes Well.

Awards and Titles

2020

Menção Honrosa na sessão de Bioengenharia. I Congresso Digital de Nanobiotecnologia e Bioengenharia (I CDNB)., Embrapa.

2020

PRÊMIO PESQUISADOR GAÚCHO 2020 na categoria PESQUISADOR DESTAQUE EM ENGENHARIAS., Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul ? FAPERGS..

2018

1º Lugar na Seção de Trabalhos Orais do 12º Encontro Brasileiro de Adsorção (12º EBA), UFSM/RS/Brasil.

2018

3º Lugar na Seção de Poster do 12º Encontro Brasileiro de Adsorção (12º EBA), UFSM/RS/Brasil.

2018

Melhor Trabalho na categoria Pesquisa, na modalidade Apresentação oral na Mostra Científica do 10º Salão Internacional de Ensino, Pesquisa e Extensão (SIEPE), UNIPAMPA.

2014

Premio Professor Giulio Massarani dentro da Área de Engenhara e Tecnologia de Alimentos no XX Congresso Brasileiro de Engenharia Química., Associação Brasileira de Engenharia Química (ABEQ).

2014

Patrono da Turma-2014 do curso de Engenharia de Alimentos, Universidade Federal do Rio Grande (FURG).

2013

Patrono da Turma-2013 do curso de Engenharia de Alimentos, Universidade Federal do Rio Grande (FURG).

2010

Professor Homenageado da Turma-2010 de Engenharia de Alimentos, Universidade Federal do Rio Grande (FURG).

2007

Professor Homenageado da Turma-2007 de Engenharia de Alimentos, Universidade Federal do Rio Grande (FURG).

2004

Patrono da Turma-2004 do curso de Engenharia Química, Universidade Federal do Rio Grande (FURG).

2002

Paraninfo da Turma-2002 do curso de Engenharia Química, Universidade Federal do Rio Grande (FURG).

2001

Paraninfo da Turma-2001 do curso de Engenharia Química, Universidade Federal do Rio Grande (FURG).

1997

Paraninfo da Turma-1997 do curso de Engenharia de Alimentos, Universidade Federal do Rio Grande (FURG).

1997

Paraninfo da Turma-1997 do curso de Engenharia Química, Universidade Federal do Rio Grande (FURG).

1996

Professor Homenageado da Turma-1996 de Engenharia de Alimentos, Universidade Federal do Rio Grande (FURG).

Scientific, Technological, Artistic and Cultural Production

Bibliographical Production

Citations

Web of Science

Total of articles: 182 Total of citations: 7022 Date: 31/08/2025

PINTO, Luiz A A

SCOPUS

Total of articles: 182 Total of citations: 7980 Date: 31/08/2025

PINTO, Luiz A. A.

Google Scholar

Total of articles: 458 Total of citations: 11740 Date: 31/08/2025

Karlsruhe Institute of Technology

IHM

Karlsruhe Institute of Technology (KIT), Campus Nord, Germany
Institute for Pulsed Power and Microwave Technology (IHM)

Karlsruhe, 10.11.2025

To whom it may concern,

I am Christian A. Gusbeth, I hold a Dr. rer. nat. in Biophysical Chemistry from the University of Bielefeld, Germany, and M.Sc. and Dipl. Phys. degrees in Physics from the University of Bucharest, Romania. I am currently a research scientist at the Institute for Pulsed Power and Microwave Technology (IHM) at the Karlsruhe Institute of Technology (KIT), Germany, where I conduct research in biochemical and biotechnological engineering. My work focuses on the use of pulsed electric fields (PEF) for bacterial decontamination, protein and lipids recovery from microalgae, and the study of stress-induction mechanisms and cellular responses such as cell death and enzymatic degradation. Through these activities, I have developed extensive expertise in the biochemistry and bioengineering applications of PEF technology, contributing to the advancement of efficient and sustainable bioprocesses.

Ms. Alice Neri da Silva Sousa is co-supervised by a colleague, Professor Débora Pez Jaeschke, PhD. I learned about the recommended curriculum through our professional acquaintance. As a senior scientist trained in biophysics, I understand the processes of adsorption, pyrolysis, and reuse of plant waste to add value to products and I found Ms. Sousa research scope to align with themes we frequently encounter in sustainable process engineering, namely adsorption phenomena, pyrolysis of agro-industrial residues, electrochemical analysis, and the conversion of biomass into higher-value materials. These processes are increasingly applied in our field to optimize resource recovery, engineer functional sorbents and sensors, and reduce environmental impacts across industrial value chains.

In addition, it can also be said that Ms. Sousa is actively involved in innovation, as she is listed as co-author/inventor of patents in a short period of time. In 2024, she was named co-inventor on two patent filings involving a biochar-based electrochemical sensor for detecting diclofenac in water and a chitosan material engineered to absorb lubricating oil. Together, these two inventions show an interdisciplinary mindset, linking chemistry, materials science, and process engineering, with a clear orientation toward sustainable and practical innovation.

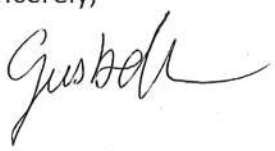
It is also noted that Ms. Sousa high scientific engagement through writing scholarly publications and participation in graduate-level projects, indicate steady development of methodological breadth. Her research contributions span seed physiology, biomass energy, adsorption technologies, and electrochemical analysis. She has actively participated in funded research projects and published her findings in national and regional conferences, showcasing her commitment to advancing knowledge in sustainable resource management and environmental innovation. In addition to her research and teaching, Alice has taken on evaluative roles, serving on academic panels and reviewing scientific articles for peer-reviewed journals such as *Scientia Forestalis*.

Karlsruhe Institute of Technology

These responsibilities reflect her growing recognition as a trusted academic contributor and evaluator.

Based on my professional assessment of Ms. Sousa's qualifications, I am confident that she meets the standards of competence expected in her field. The topics she pursues, including residue valorization, functional bio-derived materials, and environmental sensing, are timely, and the innovative approach of her work is a positive indicator of practical orientation. From my perspective, these are areas where scientifically grounded engineering can make a difference in industry and society of the United States.

Sincerely,



Christian A. Gusbeth, Dr.
Institute for Pulsed Power and Microwave Technology (IHM)
Karlsruhe Institute of Technology (KIT)
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< Back

Christian A. Gusbeth

Also published under: Christian Gusbeth, C. Gusbeth, C. A. Gusbeth, Ch Gusbeth

Affiliation
Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany

Publication Topics
Pulsed Electric Field, Pulsed Electric Field Treatment, Electric Field Treatment, Microalgae, Pore Formation, Pulse Amplitude, Pulse Duration, Pulsed Discharge, Abrasive Wear, Algal Biomass, Algal Growth, Anode Voltage

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Biography
Christian Gusbeth received the Dipl. Phys. and M.Sc. degrees in biophysics from the University of Bucharest, Bucharest, Romania, in 1995 and 1996, respectively, and the Ph.D. degree in biophysical chemistry from the University of Bielefeld, Bielefeld, Germany, in 2001.,He has been with the Institute for Pulsed Power and Microwave Technology, Karlsruhe Institute of Technology, Karlsruhe, Germany, since 2002. His current research interests include the application of pulsed electric fields for bacterial decontamination and the investigation of the interaction between electric fields and biological matter. *(Based on document published on 24 September 2013).*

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V. An
K. Baumung
Th Berghöfer
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Boost of algae growth by ultra short pulsed electric field treatment
Christian A. Gusbeth; Christian Eing; Martina Göttel; Wolfgang Frey
2013 Abstracts IEEE International Conference on Plasma Science (ICOPS)
Year: 2013 | Conference Paper | Publisher: IEEE
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Monitoring of Pulsed Electric Field-Induced Abiotic Stress on Microalgae by Chlorophyll Fluorescence Diagnostic
Ralf Straessner; Christian Eing; Martina Goettel; Christian Gusbeth; Wolfgang Frey
IEEE Transactions on Plasma Science
Year: 2013 | Volume: 41, Issue: 10 | Journal Article | Publisher: IEEE
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Pulsed Electric Field Treatment of Microalgae—Benefits for Microalgae Biomass Processing
Christian Eing; Martina Goettel; Ralf Straessner; Christian Gusbeth; Wolfgang Frey
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Exhibit E - Petitioner's authorship of scholarly articles in professional or major trade publications or other major media

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Article

Extraction of Oil from Amazonian *Attalea tessmannii* Kernels: Kinetics Modeling, Diffusivity Analyses, and Physicochemical Characterization

Sheraz Ahmad, Alice Neri da Silva Sousa, Viviane de Carvalho Arabidian, Keiti Roseani Mendes Pereira, Ricardo Scherer Pohndorf, Anelise Christ-Ribeiro, Isaac dos Santos Nunes, Débora Pez Jaeschke,* Nauro da Silveira Junior, Luiz Antonio de Almeida Pinto, and Tito Roberto Sant'Anna Cadaval Junior

Cite This: *ACS Omega* 2025, 10, 27525−27533

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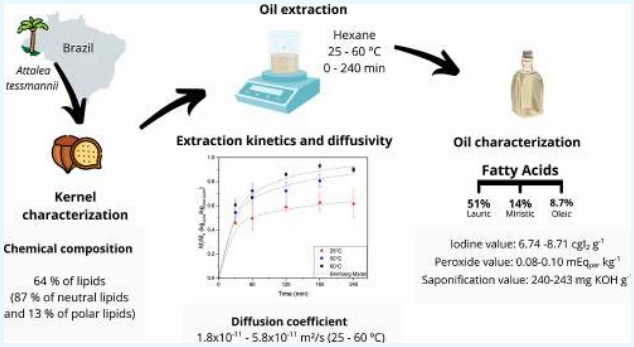
ABSTRACT: The Amazon rainforest, recognized for its biodiversity, is an important source of timber and nontimber products that support the livelihoods of traditional communities. Among these resources, palm fruits are especially important because of their economic and ecological value. This study investigates *Attalea tessmannii*, an underexplored palm species, focusing on the chemical composition of its kernel, lipid extraction (kinetics and diffusivity analysis), and oil characterization. The kernel exhibited a high lipid content of 64.19%. Lipid extraction using hexane reached maximum yield at 60 °C after 180 min. Among the kinetic models tested, the Brimberg model showed the best fit, with an activation energy of 27.5 kJ mol^{-1}. The diffusion coefficient ranged from 1.8 × 10^{-11} to 5.8 × 10^{-11} m^2/s (25−60 °C). The oil was rich in short-chain fatty acids, mainly lauric acid (~50%). The physicochemical parameters of *A. tessmannii* kernel oil indicated its potential for use in food, pharmaceutical, and biodiesel applications.



1. INTRODUCTION

The Amazon rainforest has great biodiversity and provides a variety of timber and nontimber products that support the income and survival of traditional communities. Nontimber forest products include various materials, such as fruits, nuts, herbs, and resins, that can be applied in different industrial sectors. Numerous of these materials remain underexplored and their sustainable exploitation has the potential to enhance the local economy through the production of chemicals and fuels, contributing to the conservation of the forest.[1,2]

Among the nontimber products, the fruits of palm trees (family *Arecaceae*) play a significant role in the forest ecosystem.[3] The palm tree *Attalea tessmannii* is an underexplored vegetable that yields a fruit popularly referred to as "*cocão*". This fruit is composed of epicarp, mesocarp, endocarp, and kernel. The kernel stands out as the most valuable part of the fruit due to its high oil content. It is commonly consumed raw or processed into a type of flour that is mixed with spices. Additionally, local cooperatives utilize cold pressing to extract the kernel oil, which is then used as an ingredient in regional cuisines. Furthermore, the remaining cake from the oil extraction is used to produce coal.[4] However, these products are primarily consumed by local communities, and there is a lack of information in the literature regarding the composition of *A. tessmannii* kernels.

Other palm tree fruits from the same region, such as *babassu* (*Attalea speciosa*) and *buriti* (*Mauritia flexuosa*), are known for their high oil content, presenting mostly lauric, myristic, oleic, and palmitic fatty acids.[5,6] These oils present high physical and chemical stability, along with emollient properties and bioactive compounds, being mostly used in the food and cosmetic industry as well as for biodiesel production.[7,8] Hence, the kernel from *A. tessmannii* presents potential for the development of new products for use in food, pharmaceutical, and energy sectors. However, similar investigations on *A. tessmannii* are still missing. This gap points out the novelty of the present study and its contribution to a better understanding of the potential applications of this underexplored Amazonian palm, supporting the sustainable use of Amazonian

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biodiversity, and offering economic opportunities for traditional communities. Therefore, the central hypothesis of this study is that *A. tessmannii* kernels are a promising source of oil with favorable characteristics for use in food, cosmetic, or biofuel sectors.

The extraction of vegetable oils, such as those from palm kernels, typically involves the use of organic solvents like hexane. This solvent is often used because of its operational simplicity, effectiveness, controllability, and ease of recovery.[9] Understanding the factors that influence oil extraction is essential for designing, optimizing, and controlling extraction processes. This can be achieved by conducting kinetic, diffusion, and thermodynamic studies. After extraction, the oil−solvent mixture is heated to evaporate and recover the solvent, leaving behind the crude oil. This crude oil may then undergo refining processes to remove impurities, improve physicochemical quality, and increase its commercial value and applicability across various industrial sectors.[10,11]

Despite the widespread application of oil extraction to various plant species, there is a lack of research focused on the oil extraction of *A. tessmannii* kernels and the physicochemical characteristics of the extracted oil. Hence, the present work aims to evaluate the chemical composition of *A. tessmannii* kernel, explore the parameters for lipid extraction, assess the kinetics and diffusivity coefficients of the extraction process, and characterize the obtained oil regarding its fatty acid profile and physical and chemical properties.

2. MATERIAL AND METHODS

2.1. Material Acquisition and Preparation. *A. tessmannii* ripened fruits were harvested directly from the soil by extractivists from December 2022 to February 2023. Figure 1 presents the location where the harvest was performed, at the Mogno State Forest, in Tarauacá, Acre, Brazil (8°08′08.0″S 70°45′54.0″W). After collection, the fruits were transferred to a local cooperative, *Cooperativa de Produtores Familiares e Economia Solidária da Floresta Estadual do Mogno* (COOPERMOGNO), where they were naturally dried and stored in a protected environment at 10 cm above the soil level. The parts of the fruit were separated by power and chainsaws, and the kernels were fragmented by maceration. Samples were kept at −18 °C until further experiments.

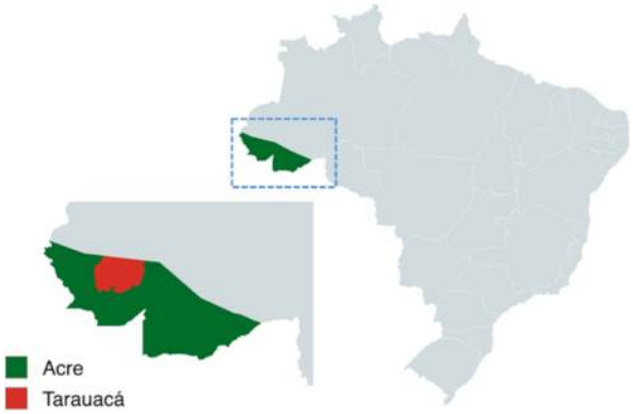

Figure 1. Harvest location of ripe *Attalea tessmannii* fruits: Mogno State Forest, Tarauacá, Acre, Brazil (8°08′08.0″S 70°45′54.0″W).

2.2. Kernel Characterization. The chemical proximal composition of kernels was determined according to AOAC methods.[12] The moisture content was evaluated by drying at 105 °C overnight. The ash content was evaluated in a muffle at 550 °C for 6 h. Protein content was determined by Kjeldahl method using a value of 5.3 for the *N* factor. The total lipid content was assessed following the Bligh & Dyer methodology,[13] with methanol and chloroform as solvents.[13] After lipid quantification, samples were stored at −18 °C for further analyses. The carbohydrate content was determined by difference, which was calculated by subtracting the measured proportions of moisture, ash, protein, and lipids from the total composition (100%).

The total neutral lipid content of the kernels was determined using the Soxhlet apparatus with hexane as the solvent at the condensing temperature. For that, 2 g of sample was placed in a paper cartridge, and 150 mL of solvent was refluxed for 6 h. Then, the solvent underwent rotatory evaporation, and lipids were quantified through gravimetric analysis. Following quantification, samples were stored at −18 °C for subsequent analyses.

2.3. Lipid Extraction. Lipid extraction was performed using hexane (5:1 solvent-to-kernel, w/w ratio) at 25, 50, and 60 °C under agitation with a magnetic stirrer at 200 rpm. The glass flasks containing the samples were immersed in a water bath, and samples were withdrawn at 15, 30, 60, 120, 180, and 240 min. The total amount of lipids in the extracts was quantified gravimetrically after centrifugation and solvent evaporation at 70 °C.

2.4. Kinetic Analyses. The experimental data were fitted to the pseudo-first-order and Brimberg models, given by eqs 1 and 2, respectively. These models are commonly used to describe oil adsorption processes. Since solid−liquid extraction is the inverse of adsorption, adsorption kinetics equations can effectively be applied to model extraction data.[14,15]

$$\frac{m_l}{m_{tl}} = 1 - \exp(-k_1 t) \tag{1}$$

$$\frac{m_l}{m_{tl}} = 1 - \exp(-k_2 t^n) \tag{2}$$

in which m_l is the lipid content at time t (g 100 g^{-1}), m_{tl} is the total lipid content of the kernel (g 100 g^{-1}), t is the time (min), k_1 and k_2 are the extraction rate constants (min^{-1}) and n is the model coefficient.

The temperature effect on the extraction rate constant was calculated by the Arrhenius equation, presented in eq 3.

$$k = k_0 \exp\left(\frac{-E_a}{RT}\right) \tag{3}$$

in which k is the extraction rate constant (min^{-1}), k_0 is the frequency factor (min^{-1}), E_a is the activation energy (J mol^{-1}), R is the ideal gas constant (8.314 J mol^{-1} K^{-1}), and T is the absolute temperature (K).

2.5. Diffusion Analysis. Diffusivity was determined using the modified Fick's law of diffusion,[16] assuming a homogeneous medium, spherical particles, and constant concentration, according to eq 4.

$$\frac{M_t}{M_\infty} = 1 - \sum_{n=1}^{\infty} A_n \exp(-B_n t) \tag{4}$$

where t is the time (s), A_n and B_n are the coefficients of the model that involve the diffusion coefficient, and M_t and M_∞ are the masses of oil (kg of oil kg^{-1}) that diffused in time t and

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infinite time, respectively. This model assumes that the solvent washes away the oil on the particle surfaces in a short period through a nondiffusive process. For sufficiently long times, Fick's equation can be rewritten according to eq 5, where A is the pre-exponential coefficient, given by eq 6.

$$\frac{M_t}{M_\infty} = 1 - A\exp(-B_1 t) \tag{5}$$

$$A = \left(1 - \frac{M_t}{M_\infty}\right) A_1 \exp(-B_1 t_0) \tag{6}$$

The coefficients A_1 and B_1 can be obtained by eqs 7 and 8, respectively. The equation for determining A_1 is associated with spherical geometry and B_1 with the effective diffusivity coefficient, where D_e is the effective diffusion coefficient (m^2 s^{-1}) and R is the average radius of the particle (m).

$$A_1 = \frac{6}{\pi^2} \tag{7}$$

$$B_1 = \frac{D_e \times \pi^2}{R^2} \tag{8}$$

2.6. Oil Characterization. *2.6.1. Analysis of Fatty Acids Methyl Esters.* The lipids (30 mg) were esterified according to Hartman et al.[17] using 500 μL of KOH (0.1 M). The mixture was vortexed and kept in a water bath at 60 °C for 1.5 h. Then, 1.5 mL of 1 M H_2SO_4 was added to the flasks, and the mixture was incubated at 60 °C for 1.5 h. After cooling, the samples were vortexed with 2 mL of *n*-hexane, followed by a rest (10 min) to facilitate phase separation. The *n*-hexane phase was analyzed according to Borges et al.[18] in a gas chromatograph (GC−FID, Shimadzu, 2010AF, Tokyo, Japan), equipped with a capillary column of fused silica SP-2560 (100 m × 0.25 mm x 0.2 μm) and using a flame ionization detector (FID). The carrier gas was N_2, and the flame gases were H_2 and synthetic air. The sample split ratio was 1:100. The column temperature was adjusted to 100 °C for 15 min and then increased to 250 °C at a heating ramp of 4 °C min^{-1}, remaining at this temperature for 45 min. The injector and detector temperatures were 250 and 255 °C, respectively. For fatty acid identification, the retention times were compared to those of a methyl ester standard (Supelco, 37-component FAME mix) previously analyzed by gas chromatography−mass spectrometry (GC−MS).

2.6.2. Analysis of Iodine, Acidity, Peroxide, and Saponification Indices. The iodine, acidity, peroxide, and saponification indices were determined using a nuclear magnetic resonance (NMR) spectrometer (Bruker High Field, model 400 MHz Ascend, Rheinstetten, Germany) with a 9.4 T magnet (400 MHz at ^1H) and a 5 mm diameter probe. For spectra acquisition, 20 mg of lipids were dissolved in 0.7 mL of $CDCl_3$ and introduced into the equipment. A standard ^1H pulse sequence was employed, consisting of a 90° pulse, an acquisition time of 9.109 s, 2000 scans, and a spectral window of 24.03 kHz.

2.6.3. Fourier Transform Infrared Spectroscopy and Differential Scanning Calorimetry. The lipid extracts were analyzed by Fourier transform infrared (FTIR) spectroscopy (Shimadzu, Prestige 21, 210.045, Japan) in the range of 400−4000 cm^{-1}. The thermal properties of the extracts were determined by differential scanning calorimetry (DSC) (Shimadzu, DSC-60, Japan).

2.7. Statistical Analysis. Experimental data were analyzed using analysis of variance (ANOVA) and Tukey's test (95% confidence) with Statistica 13.5 (TIBCO Software Inc.). The kinetic and diffusion parameters were obtained by nonlinear regression using the MatLab software, employing the Levenberg−Marquardt algorithm. The quality of fit and accuracy were evaluated by the sum of square errors (SSE) (eq 9), the determination coefficient (R^2) (eq 10), the adjusted determination coefficient (R^2_{adj}) (eq 11), and the root-mean-square error (RMSE) (eq 12).

$$\mathrm{SSE} = \sum_{i=1}^{n} (y_{i,\mathrm{model}} - y_{i,\mathrm{exp}})^2 \tag{9}$$

$$R^2 = \left(\frac{\sum_{i=1}^{n} (y_{i,\mathrm{exp}} - \overline{y}_{i,\mathrm{exp}})^2 - \sum_{i=1}^{n} (y_{i,\mathrm{exp}} - \overline{y}_{i,\mathrm{model}})^2}{\sum_{i=1}^{n} (y_{i,\mathrm{exp}} - \overline{y}_{i,\mathrm{exp}})^2} \right) \tag{10}$$

$$R^2_{\mathrm{adj}} = 1 - (1 - R^2) \cdot \left(\frac{n-1}{n-p} \right) \tag{11}$$

$$\mathrm{RMSE} = \sqrt{\frac{\sum_{i=1}^{N} (y_{i,\mathrm{exp}} - y_{i,\mathrm{model}})^2}{N}} \tag{12}$$

where N is the number of experimental points, $y_{i,\mathrm{model}}$ is each value of the y predicted by the fitted model, $y_{i,\mathrm{exp}}$ is each value of y measured experimentally, $\overline{y}_{i,\mathrm{exp}}$ is the average of y experimentally measured, $\overline{y}_{i,\mathrm{model}}$ is the average of predicted values, and p is the number of parameters of the fitted model.

3. RESULTS AND DISCUSSION

3.1. Chemical Composition of the Kernel. *A. tessmannii* kernel presented 64.19 ± 3.77% of total lipids, 22.53 ± 2.66% of proteins, 11.06 ± 1.57% of carbohydrates, 3.11 ± 0.24% of ash, and 2.04 ± 0.03% of moisture. High contents of oil were expected in the almond. Additionally, the presence of high protein content indicates the potential of this kernel as a nutritional resource. The neutral lipid content analysis, performed with hexane, resulted in 55.68 ± 2.44% lipids, indicating a low amount of polar lipids in the almonds. To the best of our knowledge, the proximate composition of the material studied in this work has not been previously documented in the literature. Similar lipid content (62%) was found for babassu (*A. speciosa M.*) kernel by Oliveira et al.[19] The authors also reported 8% protein, 28% carbohydrates, and 1% ash. Moreover, the results obtained in the presented work for total lipids, protein, and ash content are within the range reported by Venkatachalam and Sathe[21] for edible nuts: 42.88−66.71%, 7.5−21.56%, and 1.16−3.28%, respectively.

3.2. Extraction Kinetics and Activation Energy. Figure 2 presents the lipid content over time at all analyzed temperatures, with the lines representing the Brimberg model fitted to the experimental data. It is possible to observe two distinct stages during lipid extraction: an initial rapid phase, often referred to as the washing stage, followed by a slower phase driven by diffusion. This two-step behavior is common in solid−liquid extraction systems and results from the transition from easily accessible lipids on the particle surface to those found within the cellular structure, which require diffusion through the matrix. In the washing stage, the solvent

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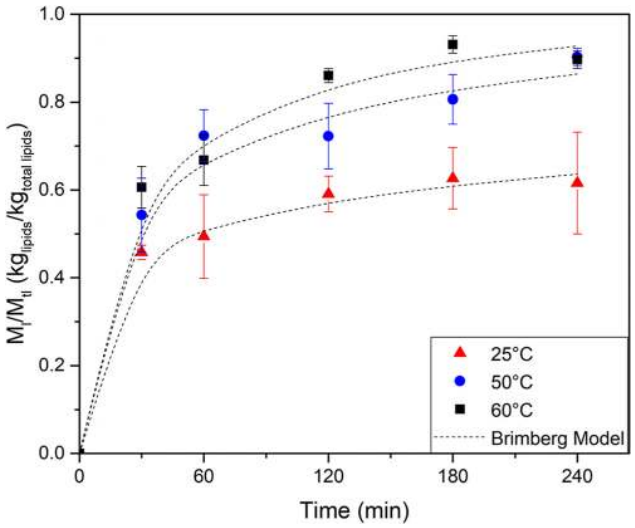

Figure 2. Lipid extraction kinetics from *Attalea tessmannii Burret* at different temperatures.

penetrates the solid matrix, disrupting cell structures. As a result, internal compounds become exposed and are rapidly transferred into the extraction medium.[20]

The results showed that lipid extraction increased with temperature, reaching its maximum at 60 °C after 180 min, yielding 51.84% of lipids. In contrast, at 25 °C, the extraction yield was approximately 1.5 times lower than the values obtained at 60 °C, with a maximum lipid content in the extracts of 32.9% achieved after 120 min. The increase in lipid yield with temperature is attributed to the reduction in solvent viscosity, as well as the enhanced solubility and diffusivity of lipids in the solvent, which facilitate the mass transfer.[22] Similar results were found by Alale et al.[25] that extracted oil from shea nut kernels using petroleum ether and *n*-hexane at 45−60 °C found that steady-state conditions occur between 110 and 130 min.

Table 1 presents the kinetic parameters and statistical indices obtained by fitting the experimental data to pseudo-first-order and Brimberg models. The Brimberg model was the most suitable for representing the extraction kinetics at all temperatures, as evidenced by the highest values of R^2_{adj} and the lowest values of SSE and RMSE. The adequacy of the Brimberg model suggests that lipid extraction from *A. tessmannii* follows a nonlinear kinetic pattern with a variable extraction rate. The kinetic constant k_2 decreased as the temperature increased, indicating that the extraction rate was higher at lower temperatures (25−50 °C) and decreased at 60 °C. In contrast, the parameter *n* increased with temperature, suggesting a tendency toward more linear kinetic behavior at higher temperatures. The variation in kinetic constants compared to other materials reflects differences in matrix structure and lipid accessibility. Pohndorf et al.[24] evaluated the lipid extraction from *Spirulina* sp. at 20−60 °C, and the Brimberg model was also suitable to describe experimental data. These researchers obtained values of *k* from 0.113 to 0.446 min^{-1} and values of *n* from 0.43 to 0.75. Other authors evaluated the first-order model for the lipid extraction process from Ghana shea nut at 20−35 °C and obtained values of *k* from 0.0076 to 0.0118 min^{-1}.[25]

Table 1. Kinetic Parameters of Lipid Extraction from *Attalea tessmannii Burret* at 25, 50, and 60 °C

	25 °C	50 °C	60 °C
		Pseudo-First Order	
k_1 (min^{-1})	0.00703 ± 0.001[b]	0.01782 ± 0.002[a]	0.02197 ± 0.002[a]
R^2	0.4947	0.8538	0.9405
SSE	0.1425	0.07697	0.03617
RMSE	0.1688	0,1241	0,08505
		Brimberg Model	
k_2 (min^{-1})	0.2614 ± 0.05[a]	0.1945 ± 0.03[ab]	0.1453 ± 0.05[b]
N	0.2468 ± 0.08[b]	0.4247 ± 0.06[a]	0.528 ± 0.06[a]
R^2	0.9952	0.9849	0.9906
R^2_{adj}	0.994	0.984	0.9883
SSE	0.00134	0.00793	0.528
RMSE	0.01833	0.04451	0.03774

Figure 3 shows the Arrhenius plot used to determine the activation energy of the lipid extraction process. The activation energy of the lipid extraction was 27.5 kJ mol^{-1}. Activation energy is the minimum energy required to begin an extraction process, and lower activation energy values would indicate a predominantly washing-controlled process, whereas higher values could indicate resistance to mass transfer.[26] The moderate activation energy value obtained in the present work indicates that the process is mainly diffusion-controlled, which aligns with the nature of hexane extraction and the structural characteristics of oil-rich kernels. This result is similar to the ones obtained by Shuai et al.[23] (26.42−29.59 kJ mol^{-1}) for macadamia oil extraction. Moreover, Zhang et al.[27] calculated the activation energy using different solvents for the extraction of *Pachira macrocarpa* seeds oil and obtained values ranging from 25.71 to 32.35 kJ mol^{-1}.

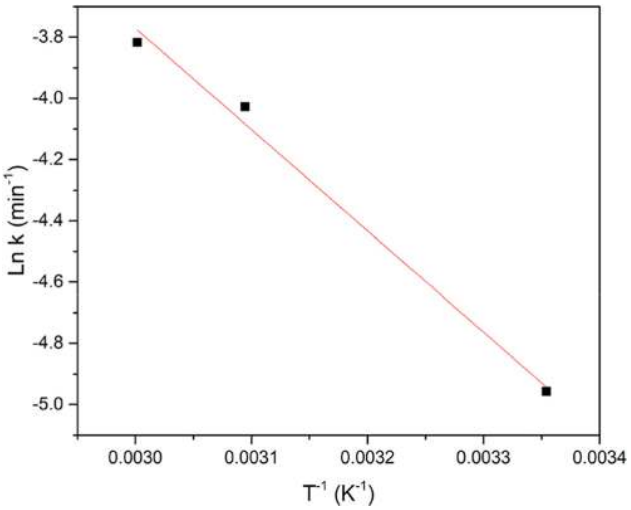

Figure 3. Arrhenius plot for lipid extraction from *Attalea tessmannii* kernel.

3.3. Diffusion Analyses. Table 2 presents the results of fitting the diffusive model to the experimental data, along with the statistical parameters of the fit. The values of the A coefficient decreased with the increase in temperature. The decrease in the A coefficient with temperature may reflect a reduction in the contribution of external mass transfer in comparison to internal diffusion, as higher temperatures tend to enhance solvent penetration. Moreover, an increase in the extraction rate was observed in the first minutes of the

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Table 2. Adjustment Parameters of the Diffusion Model at Different Oil Extraction Temperatures from *Attalea tessmannii* Kernel

extraction temperature (°C)	25	50	60
A ($\times 10^2$)	99.9	94.4	95.4
B ($\times 10^4$)	1.18	2.71	3.78
SSE	0.0113	0.0091	0.0048
R^2	0.810	0.903	0.954
$R^2_{adj.}$	0.783	0.889	0.947
RMSE	0.1062	0.0952	0.0693

operation, as shown in Figure 2, indicating that this initial stage was relatively small and corresponds to the washing of the oil from the surface of the sample. Therefore, diffusion dominated the extraction process over time, supporting the applicability of the diffusive model. Furthermore, the increase in the B coefficient with temperature reinforces the dominance of the diffusion-controlled regime, in which the internal mass transfer becomes the limiting step.[22] At higher temperatures, especially 60 °C, the model fit improved, as evidenced by an adjusted coefficient of determination (R^2_{adj}) of 0.95 and a lower root-mean-square error (RMSE).

The determination of the diffusivity coefficient (D_e) is important for understanding the oil extraction phenomenon and simulating the behavior of industrial extractors. The diffusion coefficient increased from 1.8×10^{-11} to 5.8×10^{-11} m^2/s with an increase in temperature from 25 to 60 °C, as shown in Figure 4. This increase in the diffusion coefficient

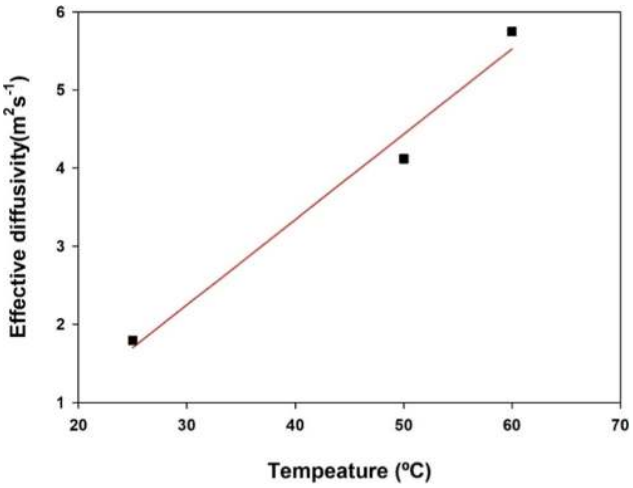

Figure 4. Influence of extraction temperature on effective diffusivity of oil from *Attalea tessmannii* kernel.

with temperature can be attributed to the enhanced solubility of the crude oil and the solvent at higher temperatures, favoring solute diffusion.

Crude oil extracted from oilseeds has some minor components. Among them are tocopherols, which are intrinsically linked to oil and phospholipids that are part of the cell membrane and are responsible for maintaining cellular integrity. The amount of these compounds in the material structure can affect the extraction rate and consequently the diffusion coefficient.[28] Wickramasinghe Mudiyanselage and Wickramasinghe[29] studied the extraction of canola oil with hexane as solvent, finding values for the diffusivity coefficient in the range of 1.3×10^{-12} to 3.0×10^{-12} m^2/s, at temperatures from 25 to 60 °C, respectively. When compared to the extraction of wild coconut seeds, the difference in diffusion coefficient values can be attributed to the particle size and structural differences between the raw materials. Therefore, the morphological characteristics of *A. tessmannii* may contribute to the relatively high D_e values observed, which is relevant for the design of scalable extraction systems.

3.4. Oil Characterization. *3.4.1. Fatty Acids Methyl Esters (FAMEs) Profile.* Table 3 shows the FAME profile of the

Table 3. Fatty Acid Methyl Ester Profile of the Lipid Extracts from *Attalea tessmannii* Kernel Obtained with Hexane at 25, 50, and 60 °C

fatty acid methyl ester (area, %)	25 °C	50 °C	60 °C
caproic acid (C6:0)	0.28 ± 0.07[a]	0.38 ± 0.03[a]	0.35 ± 0.03[a]
caprylic acid (C8:0)	7.14 ± 0.81[a]	8.05 ± 0.63[a]	8.19 ± 0.62[a]
capric acid (C10:0)	6.78 ± 0.21[a]	7.12 ± 0.13[a]	6.97 ± 0.25[a]
undecylic acid (C11:0)	0.03 ± 0.00[a]	0.03 ± 0.00[a]	0.03 ± 0.00[a]
lauric acid (C12:0)	49.65 ± 1.5[a]	50.07 ± 4.0[a]	49.60 ± 2.1[a]
tridecylic acid (C13:0)	0.03 ± 0.00[a]	0.04 ± 0.00[a]	0.04 ± 0.00[a]
myristic acid (C14:0)	14.61 ± 0.82[a]	14.16 ± 1.35[a]	14.28 ± 0.52[a]
palmitic acid (C16:0)	7.42 ± 0.23[a]	6.98 ± 0.99[a]	7.12 ± 0.78[a]
stearic acid (C18:0)	3.18 ± 0.53[a]	2.95 ± 0.76[a]	3.04 ± 0.41[a]
oleic acid (C18:1)	8.62 ± 0.91[a]	8.04 ± 1.02[a]	8.24 ± 0.54[a]
linoleic acid (C18:2)	2.10 ± 0.13[a]	1.92 ± 0.17[a]	2.02 ± 0.09[a]
arachidic acid (C20:0)	0.06 ± 0.01[a]	0.06 ± 0.00[a]	0.05 ± 0.00[a]
eicosenoic acid (C20:1)	0.04 ± 0.00[a]	0.04 ± 0.00[a]	0.04 ± 0.00[a]
heneicosanoic acid (C21:0)	0.00 ± 0.00[a]	0.07 ± 0.00[a]	0.00 ± 0.00[a]
behenic acid (C22:0)	0.02 ± 0.00[a]	0.03 ± 0.00[a]	0.00 ± 0.00[a]
Lignoceric acid (C24:0)	0.05 ± 0.00[a]	0.07 ± 0.01[a]	0.03 ± 0.00[a]
total saturated fatty acids (SFAs)	**89.24**	**90.00**	**89.70**
total monounsaturated fatty acids (MUFAs)	**8.65**	**8.07**	**8.28**
total polyunsaturated fatty acids (PUFAs)	**2.10**	**1.92**	**2.02**

oil extracted from *A. tessmannii* kernels at different temperatures. The results showed that the FAME profile did not vary with the increase in temperature, indicating that temperature had no significant impact on the fatty acid composition. This stability can be attributed to the high content of saturated FAMEs in the oil, which comprises around 90% of its composition. This thermal stability suggests that the extraction conditions (25−60 °C) preserved the fatty acids, preventing degradation, isomerization, or oxidation processes commonly associated with higher temperatures. The analysis revealed a composition rich in lauric acid (C12:0), accounting for approximately 50% of the oil. This fatty acid is a primary source of medium-chain triglycerides, which are rapidly metabolized to provide energy and are widely used in infant formulas and athletic supplements. Additionally, the oil contained nearly 14% myristic acid (C14:0), and 8% oleic acid (C18:1). This fatty acid profile is comparable to that reported for babassu kernel, palm kernel, and coconut oil.[5,29,30] According to Neto et al.,[5] the fatty acid methyl ester profile of

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Table 4. Physicochemical Characterization of the *Attalea tessmannii* Kernel Oil Obtained at 25, 50, and 60 °C

parameters	25 °C	50 °C	60 °C
peroxide value (PV) ($mEq_{peroxides}$ kg_{oil}^{-1})	0.08 ± 0.01[a]	0.09 ± 0.00[a]	0.10 ± 0.00[a]
saponification value (SV) (mg KOH g^{-1})	240.08 ± 1.41[a]	240.23 ± 1.79[a]	242.96 ± 1.90[a]
free fatty acid (FFA) (%, oleic acid)	2.87 ± 0.05[a]	2.82 ± 0.06[a]	2.76 ± 0.09[a]
iodine value (IV) (cgI_2 g^{-1})	6.74 ± 0.81[a]	7.31 ± 0.99[a]	8.71 ± 0.72[a]

babassu kernel oil includes 40−55% of C12:0, 11−27% of C14:0, 7.8−20% of C18:1, 5.2−11% of C16:0, 2.6−7.3% of C8:0, 1.8−7.4% of C18:0, 1.4−6.6% of C18:2. Similarly, palm kernel oil contains 48% of lauric acid (C12:0), 16% of myristic acid (C14:0), 15% of oleic acid, and 8% of palmitic acid.[29] The similarity in fatty acid composition between *A. tessmannii* and other palm kernels reinforces the potential application of this species as a source of medium-chain fatty acids for the food, pharmaceutical, and biofuel industries, and its compositional stability across different extraction temperatures may offer industrial advantages.

3.4.2. Peroxide, Saponification, Free Fatty Acid and Iodine Indices. Table 4 presents the physicochemical parameters of the oil extracted at 25, 50, and 60 °C. In general, the physicochemical parameters obtained in this study did not vary with temperature and were consistent with those reported by other authors for oils containing high levels of saturated fatty acids, such as coconut and babassu oils.[7,31] This thermal stability can be attributed to the chemical structure of saturated fatty acids, which are less reactive and more resistant to thermal degradation than unsaturated ones. Therefore, variations in extraction temperature within the studied range (25−60 °C) are unlikely to affect the physicochemical integrity of oils rich in these compounds.

Moreover, the values presented in Table 4 are in the expected range for biodiesel production,[32] and are within the limits required by the regulations of Codex for vegetable oils.[33] Furthermore, due to the similarity of *A. tessmannii* kernel oil and babassu oil, this oil may also be interesting for cosmetic use, due to the emollient properties of saturated fatty acids and anti-inflammatory activity of lauric, oleic, and myristic acids.[7,19] These fatty acids penetrate the skin barrier effectively and support skin hydration and protection. Lauric acid, in particular, possesses antimicrobial and anti-inflammatory properties, making it beneficial for formulations aimed at sensitive or acne-prone skin.[34]

The low peroxide values (PV) indicated low levels of free radicals and lipid oxidation. These values are also in agreement with the low levels of free fatty acids (FFA), suggesting that *A. tessmannii* kernel oil presents high quality and stability. Similarly, Pandiselvam et al.[35] reported PV values of zero and FFA levels varying from 0.07 to 0.71 for coconut oil. Regarding the saponification values (SV), the result obtained in the present work was similar to the one obtained for coconut (244.19 mg KOH g^{-1})[31] and for babassu oil (249 mg KOH g^{-1}).[7] The SV is an indication of the average molecular weight of fatty acids in the oil, corroborating the results found for the FAME profile, which indicated the presence of short-chain fatty acids. The iodine value (IV) measures the level of unsaturation of oils. This parameter is important for biodiesel production, as the higher this value, the lower the oil oxidative stability. Similar values (6.3−9.4 cgI_2 g^{-1}) were obtained for coconut oil by Pandiselvam et al.[35]

3.4.3. Fourier Transform Infrared Spectroscopy and Differential Scanning Calorimetry. Figure 5 presents the FTIR spectra of *A. tessmannii* kernel oil. The spectra are consistent with those of other vegetable oils, and the main peaks were observed in the regions of 1100−1250 cm^{-1}, 1700−1800 cm^{-1}, and 2800−3100 cm^{-1}.[36] The peaks within the 1100−1250 cm^{-1} range correspond to −C−O stretching and $-CH_2-$ bending vibrations. In the 1700−1800 cm^{-1} region, the peaks are attributed to C═O stretching, while the 2800−3100 cm^{-1} range is associated with −C−H ($-CH_2$) stretch vibrations.[37−39] These characteristic peaks are typically associated with triglyceride structures found in vegetable oils, confirming the presence of ester functional groups. The strong band around 1745 cm^{-1} (C═O) is indicative of ester carbonyl stretching, while bands near 2920 and 2850 cm^{-1} correspond to asymmetric and symmetric stretching of CH_2 groups in long-chain fatty acids. The spectrum, therefore, corroborates the lipid nature and high degree of saturation of the sample.

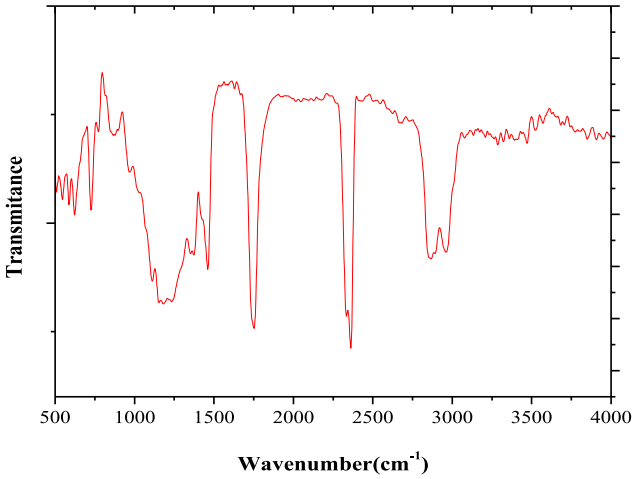

Figure 5. *Attalea tessmannii* kernel oil FTIR spectra.

The results of the DSC analyses of the *A. tessmannii* kernel oil are presented in Figure 6. The findings indicate that the melting point of the oil ranges from 0 to 36 °C, with a transition peak at approximately 26 °C. Similar results were obtained by Bauer et al. (2020),[7] that found a melting point in the same value for babassu oil. Tan and Man[40] also found melting points of approximately 26 °C for palm oil and 22 °C for coconut oil. The melting behavior reflects the high concentration of medium-chain saturated fatty acids, which contributes to the semisolid consistency of the oil at room temperature. This thermal profile is favorable for cosmetic and food applications that require fats with good spreadability and stability at ambient conditions.[41] Furthermore, the relatively low melting point is also beneficial for biodiesel applications, as it suggests favorable handling and storage characteristics, reducing or eliminating the need for preheating prior to processing or use.[42]

With DSC, an enthalpy change of −79.68 J g^{-1} was obtained during the phase transition. This high enthalpy of fusion is characteristic of oils rich in saturated fats, which have strong

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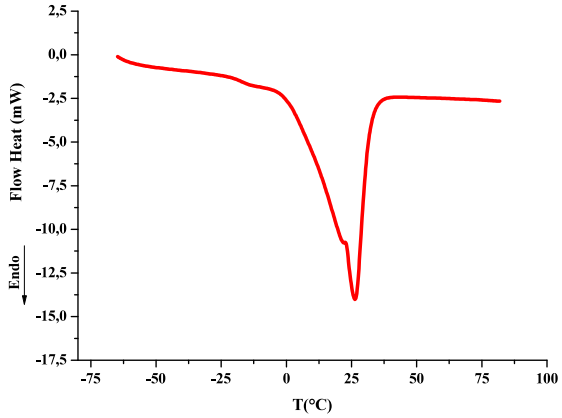

Figure 6. Thermogram of the crystallization and melting of *Attalea tessmannii* kernel oil.

van der Waals interactions due to the linear structure of their fatty acid chains. Figure 7 displays the solid fat content (SFC)

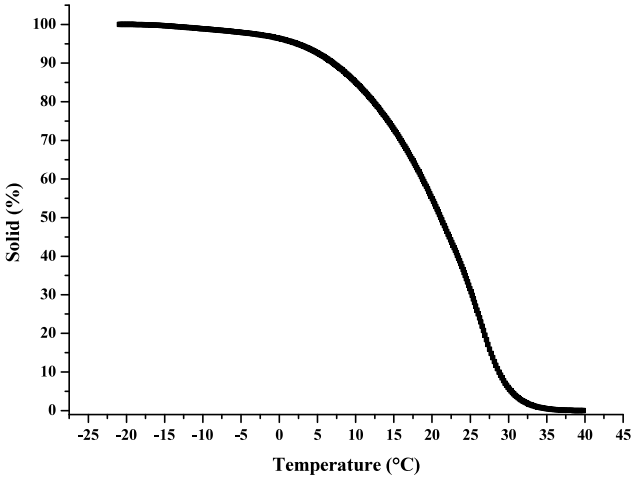

Figure 7. TG/DTG curves of *Attalea tessmannii* kernel oil.

curves for the *A. tessmannii* oil. The sample exhibited an SFC of 45% at 22 °C and 35% at 25 °C. At 10 °C, only 15% of the sample was liquefied, emphasizing the characteristics of an oil that is predominantly composed of saturated fatty acids. The relatively high SFC at room temperature reinforces the potential of this oil in energy, food, and cosmetic applications, as oils with elevated SFC values tend to exhibit better oxidative stability and longer shelf life.

4. CONCLUSION

The present study evaluated the proximate composition of *A. tessmannii* kernel, investigated the oil extraction process through kinetic and diffusivity analyses, and carried out the physicochemical characterization of the extracted oil. The kernel presented high lipid content (64.19%), and the Brimberg model was the most suitable for describing the extraction process at all temperatures (25−60 °C). The diffusion coefficient increased with temperature due to the enhanced solubility of the crude oil at higher temperatures. The oil, obtained at 25−60 °C, contained approximately 90% short-chain fatty acids, primarily lauric acid. The physicochemical properties of the oil remained stable across a range of temperatures, and, due to its high thermal and oxidative stability, it falls within the expected range for biodiesel production and meets Codex standards for vegetable oils. Additionally, *A. tessmannii* oil shows potential for cosmetic applications, particularly due to its emollient properties, attributed to saturated fatty acids. These results show that *A. tessmannii* has economic potential and can be a sustainable resource for both traditional Amazonian communities and industry. Its use can help support local economies and contribute to rainforest conservation.

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Ricardo Scherer Pohndorf: Writing—review and editing; Methodology, Validation, Formal analysis. **Anelise Christ-Ribeiro:** Methodology, Validation, Formal analysis. **Isaac dos Santos Nunes:** Writing—review and editing; Methodology, Validation, Formal analysis. **Débora Pez Jaeschke:** Writing—review and editing; Methodology, Validation, Formal analysis. **Nauro da Silveira Jr.:** Conceptualization; Writing—review and editing; Methodology, Validation, Formal analysis. **Luiz Antonio de Almeida Pinto**: Resources, Writing—review and editing, Supervision. **Tito Roberto Sant'Anna Cadaval Junior**: Writing—review and editing, Supervision, Project administration.

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Charcoal produced from *Attalea tessmannii* Burret. fruit wastes

Carvão vegetal produzido de resíduos de frutos de *Attalea tessmannii* Burret.

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Abstract

Charcoal produced from wastes from the production of oil from palm fruits contributes to a non-destructive production of the forest, encourages extractivism and complements the income of traditional populations in protected areas. The objective of this research was to determine the quality of charcoal from *Attalea tessmannii* Burret. fruits produced in a traditional community located in Gregório River State Forest Complex (Complexo de Florestas Estaduais do Rio Gregório), Acre, Brazil, and compare the charcoal of the fruits with traditional charcoal sold for barbecue. Thus, samples of charcoal from *Attalea tessmannii* fruit wastes from different pyrolysis methods were collected. The following parameters were analyzed: bulk density, moisture content (MC), volatile materials content (VM), ash content (AC) and fixed carbon content (FC) and higher heating value (HHV). *Attalea tessmannii* fruit waste charcoal had positive characteristics for food cooking: low moisture content (4.22%) and volatile materials content (5.94%) and high bulk density (330 kg m^{-3}), fixed carbon content (72.11%) and higher heating value (7,323 kcal kg^{-1}). However, the product has a high ash content. When compared to charcoal already sold for barbecue use, charcoal from *Attalea tessmannii* fruit waste showed high quality potential to be included in the market, in order to complement the income of the traditional community involved in the production process.

Keywords: Bioenergy; Energy sustainability; Pyrolysis; Non-wood product.

Resumo

O carvão vegetal produzido de resíduos da extração de óleo de frutos de palmeiras contribui para uma produção não destrutiva da floresta, incentiva o extrativismo e complementa a renda das populações tradicionais das unidades de conservação. O objetivo deste trabalho de pesquisa foi determinar a qualidade do carvão vegetal de frutos da espécie *Attalea tessmannii* Burret. produzido em uma comunidade tradicional localizada no Complexo de Florestas Estaduais do Rio Gregório, Acre, Brasil, e comparar o carvão dos frutos com carvões vegetais tradicionais comercializados para a cocção de alimentos. Para isso, foram coletadas amostras de carvão vegetal de resíduos de frutos de *Attalea tessmannii* de diferentes métodos de carbonizações. Foram analisadas a densidade a granel, os teores de umidade (TU), de materiais voláteis (TMV), de cinzas (TCZ) e de carbono fixo (TCF) e o poder calorífico superior (PCS). O carvão vegetal do fruto de *Attalea tessmannii* apresentou características positivas para uso na cocção de alimentos, como baixos teores de umidade (4,22%) e materiais voláteis (5,94%), elevados: densidade a granel (330 kg m^{-3}), de teor de carbono fixo (72,11%) e de poder calorífico superior (7323 kcal kg^{-1}). Como pontos negativos para o referido uso, o produto apresenta elevado teor de cinzas (20,65%). Quando comparado com carvões vegetais já comercializados para uso doméstico, o carvão vegetal do fruto de *Attalea tessmannii se* mostrou com elevado potencial de qualidade para ser incluído

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no mercado, sendo uma alternativa produtiva para complementar a renda da comunidade tradicional envolvida no processo produtivo.

Palavras-chave: Bioenergia; Sustentabilidade energética; Pirólise; Produto não-madeireiro.

INTRODUCTION

The plan for the sustainable use of forest products, especially oilseed species from neotropical forests, has the function of maintaining the forest, preserving the environment and generating income in traditional communities (Stachiw et al., 2016). In the natural forests of the Amazon region, one of the botanical families that stand out is Arecaceae, having a wide variety of species. These palm trees stand out from a natural, economic and ecological point of view, in addition to being a relevant part of the diet of human beings in the form of fruits and hearts of palm and even elaborated products such as sweets, beverages, oils and handicrafts (Lima et al., 2003). In Acre state, northern region of Brazil, of the 18 forest typologies that occur, 12 have palm trees, covering around 86% of the state's territory (Secretaria do Meio Ambiente, 2010). Palm trees participate in extractive economies with an important impact on supplementing the income of traditional populations.

The process of extracting almonds from palm fruits for use in food, pharmaceutical and chemical industries implies the generation of an enormous amount of wastes. In the case of *Attalea tessmannii*, the residues are the endocarp and mesocarp of the fruit. These components, which are discarded without recovery, could go through thermal processes and be used in energy production systems. This change in behavior enables the achievement of sustainability in this production chain.

Brazil is among the countries that most use renewable energy, and when it comes to bioenergy, the products that stand out the most are charcoal and firewood. The origin of the raw material for this purpose, in its vast majority, comes from wood from planted forests (*Eucalyptus* and *Pinus*), from wood wastes of native species, or even from agro-industrial wastes (Soares et al., 2014; Reis et al., 2015). The use of other sources of raw material for the production of charcoal emerges as a potential alternative to reduce the pressure on native forests. In this context, the use of fruits or parts of palm trees allows for the production of charcoal with quality equivalent or superior to that of wood charcoal, enabling a wide energy application of this material (Silva et al., 1986; Teixeira, 2008; Reis et al., 2015; Evaristo et al., 2016; Protásio et al., 2017; Padilha, et al., 2018).

Charcoal is used for various purposes, such as cooking food, barbecue, fireplaces, thermoelectric plants, cement industry, water and beverage purification, pharmaceutical, steel and metallurgical industries, gas mask filters, and more. To be considered of good quality for domestic use, charcoal must have a low moisture content (< 5%), high apparent relative density (> 280 g cm^{-3}), high fixed carbon content (> 75%), higher heating value (> 4500 kcal kg^{-1}), low volatile materials (< 25%) and a low ash content (< 2.5%) (Neves et al., 2011; Dias Júnior et al., 2020; Dias Júnior et al., 2021). In addition, charcoal is expected to have good combustion and not compromise the environment and human health through potentially toxic gas emissions in the smoke (Dias Júnior et al., 2015; Dias Júnior et al., 2017).

In order to standardize the quality of charcoal for domestic use, São Paulo state, Brazil, was the first and only Brazilian state to create a voluntary resolution, called "Premium Charcoal Seal" – SAA n. 40 of 2015. This regulation assigns minimum quality requirements for the characteristics of charcoal for domestic use, and for meeting legal, environmental and social requirements during its production (São Paulo, 2015). In Europe, for example, the EN 1860-2 (European Committee for Standardization, 2005) standard regulates the quality of charcoal and appliances to be used in the domestic environment.

The existence of this standardization initiative and of several studies on the use and quality of charcoal for cooking food (Rosa et al., 2012; Brand et al., 2015; Costa et al., 2017; Monteiro et al.,2019, Oliveira et al., 2019; Anater et al., 2019; Dias Júnior et al., 2015, 2017, 2020, 2021) shows the relevance of this theme. However, the limited amount of information on the potential of palm trees for energy purposes, especially of *Attalea tessmannii*, shows the

importance and contribution of this study to the investigation of charcoal quality and valorization of this product. This could result in an improvement in the quality of life and income of traditional populations in the Amazon area.

Considering the existence of some studies that found that charcoal from species in the genus *Attalea* have the desired quality properties for cooking food (Reis et al., 2015; Protásio et al, 2017), the hypothesis is that the charcoal from the wastes of *Attalea tessmannii* fruits could qualify for this purpose. Thus, the aim of this research was to investigate the quality of charcoal from *Attalea tessmannii*. fruits from a traditional community located in the Gregório River State Forest Complex, Acre, northern Brazil, and to compare the charcoal of the fruits with traditional charcoal sold for cooking food.

MATERIAL AND METHODS

The charcoal used in this study was produced from fruit wastes (mesocarp and endocarp) of the *Attalea tessmannii* Burret. palm tree. These wastes were generated in the process of extracting the almonds for oil production. This species is native to the neo-tropical rainforest of Northern Brazil. The charcoal was collected at the Cooperative of Family Producers and Solidary Economy of the Mogno State Forest (COOPERMOGNO), located in the Gregório River State Forest Complex, municipality of Tarauacá, Acre, Brazil (latitude: 8° 8' 8'' south, longitude: 70° 45' 54'' west, 179 a.s.l.) (Figure 1).

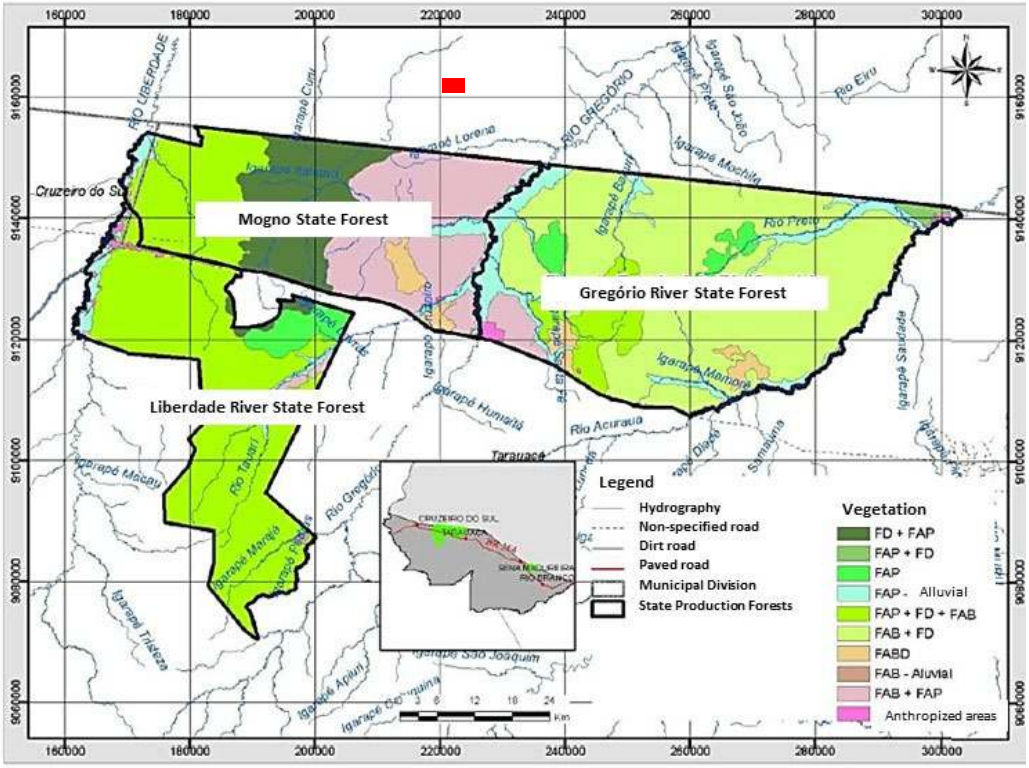

Figure 1: COOPERMOGNO location map in the Gregório River State Forest Complex – CFERG, Municipality of Tarauacá, Acre, Brazil. Source: Secretaria do Meio Ambiente (2019).
Legend: Vegetation - FD: Dense Forest; FAP: Open Forest with Palm Trees; FAB: Open Forest with Bamboo; FABD: Open Forest with Palm Trees and Bamboo.

The fruits were collected manually from the ground, after ripening. After collection, the fruits were transported to the cooperative by the producers (Figure 2A). Charcoal was produced from fruit wastes, after removing the almonds (Figures 2B and 2C).

Figure 2: Transport of *Attalea tessmannii* fruits using caçoá. B – Fruits after being cut in half, identifying their constituent parts. C – Fruits after almond extraction (endocarp). D - Oven of the hot tail type. ** In Brazil, the nomenclatures of rows of holes such as: "baianas, filas and tatus" are used to name the smoke inlets and outlets of ovens of the "hot tail" type. E - Storage of *Attalea tessmannii* fruit charcoal bags on pallets.

Charcoal was produced in a hot tail oven with a production capacity of 5 tons of *Attalea tessmannii* fruits (Figure 2D). The carbonization process is carried out empirically, with monitoring of the internal temperature according to the color of the smoke, and accordingly closing the air inlet holes. The carbonization time lasts on average between 7 and 10 days (between carbonization and cooling) depending on weather conditions. After the oven has cooled down, the charcoal is removed with the aid of a shovel, packaged and stored for later commercial sale (Figure 2E).

To characterize the charcoal from *Attalea tessmannii*, samples from four carbonizations produced in the cooperative were used (Table 1). Sampling was carried out once. The samples collected had different storage times in the cooperative shed. Each study treatment remained for different storage periods in the cooperative until the date of collection, carried out in August 2019. The charcoals containing only endocarp (T1 and T2) came from carbonization carried out with old fruits, with degradation of the epicarp and mesocarp, while they remained on the forest floor. Charcoals containing endocarp and mesocarp (T3 and T4) were produced from younger fruits (with no degradation while on the ground).

Table 1: Tested treatments and storage times in a shed of charcoal from *Attalea tessmannii* fruits

Tested treatments	Carbonization date	Parts of the Fruits	Drying time
T1	December 2017	Endocarp	19 months
T2	June 2018	Endocarp	13 months
T3	December 2018	Endo+mesocarp	7 months
T4	August 2019	Endo+mesocarp	Newly produced

The collection of charcoal with different storage times was planned, aiming to analyze the variation in the moisture content of charcoal over time. Thus, it was possible to verify the influence of storage time on changes in the moisture content of charcoal. The variables evaluated in charcoal were: bulk density, immediate chemical analysis (moisture content, volatile materials content, ash content and fixed carbon content) and higher heating value.

With the exception of bulk density, all other properties were determined for all treatments. Bulk density was determined in a sample obtained from a mixture of the four treatments analyzed in the study. To determine bulk density, the charcoal contained in a 1 m^3 box was weighed. For this, only an average of bulk density was obtained, without separation by dependent variable, unlike the other analyzed variables. The result of bulk density was obtained through the relationship between the mass and volume of the container, according to Equation 1:

$$BD = \frac{m_1 - m_2}{V} \quad (1)$$

Where: m_1= sample mass + container (g); m_2 = container mass (g); v = container volume (cm^3).

The immediate chemical analysis of charcoal from *Attalea tessmannii* fruits was performed according to ASTM D1762-84 (ASTM, 2013a) and moisture content (MC) according to NBR 14929 (Associação Brasileira de Normas Técnicas, 2003). The higher heating value was determined using an Ika C200 calorimeter, according to the procedure described in ASTM D5865 – 13 (American Society of Testing Materials, 2013b).

To assess the potential of charcoal from *Attalea tessmannii* fruits for domestic use, a comparison was made with charcoal from other species, commercialized for cooking food, obtained in the literature. We particularly looked into research papers that used charcoals from alternative species, charcoals from forest and industrial wastes, and charcoals from energy forests. The determination of quality for domestic use was based on the criteria established by the Premium Seal Resolution from São Paulo (São Paulo, 2015) (Table 2).

Table 2: Parameters for charcoal quality according to the Premium Seal of São Paulo.

Parameter	Reference value
Bulk density (BD)	> 200 kg m^{-3}
Moisture content (MC)	< 5.0%
Ash content (AC)	< 1.5%
Fixed carbon content (FC)	> 73.0%

To analyze the results, a completely randomized design with three replications per treatment was used for the analysis of variance. In treatments that showed significant differences by the F test ($p \leq 0.05$); the means were compared by Tukey's test of means ($p \leq 0.05$). To establish the correlation between the higher heating value and the immediate chemical composition of charcoal (volatile materials content, ash content and fixed carbon content), Pearson's correlation coefficient was applied.

RESULTS AND DISCUSSION

Bulk density of the charcoal from *Attalea tessmannii* fruits (Table 3) was higher than the reference value stipulated by Resolution n°. 40/2015 of the Premium Seal of São Paulo (Table 2). The bulk density of the charcoal from *Attalea tessmannii* fruits is similar to the values found for charcoal from *Attalea speciosa* (babaçu), as they belong to the same botanical genus (Protásio et al., 2013). This similarity is due the morphological characteristics between the fruits of the two species. This variable also had a value similar to or higher than those obtained for wood charcoals (Table 3).

Table 3: Bulk densities (BD) of charcoal from different types of biomass.

Biomass	Bulk density (kg m^{-3})	Author
Charcoal from *Attalea tessmannii* fruits	330	Current study
Charcoal from *Attalea speciosa*	340	Protásio et al. (2013)
Charcoal from residues/mixed	370	Rosa et al. (2012)
Charcoal from mixed wood	230 to 270	Costa et al. (2017)
Charcoal from energy forest (eucalypt)	156.41 to 355	Donato et al. (2020)

Bulk density, along with true density, indicates the degree of efficiency of the carbonization process, influencing the porosity of charcoal. The higher the density, the lower the porosity. Thus, both variables influence thermal conductivity, time of heat supply and energy flow between charcoal pieces in barbecue equipment, influencing combustion and yield performance in the process of preparing food (Dias Júnior et al., 2020). In addition, Dias Júnior et al. (2020) emphasized the preference of consumers for barbecue charcoal with higher density.

In general, the charcoal from *Attalea tessmannii* fruits has high bulk density, which contributes to the good quality of the product in this respect, when considering the use for food cooking.

With respect to the moisture content (MC), with the exception of T3 treatment (Table 4), which had a higher moisture content, the other treatments fit into the Premium Seal Quality requirement parameters (São Paulo, 2015). As the variation between treatments was not statistically significant, differences in the moisture content observed between treatments can be attributed to variability within the material, since charcoal is a very hygroscopic material.

Table 4: Physical and energy properties of charcoal from *Attalea tessmannii* fruits.

Treatment	MC (%)	VM(%)	AC(%)	FC(%)	HHV (kcal kg^{-1})
T1	3.82^{a}	4.84^{b}	24.68^{a}	70.48^{a}	7,326^{b}
T2	3.97^{a}	3.97^{b}	19.11^{a}	71.73^{a}	7,132^{c}
T3	5.94^{a}	6.53^{ab}	22.30^{a}	71.17^{a}	7,332^{b}
T4	3.14^{a}	8.44^{a}	16.51^{a}	75.05^{a}	7,502^{a}

Where: MC = moisture content; VM = volatile materials content; AC = ash content; HHV = higher heating value.

The analysis of the variation of moisture content related to storage time is important, since charcoal production is not the main economic activity in the community; but it is an income complementation. Therefore, storage of charcoal is a common practice to increase the amount of product to be marketed at the rights selling time. It is important to note that the values of moisture content remained low over the storage period and without significant variations between the different storage times. In a study carried out by Sousa et al. (2020), analyzing samples of charcoal from wood and fruit wastes from *Attalea tessmannii* in Acre state (Brazil), the authors obtained moisture contents of 6.74% and 4.22%, respectively for the analyzed samples, the latter being very close to the moisture contents observed in this research.

Storage is done in places where there is a great variability of relative humidity. In the Amazon region, the dry and rainy periods are very intense. In the municipality of Tarauacá, Acre, Brazil, the rainy season is between October and April, and the dry season between June and August. In the interval from 1994 to 2019, the average annual precipitation was 2,288 mm (1,642 to 2,973 mm). The lowest average temperatures throughout the year occurs in July (24.9 °C), while the highest ones occur in October (26.6 °C). In the period from December to March, typically rainy in Tarauacá, Acre, Brazil, the highest values of relative humidity occur; around 87.5%, while in the dry period from June to August, relative humidity decreases, with a minimum in August, at approximately 79% (Sousa, 2020). Considering these environmental conditions, coupled with the hygroscopic characteristic of charcoal, the samples showed stability in the moisture content during storage, which is a positive aspect of quality of this

product. The moisture content of charcoal has an inverse relationship with the ease of ignition and with the formation of fines during storage (Dias Júnior et al., 2020). Charcoals with a higher moisture content will be difficult to start combustion and produce more smoke during the initial phase. Therefore, lower moisture contents are desired for a higher quality product.

Reis et al. (2015) found average moisture contents of 6.18% for charcoal from the coconut of *Attalea speciosa*, produced in an artisan way, with the same peculiarities of the production process used for the production of charcoal analyzed in this research. However, the authors did not take into account the storage conditions of the product. *Attalea tessmannii* and *Attalea speciosa* fruits are palm fruits of the same botanical genus and have similar morphology and bulk density, differing only in size. Therefore, even considering the morphological similarity, and the permanence in storage of the charcoal from *Attalea tessmannii* fruits, the latter had a lower moisture content.

As for the volatile materials content (VM), the lower, the better for charcoal for domestic consumption, aiming at the lowest amount of gases released during the preparation of food. However, Brahan (2002) considers the very low values of volatile materials, present in charcoal, to be a problem for ignition. In studies conducted by Griessacher et al. (2012) and Protásio et al. (2017) with carbonization of biomass from *Attalea speciosa*, the authors obtained volatile materials between 5 and 8% in carbonizations, with temperatures ranging from 650 to 850 °C. In this context, with the use of masonry ovens for the production of charcoal in family farming it is possible to achieve temperatures near 450 °C (Carvalho et al., 2020). However, although there were differences in carbonization temperatures, which influence the amount of volatile materials in charcoal, the results obtained in both studies were similar.

The influence of the parts of the fruits on the immediate chemical composition of the charcoal was clearly identified. The fruits used in the T1 and T2 treatments contained only the endocarp (VM 4.84% and 3.97%) and those used in T4 treatment, for being younger, had mesocarp and endocarp (VM 8.44%). Therefore, charcoal that contained only endocarp had lower volatile contents. Teixeira (2008) described endocarp as the most important fruit component for production of charcoal, due to its differentiated chemical aspect compared to lignin and carbon contents of the other fruit components. Considering domestic use, the charcoal from *Attalea tessmannii* fruits will produce little flame and low emission of toxic materials. On the other hand, it is difficult for ignition. Charcoal producers have already observed the difficulty of ignition as a characteristic of the product. This leads to the need to add a firelighter in the packaging.

The ash contents (AC) shown in Table 4 did not fit the quality requirement parameters of the Premium Seal (São Paulo, 2015). The ash content of charcoal is related to the raw material from which it originated, consisting of inorganic elements that do not degrade in the carbonization process (Padilha et al., 2018). Because *Attalea tessmannii* charcoal is obtained from a fruit, the chemical and nutritional composition of this part of the plant can interfere with the AC. In addition to the natural ash content, the harvesting, storage and handling processes in the preparation of the raw material or in carbonization, during the stages of unloading from the oven, sieving and packaging of charcoal, can contribute to increasing the ash content due to external contamination. In general, the ash contents of the charcoal analyzed in this study are high.

Protásio et al. (2017), producing charcoal from *Attalea speciosa*, obtained ash contents ranging from 5 to 8%, at tempearatures between 450 and 750 ºC. Reis et al. (2015) found an AC of 3.61% for *Attalea speciosa* coconut and 2.24% for sawmill waste. All of these had mean AC values much lower than those observed in the present research. Among the studies on quality of charcoal produced with other types of biomass, higher values of ash content (AC) were observed. Vale et al. (2011), evaluating the charcoal from *Jatropha curcas*, found high ash contents for charcoals from the epicarp (25%) and cake (10.43%), which is the co-product obtained after mechanical extraction of the oil from the seeds. The same authors stated that AC values above 7% are considered high and that these are related to the presence of minerals from chemical fertilization of the soil. Despite the fact that *Attalea tessmannii*

charcoal has high AC values, this factor does not limit its use in cooking food, it only represents a greater amount of residues in the burning equipment after use.

When comparing the results of fixed carbon content (FC) with the quality requirement parameters of the Premium Seal (São Paulo, 2015), which establishes 73% of FC, only treatment T4 had values within the established criteria. Similar FC results for wood charcoal quality were found by Anater et al. (2019), who reported an average FC of 74.95%. The mean FC values of the other treatments were higher than those found by Oliveira et al. (2015), with an average value of 68.21% and Brand et al. (2015), with an average TCF of 65.17%. The FC values observed in charcoal from *Attalea tessmannii* fruit were closer to those found by Protásio et al. (2017). The same author, evaluating the laboratory carbonization of *Attalea speciosa* coconut (complete fruit) at a temperature of 450 ºC and temperatures above 650 ºC, obtained FC of 73% and 85%, respectively.

The higher fixed carbon content makes it possible to prolong the burning time of fuel in equipment intended for energy conversion. This may result in increased efficiency in the use of heat produced by charcoal oxidation reactions (Protásio et al., 2017). The results of higher heating value (HHV) differed between the treatments of charcoal from *Attalea tessmannii* fruits (Table 4). Evaristo et al. (2016), in a study evaluating the energy potential of the macaúba palm fruit, found higher HHV (7,859 kcal kg^{-1}) for endocarp than for epicarp (7,464 kcal kg^{-1}), with higher values than in the present study. Despite the morphological similarity of *Acrocomia aculeata* (macaúba) fruit with *Attalea tessmannii* fruit, the behavior observed by Evaristo et al. (2016) did not occur in the latter species.

Charcoal from *Attalea tessmannii* fruit has a high energy potential, as its higher heating value (HHV)) is greater than that of charcoal produced from other fruits, leaves, shells and even from some wood species (Table 5). In general, as the HHV is directly linked to the quality potential of charcoal for domestic use, the higher the HHV, the better the charcoal, as it has more energy per unit of mass.

Pearson's correlation analysis between the higher heating value (HHV) and the immediate chemical composition of charcoal demonstrated a strong, positive and significant correlation between the HHV and the content of volatile materials (r = 0.92). However, the fixed carbon content and the ash content had no significant correlation with the heating value.

Table 5: Higher heating value (HHV) of charcoal from different types of biomass.

Biomass	Type	HHV (kcal kg^{-1})	Source
Charcoal from *A. tessmannii* fruits	Meso+endocarp	7.323	Current study
Attalea speciosa	endocarp	6.926-7.165	Protásio et al. (2017)
Jatropha	epicarp	3.954	Vale et al. (2011)
Jatropha	cake	6.234	Vale et al. (2011)
Pinus	needle	6.611	Muñiz et al. (2014)
Coconut (500°C)	shell	7.067	Padilha et al. (2018)
Hybrid eucalypt (7 years)	Reforested wood	7.193	Soares et al. (2014)
Eucalypt clones		7.643 – 7.665	Neves et al. (2011)
Eucalypt clones		7.290 – 7440	Protásio et al. (2013)
Caesalpinia pyramidalis (catingueira)	Native wood	6.248	Medeiros Neto et al. (2014)
Handroanthus serratifolius (Pau d´arco)		6.977	

When performing a global analysis of the properties of charcoal from *Attalea tessmannii* fruits compared with other types of charcoal present on the market and already sold for cooking (Table 6), its low contents of moisture and volatile materials can be regarded as positive aspects, as well as its higher heating value. On the other hand, its high ash content can be highlighted as a disadvantage.

Table 6: Comparison between *Attalea tessmannii* fruit charcoal with other charcoals for domestic use sold in different regions of Brazil: Acre, Santa Catarina, Paraná, Paraíba, Pará and Mato Grosso.

Place of sale	Raw material	MC (%)	VM (%)	AC (%)	FC (%)	HHV (kcal kg^{-1})	Source
Acre	*Attalea tessmannii* fruit	4.22	5.94	20.65	72.11	7,323	Current study
Santa Catarina	*Eucalyptus*	8.21	29.26	3.89	66.85	7,944	Brand et al. (2015)
	Acacia mearnsii	7.00	35.76	0.81	63.43	7,448	
	Mixed wood	8.59	27.67	3.44	68.79	4,301	
	Eucalyptus and planted *Mimosa scabrella*	6.78	39.47	2.42	58.12	4,736	
Paraíba	Mixed wood	-	-	-	-	7,655	Monteiro et al. (2019)
Paraná	Mixed wood	5.79	22.93	2.12	74.96	7,321	Anater et al. (2019)
Pará	Mixed wood - Brand A	6.11	24.95	2.22	72.83	7,020	Oliveira et al. (2019)
	Mixed wood - Brand B	6.03	17.38	1.71	80.91	7,450	
	Mixed wood - Brand C	6.27	19.31	2.58	78.11	7,375	
Mato Grosso	Mixed wood - Brand 4	4.00	21.23	2.31	76.46	7,230	Costa et al. (2017)
	Mixed wood - Brand 7	6.00	11.56	2.75	85.69	7,479	
Premium Seal	-	> 5.0	> 23.5	> 1.5	< 73	-	-

Where: MC = Moisture content; VM = volatile materials content; AS = ash content; FC = fixed carbon content; HHV = higher heating value.

Charcoal from *Attalea tessmannii* fruits, as it comes from a palm tree, is considered a non-woody product. To obtain the fruits, there is no degradation of the native forest. Another important aspect is the fact that the carbonized part of the fruit constitutes wastes from the almond extraction process, which is characterized as the utilization of a resource that would otherwise be an untreated residue, which would generate pollution. It is important to emphasize that this charcoal is produced by traditional families and this non-woody product contributes to increasing their income. One aspect to increase the quality of the product would be the addition of a firelighter to the package, to improve its ignition property, which is hampered by the low content of volatile materials in the charcoal.

From the social aspect, the production of good quality charcoal and its sale will generate local income and improve the quality of life, in addition to the possibility of expanding the market for the product. Positive results generated in this research also contribute to the dissemination of information on the quality of charcoal, which can be used as a marketing tool for the product.

CONCLUSION

Charcoal produced from *Attalea tessmannii* fruits had low moisture content and volatile materials content and high bulk density, fixed carbon content and higher heating value, but high ash content. When compared to charcoal already sold for domestic use, charcoal from *Attalea tessmannii* fruits showed high quality potential to be included in the market.

Regarding the importance of the product as a supplement to the income of the traditional community involved in its production, storage is an important factor to increase the volume of product to be sold. Thus, storage can be carried out without influencing to the quality of the product, as it does not affect the moisture content of charcoal over time.

The low contents of volatile materials that reduce the ignition power leads to the need to develop a firelighter, which, if added to the packaging, would reduce the impact of this property on the product.

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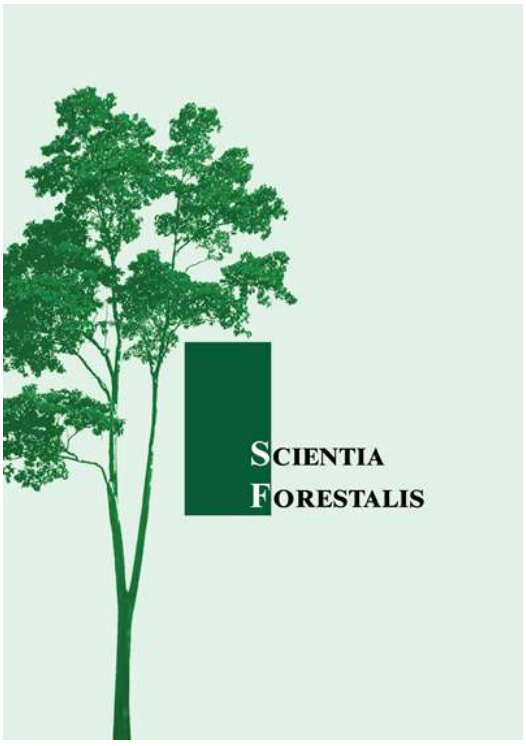

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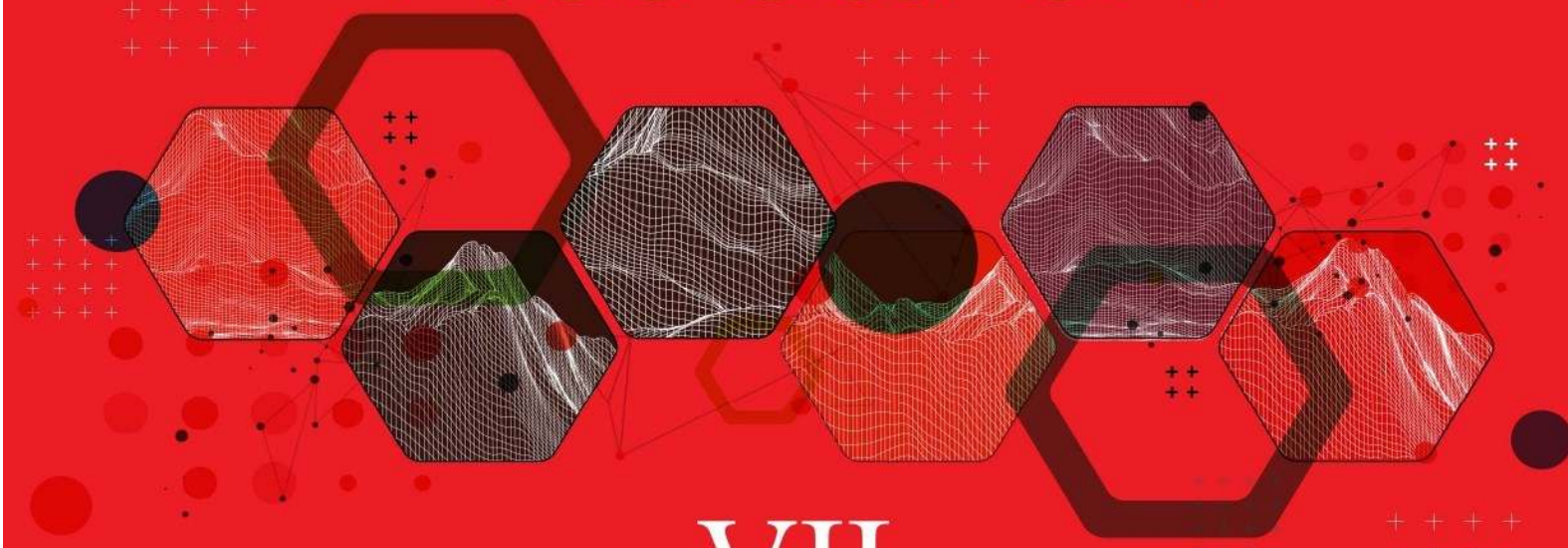

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08

Quality of charcoal produced from wood residues and planted forests

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ABSTRACT

Objective: The objective of this study was to compare the quality of charcoal for domestic use produced from solid residues of the wood industry in the Amazon region with charcoal produced from eucalyptus. **Methods:** Samples of the most commercially sold brand in the municipality of Rio Branco – AC were collected, as well as samples of eucalyptus charcoal sold in the municipality of Vila Velha – ES. The moisture content, volatile materials, ash, and fixed carbon (FC) were analyzed in the Chemistry and Biodiesel Laboratory, located on the campus of the Federal University of Acre (UFAC) in Rio Branco. **Results:** After performing the analysis of variance, significant differences were observed between charcoal made from wood residues and eucalyptus charcoal. Charcoal from eucalyptus showed higher levels of volatile materials and lower levels of ash compared to charcoal from wood residues. **Conclusion:** Charcoal produced from eucalyptus wood showed characteristics closer to the standards required by the Premium Seal when compared to charcoal from wood residues. The heterogeneity of wood residues affects the quality of charcoal.

Keywords: Wood Residue, Eucalyptus, Biomass.

■ INTRODUCTION

Brazil is among the countries that produce and use the most renewable energy in the world. According to the National Energy Balance (2022), the share of renewables in the energy matrix in 2021 was 44.7% of the total internal supply, of which 8.7% came from firewood and charcoal, an increase of 1.4% compared to 2021 (ENERGY RESEARCH COMPANY, 2022).

According to CERPH – National Reference Center for Small Hydroelectric Plants (Brazil, 2015), about 40% of the firewood produced in Brazil is converted into charcoal, with 9% consumed in the residential sector, 2% in the commercial sector, 0.15% in the agricultural sector, and 87% in the industrial sector. In the residential sector, most charcoal is used for cooking, while in the industrial sector, the main consumers are pig iron industries (MAYER et al., 2015).

Charcoal can be obtained through the carbonization of any biomass, with wood being the most commonly used raw material due to its high productivity and quality (Pinheiro *et al.*, 2006). Souza *et al.* (2016) describe that the physical characteristics of wood (lignin content, moisture, density), temperature, and the carbonization protocol are factors that influence the quality and market acceptance of charcoal.

The wood used as raw material for charcoal production may come from planted forests (Eucalyptus, Black Acacia, and Pine), native forests, or wood residues from forest exploitation or the wood industry. According to Aguillar (2015), 71% of residue types are destined for the production of firewood and charcoal.

To obtain higher-quality charcoal for domestic use, it is essential that it presents characteristics such as high apparent relative density, high fixed carbon content, high calorific value, low moisture, low volatile matter, and low ash content, as defined by the São Paulo Premium Seal Resolution No. 40/2015 (RIBEIRO; VALE, 2006).

The objective of this study was to assess the quality of charcoal produced from wood residues compared to that from reforested wood, both intended for domestic use, through immediate chemical analysis.

■ METHODS

Two samples of charcoal were acquired: one from the municipality of Rio Branco – AC and the other sold in Vila Velha – ES. The samples were identified as charcoal from wood residues and

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eucalyptus charcoal. From the packaging, all information was recorded, such as manufacturer's address, charcoal origin, volume and/or weight, and registration in environmental agencies.

Samples were prepared for immediate chemical composition analysis by first collecting a representative sample from each package, which was then crushed in a porcelain mortar using a pestle. The crushed samples were sieved with 40- and 60-mesh screens, using the material retained on the 60-mesh screen.

The immediate chemical analysis was carried out in the Chemistry and Biodiesel Laboratory located on the campus of the Federal University of Acre (UFAC), in Rio Branco. Analyses were conducted according to standard NBR 8112 (BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS, 1986) to determine moisture, ash, and fixed carbon contents.

Statistical analysis was performed using Action Stat software, employing analysis of variance (ANOVA) at a 5% significance level to verify the existence of significant differences among the different charcoals.

■ RESULTS

Information about the commercial charcoal samples from wood residues and eucalyptus is shown in Table 1.

Both packages were registered with IBAMA as the environmental regulatory agency, listing the product's weight, price, and distributor.

Table 1. Mean values from the immediate chemical analysis of charcoal from wood residues and eucalyptus charcoal.

Origin	Weight (kg)	Price (R$)	Purchase location	Environmental registration
Eucalyptus	2	9.39	Vila Velha	IBAMA
Wood residue	3	8.69	Rio Branco	IBAMA

The mean values of the immediate chemical analysis of charcoal from wood residues and eucalyptus are presented in Table 2.

Table 2. Mean values from the immediate chemical analysis of charcoal from wood residues and eucalyptus charcoal.

Origin	TU%*	TMV%	TCZ%	TCF%
Eucalyptus	10.66	23.52	2.87	62.95
Wood residue	6.74	8.29	2.00	89.71

TU = moisture content; TMV = volatile matter content; TCZ = ash content; TCF = fixed carbon content. *Percentage on a wet basis.

The average moisture content of the samples was considered high for domestic use: 10.66% (eucalyptus) and 6.74% (residues).

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The charcoal made from eucalyptus wood showed average volatile matter values of 23.52%, which are within the acceptable limit established by the Premium Seal. However, the charcoal produced from wood residues presented average values of 8.29%, which is considered a low-quality product for domestic use.

The charcoal made from eucalyptus showed an ash content of 2.87%, and the charcoal from residues showed 2% ash content, both above the limit established by the Premium Seal.

As for the fixed carbon content, the average values were 69.95% and 89.71% for the samples of eucalyptus and wood residue charcoal, respectively.

■ DISCUSSION

In the charcoal sold in the municipality of Vila Velha (ES), the label indicates that it comes from eucalyptus wood. The packaging of the charcoal sold in Rio Branco (AC), however, does not provide information about the origin of the wood used in its production, nor does it specify whether the raw material comes from wood residues. Nevertheless, it was verified, together with the environmental control agency of the state of Acre, that all active and licensed charcoal producers in the state use wood residues as raw material for charcoal production.

Anater (2017), when analyzing the quality of charcoal for household use sold in the city of Curitiba, observed that some packages did not include information about the origin of the wood used in its production. Joint Resolution IBAMA/SEMA/IAP No. 47, dated September 28, 2007, establishes that although the transport of packaged charcoal for retail trade is exempt from the DOF requirement, the packaging must visibly include registration with the appropriate regulatory agency and indicate the origin of the raw material (whether native or exotic species, or from wood industry residues).

The average moisture content of the samples was considered high for household use in both cases studied. For charcoal to be considered of good quality, the Premium Seal standard sets a maximum average value of 5% (SÃO PAULO, 2015). Gomes (2006) note that low moisture content results in a product with higher heating value, as a high moisture content compromises performance during the thermal process.

Charcoal derived from eucalyptus wood meets the acceptable limit of volatile matter established by the Premium Seal. However, the charcoal produced from wood residues showed lower values, classifying it as a poor-quality product for household use. High levels of volatile matter can also be harmful to the consumer's health, as they cause heavy smoke emissions and the release of toxic substances (BRAHAN, 2002).

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Ash contents were above the ideal value, which is 1.5% according to the Premium Seal (SÃO PAULO, 2015). High ash levels may be related to the chemical composition of the wood and to contaminants introduced during charcoal removal from the kiln.

The Premium Seal establishes that good-quality household charcoal should have a fixed carbon content above 73%. In this parameter, the charcoal made from wood residues presented acceptable values for household use. Fixed carbon content is related to carbonization temperature (SOARES, 2011), as well as lignin and extractive contents (OLIVEIRA *et al.*, 2010).

CONCLUSION

Charcoal produced from eucalyptus wood showed characteristics closer to those required by the Premium Seal standard when compared to charcoal made from wood residues. In addition to presenting better quality, the eucalyptus charcoal also had higher ignition power due to its higher volatile matter content. The diversity of wood residues used in the production of residue-based charcoal contributed to the lower quality of that product.

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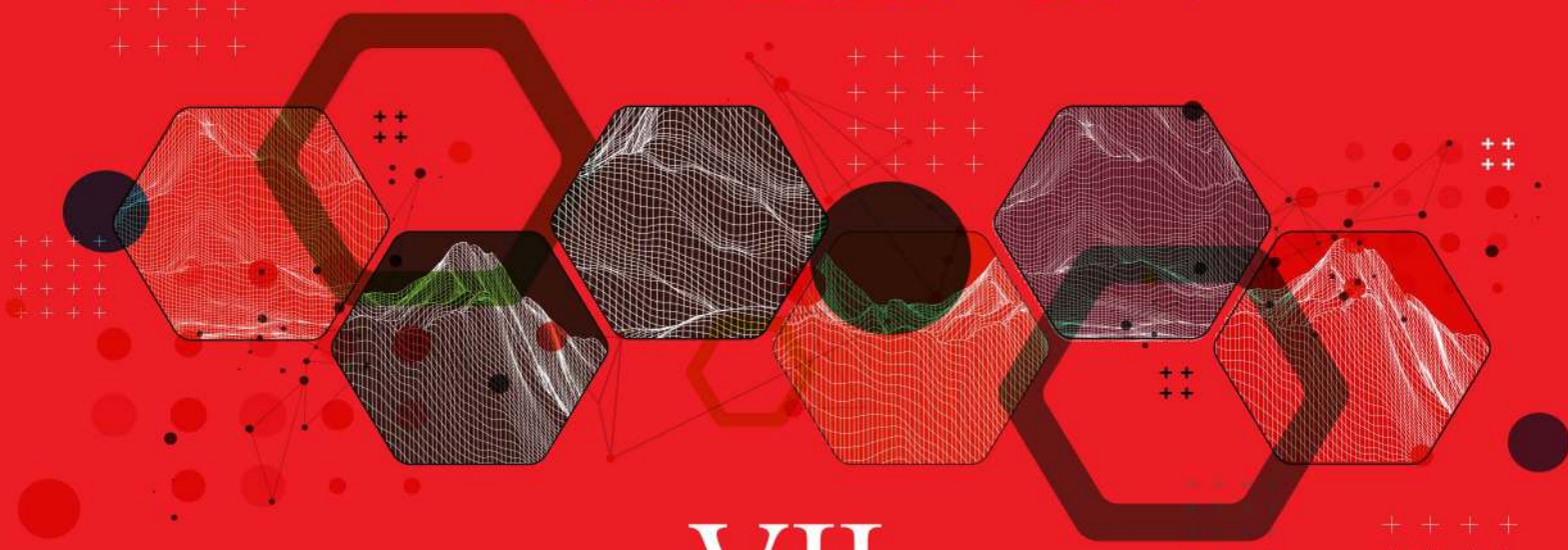

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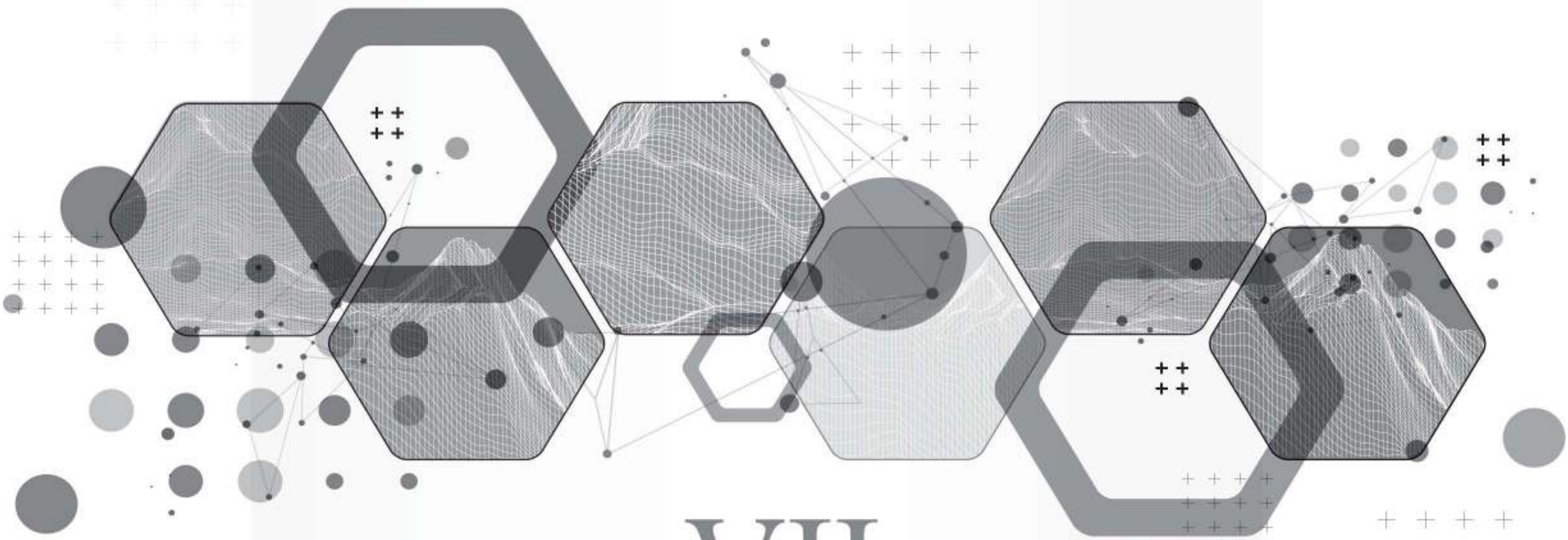

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08

Qualidade do carvão vegetal produzido de resíduos madeireiros e de floresta plantada

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RESUMO

Objetivo: O objetivo do trabalho foi comparar a qualidade do carvão vegetal para uso doméstico produzido de resíduos sólidos da indústria madeireira da região Amazônica e carvão vegetal produzido de eucalipto. **Métodos:** Foram coletadas amostras da marca mais comercializada no município de Rio Branco - AC e adquiridas amostras de carvão vegetal de eucalipto comercializado no município de Vila Velha – ES. Foram analisados os teores de umidade, de materiais voláteis, de cinzas e de carbono fixo (TCF), realizadas no Laboratório de Química e Biodiesel, localizado no campus da Universidade Federal do Acre (UFAC) em Rio Branco. **Resultados:** Após realizar a análise de variância, foram observadas diferenças significativas entre o carvão vegetal de resíduos madeireiros e o carvão vegetal de eucalipto. O carvão proveniente do eucalipto possui maiores teores de materiais voláteis e menores teores de cinzas, comparado ao carvão de resíduos madeireiros. **Conclusão:** O carvão vegetal produzido da madeira de eucalipto apresentou características mais próximas às exigidas pelo Selo Premium, quando comparado ao carvão de resíduos madeireiros. A heterogeneidade dos resíduos madeireiros interfere na qualidade do carvão vegetal.

Palavras-chave: Resíduo Madeireiro, Eucalipto, Biomassa.

INTRODUÇÃO

O Brasil está entre os países que mais produz e utiliza energias renováveis no mundo. De acordo com o Balanço Energético Nacional (2022), a participação de renovável na matriz energética no ano de 2021 foi de 44,7% do total da oferta interna, sendo que desse valor, 8,7% é de lenha e carvão vegetal, um aumento de 1,4% em relação ao ano de 2021 (EMPRESA DE PESQUISA ENERGÉTICA, 2022).

Segundo CERPCH – Centro Nacional de Referência em Pequenas Centrais Hidrelétricas (Brasil, 2015), cerca de 40% da lenha produzida no Brasil é transformada em carvão vegetal, sendo consumidos 9% no setor residencial; 2% no setor comercial; 0,15% no setor agropecuário e 87% no setor industrial. No setor residencial a maior utilização do carvão vegetal é na alimentação e o setor industrial, o maior consumidor são as indústrias de ferro-gusa (MAYER *et al.*, 2015).

O carvão vegetal pode ser obtido por meio da carbonização de qualquer biomassa, sendo a madeira a matéria-prima mais utilizada pela sua alta produtividade e qualidade (Pinheiro *et al.* (2006). Souza *et al.* (2016) descreve que as características físicas da madeira (teor de lignina, umidade, densidade), temperatura e o protocolo utilizado no processo de carbonização são fatores que influenciam na qualidade viabilizando a sua aceitação no mercado.

A madeira utilizada como matéria-prima na produção do carvão vegetal, pode ser proveniente de plantações de florestas plantadas (Eucalipto, Acácia Negra e Pinus), de florestas nativas ou de resíduos de madeira, tanto da exploração florestal, quanto da indústria madeireira. Segundo Aguillar (2015), 71% dos tipos de resíduos são destinados para a produção de lenha e carvão vegetal.

De forma a se obter uma maior qualidade do carvão vegetal para uso doméstico, é primordial que o mesmo apresente características como alta densidade relativa aparente, alto teor de carbono fixo, alto poder calorífico, baixa umidade, baixo teor de materiais voláteis e baixo teor de cinzas, previstas na Resolução do Selo Premium de São Paulo n°40/2015 (RIBEIRO; VALE, 2006).

O objetivo deste trabalho foi averiguar a qualidade do carvão vegetal proveniente de resíduos madeireiros em comparação ao carvão vegetal de reflorestamento, ambos destinados ao uso doméstico, por meio da análise química imediata.

MÉTODOS

Foram adquiridas duas amostras de carvão vegetal, uma proveniente do município de Rio Branco - AC e a outra comercializada no município de Vila Velha – ES. As amostras foram identificadas como carvão vegetal de resíduos madeireiros e como carvão de

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eucalipto. Da embalagem tomou-se nota de todas as informações como, endereço do fabricante, origem do carvão vegetal, volume e/ou peso e registro em órgãos ambientais.

As amostras foram preparadas para avaliação da composição química imediata coletando primeiramente uma amostra representativa de cada embalagem e, logo após, trituradas em cadinho de porcelana, com auxílio de pistilo. As amostras trituradas foram depositadas em peneiras de 40 e 60 mesh, sendo utilizado o material retido na peneira de 60 mesh.

A análise química imediata foi realizada no Laboratório de Química e Biodiesel, localizado no campus da Universidade Federal do Acre (UFAC), em Rio Branco. Essas análises foram feitas segundo a norma NBR 8112 (ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS, 1986) visando à determinação dos teores de umidade, cinzas e carbono fixo.

A análise estatística foi realizada com auxílio do Action Stat, feita a análise de variância (ANOVA) com 5% de significância para verificar a existência de diferença significativa entre as distintas procedências dos carvões.

RESULTADOS

As informações sobre as amostras comerciais de carvão vegetal de resíduos madeireiros e de carvão vegetal de eucalipto são identificadas na Tabela 1.

Ambas as embalagens apresentaram registro no IBAMA como órgão de fiscalização ambiental, a massa e o distribuidor do produto.

Tabela 1. Valores médios da análise química imediata do carvão vegetal de resíduos madeireiros e carvão vegetal de eucalipto.

Procedência	Peso (kg)	Preço (R$)	Local de compra	Registro órgão ambiental
Eucalipto	2	9,39	Vila Velha	IBAMA
Resíduo madeireiro	3	8,69	Rio Branco	IBAMA

Os valores médios da análise química imediata do carvão vegetal de resíduos madeireiros e carvão vegetal de eucalipto estão na Tabela 2.

Tabela 2. Valores médios da análise química imediata do carvão vegetal de resíduos madeireiro e carvão vegetal de eucalipto.

Procedência	TU%*	TMV%	TCZ%	TCF%
Eucalipto	10,66	23,52	2,87	62,95
Carvão de resíduos	6,74	8,29	2,00	89,71

TU= teor de umidade do carvão vegetal; TMV = teor de materiais voláteis; TCZ = teor de cinzas; TCF = teor de carbono fixo. *Porcentagem na base úmida.

O teor de umidade médio das amostras foi considerado alto para uso doméstico 10,66% (carvão de eucalipto) e 6,74% (carvão de resíduos).

O carvão vegetal proveniente de madeira de eucalipto apresentou valores médios de materiais voláteis de 23,52%, estando dentro do limite aceitável estipulado pelo Selo Premium. No entanto, o carvão produzido de resíduos madeireiros apresentou valores médios de 8,29%, considerado um produto de má qualidade para o uso doméstico.

O carvão de proveniente do Eucalipto apresentou teor de cinzas de 2,87% e o carvão de resíduos 2% de teor de cinzas, ambos acima do limite estipulado pelo Selo Premium.

Para o teor de carbono fixo os valores médios foram 69,95% e 89,71% para as amostras de carvão de eucalipto e resíduos madeireiros, respectivamente.

DISCUSSÃO

No carvão vegetal comercializado no município de Vila Velha (ES), a espécie é destacada na embalagem, informando que é proveniente da madeira de eucalipto. A embalagem do carvão vegetal comercializado no município de Rio Branco (AC) não apresentou informações sobre a origem da madeira utilizada para produção do carvão vegetal, não informando se a matéria-prima seria proveniente de resíduos madeireiros. Porém, foi constatado, junto ao órgão fiscalizador do Acre, que todas as carvoarias ativas e licenciadas no estado apresentam os resíduos madeireiros como matéria-prima para produção de carvão vegetal.

Anater (2017) verificando a qualidade do carvão vegetal para uso doméstico comercializado na cidade de Curitiba observou que algumas das embalagens não disponibilizavam a origem da madeira utilizada para produção do carvão vegetal. A Resolução Conjunta IBAMA/ SEMA/ IAP nº 47, de 28 de setembro de 2007, define que a isenção do DOF para o transporte de carvão vegetal empacotado do comércio varejista, as embalagens devem conter, visivelmente, informações o registro no órgão fiscalizador e informações da proveniência da matéria-prima (espécie nativa ou exótica, ou proveniente de resíduos da industrialização madeireira).

O teor de umidade médio das amostras foi considerado alto para uso doméstico nas duas procedências estudadas. Para que o carvão seja considerado de boa qualidade, o Selo Premium estabelece um valor médio de no máximo de 5% (SÃO PAULO, 2015). Gomes (2006) relata que o baixo teor de umidade resulta em um produto de maior poder calorífico, pois utilizar carvão vegetal com um elevado teor de água compromete o seu rendimento durante o processo térmico.

O carvão vegetal proveniente de madeira de eucalipto está dentro do limite aceitável de materiais voláteis estipulado pelo Selo Premium. Contudo, o carvão produzido de resíduos madeireiros apresentou valores considerado como produto de má qualidade para o uso doméstico. O alto teor de materiais voláteis pode ser danoso à saúde do consumidor final, acarretando grande liberação de fumaça e substâncias tóxicas (BRAHAN, 2002).

Os teores de cinzas ficaram acima do ideal, que é de 1,5% pelo Selo Premium (SÃO PAULO, 2015). Os altos teores de cinza podem estar ligados à composição química da madeira e aos contaminantes provenientes da retirada do carvão do forno.

O Selo Premium descreve que em carvão vegetal para uso doméstico de boa qualidade o teor de carbono fixo deve ser superior 73%, para este parâmetro o carvão de resíduos apresentou valores aceitáveis para uso doméstico. O carbono fixo está relacionado com a temperatura de carbonização (SOARES, 2011), teores de lignina e extrativos (OLIVEIRA *et al.*, 2010).

CONCLUSÃO

O carvão vegetal produzido da madeira de eucalipto apresentou características mais próximas às exigidas pelo Selo Premium, quando comparado ao carvão de resíduos madeireiros. Além da melhor qualidade apresentada pelo carvão proveniente do eucalipto, o seu poder de ignição é maior, devido aos maiores valores de materiais voláteis. A diversidade nos resíduos madeireiros utilizados na produção de carvão vegetal contribui para essa baixa qualidade do produto.

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Clesia Maria De Oliveira; Natália Escobar Alioti Lima; Osmar Siena

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Production and characterization of an activated carbon-based catalyst from grape pomace impregnated with iron

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Resumo/Abstract

RESUMO - A crescente demanda por materiais catalíticos econômicos e sustentáveis tem impulsionado a utilização de resíduos agroindustriais como fonte alternativa para sua produção. Este trabalho teve como objetivo produzir e modificar carvão ativado a partir de bagaço de uva, visando sua aplicação como catalisador após a adsorção de íons de ferro. O carvão ativado foi obtido por pirólise do bagaço de uva impregnado com $ZnCl_2$, apresentando área superficial de 443,7 $m^2\ g^{-1}$. A modificação foi realizada por meio da adsorção de íons Fe^{3+} em diferentes concentrações (200, 300 e 400 mg L^{-1}). Os resultados mostraram que a capacidade de adsorção aumentou com a concentração inicial de ferro, atingindo 217,5 mg g^{-1} a 400 mg L^{-1}. A espectroscopia FTIR revelou alterações nos grupos funcionais após a adsorção, com aparecimento de bandas características de Fe–O e FeOOH, confirmando a fixação dos íons metálicos. A combinação de elevada área superficial e presença de grupos ativos demonstra que o material possui potencial promissor como catalisador de baixo custo a partir de resíduo agroindustrial. Palavras-chave: resíduos agroindustriais, impregnação metálica, pirólise.

ABSTRACT – The growing demand for economical and sustainable catalytic materials has driven the use of agro-industrial residues as an alternative source for their production. This work aimed to produce and modify activated carbon from grape pomace, targeting its application as a catalyst after adsorption of iron ions. The activated carbon was obtained by pyrolysis of grape pomace impregnated with $ZnCl_2$, exhibiting a surface area of 443.7 $m^2\ g^{-1}$. Modification was carried out through adsorption of Fe^{3+} ions at different concentrations (200, 300, and 400 mg L^{-1}). Results showed that the adsorption capacity increased with the initial iron concentration, reaching 217.5 mg g^{-1} at 400 mg L^{-1}. FTIR spectroscopy revealed changes in functional groups after adsorption, with the appearance of characteristic Fe–O and FeOOH bands, confirming the fixation of metal ions. The combination of high surface area and presence of active groups demonstrates that the material holds promising potential as a lowcost catalyst derived from agro-industrial residue.

Keywords: agroindustrial waste, metal impregnation, pyrolysis.

Introduction

The development of low-cost catalytic materials has gained prominence due to its scientific, economic, and environmental relevance. In this context, agro-industrial residues represent an alternative for the production of biochar and activated carbon. Depending on the source material, the pyrolysis of these residues can generate materials with favorable porosity characteristics, surface area, pore structure, and physicochemical properties for applications in adsorption and catalysis (1). Among the various residues already studied, grape pomace, a byproduct of the wine industry, stands out for its promising potential in generating carbonaceous materials with adsorption applications (2).

In this study, the modification of activated carbon through the adsorption of iron ions is proposed, aiming at its subsequent use as a catalyst. Metal impregnation enables the fixation of metals on the carbon surface, and the reduction of the adsorbed metals promotes the formation of metallic elements or low-valence ions, altering the porous structure of the material. These modifications increase the number of active sites, thereby improving the material's efficiency as a catalyst.

Experimental

The activated carbon was produced from Bordô grape pomace obtained from the wine industry. Initially, the raw pomace was dried at 105 ± 5°C for 24 h, followed by grinding and sieving. The material retained between 20 and 48 mesh was impregnated with $ZnCl_2$ at a 1:1 ratio, under stirring at 25°C for 24 h. Afterwards, the samples were filtered and dried at 110°C. For the pyrolysis, 15g of the impregnated sample was placed in a quartz tube inside a fixed-bed tubular furnace. Carbonization was carried out under an N_2 flow of 200 mL min^{-1}, with a heating rate of 10°C min^{-1} up to 700°C and a residence time of 60 min. After cooling, the activated carbon was washed with HCl (0.5 mol L^{-1}) under stirring at 95°C for 30 min. Then the

material was washed with distilled water until neutral pH and dried at 110°C for 24 h.

For the iron adsorption tests, 0.1 g of activated carbon was used in 100 mL of solutions containing different concentrations of $Fe(NH_4)(SO_4)_2 \cdot 6H_2O$ (200, 300, and 400 mg L^{-1}). The samples were kept under stirring at 100 rpm at 25°C for 24 h (3). Afterwards, the samples were filtered, and the iron concentration in the aqueous medium was determined using the 1,10-phenanthroline complexation method (4). The adsorption capacity at equilibrium (q_e) was calculated according to Equation 1, and the removal rate was calculated according to Equation 2.

$$q_e = (C_0 - C_e / m) \cdot V \quad (1)$$

where C_0 and C_e are the initial and equilibrium concentrations, respectively (mg L^{-1}), m is the mass of adsorbent (g), and V is the volume of the solution (L).

$$Tr\ (\%) = (C_0 - C_e / C_0) \cdot 100 \quad (2)$$

For the characterization of the samples, Fourier-transform infrared spectroscopy (FTIR) was performed. The surface area of the grape pomace activated carbon, before adsorption, was determined using BET (Brunauer–Emmett–Teller) analysis.

Results and Discussion

The surface area of the activated carbon was 443.7 $m^2\ g^{-1}$, indicating that the material has suitable characteristics for applications as an adsorbent or catalyst. Table 1 presents the results for the equilibrium adsorption capacity and the removal rate at different iron concentrations.

Table 1. Adsorption capacity (q_e) and removal rate (Tr) of iron by grape pomace activated carbon at different initial solution concentrations (C_0: 200, 300, and 400 mg L^{-1}).

ID	C_0 (mg $^{L-1}$)	q_e (mg $^{g-1}$)	Tr (%)
CA-Fe200	200	25.9 ± 4.14	25.9 ± 2.07
CA-Fe300	300	101.8 ± 4.85	33.9 ± 1.62
CA-Fe400	400	217.5± 3.56	54.4 ± 0.89

The results show that increasing the initial iron concentration raises both the adsorption capacity and the removal rate, which is expected due to the higher concentration gradient that facilitates solute diffusion to the adsorbent surface (5).

Image 1 shows the FTIR spectra of the evaluated materials, highlighting changes in the properties of the activated carbon after adsorption, particularly in the intensity of the functional group bands. All spectra showed a shoulder around 3300 cm^{-1}, attributed to the stretching vibrations of N–H and O–H bonds (3). The region around 2900 cm^{-1} is associated with the C–H bonds of methyl and methylene groups (6), while the band at 3034 cm^{-1} indicates –OH stretching. The range of 2100–2000 cm^{-1} can be attributed to the allene group (7), and changes between 1500 and 1600 cm^{-1} suggest vibrations of N–H, phenolic hydroxyls, or C=C/C=O groups. Characteristic bands of Fe–O and FeOOH, although subtle, suggest the immobilization of metal ions, particularly at higher iron concentrations. The region at 686 cm^{-1}, absent in the unmodified carbon, is attributed to FeOOH stretching, typical of activated carbons modified with Fe^{3+} (3).

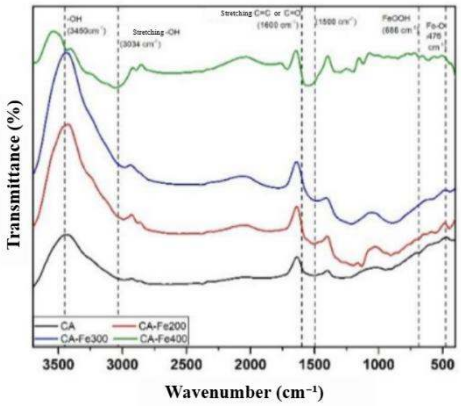

Image 1. Infrared spectra of activated carbon (AC) and carbons after iron adsorption at concentrations of 200 mg L^{-1} (AC-Fe200), 300 mg L^{-1} (AC-Fe300), and 400 mg L^{-1} (AC-Fe400).

Conclusions

The results of this study demonstrated that activated carbon obtained from grape pomace is capable of efficiently adsorbing iron, enabling its application as a catalytic material. The incorporation of Fe induces changes in the surface functional groups, particularly at higher concentrations, as evidenced by FTIR analyses. Furthermore, the high surface area of the activated carbon facilitates the immobilization of metal ions, representing a promising feature for its use in catalytic reactions.

Acknowledgements

We thank CAPES *(Coordination for the Improvement of Higher Education Personnel)*, CNPq *(National Council for Scientific and Technological Development)*, and FAPERGS *(Research Support Foundation of the State of Rio Grande do Sul)* for financial support.

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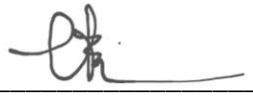
_____ Date: November 11, 2025.

Produção e caracterização de catalisador à base de carvão ativado de bagaço de uva adsorvido com ferro

Alice Neri da Silva Sousa[1]; Fernanda Luz de Freitas[1]; Paula Schneid Alves[1*]; Caroline Pereira Roldão[1]; Luiz Antonio de Almeida Pinto[1]; Débora Pez Jaeschke[1]; Vanessa Bongalhardo Mortola[1]; Tito Roberto Sant'Anna Cadaval Junior[1]

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Resumo/Abstract

RESUMO – A crescente demanda por materiais catalíticos econômicos e sustentáveis tem impulsionado a utilização de resíduos agroindustriais como fonte alternativa para sua produção. Este trabalho teve como objetivo produzir e modificar carvão ativado a partir de bagaço de uva, visando sua aplicação como catalisador após a adsorção de íons de ferro. O carvão ativado foi obtido por pirólise do bagaço de uva impregnado com $ZnCl_2$, apresentando área superficial de 443,7 $m^2\ g^{-1}$. A modificação foi realizada por meio da adsorção de íons Fe^{3+} em diferentes concentrações (200, 300 e 400 mg L^{-1}). Os resultados mostraram que a capacidade de adsorção aumentou com a concentração inicial de ferro, atingindo 217,5 mg g^{-1} a 400 mg L^{-1}. A espectroscopia FTIR revelou alterações nos grupos funcionais após a adsorção, com aparecimento de bandas características de Fe–O e FeOOH, confirmando a fixação dos íons metálicos. A combinação de elevada área superficial e presença de grupos ativos demonstra que o material possui potencial promissor como catalisador de baixo custo a partir de resíduo agroindustrial.
Palavras-chave: resíduos agroindustriais, impregnação metálica, pirólise.

ABSTRACT – The growing demand for economical and sustainable catalytic materials has driven the use of agro-industrial residues as an alternative source for their production. This work aimed to produce and modify activated carbon from grape pomace, targeting its application as a catalyst after adsorption of iron ions. The activated carbon was obtained by pyrolysis of grape pomace impregnated with $ZnCl_2$, exhibiting a surface area of 443.7 $m^2\ g^{-1}$. Modification was carried out through adsorption of Fe^{3+} ions at different concentrations (200, 300, and 400 mg L^{-1}). Results showed that the adsorption capacity increased with the initial iron concentration, reaching 217.5 mg g^{-1} at 400 mg L^{-1}. FTIR spectroscopy revealed changes in functional groups after adsorption, with the appearance of characteristic Fe–O and FeOOH bands, confirming the fixation of metal ions. The combination of high surface area and presence of active groups demonstrates that the material holds promising potential as a lowcost catalyst derived from agro-industrial residue.
Keywords: agroindustrial waste, metal impregnation, pyrolysis.

Introdução

O desenvolvimento de materiais catalíticos de baixo custo tem ganhado destaque devido à sua relevância científica, econômica e ambiental. Nesse contexto, os resíduos agroindustriais são uma alternativa para a produção de *biochar* e carvão ativado. Dependendo do material de origem, a pirólise desses resíduos pode gerar materiais com características de porosidade, área superficial, estrutura de poros e propriedades físico-químicas favoráveis para aplicações em adsorção e catálise (1). Dentre os diversos resíduos já estudados, destaca-se o bagaço de uva, um subproduto da indústria vitivinícola, que tem demonstrado potencial promissor na geração de materiais carbonáceos com aplicações em adsorção (2).

Neste estudo, propõe-se a modificação do carvão ativado por meio da adsorção de íons de ferro, visando seu uso posterior como catalisador. A impregnação metálica permite a fixação dos metais na superfície do carvão, e a redução dos metais adsorvidos promove a formação de elementos metálicos ou íons de baixa valência, alterando a estrutura porosa do material. Essas modificações aumentam os sítios ativos, melhorando a eficiência do material como catalisador.

Experimental

O carvão ativado foi produzido a partir de bagaço de uva-bordô, proveniente da indústria vitivinícola. Inicialmente, o bagaço in natura foi submetido à secagem a 105±5 ºC por 24 h, seguido de moagem e peneiramento. O material retido entre as malhas 20 e 48 mesh foi impregnado com $ZnCl_2$, na proporção 1:1, sob agitação a 25 °C por 24 h. Após, as amostras foram filtradas e secas a 110 °C. Para a pirólise, utilizou-se 15g de amostra impregnada, inserida em tudo de quartzo, em forno tubular de leito fixo. A carbonização foi conduzida com fluxo de N2 de 200 mL min^{-1}, rampa de aquecimento de 10ºC min-1 até atingir 700ºC, e tempo de residência de 60 min. Após o resfriamento, o carvão ativado foi submetido à lavagem com HCl (0,5 mol L^{-1}), sob agitação a 95 °C durante 30 min. Em seguida, o material foi

lavado com água destilada até pH neutro e seco a 110 °C por 24 h.

Para os ensaios de adsorção de ferro, foram utilizados 0,1 g de carvão ativado em 100 mL de soluções contendo diferentes concentrações de $Fe(NH_4)(SO_4)_2 \cdot 6H_2O$ (200, 300 e 400 mg L^{-1}). As amostras foram mantidas sob agitação de 100 rpm a 25 °C por 24 h (3). Após, as amostras foram filtradas, e a concentração de ferro no meio aquoso foi determinada pelo método de complexação com 1,10-fenantrolina (4). A capacidade de adsorção no equilíbrio (q_e) foi determinada conforme a Equação 1, e a taxa de remoção, conforme a Equação 2.

$$q_e = (C_0 - C_e/m) \cdot V \qquad (1)$$

onde C_0 e C_e são as concentrações inicial e no equilíbrio, respectivamente (mg L^{-1}), m é a massa de adsorvente (g) e V é o volume da solução (L).

$$T_r(\%) = (C_0 - C_e/C_0) \cdot 100 \qquad (2)$$

Para a caracterização das amostras, foi realizada espectroscopia no infravermelho por transformada de Fourier (FTIR). A área superficial do carvão ativado de bagaço de uva, antes da adsorção, foi determinada por meio da análise BET (Brunauer–Emmett–Teller).

Resultados e Discussão

A área superficial do carvão ativado foi de 443,7 $m^2\ g^{-1}$, indicando que o material apresenta características adequadas para aplicações como adsorvente ou catalisador. Na Tabela 1 são apresentados os resultados referentes à capacidade de adsorção no equilíbrio e a taxa de remoção em diferentes concentrações de ferro.

Tabela 1. Capacidade de adsorção (q_e) e taxa de remoção (T_r) de ferro pelo carvão ativado de bagaço de uva em diferentes concentrações iniciais da solução (C_0, 200, 300 e 400 mg L^{-1}).

Id.	C_0 (mg L^{-1})	q_e (mg g^{-1})	T_r (%)
CA-Fe200	200	25,9 ± 4,14	25,9 ± 2,07
CA-Fe300	300	101,8 ± 4,85	33,9 ± 1,62
CA-Fe400	400	217,5± 3,56	54,4 ± 0,89

Os resultados mostram que o aumento da concentração inicial de ferro eleva a capacidade de adsorção e a taxa de remoção, o que é esperado devido ao maior gradiente de concentração, que favorece a difusão do soluto até a superfície do adsorvente (5).

A Figura 1 apresenta os espectros de FTIR dos materiais avaliados, evidenciando alterações nas propriedades do carvão ativado após a adsorção, especialmente na intensidade das bandas dos grupos funcionais. Todos os espectros apresentaram um ombro em torno de 3300 cm^{-1} atribuído às vibrações de estiramento das ligações N–H e O–H (3). A região de 2900 cm^{-1} está relacionada às ligações C–H de grupos metila e metileno (6), enquanto a banda em 3034 cm^{-1} indica estiramento de –OH. A faixa de 2100-2000 cm^{-1} pode ser atribuída ao grupo aleno (7), e mudanças entre 1500 e 1600 cm^{-1} sugerem vibrações de N–H, hidroxilas fenólicas ou grupos C=C/C=O. Bandas características de Fe–O e FeOOH, ainda que discretas, sugerem a fixação dos íons metálicos, especialmente em maiores concentrações de ferro. A região de 686 cm^{-1}, ausente no carvão não modificado, é atribuída ao estiramento do FeOOH, típico de carvões ativados modificados com Fe^{3+} (3).

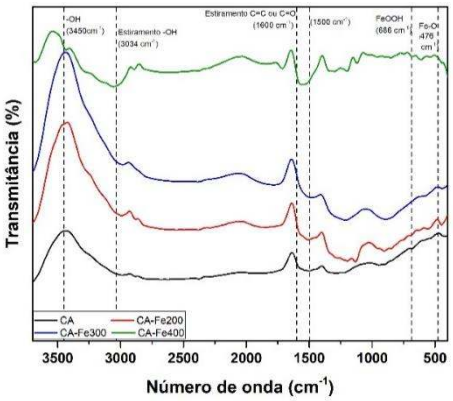

Figura 1. Espectros de infravermelho do carvão ativado (CA) e dos carvões após adsorção com ferro nas concentrações de 200 mg L^{-1} (CA-Fe200), 300 mg L^{-1} (CA-Fe300) e 400 mg L^{-1} (CAFe400).

Conclusões

Os resultados deste estudo demonstraram que o carvão ativado obtido a partir de bagaço de uva é capaz de adsorver ferro de forma eficiente, possibilitando sua aplicação como material catalítico. A incorporação de Fe promove alterações nos grupos funcionais da superfície, especialmente em maiores concentrações, conforme evidenciado pelas análises de FTIR. Além disso, a elevada área superficial do carvão ativado favorece a fixação dos íons metálicos, configurando-se como uma característica promissora para seu uso em reações catalíticas.

Agradecimentos

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23rd CBCat
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presented the poster entitled

Production and Characterization of an Activated Carbon-Based Catalyst from Grape Pom Impregnated with Iron

at the 23rd Brazilian Congress on Catalysis: Catalysis for a Sustainable Energy Transition, held from September 21 to 26 2025, in Natal - Rio Grande do Norte, Brazil.

Kátia Bernardo Gusmão
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apresentaram o trabalho em pôster intitulado

Produção E Caracterização De Catalisador À Base De Carvão Ativado De Bagaço De Uva Adsorvido Com Ferro

no 23º Congresso Brasileiro de Catálise: Catálise para uma Transição Energética Sustentável, realizado entre os dias 21 a 26 de setembro de 2025, em Natal – RN, Brasil.

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Supporting evidence for the nature of professional publication and peer-review procedure

About us

Who we are

The Brazilian Catalysis Society will, each week, starting on June 23, 2020, **publish on its website a little about the history of each of our researchers** . We believ of this history and how catalysis has changed the lives of our researchers will be an incentive for young researchers. We decided to start with our Honorary Member re The first will be **Prof. Dr. Martin Schmal** , who also shared with us a bit of the history of catalysis in Brazil.

Catalysis in Brazil

In the 1960s, catalysis in Brazil was sporadic and limited. It truly began with Professor Remulo Ciola in São Paulo. Besides being a Chemistry professor at the Univer Paulo, he worked at the country's first refining plant in Capuava. Professor Ciola also inaugurated the course on heterogeneous catalysis at USP, pioneering it in the c set up his laboratory with what he managed to bring from the industry, when I met him in 1971, recently arrived from Germany. Research in catalysis also began at the Research Center (CENPES) in the early 1960s, concentrated in the petrochemical area, mainly supporting the petrochemical industry cluster – “Petroquisa”.

PRONAQ – PRONAC

In the early 1980s, the Minister of Planning, Antonio Delfim Neto, created a National Chemistry Program, coordinated by Professor Fernando Gallembeck. It was a program aimed at developing chemistry in the country, with separate programs: "Large Equipment"; "Natural Processes and Products"; "Shale Chemistry"; "Alcohol totaling 12 programs, one of which was "Catalysis." Dr. Peter Seidl, coordinator of the Chemistry Project at CNPq (National Council for Scientific and Technological Dev approached me at the time to coordinate and form a Catalysis Group in Brazil. After a series of meetings in Brasília, the first Chemistry Program (PRONAQ) was lau Catalysis Group received a relatively small budget, but enough to purchase small equipment and consumables for each laboratory. The great challenge was to form t create an integrated catalysis project, find new groups, and coordinate everything with limited funds. At the time, I contacted Dr. Roger Frety and Dr. Yiu Lau La developed a plan. The idea was to provide these laboratories with a catalytic and chromatographic test. We selected the first 10 laboratories and programmed the resources from CNPq, for a period of 24 months.

There were different types of structural problems. Not all laboratories had the freedom to manage the money, and it wasn't applied to the intended laboratories du and inflation. In some cases, the money was only enough to buy the chromatograph casing. Several projects were rescheduled. However, as expected, this proj forward, and several other laboratories took a back seat. The CNPq funding was insufficient, and so we began to receive full support from FINEP. The idea remained th equip the laboratories with a minimum structure for catalytic testing and now with equipment for characterizations, such as measurements of surface areas, pore v topics related to catalytic processes.

The National Chemistry Program (PRONAQ) was terminated soon after, but the catalysis sub-area continued, and with the support of FINEP, we created a separa catalysis, renamed PRONAC, with a C, under my coordination. However, after 3 years, problems caused by high inflation led to its interruption. It is worth noting tha was fundamental and served as a pillar of catalysis in universities in Brazil, taking root in different regions, mainly the South, Southeast, and Northeast. The backbone research in the country was formed, which had an impact on the various subsequent events of SBCat.

Research in Industries

In Brazil, three important petrochemical complexes were created, the first and oldest being the São Paulo Petrochemical Complex, dating from the 1960s. All the tech imported, and the processes worked, with the catalyst being a completely unknown secret to the technicians. Manufacturer recommendations were followed, and th its origin, or performance were not questioned.

With the support of FINEP (Brazilian Innovation Agency), new investments were made in research laboratories in companies during the 1970s, in addition to Researc which were intended to support research in industries. Significant investments were made and new research laboratories were built in various industries in the Petrochemical Complex, such as: CIQUINE, COPENE, NITROCARBONO, NITROFÉRTIL, POLIALDEN, etc., primarily for research in catalysis and catalytic processes, but als the entire analytical infrastructure and pilot plants. In the mid-1980s, two important catalyst factories were established in Brazil: Fábrica Carioca de Catalisadores Newtechnos. Oxiteno also established a catalyst factory in the mid-1980s, producing zinc oxide and silver oxide for its own consumption and for sale.

In the early 1990s, all research projects in the country's industries were abruptly halted with the election and inauguration of the new president in 1992, Collor de Mell the most fatal and frustrating phase for the country. All laboratories in the industries closed. PETROQUISA, the petrochemical holding company in the country, was shu industrial and academic research was interrupted and scrapped. FCC, Newtechnos, and part of Oxiteno remained, operating with their own resources but als significant losses. The training of qualified personnel was destroyed. All project firms closed, and the country regressed. There was no more support for scientific r universities, and consequently, all postgraduate courses suffered. For 10 years, no young people were hired for research centers in the country.

Brazilian Society of Catalysis (SBCat)

The starting point for the creation of SBCat was the organization of the 6th Ibero-American Symposium on Catalysis in 1978. At the previous symposium in Lisbo presented a paper, and to my surprise, the Assembly proposed that I take the next Symposium to Brazil. Practically no one from Brazil had participated with a paper u was very daunting to bring it to Brazil, and there were several opposing votes, mainly because of the dictatorship reigning in the country. So, I asked for a period of 6 respond. Professor Portella, president of the Symposium, insisted, and supported by other colleagues, I approached Petrobras, the main research center in the c Leonardo Nogueira thought it was risky to hold an event of this nature in the country. The university lacked the resources, both financial and structural, and the kn catalysis, so what to do?

The idea was to approach the Brazilian Petroleum Institute (IBP), which already had experience in organizing petroleum and petrochemical events. With the support Petrobras, and especially the CNPq (National Council for Scientific and Technological Development) to bring in some international speakers (Prof. Boudard), we h Ibero-American Catalysis Symposium in Rio de Janeiro in 1978. The result was extremely positive, with the presence of approximately 200 people from Spain, Portugal, Mexico, and also from other European countries such as France and Italy. Soon after the Symposium, we were encouraged by leaders of the Ibero-American comr colleagues from the symposium to form a catalysis collective in Brazil. How? The IBP accepted, and the Catalysis subgroup was created within the Petrochemical Cc with representatives from universities in each region of the country and representatives from industry—Petrobras, Oxiteno, Degussa, and Petroquisa—with Dr Nogueira chosen as coordinator. The committee planned the following proposals:

(i) Organize the seminar every two years;
(ii) Organize courses on heterogeneous and homogeneous catalysis;
(iii) Publish a book with catalytic glossaries;
(iv) Conduct a survey of catalysis in industries;
(v) Organize future Ibero-American symposia on catalysis;
(vi) Support groups in promoting catalysis in Brazil;
(vii) Create regional catalysis centers in Brazil.

In 1996, when we held the 8th Catalysis Seminar in Rio de Janeiro, one of the most important due to the presence of famous speakers such as Professor Gabor So Professor Prins, among other international figures, the first idea of forming a Brazilian Catalysis Society arose. At the 9th Catalysis Seminar in São Paulo, the participants was already so large that Professor Dilson Cardoso proposed transforming it into the Brazilian Catalysis Congress, of which I was the first president. The the Brazilian Catalysis Society gave a sensational boost to relations with universities, industries, and the international community.

A major challenge was joining our International Association of Catalysis Societies (IACS), which brings together all societies from countries with a certain level of deve catalysis. There were significant requirements, such as consistent publications in international journals; interactions with industry; regular internal congresses; participation in international congresses. Once again, we accepted the challenge, and as President of the Society, on our first attempt, at the International Catalysis C Granada in 2000, we presented our proposal, which was accepted unconditionally and with applause. It was the most important achievement of the Society's in phase. We have been affiliated with IACS since 2000. The participation of Brazilians in this Congress was very positive. We had 26 participants and a large presentations. Finally, we also joined the Ibero-American Catalysis Society (FISOCAT) in 2002.

29th cbcta

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THE FUTURE OF FOOD: INNOVATION, HEALTH, AND SUSTAINABILITY IN THE FOOD PRODUCTION CHAIN

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Florianópolis/Santa Catarina, October 17, 2

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Certificado

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AVALIAÇÃO DA COMPOSIÇÃO PROXIMAL DA Attalea tessmannii (COCÃO)

dos autores **Carla Pereira Wenderroschs Gomes, Bruno Marques, Rejane Macedo Martins, Alice Neri Silva Sousa, Débora Pez Jaeschke, Luiz Antônio Almeida PINTO, Tito Roberto Sant'Anna Cadaval, Anelise CHRIST-RIBEIRO**, foi aprovado no 29° Congresso Brasileiro de Ciência e Tecnologia de Alimentos, realizado no período de 14 a 17 de outubro de 2024, na forma de apresentação **E-pôster**, tendo como autor(a) apresentador(a) **Carla Pereira Wenderroschs Gomes**.

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Certificat

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EFFECT OF SOLID-STATE FERMENTATION BY Rhizopus oryzae ON THE PROXIMATE COMPOSITIO OF Attalea tessmannii (COCÃO)

authored by **Carla Pereira Wenderroschs Gomes, Bruno Marques, Rejane Macedo Alice Neri Silva Sousa, Débora Pez Jaeschke, Luiz Antônio Almeida Pinto, Tito Sant'Anna Cadaval, Anelise CHRIST-RIBEIRO**, was approved for the 29th Brazilian C of Food Science and Technology, held from October 14 to 17, 2024, in the form of an **E** presentation, with **Carla Pereira Wenderroschs Gomes** as the presenting author.

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EFEITO DA FERMENTAÇÃO EM ESTADO SÓLIDO POR Rhizopus oryzae NA COMPOSIÇÃO PROXIMAL DA Attalea tessmannii (COCÃO)

324

dos autores **Carla Pereira Wenderroschs Gomes, Bruno Marques, Rejane Macedo Martins, Alice Neri Silva Sousa, Débora Pez Jaeschke, Luiz Antônio Almeida Pinto, Tito Roberto Sant'Anna Cadaval, Anelise CHRIST-RIBEIRO**, foi aprovado no 29° Congresso Brasileiro de Ciência e Tecnologia de Alimentos, realizado no período de 14 a 17 de outubro de 2024, na forma de apresentação **E-pôster**, tendo como autor(a) apresentador(a) **Carla Pereira Wenderroschs Gomes**.

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Certificamos que o trabalho intitulado,

CINÉTICA DE EXTRAÇÃO DE LIPÍDEOS DAS AMÊNDOAS DE FRUTOS DE COCÃO (Attalea tessmannii)

327

dos autores **KAROLINA FERRAZ AGUIAR SANTOS, Pedro BRANDÃO, Alice SOUSA, Sheraz AHMAD, Nauro SILVEIRA JÚNIOR, Débora JAESCHKE, Luiz PINTO, Tito CADAVAL JUNIOR, Keiti PEREIRA**, foi aprovado no 29° Congresso Brasileiro de Ciência e Tecnologia de Alimentos, realizado no período de 14 a 17 de outubro de 2024, na forma de apresentação **E-pôster**, tendo como autor(a) apresentador(a) **KAROLINA FERRAZ AGUIAR SANTOS**.

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authored by **KAROLINA FERRAZ AGUIAR SANTOS, Pedro BRANDÃO, Alice SOUSA, Sheraz AH Luiz HAN, Nauro SILVEIRA JUNIOR, Débora JAESCHKE, Anelise CHRIST-RIBEIRO, Luiz PINTO CADAVAL JUNIO**R, was approved for the 29th Brazilian Congress of Food Science and Technolog from October 14 to 17, 2024, in the form of an **E-poster** presentation, with **KAROLINA F AGUIAR SANTOS** as the presenting author.

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ANÁLISE DE PERFIL DE ÁCIDOS GRAXOS DO ÓLEO DE AMÊNDOA DOS FRUTOS DE COCÃO (Attalea tessmannii)

330

dos autores **KAROLINA FERRAZ AGUIAR SANTOS, Pedro BRANDÃO, Alice SOUSA, Sheraz AHMAD, Luiz HAN, Nauro SILVEIRA JUNIOR, Débora JAESCHKE, Anelise CHRIST-RIBEIRO, Luiz PINTO, Tito CADAVAL JUNIOR**, foi aprovado no 29° Congresso Brasileiro de Ciência e Tecnologia de Alimentos, realizado no período de 14 a 17 de outubro de 2024, na forma de apresentação **E-pôster**, tendo como autor(a) apresentador(a) **KAROLINA FERRAZ AGUIAR SANTOS**.

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Food Science and Technology

Supporting evidence of peer-review proceeding and nature of the publication

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- ✔ Where available, URLs for the references have been provided.
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- ✔ The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines, which is found in About the Journal.

Author Guidelines

Food Science and Technology (CTA) publishes scientific articles in the field of food science. Works should be written in English and follow the editorial standards below.

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Food Science and Technology (CTA) accepts submissions of review articles and articles presenting results of original research. Articles are assessed by double-blind peer review process.

The rejection of a manuscript can be decided by the Editor in Chief, Adjunct Associate Editor and Associated Editors.

The acceptance of a manuscript depends on the review of at least two anonymous referees designated by the Editorial Board. The referees' reviews will be sent to the authors to guide them in all needed changes related to their manuscripts. In the case of disagreement between their reviews, the final decision will be made by the Editor responsible for the manuscript or if he/she finds it necessary, another referee will be heard, and the three reviews will be analyzed by the sbCTA Editorial Board, who will finally decide on the acceptance of the manuscript.

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Contents

Original Research

The manuscript must present clear and concise results of a research based on scientific methods.

Review Articles

Manuscripts should present an overview pertinent to the theme of the Journal with focus on literature published in the past five years.

Research involving humans

When presenting results of research involving humans, the approval process number granted by the Research Ethics Committee (resolution # 196/96, October 10, 1996, Brazilian National Health Council) should be provided.

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Reviewing the manuscript structure and information provided is the authors' responsibility. Original manuscripts should not exceed 16 pages (excluding the references).

The text should be presented with double spacing between lines in a one-column format. All lines should be flush with left margin of column leaving a 2.5-cm margin on right and left. Text lines must be sequentially numbered throughout the text. All pages should be sequentially numbered (see item "Files Format" at the end of this guide).

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The manuscript cover letter must include the following:

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The manuscript title page must include the following:

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Abstract, Practical Application and keywords page

Abstract

The abstract must:

- Be only in English;
- Be a single paragraph containing fewer than 200 words;
- Clearly state the main objective and rationale of the article;
- State briefly the major conclusions;
- If applicable, describe materials methods and results;
- Summarize the conclusions;
- Be sparing with abbreviations and acronyms.

The abstract should not include:

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Short text with a maximum of 85 characters, indicating innovations and important features of the study. The “Practical Application” will be published.

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The manuscript should have at least three (3) and a maximum of six (6) Keywords. Keywords should be only in English. Avoid using terms included in the main text of the manuscript in the Keywords.

Text pages

The manuscript should be arranged as follows:

1. Introduction;
2. Materials and Methods; should include experimental design and statistical data

analysis;

1. Results and Discussion (may also be separated);
2. Conclusions;
3. References;
4. Acknowledgements (optional).

In the main text:

- Abbreviations, acronyms, and symbols must be clearly defined on first usage;
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Provide a maximum of seven (7) Tables, Figures, and Charts. They should be numbered in Arabic numerals in the order they are called out in the text. In the *Manuscrito.pdf* – version for reviewer's evaluation and in the *Manuscrito.doc* – version for production, tables, equations, figures, charts and their respective captions should be included within the main text in the places indicated by the authors. Please see below the instructions for the version for production.

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Figures and charts should be provided in the main text and numbered consecutively using Arabic numerals and their respective captions should be included within the main text in the place indicated by the authors. When supplying figures containing photographs or micrographs, ensure that they are scanned at high resolution so that each photo is at least 1,000 pixels wide. All photographs should contain the author's name. Charts should be used to present files, schemes, and flowcharts.

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- Show data that are not shown in the graphs;
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Books

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Universidade Estadual de Campinas - UNICAMP. (2006). *Tabela brasileira de composição de alimentos - TACO* (versão 2, 2. ed.). Campinas: UNICAMP/NEPA.

Book Chapter

Sgarbieri, V. C. (1987). Composição e valor nutritivo do feijão Phaseolus vulgaris L. In E. A. Bulisani (Ed.), *Feijão: fatores de produção e qualidade* (cap. 5; pp. 257-326). Campinas: Fundação Cargill.

Journal Articles

Versantvoort, C. H., Oomen, A. G., Van de Kamp, E., Rompelberg, C. J., & Sips, A. J. (2005). Applicability of an in vitro digestion model in assessing the bioaccessibility of mycotoxins from food. *Food and Chemical Toxicology, 43*(1), 31-40.

Sillick, T. J., & Schutte, N. S. (2006). Emotional intelligence and self-esteem mediate between perceived early parental love and adult happiness. *E-Journal of Applied Psychology, 2*(2), 38-48. Retrieved from http://ojs.lib.swin.edu.au/index.php/ejap

Electronic work (e-work)

Richardson, M. L. (2000). *Approaches to differential diagnosis in musculoskeletal imaging* (version 2.0). Seattle: University of Washington School of Medicine. Retrieved from http://www.rad.washington.edu/mskbook/index.html

Legislation

Brasil, Ministério da Educação e Cultura. (2010). *Institui a Política Nacional de Resíduos Sólidos; altera a Lei nº 9.605, de 12 de fevereiro de 1998; e dá outras providências* (Lei nº 12.305, de 2 de agosto de 2010). Diário Oficial da República Federativa do Brasil.

Theses and Dissertations

Fazio, M. L. S. (2006). *Qualidade microbiológica e ocorrência de leveduras em polpas congeladas de frutas* (Dissertação de mestrado). Universidade Estadual Paulista, São José do Rio Preto.

Articles previously presented at scientific conferences

Sutopo, W., Nur Bahagia, S., Cakravastia, A., & Arisamadhi, T. M. A. (2008). A Buffer stock Model to Stabilizing Price of Commodity under Limited Time of Supply and Continuous Consumption. In

Proceedings of The 9th Asia Pacific Industrial Engineering and Management Systems Conference (APIEMS), Bali, Indonesia.

Files format

The main manuscript text should be submitted as follows:

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- Double spacing between lines;
- Figures, tables, tables, equations and respective legends must be incorporated in the text in the position preferred by the author;
- The file cannot exceed 16 pages, in addition to the list of bibliographic references
- Lines and pages must be numbered sequentially;
- The cover page with the name of the authors and institutions must be presented in a separate file
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English

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We hereby certify that

The extended abstract entitled "**Charcoal quality produc wood residues and planted forests**", authored by "**Alice Silva Sousa; Keiti Roseane Mendes Pereira; Anderson d Silva; Sebastião Kennon Ferreira Santos; Carolina Nogueira** was published in the proceedings of the **V National Fo Charcoal and the III seminar on Forest Biomass Energy**, o by the Society of Forest Research - SIF, held in Belo Horizont Gerais, on May 15 and 16, 2019, with a total workload of 14 ho

Viçosa, May 16, 2019.

Prof. Angélica de Cássia Oliveira Carneiro
Technical Coordinator

Prof. Glêison Augusto dos Sa
Scientific Director - SIF

Schedule

Day 05/**14** – Tuesday

Time	Activity
4:00 PM to 7:00 PM	Accreditation and registration

Day 05/**15** – Wednesday

Time	Activity
7:00 AM	Accreditation and registration
8:00 AM	Opening ceremony Composition: Angélica de Cássia, Sebastião Renato Valverde, Gleison Santos, Saenandoah Dutra, Leonardo Chagas.
	Panel 1 – Moderator Sebastião Renato Valverde / UFV
9:00 AM	Brazilian forest biomass market Speaker: Rômulo Sousa Lisboa (STCP)
9:30 AM	Production of pig iron and steel using charcoal: national and international perspective Speaker: Fausto Varela (Sindifer)
10:00 AM	Coffee break
10:30 AM	Business Space 1
10:40 AM	Biomass for Pellet Production: Challenges, Perspectives, and Market Speaker: Thiago de Paula Protásio (UFRA)
11:10 AM	Important aspects of forest improvement for charcoal production Speaker: Gleison Augusto dos Santos (UFV)
11:40 AM	Panel Debates - 1
12:00 PM	Lunch break
	Panel 2 – Moderator Paulo F. Trugilho / UFLA
2:00 PM	Normative Deliberation 227 – Atmospheric emissions from charcoal production furnaces – Direct and indirect implications for charcoal production in Minas Gerais Speaker: Adriana Maugeri (Minas Gerais Forest Industry Association)
2:30 PM	Strategic charcoal production according to business size Speaker: Augusto Valencia Rodriguez (Biomtec)
3:00 PM	Monitoring and automation technology for charcoal production furnaces Speaker: Luís Paulo Tolentino (Coltech)
3:30 PM	Business Space - 2
3:30 PM	Coffee break
4:00 PM	Business Space - 3
4:10 PM	External cooling of charcoal produced in masonry furnaces Speaker: Arthur Queiroz Lana (ESALq/USP)
4:40 PM	Technical and economic assessment of interlocking bricks/blocks for charcoal kiln construction Speaker: Wellington Almeida (Plantar Siderúrgica)
5:10 PM	Efficiency assessment of charcoal production chains Speaker: Túlio Jardim Raad (Carboraad)
5:40 PM	Panel Debates 2

Day 05/**16** – Thursday

Time	Activity
	Panel 3 – Moderator Márcio Aredes Martins / UFV
8:30 AM	Charcoal quality from eucalyptus clones in silicon production Speaker: Diego Correa Ramos (Grupo RB)
9:00 AM	Refractory linings for kilns, ducts, and furnaces Speaker: Cristiano Juste (Refragum)
9:30 AM	Business Space - 4
9:40 AM	Coffee break
10:00 AM	Business Space - 5
10:10 AM	Opportunities and market for condensable products from wood pyrolysis Speaker: Adriana Vilela (Rima Industrial)
10:40 AM	State of the art of carbonization gas combustion in Brazil: Current situation and perspectives Speaker: Roosevelt Almado (ArcelorMittal Biofloresta)
11:10 AM	Use of combusted gases from the gas burner for wood drying Speaker: Humberto Fauller (DEF/UFV)
11:40 AM	Panel Debates 3
12:10 PM	Lunch break
	Panel 4 – José Dilcio Rocha / Embrapa Territorial
2:00 PM	Heat and electricity generation from biomass gasification Speaker: Electo Eduardo Silva Lora
2:30 PM	Technological innovations in charcoal production: challeng and perspectives Speaker: Ezio V. Santos (Aperam Bioenergia)
3:00 PM	Charcoal production technology in metal kilns Speaker: Sidney Pessoa (DPC)
3:30 PM	Coffee break
4:00 PM	Business Space - 6
4:10 PM	Continuous carbonization technology – CARBOVAL Speaker: Fernando Latorre (Vallourec)
4:40 PM	Environmental policy for the charcoal production chain: Mistakes and successes Speaker: Luiz Carlos Cardoso Vale
5:40 PM	Panel Debates 4
5:45 PM	Roundtable: Researchers, consultants, industrialists, produ and government – Topic - The future of charcoal-based ste Points to be discussed: Technical aspects, public policies, financing sources for the charcoal sector; incentives, main bottlenecks, and perspectives, among others. Sustainable Steelmaking Project Consultant Moderator: Angélica de Cássia Oliveira Carneiro Guests: Sebastião Renato Valverde – SIF/UFV João Câncio de Andrade – Asiflor José Otavio Brito – IPEF Representative of the sustainable steelmaking project – MDI Nestor Claret – Plantar Siderúrgica Adriana Maugeri – Minas Gerais Forest Industry Association Fausto Varela Cançado – Sindifer Luiz Carlos Cardoso Vale Rosimeire Cavalcante dos Santos – UFRN
7:00 PM to 10:00 PM	**Closing cocktail**

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Date: October 2, 2025.

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III Seminário de Energia da BIOMASSA FLORESTAL

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O resumo expandido intitulado **"Qualidade do carvão vegetal produzido de resíduos madeireiros e de floresta plantada"**, de autoria de **"Alice Neri da Silva Sousa; Keiti Roseane Mendes Pereira; Anderson de Araújo Silva; Sebastião Kennon Ferreira Santos; Carolina Nogueira Xavier"**, foi publicado nos anais do **V Fórum Nacional sobre Carvão Vegetal e III Seminário de Energia da Biomassa Florestal**, promovido pela Sociedade de Investigações Florestais – SIF, em Belo Horizonte, Minas Gerais, nos dias 15 e 16 de maio de 2019, com duração total de 14 horas.

Viçosa, 16 de maio de 2019.

Profª Angélica de Cássia Oliveira Carneiro
Coordenadora Técnica

Prof. Glêison Augusto dos Santos
Diretor Científico - SIF

Dia 14/05 - Terça-feira

Horário	Atividade
16 às 19h	Credenciamento e inscrição

Dia 15/05 - Quarta-feira

Horário	Atividade
07:00h	Credenciamento e inscrição
08:00h	Solenidade de abertura Composição: Angélica de Cássia, Sebastião Renato Valverde, Gleison Santos, Saenandoah Dutra, Leonardo Chagas.
	Painel 1 – Moderador Sebastião Renato Valverde / UFV
09:00h	Mercado brasileiro de biomassa florestal Palestrante: Rômulo Sousa Lisboa (STCP)
09:30h	Produção de ferro gusa e aço à carvão vegetal: Perspectiva nacional e internacional Palestrante: Fausto Varela (Sindifer)
10:00h	Coffe break
10:30h	Espaço Empresarial 1
10:40h	Biomassas para produção de Pellets: Desafios, Perspectivas e Mercado Palestrante: Thiago de Paula Protásio (UFRA)
11:10h	Aspectos importantes do melhoramento florestal para produção de carvão vegetal" Palestrante: Gleison Augusto dos Santos (UFV)
11:40h	Debates Painel - 1
12:00h	Intervalo para almoço
	Painel 2 – Moderador Paulo F. Trugilho / UFLA
14:00h	Deliberação Normativa 227 – Emissões atmosféricas dos fornos de produção de carvão vegetal – Implicações diretas e indiretas na produção de carvão vegetal em MG Palestrante: Adriana Maugeri (Associação Mineira da Indústria Florestal)
14:30h	Estratégica produção de carvão vegetal de acordo com o porte do negócio Palestrante: Augusto Valencia Rodriguez (Biomtec)
15:00h	Tecnologia de monitoramento e automação de fornos de produção de carvão vegetal Palestrante: Luís Paulo Tolentino (Coltech)
15:30h	Espaço Empresarial - 2
15:30h	Coffe break
16:00h	Espaço Empresarial - 3
16:10h	Resfriamento externo do carvão vegetal produzido em fornos de alvenaria Palestrante: Arthur Queiroz Lana (ESALq/USP)
16:40h	Avaliação técnica e econômica de tijolos/tijolão de encaixe para construção de fornos de carvão Palestrante: Wellington Almeida (Plantar Siderúrgica)
17:10h	Avaliação da eficiência das cadeias de produção de carvão vegetal Palestrante: Túlio Jardim Raad (Carboraad)
17:40h	Debates Painel 2

Dia 16/05 - Quinta-feira

Horário	Atividade
	Painel 3 – Moderador Márcio Aredes Martins / UFV
08:30h	Qualidade do carvão vegetal de clones de eucalipto na produção de silício Palestrante: Diego Correa Ramos (Grupo RB)
09:00h	Revestimentos refratários para fornos, dutos e fornalhas Palestrante: Cristiano Juste (Refragum)
09:30h	Espaço Empresarial - 4
09:40h	Coffe break
10:00h	Espaço Empresarial - 5
10:10h	Oportunidade e mercado dos produtos condensáveis da pirólise da madeira Palestrante: Adriana Vilela (Rima Industrial)
10:40h	Estado da arte da queima dos gases da carbonização no Brasil: Situação atual e perspectivas Palestrante: Roosevelt Almado (ArcelorMittal Biofloresta)
11:10h	Utilização dos gases combustos do queimador de gases para secagem da madeira Palestrante: Humberto Fauller (DEF/UFV)
11:40h	Debates Painel 3
12:10h	Intervalo para almoço
	Painel 4 – José Dilcio Rocha / Embrapa Territorial
14:00h	Geração de calor e eletricidade a partir da gaseificação de biomassa Palestrante: Electo Eduardo Silva Lora
14:30h	Inovações tecnológicas da produção de carvão vegetal: Desafios e Perspectivas Palestrante: Ezio V. Santos (Aperam Bioenergia)
15:00h	Tecnologia de produção de carvão vegetal em fornos metálicos Palestrante: Sidney Pessoa (DPC)
15:30h	Coffe break
16:00h	Espaço Empresarial - 6
16:10h	Tecnologia de carbonização contínua – CARBOVAL Palestrante: Fernando Latorre (Vallourec)
16:40h	Política de Meio Ambiente para a cadeia produtiva de carvão vegetal: Erros e acertos Palestrante: Luiz Carlos Cardoso Vale
17:40h	Debates Painel 4
17:45h	Mesa redonda: Pesquisadores, consultores, industriais, produtores e governo - Tema – Futuro da siderurgia a carvão vegetal? Pontos a serem discutidos: Aspectos técnicos, políticas públicas, fontes de financiamento para o setor de carvão vegetal; incentivos, principais gargalos e perspectivas, dentre outros. Consultor do Projeto Siderurgia Sustentável Moderadora: Angélica de Cássia Oliveira Carneiro Convidados: Sebastião Renato Valverde – SIF/UFV João Câncio de Andrade – Asiflor José Otavio Brito – IPEF Representante do projeto siderurgia sustentável – MDIC/MCTIC/MMA Nestor Claret – Plantar Siderúrgica Adriana Maugeri – Associação Mineira da Indústria Florestal Fausto Varela Cançado – Sindifer Luiz Carlos Cardoso Vale Rosimeire Cavalcante dos Santos - UFRN
19 ás 22h	**Coquetel de encerramento**

VICBCTEM
Brazilian Congress of Wood Science and Technology

October 16 to 18
PELOTAS

CERTIFICATE

The work entitled **Energy potential of sawmill wood residues in Rio Branco,** authored by **Keiti Roseani Mendes Pereira, Osmar Philipe Barbosa Farrapo, Neri da Silva Sousa, Susy Pereira Pinto**, was presented in the poster categ the **VI Brazilian Congress of Wood Science and Technology – VI CBCTEM** from October 16 to 18, 2024.

Prof. Leonardo da Silva Oliveira
Coordinator of the Committee
Organizer of the VI CBCTEM

Prof. Carlos Roberto Sette Júnior
President of the Brazilian Society
of Wood Science and Technology

ORGANIZATION

BRAZILIAN SOCIETY OF WOOD SCIENCE AND TECHNOLOGY

FEDERAL UNIVERSITY OF PELOTAS RS-BRAZIL

Wood Industrial Engineering UFPEL

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CONFEA Federal Council of Engineering and Agronomy

CREA Regional Councils of Engineering and Agronomy

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Verify authenticity: https://www.conference.net.br/certificado/verificacao/MGlGQTEyS

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: October 2, 2025.

VICBCTEM
Congresso Brasileiro de Ciência e Tecnologia da Madeira

16 a 18 de outubro de 2024
PELOTAS

CERTIFICADO

O trabalho intitulado **Potencial energético dos resíduos madeireiros de serraria em Rio Branco, Acre** de autoria de **Keiti Roseani Mendes Pereira, Osmar Philipe Barbosa Farrapo, Alice Neri da Silva Sousa, Susy Pereira Pinto** foi apresentado na categoria poster no **VI Congresso Brasileiro de Ciência e Tecnologia da Madeira - VI CBCTEM**, ocorrido de 16 a 18 de outubro de 2024.

Prof. Leonardo da Silva Oliveira
Coordenador da Comissão Organizadora do VI CBCTEM

Prof. Carlos Roberto Sette Júnior
Presidente da Sociedade Brasileira de Ciência e Tecnologia da Madeira

REALIZAÇÃO
SOCIEDADE BRASILEIRA DE CIÊNCIA E TECNOLOGIA DA MADEIRA
UNIVERSIDADE FEDERAL DE PELOTAS RS-BRASIL
Engenharia Industrial Madeireira UFPEL

PATROCÍNIO MASTER
cmpc
CONFEA Conselho Federal de Engenharia e Agronomia
CREA Conselhos Regionais de Engenharia e Agronomia
mútua Caixa de Assistência dos Profissionais do Crea
CAPES

Supporting evidence for peer-review proceeding and nature of the publication

Submission of Papers

Important information

1. Registration and submission of scientific papers will open on **January 12, 2026, with a final deadline of July 12, 2026** .
2. Submitted and approved scientific papers will be presented in poster or oral presentation format. The selection of papers for oral presentation will be made by the event's Scientific Committee, and authors will be notified in advance.
3. The ten best papers will be selected for publication in the journals Árvore (https://www.revistaarvore.ufv.br/rarv) and CERNE (https://cerne.ufla.br/site/index.php/CERNE), with five papers allocated to each journal.

General guidelines

Those registered for the VII CBCTEM will be entitled to submit up to two scientific papers as first author. Papers with a maximum of eight authors will be accepted, including one main author and up to seven co-authors. Only papers submitted

through the event's official system and with the registration fee duly paid will be accepted.

Papers must be submitted as a complete work, between eight and ten pages long, written in Portuguese. Scientific papers must adhere to the guidelines and instructions available for download below the thematic areas; submissions that do not follow these guidelines will not be accepted.

Approved scientific papers will be published in the event's Proceedings. Poster presentations must be prepared and printed by the authors. The poster template, in PowerPoint format, will be available from April onwards and must be used, including the VII CBCTEM logo in the header and the logos of the organizing institutions in the footer.

The schedule of presentations will be released at the beginning of September.

Thematic areas

Wood/Biomass Quality

Wood Products: Panels, engineered products, preserved wood, furniture and flooring.

Bioenergy

Biorefinery and non-timber forest products

To submit work to the conference, register or log in to the system using your registered credentials.

Template for the Complete Project

Exhibit F - Petitioner's work in public exhibitions

23rd CBCat
Brazilian Congress on Catalysis

SBCAT
BRAZILIAN SOCIETY OF CATALYSIS

CERTIFICATE

We hereby certify that

Alice Neri Da Silva Sousa; Fernanda Luz De Freitas; Paula Schneid Alves; Caroline Pereira Roldão; Luiz Antonio De Almeida Pinto; Débora Pez Jaeschke; Vanessa Bongalhardo Mortola; Tito Roberto Sant'anna Cadaval Junior

presented the poster entitled

Production and Characterization of an Activated Carbon-Based Catalyst from Grape Pom Impregnated with Iron

at the 23rd Brazilian Congress on Catalysis: Catalysis for a Sustainable Energy Transition, held from September 21 to 26 2025, in Natal - Rio Grande do Norte, Brazil.

Kátia Bernardo Gusmão
President of SBCat

Sibele B. C. Pergher
President of the Organizing Committee

Anne Gabriella Dias Santos
President of the Scientific Committee

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

_____ Date: November 11, 2025.

CERTIFICADO

Certificamos que

Alice Neri Da Silva Sousa; Fernanda Luz De Freitas; Paula Schneid Alves; Caroline Pereira Roldão; Luiz Antonio De Almeida Pinto; Débora Pez Jaeschke; Vanessa Bongalhardo Mortola; Tito Roberto Sant'anna Cadaval Junior

apresentaram o trabalho em pôster intitulado

Produção E Caracterização De Catalisador À Base De Carvão Ativado De Bagaço De Uva Adsorvido Com Ferro

no 23º Congresso Brasileiro de Catálise: Catálise para uma Transição Energética Sustentável, realizado entre os dias 21 a 26 de setembro de 2025, em Natal – RN, Brasil.

Kátia Bernardo Gusmão
Presidente da SBCat

Sibele B. C. Pergher
Presidente do Comitê Organizador

Anne Gabriella Dias Santos
Presidente do Comitê Científico

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II
REGIONAL
RESEARCH CONGRESS
OF THE STATE
OF ACRE
XXV
UFAC
SCIENTIFIC INITIATION
SEMINAR

Federal University of Acre
Vice President's Office for Research and Graduate Studies
Research Directorate

CNPq

25 YEARS

CERTIFICATE

We certify that the work entitled **INFLUENCE OF SOAKING VOLUM**
ELECTRICAL CONDUCTIVITY TEST IN CEDAR SEEDS (CEDRELLA FISSILIS – M
authored by **ALICE NERI DA SILVA SOUSA, ALICE NERI DA SILVA SOUSA, KAR**
FAUSTINO DA SILVA, CLEVERSON CARVALHO, was presented as a **Poste**
Regional Research Congress of the State of Acre and the XXV Scientifi
Seminar of the Federal University of Acre – UFAC, held from October 3 to Octo
at the Federal University of Acre, Main Campus.

INNOVATION:
SUSTAINABILITY
AND REGIONAL DEVELOPMENT

Rio Branco - Acre, Janu

Prof. Dr. Fabio Augusto Gomes
Research Director

Prof. Dr. Josimar Batista Ferreira
Vice President for Research and Graduate Studies

This certificate can be validated at: https://sistemas.ufac.br/plataforma_certificados/validar_certificado/00002-00003-RFB5N29DY47/

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Date: October 2, 2025.

II CONGRESSO REGIONAL DE PESQUISA DO ESTADO DO ACRE

XXV SEMINÁRIO DE INICIAÇÃO CIENTÍFICA DA UFAC

Universidade Federal do Acre
Pró-Reitoria de Pesquisa e Pós-Graduação
Diretoria de Pesquisa

CERTIFICADO

355

Certificamos que o trabalho intitulado: **INFLUÊNCIA DO VOLUME DE EMBEBIÇÃO NO TESTE DE CONDUTIVIDADE ELÉTRICA EM SEMENTES DE CEDRO (CEDRELLA FISSILIS - MELIACEAE)** de autoria de **ALICE NERI DA SILVA SOUSA, ALICE NERI DA SILVA SOUSA, KARINE MILENE FAUSTINO DA SILVA, CLEVERSON CARVALHO** foi apresentado em **Pôster** no II Congresso Regional de Pesquisa do Estado do Acre e XXV Seminário de Iniciação Científica da Universidade Federal do Acre – UFAC, que ocorreram de 3 de outubro de 2016 a 7 de outubro de 2016, na Universidade Federal do Acre, Campus Sede.

INOVAÇÃO: SUSTENTABILIDADE E DESENVOLVIMENTO REGIONAL

Rio Branco - Acre, 11 de Janeiro de 2017

Prof. Dr. Fábio Augusto Gomes
Diretor de Pesquisa

Prof. Dr. Josimar Batista Ferreira
Pró-Reitor de Pesquisa e Pós-Graduação

Vice 's Office
for Extension and Culture

Federal
University of

Extension Certificate

We certify that **Alice Neri da Silva Sousa** presented the work "**Quality of Charcoal for Domestic Use from a Charcoal Plant in the Municipality of Bujari, Acre**" during the activities of the "**XII Forestry Week**", organized by the **Center for Biological and Natural Science** of the Federal University of Acre, held at the **Federal University of Acre - Rio Branco/Acre**, from **September 17 to 21, 2018**.

Rio Branco - Acre, February 14, 201

Prof. Dr. Isaac Dayan Bastos da Silva
Vice President for Extension and Culture

Francisco Gilvan Martins Do Nascimento
Acting Director of Extension Activities

Prof. Dr. Keiti Roseani Mende
Extension Project Coord

I. Title of the activity: XII Forestry Week.

II. Classification: Event.

III. Objectives: General Objective: To promote the exchange of experiences and technical knowledge among professi from various institutions, researchers, and students of the Forestry Engineering program. **Specific Objectives: -** S integration of UFAC's Forestry Engineering program with public sector organizations, other higher education institution organizations, unions, and associations in the forestry sector; - Introduce Forestry Engineering students and stude environmental and/or agricultural programs to new technologies related to forest science in Acre; - Provide access to issues related to the exploitation and conservation of the Amazon forest ecosystem.

IV. Involved institutions: Funtac - 34.700.153/0001-63

V. Speakers or Lecturers: - Technician in wood technology - Technician in biotechnology - Technician in the manager and non-timber forest resources - Technician in geotechnology

VI. Program Content or Syllabus: This activity aims to contribute to the student's development across various dis through reflections and discussions with professionals via lectures.

DAEX - Department of Extension Activities
FUNTAC - Acre State Technology Foundation
PROEX - Vice President for Extension and Culture
SIAPE - Integrated Personnel Administration System
UFAC - Federal University of Acre

UFAC/PROEX/DAEX
Registration No.: 2019.02.0911
Date: February 14, 2019

Francisco Gilvan Martins D
Registration/SIAPE

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: October 2, 2025.

Pró-Reitoria de Extensão e Cultura

Universidade Federal do Acre

Certificado de Extensão

359

Certificamos que **Alice Neri da Silva Sousa** apresentou o banner "**Qualidade do carvão vegetal para uso doméstico de uma carvoaria no município de Bujari, Acre**" durante as atividades do "**XII Semana Florestal**", realizado pelo **Centro de Ciências Biológicas e da Natureza**, da Universidade Federal do Acre, em **Universidade Federal do Acre - Rio Branco/AC**, no período de **17 a 21 de setembro de 2018**.

Rio Branco - Acre, 14 de fevereiro de 2019.

Prof. Dr. Isaac Dayan Bastos da Silva
Pró-Reitor de Extensão e Cultura

Francisco Gilvan Martins Do Nascimento
Diretor de Ações de Extensão em Exercício

Profª. Drª. Keiti Roseani Mendes Pereira
Coordenador(a) do Projeto de Extensão

I. Título da ação: XII Semana Florestal.

II. Caracterização: Evento.

III. Objetivos: Objetivo geral: Difundir a troca de experiências e conhecimento técnico entre profissionais, estudantes de várias instituições, pesquisadores e alunos do curso de Engenharia Florestal. **Objetivos Específicos:** - Ampliar a integração da Engenharia Florestal da UFAC com organizações do poder público, outras instituições de ensino superior, organizações do terceiro setor, sindicatos e associações do setor florestal; - Apresentar aos acadêmicos de Engenharia Florestal e de outros cursos da área ambiental e/ou agrária novas tecnologias vinculadas à ciência florestal no Acre; - Proporcionar acesso às informações sobre questões relacionadas à exploração e conservação do ecossistema florestal da Amazônia.

IV. Instituições envolvidas: Funtac - 34.700.153/0001-63

V. Palestrantes ou Conferencistas: - Técnico da área de tecnologia da madeira - Técnico da área de biotecnologia - Técnico da área de manejo de recursos florestais madeireiros e não madeireiros - Técnico da área geotecnologia

VI. Conteúdo Programático ou Ementa: Esta atividade tem por objetivo contribuir nos diversos campos disciplinares para o desenvolvimento do aluno, a partir de reflexões e discussões com profissionais através de palestras.

UFAC/PROEX/DAEX
Registro nº.: 2019.02.0911
Em: 14 de fevereiro de 2019

Francisco Gilvan Martins Do Nascimento
Matrícula/SIAPE 1956820

66th Annual Meeting of SBPC

July 22 to 27, 2014

Federal University of Acre - UFAC - Rio Branco/AC

Certificate

We hereby certify that the work **EROSIVE PROCESSES IN A PERMANENT PRESERVATION AREA OF A STREAM IN JI-PARANÁ / RO**, authored by *Alice Neri da Silva Sousa, Lorena de Souza Tavares, Jocimar Coutinho Rodrigues Junior, Bruna Vasconcelos Felix, and Bruno Aparecido Pereira Castellan*, was presented in poster format at the 66th Annual Meeting of SBPC (Brazilian Society for the Advancement of Science), held from July 22 to 27, 2014, at the Federal University of Acre - UFAC, Rio Branco/AC, Brazil.

361

Helena B. Nader
President of SBPC

66th Annual Meeting of SBPC

July 22 to 27, 2014

Federal University of Acre - UFAC - Rio Branco/AC

Certificate

We hereby certify that the work **SOCIO-ENVIRONMENTAL RISK ASSESSMENT IN A STREAM IN THE CITY OF JI-PARANÁ/RO**, authored by *Bruna Vasconcelos Felix, Lorena de Souza Tavares, Jocimar Coutinho Rodrigues Junior, Bruno Aparecido Pereira Castellan e Alice Neri da Silva Sousa*, was presented in poster format at the 66th Annual Meeting of SBPC (Brazilian Society for the Advancement of Science), held from July 22 to 27, 2014, at the Federal University of Acre - UFAC, Rio Branco/AC, Brazil.

362

Helena B. Nader
President of SBPC

66th Annual Meeting of SBPC

July 22 to 27, 2014

Federal University of Acre - UFAC - Rio Branco/AC

Certificate

We hereby certify that the work **IDENTIFICATION AND INFLUENCE OF SOLID WASTE DEPOSITED IN THE 50 STREAM IN JI-PARANÁ/RO**, authored by *Bruno Aparecido Pereira Castellan, Lorena de Souza Tavares, Jocimar Coutinho Rodrigues Junior, Alice Neri da Silva Sousa e Bruna Vasconcelos Felix*, was presented in poster format at the 66th Annual Meeting of SBPC (Brazilian Society for the Advancement of Science), held from July 22 to 27, 2014, at the Federal University of Acre - UFAC, Rio Branco/AC, Brazil.

363

Helena B. Nader
President of SBPC

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: November 12, 2025.

66ª Reunião Anual da SBPC

22 a 27 de julho de 2014

Universidade Federal do Acre - UFAC - Rio Branco/AC

Certificado

Certificamos que o trabalho **PROCESSOS EROSIVOS EM ÁREA DE PRESERVAÇÃO PERMANENTE DE UM CÓRREGO EM JI-PARANÁ / RO**, de autoria de *Alice Neri da Silva Sousa, Lorena de Souza Tavares, Jocimar Coutinho Rodrigues Junior, Bruna Vasconcelos Felix* e *Bruno Aparecido Pereira Castellan*, foi apresentado, na forma de pôster, na 66ª Reunião Anual da SBPC, realizada de 22 a 27 de julho de 2014, na Universidade Federal do Acre - UFAC, Rio Branco/AC, Brasil.

365

Helena B. Nader
Presidente da SBPC

66ª Reunião Anual da SBPC

22 a 27 de julho de 2014

Universidade Federal do Acre - UFAC - Rio Branco/AC

Certificado

Certificamos que o trabalho **AVALIAÇÃO DE RISCOS SOCIOAMBIENTAIS EM UM CÓRREGO NO MUNICÍPIO DE JI-PARANÁ/RO**, de autoria de *Bruna Vasconcelos Felix, Lorena de Souza Tavares, Jocimar Coutinho Rodrigues Junior, Bruno Aparecido Pereira Castellan* e *Alice Neri da Silva Sousa*, foi apresentado, na forma de pôster, na 66ª Reunião Anual da SBPC, realizada de 22 a 27 de julho de 2014, na Universidade Federal do Acre - UFAC, Rio Branco/AC, Brasil.

366

Helena B. Nader
Presidente da SBPC

66ª Reunião Anual da SBPC

22 a 27 de julho de 2014

Universidade Federal do Acre - UFAC - Rio Branco/AC

Certificado

Certificamos que o trabalho **IDENTIFICAÇÃO E INFLUÊNCIA DE RESÍDUOS SÓLIDOS DEPOSITADOS NO CÓRREGO 50 EM JI-PARANÁ/RO**, de autoria de *Bruno Aparecido Pereira Castellan*, *Lorena de Souza Tavares*, *Jocimar Coutinho Rodrigues Junior*, *Alice Neri da Silva Sousa* e *Bruna Vasconcelos Felix*, foi apresentado, na forma de pôster, na 66ª Reunião Anual da SBPC, realizada de 22 a 27 de julho de 2014, na Universidade Federal do Acre - UFAC, Rio Branco/AC, Brasil.

367

Helena B. Nader
Presidente da SBPC

SBPC's annual meeting takes place in Acre for the first time.

Published on July 23, 2014 at 6:53 PM. Updated on November 1, 2022 at 12:41 PM.

Held for the fourth time in the Northern region and for the first time in the state of Acre, the 66th Annual Meeting of the Brazilian Society for the Advancement of Science opened on Tuesday evening, the 23rd, in the capital Rio Branco. With the auditorium of the Federal University of Acre (UFAC) packed and more than 5,400 people registered for the activities, including 2,900 students and professors from the state of Acre, the event was

attended by the Minister of Science, Technology and Innovation, Clelio Campolina Diniz, among other authorities.

Campolina highlighted the importance of welcoming professors, researchers, and students from all over Brazil to the local community, but said that it is equally important for those coming to Rio Branco, as they will be able to learn about the local reality and better understand the difficulties and differences that exist between the regions of the country, thus enabling them to seek solutions to problems affecting national development. In his speech, the minister emphasized a topic he considers one of the most important in the current debate on science and technology. "Genetic heritage is something that needs to be taken very seriously. We need to take advantage of the extensive heritage that exists in our country so that it generates income and development without destroying it. We cannot forget to preserve and value the accumulated knowledge of the region," he stated.

The president of the SBPC (Brazilian Society for the Advancement of Science), Helena Nader, spoke about the themes that have guided the organization's work. Among them was the national code for Science, Technology & Innovation, still under consideration in the National Congress. The president was emphatic in stating the SBPC's opposition to the removal of the term "basic

research" from the draft text. "Basic research is the foundation of science, technology, and innovation. It is essential for improving the human condition in society," she argued.

Nader reforçou a necessidade de um real aumento do orçamento do Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); falou da preocupação com o contingenciamento dos recursos dos fundos setoriais de ciência e tecnologia; reforçou o repúdio da SBPC perante as invasões ao Instituto Royal, realizadas em 2013. "Construído com financiamento público e o único no gênero no país para testes pré-clínicos que utilizam animais"; alertou para a luta da entidade contra o possível fechamento da unidade Embrapa (

habitacional; e disse que o projeto de lei que dispõe sobre o acesso ao patrimônio genético apresentado pelos ministérios do Meio Ambiente (MMA), do Desenvolvimento, Indústria e Comércio Exterior (MDIC) e MCTI no mês de junho, possui muito itens que precisam ainda ser discutidos. "Tanto que o projeto já recebeu mais de cem emendas. Pedimos a retirada do caráter de urgência da tramitação. Já esperamos 14 anos, não precisamos correr agora."

A presidenta também lembrou fatos importantes acontecidos deste a última reunião, realizada em Recife. Entre eles, a aprovação do Plano Nacional da Educação (PNE). "Temos agora que fiscalizar o seu cumprimento"; o marco legal da internet; o programa de atração e fixação de doutores na Amazônia, elaborado pela regional norte do Fórum Nacional de Pró-Reitores de Pesquisa e Pós-Graduação (Foprop); e a alteração do projeto do Senado que permitia a revalidação automática de diplomas estrangeiros.

Helena Nader encerrou sua fala com um trecho do poema "O poeta fala" do acreano José Guilherme de Araújo Jorge. "Estou cada vez mais convencido de que a liberdade tem sido uma p

burguesia em seu proveito. Por isso acho que ser livre é não ter fome, não ter medo da vida, não viver ao desamparo, ter direito à terra, à educação, à saúde, ao trabalho, a viver com o mínimo necessário para que não seja apenas um animal explorado pelo dinheiro. E o resto é silêncio."

Cerimônia

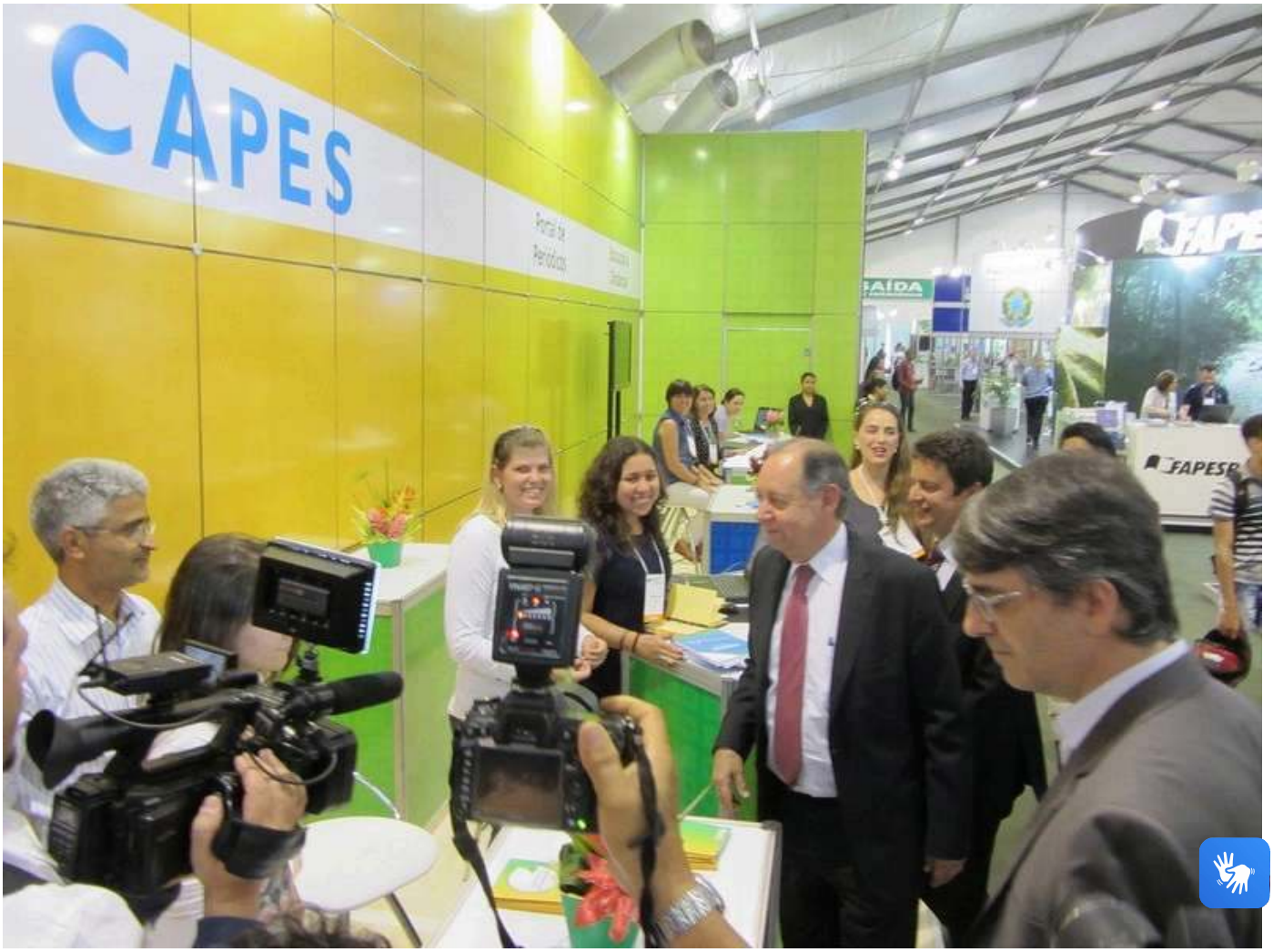
A presidenta da Associação Nacional dos Pós-Graduandos (ANPG), Tamara Naiz, lembrou que a associação foi criada há 28 anos em uma reunião anual da SBPC e disse que a entidade reconhece os avanços da educação e da C&T nos últimos anos, mas que querem ainda mais. "É o nosso dever, como estudantes, buscar o melhor."

Ainda durante solenidade de abertura, foi entregue ao jornalista Herton Escobar, do jornal Estado de S. Paulo, o 34º Prêmio José Reis de Divulgação Científica e Tecnológica.


ASSOCIAÇÃO
CIA E TECNOLOGIA
MA AMAZÔNIA
FRONTEIRAS
UFAC

ExpoT&C

A Coordenação de Aperfeiçoamento de Pessoa de Nível Superior (Capes) participa com estande da ExpoT&C, mostra de ciência, tecnologia e inovação.



A programação da 66ª Reunião Anual da SBPC segue até domingo, 27 no campus da UFAC.

(*Fabiana Santos*)

Compartilhe:

Serviços que você acessou

FEVEREIRO

Emitir DAS do MEI

Exhibit G – Petitioner's performance of a leading or critical role in distinguished organizations

11-11-2025

To the USCIS Immigration Officer

My name is Martha Andreia Brand, and I serve as a professor and researcher at *Universidade do Estado de Santa Catarina* (UDESC), where I coordinate the Laboratory of Wood Technology III in the Center for Agricultural and Veterinary Sciences. With a Ph.D. in Forest Engineering and over two decades of academic and research experience, I have had the privilege of mentoring numerous graduate students. Among them, Ms. Alice Neri da Silva Sousa stood out for her remarkable initiative and clear capacity to assume leadership roles within our laboratory environment. I supervised her master's studies from August 2020 through August 2022. During this time, I directly observed her decisive and well-organized performance.

Throughout her graduate research, Ms. Sousa demonstrated a high level of competence and reliability, enabling her to take on a leadership role among her peers. Although she was my advisee, she independently supervised undergraduate research fellows assigned to projects associated with her thesis. She guided these students in conducting laboratory analyses, verified the quality and accuracy of their experimental work, and coordinated their timetables and technical reports. I witnessed how they readily relied on her for both scientific and methodological guidance, viewing her as a reference point within the group.

Her proactive role contributed significantly to the smooth operation, safety, and organization of our laboratory. Ms. Sousa established well-structured routines and improved internal communication among team members, which enhanced both academic productivity and workplace safety. These outcomes were crucial to maintaining the efficiency of one of UDESC's most active research units, connected to the highly ranked Forestry Engineering Graduate Program, recognized nationally for its excellence by the Brazilian Ministry of Education.

Although this leadership role occurred within an academic setting, its institutional importance was indisputable. It strengthened the quality of mentoring available to undergraduate students and elevated research standards. It reflected the University's emphasis on academic rigor and technical precision. Moreover, her demonstrated initiative and organizational skills were instrumental in her later acceptance into the doctoral program at the Federal University of Rio Grande (FURG), a testament to her reputation for professional maturity and scientific potential.

In summary, I affirm that Ms. Alice Neri da Silva Sousa played a critical and leadership role within our institutional research framework within UDESC's Wood Technology Laboratory, coordinating the efforts of fellow researchers and ensuring high experimental standards. Her performance exceeded what is typically expected of a graduate student, revealing an aptitude for independent leadership in scientific environments.

Sincerely,

Martha Andreia Brand
Professor and Coordinator, Laboratory of Wood Technology III

Email: martha.brand@udesc.br | Phone: +55 (49) 3289-9279

Martha Andreia Brand

Address to access this CV: http://lattes.cnpq.br/0920058820470751
ID Lattes: **0920058820470751**
Last updated: 01/09/2025

bachelor's at Forest Resources and Forest Engineering from Universidade Federal do Paraná (1997), master's at Forest Resources and Forest Engineering from Universidade Federal do Paraná (2000) and doctorate at Forest Resources and Forest Engineering from Universidade Federal do Paraná (2007). Has experience in Forest Resources and Forest Engineering, acting on the following subjects: biomassa florestal, pinus taeda, qualidade da madeira, indústria madeireira and resíduos industriais. **(Text informed by the author)**

Personal Information

Name

Martha Andreia Brand

Bibliographic Citation

BRAND, M. A.;BRAND, M.A.;BRAND, MARTHA ANDREIA;Brand, Martha Andrea;ANDREIA BRAND, MARTHA

Lattes iD

http://lattes.cnpq.br/0920058820470751

Nationality

Brasil

Address

Professional Address

Universidade do Estado de Santa Catarina, Centro Agroveterinário, Departamento de Engenharia Florestal.
Avenida Luiz de Camões - de 1371/1372 a 2445/2446
Conta Dinheiro
88520000 - Lages, SC - Brasil
Telephone: (49) 4932899279
Fax: (49) 32899279
Homepage URL: http://www.cav.udesc.br

Formal Education/Degree

2003 - 2007

Ph.D. in Engenharia Florestal.
Universidade Federal do Paraná, UFPR, Brasil. ,
Year of degree: 2007.
Advisor: Graciela Ines Bolzon de Muniz.
Keywords: cogeração; resíduos madeiráveis; energia de biomassa.
Major Area: Agrarian Sciences
Major Area: Agrarian Sciences / Area: Forest

Resources and Forest Engineering / Subarea: Energia de Biomassa Florestal.

1998 - 2000

Master in Engenharia Florestal.
Universidade Federal do Paraná, UFPR, Brasil.
Year of degree: 2000.
Advisor: Graciela Inês Bolzon de Muñiz.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: Balanço de materiais; Serraria; Laminadora; Manufatura de painéis; Balanço energético.
Major Area: Agrarian Sciences
Major Area: Agrarian Sciences / Area: Forest Resources and Forest Engineering / Subarea: Tecnologia e Utilização de Produtos Florestais / Specialty: Processamento Mecânico da Madeira.
Activity sectors: Energy; Quality and Productivity.

1993 - 1997

Graduation in Engenharia Florestal.
Universidade Federal do Paraná, UFPR, Brasil.
Advisor: Graciela Inês Bolzon de Muñiz.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.

1988 - 1990

Curso técnico/profissionalizante in Técnico em Agropecuária.
Colégio Agrícola Vidal Ramos, COLÉGIO AGRICOLA, Brasil.

Complementary Education

2002 - 2002

Disciplina de Metodologia da Pesquisa.
Universidade do Planalto Catarinense, UNIPLAC, Brasil.

2002 - 2002

Disciplina de Metodologia do Ensino Superior.
Universidade do Planalto Catarinense, UNIPLAC, Brasil.

Professional Experience

Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, EPAGRI, Brasil.

Contract

2017 - Present

Type of contract: Pesquisador em projeto em rede, Functional Placement: sem vinculo

Universidade Federal de Santa Catarina, UFSC, Brasil.

Contract

2014 - 2017

Type of contract: Pesquisador de projeto em rede, Functional Placement: pesquisador

Universidade do Estado de Santa Catarina, UDESC, Brasil.

Contract

2007 - Present

Type of contract: Professor, Functional Placement: Professor Associado, nível VII, Credit Hours: 40, Regime: Exclusive Dedication.

Activities

05/2024 - Atual

Councils, Commissions and Consulting, Centro Agroveterinário.

Position or Function
Comissão de Extensão do CAV.

01/2019 - Atual

Manager and Administrative Positions, Centro Agroveterinário, Departamento de Engenharia Florestal.

Position or Function
Coordenadora do Laboratório de Tecnologia da Madeira III.

07/2014 - Atual

Councils, Commissions and Consulting, Comissão Editorial da Revista de Ciências Agroveterinárias.

Position or Function
Representante do Departamento de Engenharia Florestal.

03/2012 - Atual

Teaching, Engenharia Florestal, Degree: Pos-Graduation

Disciplines Taught
Energia e Desenvolvimento
Engenharia do Ambiente na Indústria Florestal
Metodologia Científica e da Pesquisa
Qualidade da Madeira e Produtos Florestais
Tópicos especiais em caracterização da madeira e processos industriais
Transformação da Madeira e Produtos Florestais

01/2012 - Atual

Teaching, Engenharia Florestal, Degree: Graduation

Disciplines Taught
Anatomia e Identificação de Madeiras
Celulose e Papel
Energia de Biomassa Florestal
Metodologia científica
Preservação e Secagem da Madeira
Química de Madeira

07/2007 - Atual

Research and Development, Grupo de Pesquisa Qualidade e Utilização de Recursos Florestais-Ambientais.

Research Fields
Qualidade da Madeira
Energia de Biomassa Florestal
Extração e transformação de materiais

02/2021 - 12/2022

Manager and Administrative Positions, Curso de Mestrado em Engenharia Florestal.

Position or Function
Coordenador do Curso de Mestrado em Engenharia Florestal.

03/2017 - 03/2020

Councils, Commissions and Consulting, Centro Agroveterinário.

Position or Function
Presidente da Comissão de Pesquisa do Departamento de Engenharia Florestal.

03/2014 - 03/2018

07/1995 - 07/1995

Trainee Activities , Divisâo Madeira.

Trainee Activities
Acompanhamento das atividades da divisão Florestal do IPT-SP.

Research line

1.

Qualidade da Madeira

Objective: Qualificar, analisar e desenvolver a matéria-prima e produtos de base florestal.
Major Area: Agrarian Sciences
Keywords: qualidade da madeira.

2.

Energia de Biomassa Florestal

Objective: Quantificar e qualificar a Biomassa Florestal e Industrial para o uso na Geração de Energia.
Major Area: Agrarian Sciences
Keywords: biomassa florestal.

3.

Extração e transformação de materiais

Research projects

2022 - Current

Desenvolvimento da cadeia produtiva de pellets no Brasil nos últimos 10 anos e análise prospectiva do crescimento para a próxima década

Situation: In progress; Nature: Research.
Participant students: Graduation: (2) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Flávio José Simioni - Member / Djeison Felipe Voos - Member.

2021 - Current

Emprego de redutores de emissão de formaldeído na produção de painéis de fibra de média densidade (MDF)

Project certified by the coordinator Alexsandro Bayestorff da Cunha in 08/08/2023.

Description: Número de autorização na UDESC NPP2015010003792, execução de 01/09/2021 a 31/07/2024.
Situation: In progress; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Coordinator / Polliana D'Angelo Rios - Member.

2020 - 2022

Estudo de adsorção dos metais Cu(II) e Zn(II) em solução aquosa utilizando biochar obtido a combustão de biomassa de Pinus sp. em termelétrica

Description: Número de autorização na UDESC NPP2015010003503, Execução de 01/08/2020 a 31/07/2022.
Situation: Completed; Nature: Research.

Members: Martha Andreia Brand - Member / SCHEIN, VIVIANE APARECIDA SPINELLI - Coordinator.

2020 - 2021

Qualidade da madeira de árvores de Pinus taeda com lenho anormal de compressão

Project certified by the coordinator Alexsandro Bayestorff da Cunha in 08/08/2023.

Description: Número de autorização na UDESC NPP2015020002824, Execução de 01/08/2020 a 31/07/2021.
Situation: Completed; Nature: Research.

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Coordinator / Polliana D'Angelo Rios - Member.

2020 - Current

Sistema de medição para indicação do nível de biomassa em gaseificador do tipo contracorrente

Description: Autorização institucional: NPP2015010003907.
Situation: In progress; Nature: Research.
Participant students: Graduation: (2) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Matheus Fontanelle Pereira - Member / Thiago Henrique Mombach - Member.

S, T & A Production Rate: 1

2020 - Current

Desenvolvimento de protótipo para torrefação de biomassa na geração de energia

Description: Número do registro institucional (UDESC): NPP2015010003906.
Situation: In progress; Nature: Research.
Participant students: Graduation: (2) / Academic master's degree: (2) .

Members: Martha Andreia Brand - Coordinator / Matheus Fontanelle Pereira - Member / Ariton Araldi - Member / Marlon Filippe Santos da Silva - Member.

S, T & A Production Rate: 2

2020 - Current

POTENCIAL ENERGÉTICO DOS FRUTOS E DO BIOCARVÃO VEGETAL DA ESPÉCIE Attalea tessmannii (COCÃO) EXPLORADO E PRODUZIDO NO ESTADO DO ACRE, BRASIL

Description: Número do registro institucional (UDESC): NPP2015010003904.
Situation: In progress; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Alice Neri da Silva Sousa - Member / Keiti Roseani Mendes Pereira - Member / Ananias F. Dias Júnior - Member.

2019 - 2023

Qualidade da madeira de Eucalyptus benthamii de rotação longa nos processos de desdobro e secagem

Project certified by the coordinator Alexsandro Bayestorff da Cunha in 08/08/2023.

Description: Número de autorização na UDESC - NPP2015 2000301. 01/08/2019 a 31/07/2023.
Situation: Completed; Nature: Research.
Participant students: Graduation: (2) .

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Coordinator / Polliana D'Angelo Rios - Member.

2019 - 2021

Viabilidade técnica e econômica da produção de carvão de briquetes produzidos com misturas de resíduo de abatedouro de aves e maravalha de Pinus spp.

Description: Número de autorização na UDESC NPP2015010003250, Execução de 01/07/2019 a 31/07/2021.
Situation: Completed; Nature: Research.
Participant students: Academic master's degree: (1) .

Members: Martha Andreia Brand - Member / Philipe Ricardo Casemiro Soares - Coordinator.

2019 - 2021

Nanocritais de celulose com qualidade morfológica e química para reforço estrutural de papel

Project certified by the coordinator Polliana D`Angelo Rios in 08/08/2023.

Description: Número de autorização na UDESC NPP2015010003263, Execução de 01/08/2019 a 31/07/2021.
Situation: Completed; Nature: Research.

Members: Martha Andreia Brand - Member / Alexsandro Bayestorff da Cunha - Member / Polliana D'Angelo Rios - Coordinator.

2019 - 2020

Efeito da composição da biomassa nos parâmetros de processo em peletizadora de matriz plana e na qualidade de pellets para uso energético

Description: buscando aumentar o potencial de utilização múltipla da madeira por meio do seu uso energético em forma de pellet, este projeto tem como objetivo de analisar a qualidade dos pellets produzidos a partir de diferentes misturas contendo madeira de Pinus e de Eucalyptus, a fim de estabelecer a qualidade das diferentes misturas nos parâmetros de peletização, com base nos critérios de qualidade da norma ISO 17225-2..
Situation: Completed; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) .

Members: Martha Andreia Brand - Coordinator / Alexsandro Bayestorff da Cunha - Member / Aline Lima de Sena - Member.

S, T & A Production Rate: 1

2018 - 2021

Aplicação do biochar obtido a partir da combustão de biomassa de Pinus sp. em termelétrica na adsorção de metais para remediação ambiental

Description: O objetivo deste projeto será avaliar as características do biochar residual da combustão de biomassa de Pinus sp. e sua eficiência como adsorvente de metais pesados em água resisual e solos contaminados com estéril de mina de carvão. Número do registro institucional (UDESC): NPP2015010002983.
Situation: Completed; Nature: Research.
Participant students: Graduation: (1) / Academic master's degree: (1) / Doctorate: (1) .

Members: Martha Andreia Brand - Coordinator / Alexsandro Bayestorff da Cunha - Member / Viviane Spinelli Schein - Member / Polliana D'Angelo Rios - Member / Reny Aldo Henne - Member / Mari Lucia Campos - Member /

e entorno de onde o projeto da co-geradora. Para tanto foram realizadas análises da fauna, flora, comunidade humana, condições climáticas, edáficas e hidrícas. Deste levantamento originou-se um Relatório de Impacto ambiental e recomendações para mitigação dos efeitos negativos e maximização dos efeitos positivos do empreendimento. Como resultado houve a implantação da co-geradora obedecendo todos os pressupostos do relatório..
Situation: Completed; Nature: Development.

Members: Martha Andreia Brand - Coordinator / Estelamaris Agostini - Member.
Financier(s): Universidade do Planalto Catarinense - Cooperation / Tractebel Energia S.A. - Grant.

Other Projects

2006 - 2007

Estudo da variação das propriedades físicas da madeira relacionadas ao processo de secagem controlada e co-geração de energia

Description: Este projeto foi aprovado na Chamada pública 07/2006 - Apoio a Pesquisa Científica Básica - Linha I, lançado pela Fundação de Apoio à Pesquisa do Estado de Santa Catarina. Fez parte deste projeto o plano de expansão dos Laboratórios de Sacegem da Madeira e Energia da Madeira do Centro de Ciências e Tecnológicas da UNIPLAC..
Situation: Completed; Nature: Other.
Participant students: Graduation: (1) .

Members: Martha Andreia Brand - Member / Valdeci José da Costa - Coordinator.
Financier(s): Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina - Grant / Universidade do Planalto Catarinense - Cooperation.

Member of editorial board

2025 - Present

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2021 - 2023

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2019 - 2021

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2017 - 2019

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2014 - 2016

Scientific Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

Member of advisory committee

2019 - Present

Development agency: Associação Brasileira de Normas Técnicas

Scientific journal referee

2001 - Present

Journal: Floresta (UFPR)

2011 - Present

Journal: Ambiência (UNICENTRO)

2012 - Present

Journal: British Journal of Applied Science & Technology

2008 - Present

Journal: Pesquisa Florestal Brasileira (Impresso)

2012 - Present

Journal: Energia na Agricultura (UNESP. Botucatú. CD-Rom)

2013 - Present

Journal: Ciência Rural (UFSM. Impresso)

2014 - Present

Journal: Ciência da Madeira

2014 - Present

Journal: Bosque (Valdivia. Impresa)

2014 - Present

Journal: FLORAM - Revista Floresta e Ambiente

2014 - Present

Journal: Scientia Forestalis (IPEF)

2014 - Present

Journal: Wood Material Science and Engineering

2014 - Present

Journal: Ciência Florestal (UFSM. Impresso)

2016 - Present

Journal: Biomass and bioenergy

2016 - Present

Journal: Anais da Academia Brasileira de Ciências (Online)

2016 - Present

Journal: Revista Brasileira de Engenharia Agrícola e Ambiental (Online)

2016 - Present

Journal: Energy and Fuel

2017 - Present

Journal: Journal of Power and Energy

2018 - Present

Journal: Revista Árvore (on-line)

2016 - Present

Journal: ENERGY

2018 - Present

Journal: Journal of Renewable and Sustainable Energy

2019 - Present

Journal: Philippine Journal of Science

2020 - Present

Journal: FUEL

2012 - Present

Journal: REVISTA DE CIÊNCIAS AGROVETERINÁRIAS

2020 - Present

Journal: Songklanakarin Journal of Science and Technology

2019 - Present

Journal: Journal of Waste Resources and Reprocessing

2019 - Present

Journal: RENEWABLE & SUSTAINABLE ENERGY REVIEWS

2022 - Present

Journal: AMBIENTE & SOCIEDADE (ONLINE)

2022 - Present

Journal: AMBIENTE & SOCIEDADE (ONLINE)

2022 - Present

Journal: BioResources

2022 - Present

Journal: BioResources

2023 - Present

Journal: Cerne

2025 - Present

Journal: Journal of Renewable Materials

Funding project reviewer

2018 - Present

Development agency: Universidade Federal do Rio Grande do Norte

2018 - Present

Development agency: Conselho Nacional de Desenvolvimento Científico e Tecnológico

Areas of Expertise

1.

Major Area: Agrarian Sciences / Área: Forest Resources and Forest Engineering / Subarea: Energia de Biomassa Florestal.

2.

Major Area: Engineering / Área: Material and Metallurgical Engineering / Subarea: Materiais Não-Metálicos/Specialty: Extração e Transformação de Materiais.

Languages

English

Comprehends Reasonably, Speaks Reasonably, Reads Well, Writes Reasonably.

Spanish

Comprehends Well, Speaks Well, Reads Well, Writes Reasonably.

Scientific, Technological, Artistic and Cultural Production

Bibliographical Production

Citations

Web of Science

Total of articles: 40 Total of citations: 353 Date: 06/09/2023

Brand, M.A.

SCOPUS

Total of articles: 57 Total of citations: 498 Date: 06/09/2023

Brand, M.A.

Full articles published in journals

Sort by

Chronological Order

1.

RODRIGUES, T.M. ; **BRAND, M. A.** ; RECH, T.D. ; BALSISSERA, T.C. ; PINTO, C.E. ; GARAGORRY, F.C. ; CUNHA, A. B. ; RIOS, P. D. ; TEREZO, R.F. ; SOUZA, G. DE O. ; RIBEIRO, L.DE l. . Biomass of South Brazilian highland grassland under management with burning and mowing: Characterization of vegetation and feedstock for energy. Biomass & Bioenergy JCR, v. 197, p. 01-10, 2025.

2.

SOUZA, G. DE O. ; **BRAND, M. A.** ; CUNHA, A. B. ; RIOS, P. D. ; TEREZO, R.F. ; BORTOLETTO JUNIOR, G. ; RODRIGUES, T.M. ; RIBEIRO, L.DE l. ; SURDI, P.G. ; BRITO, F.M.S. . Efeito da matéria-prima e do adesivo na degradação térmica de painéis de partículas. AMBIENTE CONSTRUÍDO (ONLINE), v. 25, p. 01-15, 2025.

3.

ALVES CORRÊA, CAMILA ; BAYESTORFF DA CUNHA, ALEXSANDRO ; VIEIRA, HELENA CRISTINA ; TEIXEIRA, MATHEUS ZANGHELINI ; DE CAMARGO, TARCISIO FRANSCISCO ; MELO, NATALIA DURIGON ; **BRAND, MARTHA ANDREIA** ; D?ANGELO RIOS, POLLIANA ; FIGUEIREDO TEREZO, RODRIGO . Technical feasibility of medium-density fibreboard (MDF) produced with oversized Pinus spp. fibres and partial incorporation of low-pressure melamine laminate residues. Wood Material Science and Engineering JCR, v. 1, p. 1-11, 2025.

4.

SILVA DA SILVA, WASHINGTON DUARTE ; SANTOS, JOIELAN XIPAIA DOS ; NISGOSKI, SILVANA ; NAIDE ACOSTA, TAWANI LORENA ; VIEIRA, HELENA CRISTINA ; SOUZA, DEIVISON VENICIO ; DALLA CORTE, ANA PAULA ; **BRAND, MARTHA ANDREIA** ; MUÑIZ, GRACIELA INES BOLZON DE . Density, chemistry and energy potential of wood waste from five least explored Amazonian species: contribution to a circular bioeconomy. Wood Material Science and Engineering JCR, v. 1, p. 1-9, 2025.

5.

, BAYESTORFF DA CUNHA, ALEXSANDRO ; CALINE DE MELLO, DÉBORA ; LIMA FERREIRA, JOELSON ; **BRAND, MARTHA ANDREIA** ; D´ANGELO RIOS, POLLIANA ; ALVES CORRÊA, CAMILA ; COSTA DE LIZ, GEFFERSON . Industrial boiler ash as an alternative for reducing formaldehyde emissions in medium-density fiberboards. WOOD MATERIAL SCIENCE AND ENGINEERING JCR, v. 19, p. 1-10, 2024.

6.

SOUSA, ALICE NERI DA SILVA ; PEREIRA, KEITI ROSEANI MENDES ; DIAS JUNIOR, ANANIAS FRANCISCO ; FLORIANI, MATHEUS BERTOTTI ; **BRAND, MARTHA ANDREIA** . Charcoal produced from Attalea tessmannii Burret. fruit wastes. SCIENTIA FORESTALIS JCR, v. 50, p. 1-11, 2022. **Citações:** WEB OF SCIENCE 1

7.

KREFTA, S.C. ; CUNHA, A. B. ; **BRAND, M.A.** . Influência do revestimento nas propriedades de painéis compensados não-estruturais de uso exterior submetidos a câmara de intemperismo acelerado. Scientia Forestalis JCR, v. 50, p. e3849, 2022. **Citações:** WEB OF SCIENCE 1

8.

SIMIONI, FLÁVIO JOSÉ ; **BRAND, MARTHA ANDREIA** ; BIANCHINI, DEBORA CRISTINA . Energy viability of industrial drying of wood chips. Biofuels JCR, v. 14, p. 259-266, 2022.

9.

BRAND, M.A.; RODRIGUES, T.M. ; SILVA, J.P. DA ; OLIVEIRA, J. . Recovery of agricultural and wood wastes: The effect of biomass blends on the quality of pellets. FUEL JCR, v. 284, p. 118881-118887, 2021. **Citações:** WEB OF SCIENCE 32 | SCOPUS 34

10.

BRAND, M.A.; BALDUINO JUNIOR, A. ; FRIEDERICHS, G. ; CUNHA, A. B. . ENERGETIC POTENTIAL OF Phyllostachys bambusoides AS AN ALTERNATIVE SOURCE OF BIOMASS. FLORESTA (ONLINE) (CURITIBA), v. 51, p. 201-210, 2021.

11.

RODRIGUES, T.M. ; RECH, T.D. ; BALSISSERA, T.C. ; PINTO, C.E. ; GARAGORRY, F.C. ; **BRAND, M.A.** . IMPACT OF WEATHER CONDITIONS ONTHE ENERGETICQUALITY OF ACICULATED DRY BRANCHES OF Araucaria angustifolia(Bertol.) Kuntze PRODUCED THROUGHOUT AYEAR. FLORESTA (ONLINE) (CURITIBA), v. 51, p. 785-793, 2021.

12.

DORS, PRISCILLA ; CAMPOS, MARI LUCIA ; **BRAND, MARTHA ANDREIA** ; MIQUELLUTI, DAVID JOSÉ . Biochar and its adsorbent power. How are scientific publications about this issue?. RESEARCH, SOCIETY AND DEVELOPMENT, v. 10, p. e61101018520, 2021.

13.

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26.

Tag: Energy Technology Research Award

MarthaAndreia Brand | Energy | Women Researcher Award

Published on 22/03/2025 | by Academic Awards

Dr. MarthaAndreia Brand | Energy | Women Researcher Award

Professor at UDESC, Brazil.

Martha Andreia Brand is a Brazilian forest engineer and researcher specializing in forest resources, biomass energy, and wood quality. She earned her bachelor's (1997), master's (2000), and doctorate (2007) from the Universidade Federal do Paraná (UFPR). With extensive academic and professional experience, she is currently a professor at the Universidade do Estado de Santa Catarina (UDESC) and a researcher at Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina (EPAGRI). She has contributed significantly to forest engineering, wood processing, and industrial residues. Additionally, she serves as a reviewer for multiple scientific journals and is an active member of editorial boards.

Publication Profile

Orcid

Academic Background

Martha Andreia Brand holds a doctorate (2007), a master's degree (2000), and a bachelor's degree (1997) in Forest Resources and Forest Engineering from UFPR. Her doctoral research focused on the quality of forest biomass for energy generation, while her master's work examined the productivity and energy efficiency of forest-based industries. She also completed a technical degree in Agricultural Sciences at Colégio Agrícola Vidal Ramos. Additionally, she pursued complementary education in research methodology and higher education teaching at Universidade do Planalto Catarinense (UNIPLAC), enhancing her expertise in forestry, biomass energy, and wood technology.

Professional Experience

Martha Andreia Brand is a professor at UDESC, actively engaged in forest engineering research. She has held various academic and administrative positions, including vice-coordinator and coordinator roles in postgraduate programs. She has worked as a researcher at UFSC, EPAGRI, and UNIPLAC and provided consultancy services in forestry industries. Her experience spans academia, research, and industry, focusing on biomass energy, wood processing, and environmental sustainability. She has also collaborated with research networks and served as an editorial board member and reviewer for numerous scientific journals. Her work bridges theoretical and practical aspects of forest engineering and industrial applications.

Awards and Honors

Martha Andreia Brand has received multiple academic and professional recognitions throughout her career. She has been a distinguished researcher in forest biomass and wood technology, contributing to high-impact journals. She is a member of the Associação Brasileira de Normas Técnicas (ABNT) for biomass standardization. She has been recognized for her contributions as a scientific journal reviewer and editor. Her research projects have received funding from national and international institutions. As a professor and mentor, she has guided numerous students in forestry and environmental sciences. Her work has significantly advanced sustainable forest management and biomass utilization.

Research Focus

Martha Andreia Brand's research focuses on biomass energy, wood quality, and sustainable forestry. She explores the efficiency of biomass for energy production, industrial residues management, and the mechanical processing of wood. Her studies contribute to optimizing wood utilization in energy generation, improving forestry industry sustainability, and enhancing wood drying and preservation techniques. She is also involved in the standardization of biomass materials, ensuring quality control and environmental sustainability. Through interdisciplinary collaboration, her research aims to promote renewable energy solutions, reduce industrial waste, and improve the ecological and economic efficiency of forest-based industries.

Publication Top Notes

Apple pruning residues: Potential for burning in boiler systems and pellet production

Year: 2020

High density polyethylene matrix composite as reinforcing agent in medium density fiberboards

Year: 2020

Conclusion

Martha Andreia Brand is an accomplished researcher and professor at Santa Catarina State University (UDESC) with a strong academic background, holding a Ph.D., Master's, and Bachelor's in Forest Resources and Forest Engineering from Universidade Federal do Paraná. Her research focuses on biomass energy, wood quality, and sustainable forestry, contributing significantly to environmental sustainability. With 57 articles, 498 citations in Scopus, and an H-index of 11 in Web of Science (353 citations), her work has a substantial impact. She has led numerous research projects, served on editorial boards of prestigious journals, and advised key scientific organizations, including the National Council for Scientific and Technological Development and ABNT/CEE-242. Her extensive contributions to forestry and renewable energy make her a highly deserving candidate for Women Researcher Award.

Posted in: Biography Tagged: Best Women Energy Innovator Award, Best Women Researcher Award in Energy, Clean Energy Women Research Award, Climate Change Energy Women Award, Distinguished Women Energy Researchers, Energy Innovation Award for Women, Energy Leadership Award for Women, Energy Policy Women Research Award, Energy Technology Research Award, Female Scientists in Energy Award, Future Energy Research Award, Global Energy Sustainability Award, Global Women Energy Award, Global Women Leaders in Energy, Green Energy Women Award, Green Power Women Scientist Award, Leading Women in Energy Science, Outstanding Energy Research Award, Renewable Energy Women Researcher Award, Renewable Power Women Researcher Award, Solar Energy Women Research Award, Sustainable Energy Research Award, Sustainable Solutions Women Award, Top Women in Energy Research, Women

Achievers in Renewable Energy, Women Climate and Energy Research Award, Women Energy Research Pioneer Award, Women Energy Visionaries Award, Women Excellence in Energy Award, Women Impact in Energy Award, Women in Advanced Energy Research., Women in Clean Power Innovation, Women in Energy Breakthrough Award, Women in Energy Engineering Award, Women in Energy Research Recognition, Women in Energy Science Excellence, Women in Future Energy Award, Women in Green Energy Research, Women in Renewable Energy Recognition, Women in Science Energy Award, Women in Smart Energy Innovation, Women in Sustainable Energy Leadership, Women Innovators in Energy, Women Leaders in Climate Energy, Women Renewable Technology Award, Women Scientists in Energy Award, Women Scientists in Energy Technology, Women Scientists in Sustainable Power, Women Trailblazers in Energy, Women Transforming Energy Award

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Archives

February 2026

January 2026

December 2025

19/09/2025-12:00

The Wood Technology Laboratory at Udesc Lages is innovating in research and services focused on sustainability.

Studies on renewable energy, wood preservation, and technologies for the forestry sector are the focus.

Supporting evidence for the department distinguished reputation.

Laboratory performs thermal analyses of renewable fuels. Photo: Andressa Küster.

The **Wood Technology Laboratory III,** belonging to the Forestry Engineering course at the Center for Agricultural and Veterinary Sciences (CAV) of the University of the State of Santa Catarina (Udesc) in Lages, plays an active role in the economy of southern Brazil. Under the coordination of Professor Dr. Martha Andreia Brand, the laboratory hosts research and tests applied to the characterization, preservation, drying, and energy utilization of wood and its derivatives.

Currently, the research lines developed in the laboratory are:
- Use of apple tree pruning waste for the production of compacts for energy generation and food smoking;
- Energy potential of pruning waste from two grape varieties for energy use and food smoking;
- Development of a roasting equipment for wood chips in energy generation;
- Construction of improvements in gasifiers and process control for sustainable gasification of forest biomass;
- Automation processes in gasifiers for the production of gaseous fuels from forest biomass*.

In addition to academic research, the laboratory provides specialized technical services to companies and institutions. In September 2025, three contracts are active with companies located in the states of Santa Catarina, Paraná, and Rio Grande do Sul. The partnerships involve funding through Fapesc and CNPq, as well as collaboration with institutions such as Epagri, Embrapa, UFSC, and Uniplac. Between 2021 and 2024, the laboratory conducted weekly quality control of the biomass used in energy generation at the Klabin company, highlighting its relevance to the productive sector.

**Biomass is organic matter of plant or animal origin used as a renewable energy source. This matter is converted into energy through direct combustion or the combustion of gases released during its decomposition, generating heat, electricity, and biofuels.*

Infrastructure

With an infrastructure divided into different specialized environments, the laboratory works in an integrated way in the study of the physical, chemical, mechanical, and energy properties of wood, in order to evaluate its performance. The space is divided into four areas:

- **Biomass Energy Laboratory** : Analyzes the quality of different types of plant biomass (such as wood scraps, straw, among others) to better understand how they can be used as an energy source. To this end, analyses are performed to verify characteristics such as moisture content, particle size after grinding, material resistance, and how it can be compacted into briquettes or pellets (Briquettes and pellets are ecological biofuels made from compacted biomass waste, such as sawdust or wood chips, which replace firewood and other traditional fuels), and

charcoal production. The ultimate goal is to discover the best way to use each type of biomass —whether by burning it, transforming it into gas, liquids, or other processes for energy generation.

- **Drying Laboratory** : Conducts wood drying tests, observing defects associated with this process;
- **Climate-controlled chambers:** Intended for the preparation of wood samples and products for tests carried out in other laboratories. The ambient conditions inside the chamber are 65% relative humidity and 22°C;
- **Bioassay Laboratory:** Responsible for treatment, preservation, and studies of wood-boring agents*.

**These are organisms, such as insects (termites, beetles) and fungi, that feed on wood.*

Sustainability and Environmental Impact

The laboratory's activities contribute directly to the advancement of sustainable technologies focused on the use of renewable energy sources, a goal present among the Sustainable Development Goals (SDGs) of the United Nations (UN) 2030 Agenda. During growth, trees capture carbon from the atmosphere and store it in their structure. When wood is burned, this element returns to the air mainly in the form of carbon dioxide (CO^2), becoming part of its natural cycle.

Biomass, when managed responsibly, is considered carbon neutral. It represents a viable alternative to reduce dependence on fossil fuels, strengthen energy security, and boost the development of green industries.

The results of the research carried out also support the creation of public policies in the areas of energy and the environment, as well as guiding decisions in the private sector, promoting a cleaner and more efficient energy transition.

For more information and service requests, those interested can contact Martha Andreia Brand via email: martha.brand@udesc.br, or by phone: (49) 3289-9279, (49) 99146-9279 (WhatsApp).

Udesc Lages Communication Office
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*Under the supervision of journalist Carla Torres

14/04/2025-16:59

Udesc achieves top score in MEC ranking and stands out among the best in Brazil.

The institution ranks 21st out of 240 federal universities and institutes examined.

Supporting Evidence of the organization's distinguished reputation

The university, which celebrates its 60th anniversary in 2025, offers 60 undergraduate and 60 postgraduate courses in Santa Catarina. Photo: Rafael Cassaniga/Udesc

The State University of Santa Catarina (Udesc) obtained the highest possible score in the 2023 General Course Index (IGC), an indicator of higher education quality released on Friday, April 11th, by the National Institute of Educational Studies and Research Anísio Teixeira (Inep), of the Ministry of Education (MEC).

With this result, Udesc improves compared to the previous evaluation and achieves 21st place among all 240 Brazilian federal universities and institutes evaluated, in addition to 4th position among the 38 state universities in the country.

In the criteria that make up the MEC evaluation, Udesc saw an increase in its undergraduate score, rising from 3.29 to 3.60, and maintained its 2022 scores in postgraduate studies: 4.65 for master's degrees and 4.84 for doctoral degrees.

Among the 82 institutions evaluated in the state, only Udesc and the Federal University of Santa Catarina (UFSC) achieved the maximum score in the 2023 IGC. The positive result also highlights the state institution as the second best university in Santa Catarina and the fourth best-placed in the Southern region.

In total, 2,100 institutions were evaluated in the IGC, including universities, federal institutes, university centers, and colleges.

Quality indicators and highlighted courses

The results released by Inep include the 2023 Higher Education Quality Indicators. In addition to the IGC, the list includes the Concept of the National Student Performance Examination (Enade), the Indicator of Difference between Observed and Expected Performance (IDD), and the Preliminary Course Concept (CPC). According to the MEC, these indicators are instruments used to evaluate the quality of courses and higher education institutions in Brazil.

Regarding the Enade exam, of the 17 undergraduate courses at Udesc evaluated, three achieved the maximum score (5): Veterinary Medicine (Udesc Lages); Civil Engineering (Udesc Joinville); and Physiotherapy (Udesc Cefid). Additionally, eight other courses obtained a score of 4, considered good by the MEC: Architecture and Urbanism (Udesc Laguna); Agronomy (Udesc Lages); Mechanical Engineering, Electrical Engineering, and Production Engineering (Udesc Joinville); Civil Engineering (Udesc Alto Vale); Animal Science and Nursing (Udesc Oeste).

The exam assessed the performance of graduating students in relation to the programmatic content foreseen in the curricular guidelines of the courses, covering a sample of 9,812 courses in 2023.

Data from the CPC, which considers student performance in the Enade exam in conjunction with the added value of the educational process and the conditions of the undergraduate programs, including faculty, infrastructure, and teaching resources, also indicate that Udesc's courses are among the best in the state and the country.

The Civil Engineering course at Udesc in Joinville was the best among the 53 listed in Santa Catarina. The program also stands out as the second best-evaluated in the Southern region, out of a total of 178, behind only the Federal University of Santa Maria (UFSM). Nationally, the course achieved 13th position among the 917 Civil Engineering programs analyzed.

Another highlight was the Architecture and Urbanism course offered by Udesc in Laguna, which achieved seventh position in Southern Brazil, among the 133 courses evaluated in the region. In Santa Catarina, the program ranked second, behind only UFSC, among the 37 courses evaluated. Nationally, it occupied the 23rd position among the 565 courses examined throughout Brazil.

More information about the MEC indicators can be obtained from the Institutional Evaluation Coordination (Coai) by email **coai.reitoria@udesc.br.**

Udesc Communication Office
Email: comunicacao@udesc.br
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UDESC
UNIVERSIDADE DO ESTADO DE SANTA CATARINA

SANTA CATARINA STATE UNIVERSITY

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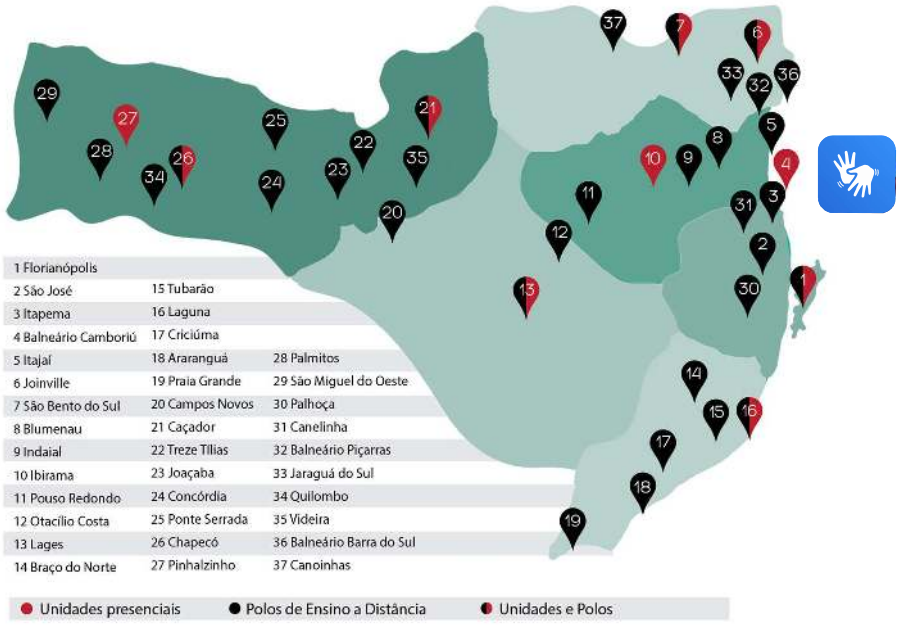

Created in 1965, the State University of Santa Catarina (Udesc), which has excellence in higher education in the areas of teaching, research, and extension and is among the best universities in Brazil and the world, has a multicampus structure, with 13 units distributed in ten cities in Santa Catarina, in the Southern Region of Brazil, in addition to around 30 in-person support centers for distance learning, in partnership with the Open University of Brazil (UAB), of the Ministry of Education (MEC).

Currently, around 14,000 students are distributed across more than 60 undergraduate and more than 50 master's and doctorate programs, which are offered free of charge in health, technology, education, art, and socioeconomic areas.

In research, Udesc maintains more than 220 groups certified by the National Council for Development and Technology (CNPq), divided into eight major areas: Agricultural Sciences; Biological; of health; Exact and Earth; Humanities; Applied Social; Engineering; Linguistics and Arts.

Udesc professors and students carry out 1,200 extension actions per year in several areas to share the knowledge obtained in teaching and research with the external community. The projects benefit more than 600,000 people annually.

Udesc offers a complete structure, including libraries and laboratories in all its units. The institution also has other distinguishing features, such as the Veterinary Hospital, the DNA Laboratory, the Physiotherapy School Clinic, the Catarinense School Museum, the University Publishing House, the Copyright Office, and three radio stations.

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PORTAL MAP

Partner universities

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Partner Universities

Check out UDESC's partner universities. Our list is organized by country.

IMPORTANT:

* Courses taught in English are offered in various countries even if they are not the native English-speaking countries.

* For universities that do not specify proof of English language proficiency, other forms of proof or placement tests will be accepted.

* In universities where there are no grades with specific course requirements, all areas of study will be considered.

Exchange Podcast

Courses

Germany

➡ **Aalen University - Agreement**

➡ **HTW Berlin** - Hochschule für Technik und Wirschaft Berlin - **Agreement**

Note: Fashion, Design, Electrical Engineering, Environmental Engineering, Civil Engineering, Architecture and Administration. Proof of C1 English required.

➡ **Merseburg University of Applied Sciences - Agreement**

➡ **Technische Hochschule Wildau - Agreement**

Note: Administration and Engineering

➡ **TH Koln - Agreement**

➡ **Ansbach University - Agreement**

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Angola

➡ **Higher Pedagogical School of Bié - Agreement**

Argentina

➡ **Catholic University of Córdoba - Agreement**

➡ **National Institute of Agricultural Technology of Argentina - Agreement**

➡ **National University of San Martín - Agreement**

➡ **National Technological University - Agreement**

➡ **National University of Rosario - Agreement**

➡ **National University of the Arts - Agreement**

Belgium

➡ **Vives University - Agreement**

➡ **KdG University - Agreement**

Belarus

➡ **Belarusian State University of Informatics and Radioelectronics - Agreement**

Bulgária

➡️ **Vasil Levski National Military University - Convênio**

➡️ **Technical University of Varna - Convênio**

Brasil

➡️ **Pontifícia Universidade Católica do Paraná - Convênio**

➡️ **HUAWEI Academy - Convênio**

Canadá

➡️ **Acordo Brasil - Quebéc** (6 instituições canadenses)

Nota: As universidades canadenses (acordo Brasil-Quebec) possuem processo diferenciado, inclusive data limite para sua inscrição.

➡️ **Concórdia University of Edmonton - Convênio Geral - Convênio Intercâmbio**

➡️ **University of Regina - Convênio e Anexo**

Nota:Comprovação do idioma inglês mínimo de 6.5 IELTS ou 80 TOEFL IBT ou Duolingo 110.

Taxa única obrigatória de $150,00.

➡️ **Universidade de McMaster - Convênio**

Nota: Convênio para Pós-Graduação.

Chile

➡️ **Universidade de Talca - Convênio**

➡️ **Universidade de Santiago do Chile - Convênio**

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➡️ Universidade Nacional da Colômbia - Convênio

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➡️ SolBridge International School of Business - Convênio

Costa Rica

➡️ Instituto Tecnológico Nacional - Convênio

Equador

➡️ Universidade Técnica Particular de Loja - Convênio

Eslovênia

➡️ University of Ljubljana - Convênio

Nota: Convênio exclusivo para a área de Engenharia Elétrica.

Estados Unidos

➡️ Bridgewater State University - Convênio

Nota: para comprovação do idioma inglês serão aceitos um dos citados abaixo:

TOFEL paper - 500, TOFEL computer - 173, TOFEL iBT - 61, IELTS - 6, PTE - 44, CEFRL - B2 ou Duolingo - 100.

Comprovação de suporte financeiro: Financial Support (USD 8.600,00 por semestre)

➡️ **University of North Florida - Convênio - Anexo - Mobilidade Acadêmica**

Nota: Convênio exclusivo para a área de Administração.

Para comprovação do idioma inglês serão aceitos um dos citados abaixo:

Toefl IBT - 61, ou IELTS - 6,5, Duolingo 110 ou 3 no College Board Advanced Placement - International English Language (AP-IEL)

Comprovação de suporte financeiro: Financial Support (USD 8.600,00 por semestre)

➡️ **Murray State University**

Espanha

➡️ **Associação Nacional de Diretores de Enfermagem - ANDE - Convênio**

➡️ **Institute of Agrifood Research and Technology (IRTA) - Convênio**

➡️ **Universidad de Extremadura - Convênio**

➡️ **Universidad de Almería - Convênio**

➡️ **Universidad La Coruña - Convênio**

➡️ **Universidad de Santiago de Compostela - Convênio**

➡️ **Universidad de Sevilla - Convênio**

➡️ **Institut Mare de Déu de la Mercè - Convênio**

➡️ **Universidad de Valladolid - Convênio**

➡️ **Universidad de Vigo - Convênio**

➡️ **Universidade do País Basco - Convênio**

➡️ **Universidade Complutense Madrid - Convênio**

Finlândia

➡️ **Universidade de Laurea - Convênio Geral - Específico**

França

➡️ **EPITA - School of Computer Science - Convênio**

➡ **ESME Sudria - Convênio**

➡ **IPAG Business School - Convênio**

➡ **Université Clermont Auvergne - Convênio**

➡ **Franche Comte - Convênio**

➡ **Rennes School of Business - Convênio**

➡ **ESC Clermont - Convênio**

➡ **Université de Versailles Saint-Quentin-en-Yvelines - Convênio**

➡ **Universidade Paris 8 - Convênio**

Holanda

➡ **Hanze University - Convênio**

➡ **University of Twente - Convênio**

Nota: Convênio exclusivo para a área de Geografia.

Hungria

➡ **Obuda University - Convênio**

Itália

➡ **Conservatoire of Music "N. Piccini"of Bari - Convênio**

➡ **Conservatorio di musica "E. R. Duni" Matera - Convênio**

➡ **Politecnico di Milano - Convênio**

Nota: mobilidade para áreas de Engenharia
Aulas em inglês e italiano - Comprovação nível B2 inglês.

➡ **Politecnico di Milano - Convênio**

Nota: mobilidade para áreas de Artes

➡ **Politecnica de Delle Marche - Ancona - Convênio - Anexo**

➡ **Università degli Studi di Ferrara - Convênio**

➡ **Università degli Studi di Firenze - Convênio - Aditivo**

Nota: Design, moda, pedagogia e arquitetura paisagística.

➡ **Università degli Studi di Milano - Convênio Geral**

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➡️ **Roma Tre - Convênio**

Nota: Convênio específico para as áreas de Engenharia.

➡️ **Istituto Italiano di Tecnologia - Convênio**

➡️ **Free University of Bozen-Bolzano - Convênio**

Marrocos

➡️ **Universidade Politécnica Mohammed VI - Convênio**

Malta

➡️ **Asomi College of Sciences - Convênio**

México

➡️ **Benemérita Universidad Autónoma de Puebla - Convênio Geral | Estudantes | Docentes**

Moçambique

➡️ **Centro de Investigação e Transferências de Tecnologias para o Desenvolvimento Comunitário (CITT) - Convênio**

➡️ **Universidade Pedagógica de Maputo - Convênio**

Paraguai

➡️ **Universidade Privada del Este - Convênio**

➡️ **Universidade Santa Clara de Asis - Convênio**

➡️ **Universidad Nacional de Asunción - Convênio**

➡️ **UniNorte - Convênio**

Peru

➡️ Pontificia Universidad Católica del Perú - Convênio

➡️ Chio Lecca Fashion School - Convênio

Polônia

➡️ Lodz University of Technology - Convênio

Portugal

➡️ Instituto Superior de Ciências Sociais e Políticas da U. de Lisboa - Geral - Convênio ESAG

➡️ Escola Superior de Educação de Lisboa - Convênio

➡️ Instituto Politécnico de Santarém – Convênio

➡️ Instituto Politécnico de Bragança – Convênio

➡️ Instituto Politécnico de Portalegre – Convênio

➡️ Instituto Politécnico Gaya - Convênio

➡️ Universidade do Minho - Convênio - Aditivo

➡️ Universidade do Porto - Engenharias - Convênio

Termo aditivo – Administração Empresarial

➡️ Instituto Politécnico do Porto - Convênio

➡️ Instituto Politécnico de Viseu - Convênio

➡️ Univ. Lusófona de Humanidades e Tecnologia - Convênio

➡️ Instituto Superior de Agronomia da Universidade de Lisboa - Convênio

➡️ Instituto Politecnico de Leiria - Convênio

➡️ Universidade Aberta de Portugal - Convênio

➡️ Instituto Politécnico da MAIA - Convênio

➡️ Universidade da MAIA - Convênio

➡️ Universidade do Algarve - Convênio

➡️ Instituto Superior de Administração e Gestão - ISAG - Convênio

➡️ Universidade Beira Interior - Convênio

➡️ Universidade de Coimbra - Convênio - Termo Aditivo (PPGH/FAED)

➡️ **Escola Superior de Enfermagem de Coimbra - Convênio**

Nota: Convênio específico para a área de Enfermagem.

➡️ **Universidade do Porto: Letras**

➡️ **Universidade de Coimbra - Escola Superior de Enfermagem - Convênio**

Nota: Convênio específico para a área de Enfermagem.

➡️ **Escola Superior de Saúde Norte (ESSNorteCVP) - Convênio**

Nota: Convênio específico para a área de Enfermagem.

Romênia

➡️ **University of Agriculture and Veterinary Medicine - Convênio**

Rússia

➡️ **National Research University | Higher School of Economics - Convênio**

➡️ **MGIMO University - Convênio**

Suécia

➡️ **Borås University - Convênio**
Nota: mobilidade somente para as áreas de Administração e Engenharia.
Aulas em inglês
Comprovação nível B2 inglês

➡️ **Halmstad University - Convênio**
Nota: Aulas em inglês. (Diversas áreas)

Proof of B2 level English proficiency

➡️ **Jönköping University - Agreement**
Note: mobility regarding areas of Administration

Proof of B2 level English.

Türkiye

➡️ **Istanbul Aydin University - Agreement**

➡️ **Eskisehir Technical University - Agreement - Erasmus Program**

➡ Üsküdar University - Agreement

Uruguay

➡ University of the Republic - Agreement

ADDRESS:
Av. Madre Benvenuta, 2007
Itacorubi, Florianópolis / SC
ZIP CODE: 88.035-901

CONTACT
Phone: (48) 3664-8000
Email: contato@udesc.br
Opening hours: 1pm to 7pm

PORTAL MAP

Market leader in packaging

As the largest producer and exporter of packaging paper and sustainable paper packaging solutions in Brazil, Klabin stands out as an innovative company, unique in the country for offering the market a solution in short-fiber, long-fiber, and fluff pulps, in addition to being a leader in the markets for corrugated cardboard packaging, industrial bags, and paperboard.

126 years of Klabin

Our history began 126 years ago, and today we have 22 industrial units, 21 in Brazil and one in Argentina.

Dow Jones Best-in-Class-Indices

Klabin has been present in the Global portfolio of the Dow Jones Sustainability Index for four consecutive years and in the Emerging Markets portfolio for three years.

OUR NUMBERS

The data below are some of the highlights from the Sustainability Report, base year 2024. To learn more, visit the portal.

22 factories, 21 in Brazil and 1 in Argentina

111 trees planted per minute

415

FURG
UNIVERSIDADE FEDERAL
DO RIO GRANDE

EQA
ESCOLA DE QUÍMICA
E ALIMENTOS

Federal University of Rio Grande
Adress: km 08, Avenue Itália,
Carreiros, Rio Grande, RS, Brazil.

DECLARATION

I, Prof. phD. Daiane Dias, pro-rector of Research and Graduate and Professor Graduate Program in Technological and Environmental Chemistry at the Federal University of Rio Grande (FURG), hereby declare that doctoral student Alice Neri da Silva Sousa has played a leading and critical distinguished research group, the Industrial Technology Laboratory (LTI).

Alice has actively participated in various activities within our group, far beyond her graduate program obligations, which primarily involve coursework and the development of her research project. She has consistently demonstrated initiative, leadership, and responsibility in multiple areas of our academic environment.

I emphasize that Alice supervised and assisted an undergraduate student in a Scientific Initiation (SI) Program from 2023 to 2024. Currently, she is guiding another undergraduate student in an SI Program (2024–2025), being fully responsible for coordinating the SI's research, teaching laboratory procedures, supervising analyses and equipment use, training in scientific writing, and performing all duties related to this supervision in the laboratory.

Furthermore, Alice participates in projects coordinated faculty members of group, assisting with analyses and equipment handling, even when these activities are unrelated to her thesis, thus demonstrating her commitment to the overall progress of research. She has also managed the budgeting of consumables, equipment, and maintenance not only for her own research but also for that of her colleagues.

Through these contributions, Alice has proven to be indispensable for the success and advancement of research projects, actively supporting the training of younger researchers while significantly strengthening the scientific achievements and recognition of our laboratory. Her leadership and dedication make her a key contributor to the distinguished reputation of the Industrial Technology Laboratory (LTI) and FURG as a whole.

October 29, 2025

Daiane Dias

Prof. phD. Daiane Dias
Federal University of Rio Grande – RS, Brazil

October 14, 2025.

Rio Grande, Brazil.

Dear Immigration Officer,

I am Tito Roberto Sant'Anna Cadaval Jr., a PhD Professor at the Federal University of Rio Grande (FURG), where I lecture Physical Chemistry and serve as a permanent professor in the Graduate Program in Technological and Environmental Chemistry (PPGQTA - FURG) and in the Graduate Program in Chemical Engineering (PPG-EQ - FURG), conducting research mainly in the following areas: adsorption, chitosan, biopolymers, nanomaterials, and the extraction and refining of fish oil. I write to attest to the significant and critical role performed by Ms. Alice Neri da Silva Sousa within our laboratory and through her work at the graduate research program. I have supervised Ms. Sousa as a PhD student since 2023.

Pursuant to the regulations of our graduate program, the responsibilities for doctoral candidates are preparing the thesis project jointly with the advisor, presenting it in a public seminar, executing the experimental plan, proposing adjustments when necessary, and fulfilling all academic requirements within defined timelines. Beyond this scope, Ms. Sousa coordinates the day-to-day activities of undergraduate scientific initiation students under her guidance, training them in laboratory procedures, analytical routines, and scientific writing, and accompanying analyses and instrument's operation. She actively supports projects that I and other faculty members lead in our research group. She assists with experiments and instrumental analyses, even when those tasks fall outside the direct focus of her dissertation, and she ensures continuity and quality across several ongoing research lines.

Ms. Sousa's role defines as critical since she independently identifies emerging issues that could affect the progress of experiments, seeks feasible solutions within her remit, implements them when appropriate, and informs the advising team with clear rationale when institutional actions, such as procurement, are required. She has prepared quotes for consumables and equipment, supported maintenance needs for shared instruments, and helped safeguard the timely execution of work that benefits other researchers in the group.

While these functions are often internal rather than publicly visible, they are indispensable to our productivity and to the reliability of our results. In our environment, meaningful internal contributions are recognized through co-authorship in articles, patents, and conference outputs whenever a trainee's work substantively advances a project, and Ms. Sousa has been acknowledged accordingly.

These activities take place within a highly productive laboratory context at FURG with long-standing academic prominence. In this setting, Ms. Sousa's combination of technical competence, mentorship of junior researchers, reliability in laboratory operations, and initiative across group needs constitutes a critical function for our research organization.

Based on my direct supervision and observation, I endorse her EB-1 petition and affirm the significance of her role.

Sincerely,

Tito Roberto Sant'Anna Cadaval Jr., Ph.D.
Adjunct Professor, Federal University of Rio Grande (FURG)
Graduate Programs in Technological and Environmental Chemistry and in Chemical Engineering
Email: titoeq@gmail.com | Phone: +55 (53) 3233-6967

Tito Roberto Sant'Anna Cadaval Junior

Scholarship Research Productivity holder CNPq - Level C

Address to access this CV: http://lattes.cnpq.br/8280825575674377
ID Lattes: **8280825575674377**
Last updated: 24/09/2025

bachelor's at Engenharia Química from Universidade Federal do Rio Grande (2004). **(Text informed by the author)**

Personal Information

Name

Tito Roberto Sant'Anna Cadaval Junior

Bibliographic Citation

Cadaval, T.R.S.;Cadaval Jr., T.R.S.;SANTANA CADAVAL, TITO ROBERTO;CADAVAL, TITO R. S.;CADAVAL, TITO R.S.;CADAVAL JR, T. R. S;CADAVAL JR, T. R. S.;cadaval jr, T.R.;CADAVAL JR, T. R.;CADAVAL, TITO ROBERTO SANTANA;CADAVAL, T. R. S.;CADAVAL JUNIOR, TITO ROBERTO SANTA'ANNA;JR, TITO ROBERTO SANTANA CADAVAL;Tito Roberto S. Cadaval;Cadaval, Tito Roberto S.;Cadaval, Tito Roberto Sant¿Anna;CADAVAL, TITO ROBERTO SANT'ANNA;SANT?ANNA CADAVAL JUNIOR, TITO ROBERTO;SANT'ANNA CADAVAL JUNIOR, TITO ROBERTO;CADAVAL, TITO ROBERTO SANT' ANNA;CADAVAL, TITO ROBERTO SANT? ANNA;CADAVAL, TITO R.;SANT'ANNA CADAVAL JUNIOR, TITO ROBERTO;CADAVAL JUNIOR, TITO ROBERTO SANT'ANNA;SANT?ANNA CADAVAL, TITO R.;CADAVAL, T.R. S.;SANT? ANNA CADAVAL, TITO ROBERTO;TITO ROBERTO SANTANNA CADAVAL;JUNIOR, TITO ROBERTO SANTANNA CADAVAL;CADAVAL JR, TITO ROBERTO SANT?ANNA;Sant¿Anna Cadaval, Tito Roberto;CADAVAL JR, TITO R.S.;ROBERTO SANT?ANNA CADAVAL JUNIOR, TITO;CADAVAL, TITO R. SANT?ANNA;SANT? ANNA CADAVAL JR, TITO ROBERTO;SANT'ANNA CADAVAL, TITO ROBERTO;CADAVAL JUNIOR, TITO ROBERTO;JUNIOR, TITO ROBERTO SANT? ANNA CADAVAL;ROBERTO SANT'ANNA CADAVAL JUNIOR, TITO;CADAVAL JUNIOR, TITO ROBERTO SANT'ANNA;R. S. CADAVAL JR., TITO;JUNIOR, TITO ROBERTO SANT'ANNA CADAVAL;CADAVAL JR, TITO R. S.;CADAVAL, TITO ROBERTO;Tito Roberto Sant?Anna Cadaval Junior;CADAVAL JR, TITO ROBERTO SANT'ANNA;ROBERTO SANT'ANNA CADAVAL, TITO;Tito Roberto Sant'Anna Cadaval Junior;CADAVAL JUNIOR, TITO ROBERTO SANT?ANNA;CADAVAL, TITO ROBERTO SANTANNA;JUNIOR, TITO;CADAVAL, TITO;ROBERTO SANT?ANNA CADAVAL JUNIOR, TITO;Tito R.S. Cadaval Junior;CADAVAL JUNIOR, TITO R.S.;CADAVAL JR., TITO ROBERTO SANTANNA

Lattes iD

http://lattes.cnpq.br/8280825575674377

Nationality

Brasil

Address

Professional Address

Universidade Federal do Rio Grande, Escola de Química e Alimentos.
Av. Itália km 8
Carreiros
96203900 - Rio Grande, RS - Brasil
Telephone: (53) 32336500

Formal Education/Degree

2012 - 2014

Ph.D. in Quimica Tecnologica e Ambiental.
Universidade Federal do Rio Grande, FURG, Brasil. , Year of degree: 2014.
Advisor: Luiz Antonio de Almeida Pinto.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: adsorção; Corantes; Vanádio; quitosana; Filmes.

2010 - 2012

Master in Quimica Tecnologica e Ambiental.
Universidade Federal do Rio Grande, FURG, Brasil. Year of degree: 2012.
Advisor: Luiz Antonio de Almeida Pinto.
Scholarship holder of: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.
Keywords: quitosana; resíduo de camarão; metais pesados.
Major Area: Exact and Earth Sciences
Major Area: Exact and Earth Sciences / Area: Chemistry / Subarea: Físico-Química.

2010 - 2012

Specialization in Engenharia de Planejamento. (Workload: 376h).
Universidade Federal do Rio Grande, FURG, Brasil.
Advisor: Rafael Lipinski Paes.

2001 - 2004

Graduation in Engenharia Química.
Universidade Federal do Rio Grande, FURG, Brasil.
Advisor: Renato Dutra Pereira Filho.
Scholarship holder of: FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL, FAPERGS, Brasil.

Complementary Education

2013 - 2013

Introdução a microscopia eletrônica de varredura. (Credit Hours: 10h).

Universidade Federal do Rio Grande, FURG, Brasil.

2010 - 2012

Pós Graduação em Engenharia de Planejamento. (Credit hours: 376h).
Universidade Federal do Rio Grande, FURG, Brasil.

2011 - 2011

Proficiência em Língua Inglesa.
Universidade Federal do Rio Grande, FURG, Brasil.

2010 - 2010

Inspetor de Controle Dimensional de Caldeiraria. (Credit hours: 152h).
FRAEND, FRAEND, Brasil.

2006 - 2006

E.S.M.S Educação, Segurança, Meio Ambiente e Saúde. (Credit hours: 8h).
SENAI - Departamento Regional do Rio Grande do Norte, SENAI/ DR/RN, Brasil.

2006 - 2006

Direção defensiva. (Credit hours: 8h).
Centro de formação de condutores de veículos ideal, CFCVI, Brasil.

2005 - 2005

Instalações Elétricas em Atmosferas Explosivas. (Credit hours: 80h).
Console engenharia, CONSOLE, Brasil.

2004 - 2005

Estágio na Unidade de Processo. (Credit hours: 1750h).
Companhia Petroquímica do Sul, COPESUL, Brasil.

2004 - 2004

Proteção respiratória. (Credit hours: 4h).
SENAI - Departamento Regional do Rio Grande do Sul, SENAI/DR/RS, Brasil.

2004 - 2004

Combate a Incêndio. (Credit hours: 4h).
SENAI - Departamento Regional do Rio Grande do Sul, SENAI/DR/RS, Brasil.

2004 - 2004

Prevenção de riscos para trabalho em espaço confin. (Credit hours: 4h).
SENAI - Departamento Regional do Rio Grande do Sul, SENAI/DR/RS, Brasil.

2004 - 2004

Primeiros socorros. (Credit hours: 4h).
SENAI - Departamento Regional do Rio Grande do Sul, SENAI/DR/RS, Brasil.

2004 - 2004

Equipamentos Rotativo (Bombas, Compress. e Turb.). (Credit hours: 40h).
Companhia Petroquímica do Sul, COPESUL, Brasil.

2003 - 2003

Processos de Extração - Plantas naturais. (Credit hours: 12h).
Universidade Estadual de Maringá, UEM, Brasil.

2002 - 2002

Encontro de Qualidade dos Alimentos e Meio Ambient. (Credit hours: 8h).
Universidade Federal do Rio Grande, FURG, Brasil.

Professional Experience

Console engenharia, CONSOLE, Brasil.

Contract

2005 - 2010

Type of contract: Celetista formal, Functional Placement: Pesquisador em engenharia química, Credit Hours: 44, Regime: Exclusive Dedication.

Companhia Petroquímica do Sul, COPESUL, Brasil.

Contract

2004 - 2004

Type of contract: Bolsista, Functional Placement: Estagiário, Regime: Exclusive Dedication.

Universidade Federal do Rio Grande, FURG, Brasil.

Contract

2015 - Present

Type of contract: Government Employee, Functional Placement: Professor Adjunto, Regime: Exclusive Dedication.

Contract

2012 - 2014

Type of contract: Bolsista, Functional Placement: Bolsista, Credit Hours: 4, Regime:

Exclusive Dedication.

Contract

2001 - 2003

Type of contract: Bolsista, Functional Placement: Bolsista Fapergs, Credit Hours: 12

Activities

01/2025 - Atual

Manager and Administrative Positions, Escola de Química e Alimentos.

Position or Function
Coordenado do Programa de Pós Graduação em Química Tecnológica e Ambiental (PPGQTA).

01/2024 - Atual

Teaching, Química, Degree: Graduation

Disciplines Taught
Extensão II - Área de Físico-Química

03/2023 - Atual

Councils, Commissions and Consulting, Reitoria, Pró-Reitoria de Pesquisa e Pós-Graduação.

Position or Function
COMITÉ GESTOR DO PROGRAMA DE COMPARTILHAMENTO DE EQUIPAMENTOS MULTIUSUÁRIOS - ProCEM.

01/2023 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Comissão de finanças do PPGQTA.

01/2023 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Comissão de bolsas do PPGQTA.

03/2022 - Atual

Councils, Commissions and Consulting, Reitoria, Pró-Reitoria de Pesquisa e Pós-Graduação.

Position or Function
Comissão de Elaboração da proposta do edital Capes ,16/2022 de PÓS-DOUTORADO - ESTRATÉGICO pelo Programa de Pós-graduação em Química Tecnológica e Ambiental.

01/2022 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Comissão de seleção do PPGQTA.

03/2021 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Comissão de Credencimento e Recredenciamento do Programa de Pós-Graduação em Química Tecnológica.

03/2021 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Comissão de planejamento estratégico e auto avaliação do PPG QTA.

03/2020 - Atual

Teaching, Química, Degree: Graduation

Disciplines Taught
Fundamentos da Produção de Petróleo

03/2020 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

Disciplines Taught
Tópicos Especiais em Físico Química

03/2020 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

Disciplines Taught
Elaboração de Tese

03/2020 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

Disciplines Taught
Elaboração de dissertação

03/2019 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

Disciplines Taught
Estágios de docência

03/2019 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Membro do Comitê Técnico Científico do CEME SUL.

03/2019 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Membro do Comitê Técnico Científico do CIA.

03/2018 - Atual

Councils, Commissions and Consulting, Escola de Química e Alimentos.

Position or Function
Membro do Comitê Institucional de Bolsas.

03/2016 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

Disciplines Taught
Operações unitárias

03/2016 - Atual

Teaching, Quimica Tecnologica e Ambiental, Degree: Pos-Graduation

2014 - 2015

Type of contract: Government Employee, Functional Placement: Professor assistente, Regime: Exclusive Dedication.

Research projects

2024 - Current

Influência do processo de coagulação na extração de compostos intracelulares de microalgas utilizando campo elétrico pulsado

Description: Este projeto é parte de uma parceria internacional entre Brasil e Alemanha. A pesquisa será conduzida a partir de diferentes experimentos de coagulação/floculação com coagulante a base de quitina para colheita de microalga Nannochloropsis oculata e eles serão realizados no Laboratório de Tecnologia Industrial localizado na Escola de Química e Alimentos da Universidade Federal do Rio Grande (FURG). Ao final destes experimentos, as amostras serão coletadas e a biomassa será liofilizada e devidamente armazenada para posteriores aplicações no Karlsruhe Institute of Technology (KIT)..
Situation: In progress; Nature: Research.
Participant students: Graduation: (1) / Doctorate: (1) .

Members: Tito Roberto Sant'Anna Cadaval Junior - Coordinator / ARABIDIAN, VIVIANE C. - Member / JAESCHKE, DÉBORA PEZ - Member / Christian Gusbeth - Member.

2024 - Current

EXTRAÇÃO SUPERCRÍTICA DE CONCENTRADOS DE ÓLEO DE RESÍDUOS DE ATUM-BONITO E SEU NANOENCAPSULAMENTO UTILIZANDO COLÁGENO DE PELE DE ATUM-BONITO COMO MATERIAL DE PAREDE

Description: O óleo de atum apresenta elevada quantidade de ácidos graxos poli-insaturados (AGPI) da família #969;-3, principalmente eicosapentaenóico (EPA) e docosahexaenóico (DHA), os quais trazem diversos benefícios à saúde humana e podem ser inseridos na formulação de produtos. O óleo de pescado obtido via extração por fluido supercrítica (EFS), torna-se uma alternativa interessante, pois a operação é seletiva, ocorre em baixas temperaturas evitando a oxidação do óleo, e não utiliza solventes tóxicos, sendo atrativa para as indústrias dos setores farmacêutico e alimentício para formulação de produtos contendo os concentrados de AGPI. O nanoencapsulamento tem como função evitar a oxidação do óleo, aumentando a vida útil do produto e impedindo perda do seu valor nutricional. O colágeno é a principal proteína dos vertebrados, e pode ser incorporado em produtos fármac[illegible]e alimentícios devido as

suas propriedades moleculares, tornando-se uma opção como material de parede das nanocápsulas. Este trabalho tem como objetivo extrair concentrados de AGPI de óleo de resíduos de atum-bonito (Katsuwonus pelamis) via extração supercrítica, e realizar o nanoencapsulamento destes concentrados, utilizando o colágeno de resíduos de atum-bonito (Katsuwonus pelamis) como material de revestimento. Para a obtenção do óleo de atum concentrado em AGPI, serão otimizadas as condições de extração com fluido supercrítico. O colágeno será extraído das peles do atum e caracterizado. Para avaliar a obtenção das nanoemulsões contendo os concentrados em AGPI será realizado um delineamento experimental fatorial 23 contendo 3 pontos centrais, que terá como variáveis de estudo o percentual de colágeno e a taxa de agitação. As nanoemulsões serão caracterizadas com relação a estabilidade físico-química conforme o tamanho de partícula, o índice de polidispersão e o potencial zeta. A estabilidade oxidativa será determinada pelo índice de peróxido. As nanoemulsões serão secas por liofilização, a fim de obter as nanoestruturas. A bioacessibilidade, perfil de liberação e atividade antioxidante dos AGPI de óleo de atum serão investigados durante a digestão in vitro. Por fim será realizado um estudo de viabilidade técnica e econômica da implantação de uma unidade de produção do nanocápsulas de concentrados de AGPI de óleo de resíduos de atum-bonito, utilizando o colágeno de resíduos de atum-bonito como material de parede..
Situation: In progress; Nature: Research.
Participant students: Graduation: (1) / Doctorate: (1) .

Members: Tito Roberto Sant'Anna Cadaval Junior - Coordinator / Rafael Lipinski Paes - Member / Andrei Vallerão Igansi - Member / Jorge Luiz Marques Junior - Member / Bruna S. Farias - Member / Luiz A. A. Pinto - Member / RIZZI, FRANCISCA ZUCHOSKI - Member / Nauro da Silveira Jr - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.

2023 - Current

Instituto Nacional de Ciência e Tecnologia em Tribologia Verde Voltada à Transição Energética

Description: Esta proposta cria uma rede nacional integrada e multidisciplinar que utilize a tribologia como ferramenta para contribuir para a solução dos enormes desafios associados à transição energética. Este ecossistema de geração de conhecimento engloba os mais eminentes grupos de tribologia, do extremo sul ao nordeste do país, congregando pesquisadores em tribologia, ciência dos materiais, física, química, bioquímica e meio ambiente para fomentar forte interação com o setor produtivo. Será fundamental o desenvolvimento de novas soluções em lubrificantes, materiais e engenharia de superfícies para a mobilidade e a energia do futuro. Propõe-se identificar e atuar nos principais desafios tribológicos decorrentes das tecnologias atuais, que irão guiar as pesquisas para otimização tribológica das novas soluções sustentáveis.
Situation: In progress; Nature: Research.

Members: Tito Roberto Sant'Anna Cadaval Junior - Coordinator / Pinto, L.A.A. - Member / Felipe Kessler - Member / Daiane Dias -

Member / bruno meira - Member / Alex Fabiani Claro Flores - Member / DINALVA AIRES DE SALES - Member / HENARA LILLIAN COSTA MURRAY - Member / JORGE ALBERTO VIEIRA COSTA - Member / JORGE LUIS BRAZ MEDEIROS - Member / JOSE HENRIQUE ALANO - Member / LUCIANO VOLCANOGLO BIEHL - Member / MICHELE GREQUE DE MORAIS - Member.
Financier(s): Conselho Nacional de Desenvolvimento Científico e Tecnológico - Grant.

2022 - 2024

DESENVOLVIMENTO SUSTENTÁVEL DAS PESCARIAS COSTEIRAS E FORTALECIMENTO DA CADEIA PRODUTIVA DA PESCA EM RIO GRANDE

Description: A sobre exploração dos recursos pesqueiros resultou, ao longo dos anos, na queda de capturas econsequentemente de receitas para milhares de pescadores de pequena e média escala queatuam na costa do Rio Grande do Sul. O último diagnóstico realizado indica que aproximadamente5.000 pescadores artesanais e 3.000 industriais dependem desta atividade como forma deobtenção de receitas (Haimovici et al., 2006). A diminuição de receitas devido à sobre exploraçãodos estoques impõe aos pescadores uma condição de extrema vulnerabilidade social,principalmente os pescadores de pequena escala. No entanto, os pescadores industriais tambémestão expostos a uma situação delicada devido à frágil estruturação da cadeia produtiva depescados no município de Rio Grande e noestado do Rio Grande do Sul e diminuição paulatina na fonte de matéria prima devido à sobreexploração. Adicionalmente, nos anos de 2014 e 2016 as receitas e os postos de trabalho domunicípio de Rio Grande foram reduzidos drasticamente devido ao desmantelamento do polonaval e toda a cadeia produtiva associada à fabricação de plataformas de petróleo. Estando acidade de Rio Grande localizada à frente de uma das regiões pesqueiras mais produtivas do país,é natural projetar uma indústria pesqueira competitiva que gere emprego e receitas para omunicípio. O estado atual de sobre exploração dos recursos pesqueiros ainda pode serinterpretado como uma oportunidade para convencer os usuários sobre a necessidade de seestabelecer as bases de uma exploração sustentável e desenvolvimento de longo prazo para aindústria pesqueira no município de Rio Grande.
Situation: Completed; Nature: Research.
Participant students: Graduation: (4) / Academic master's degree: (2) / Doctorate: (3) .

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / Luiz Antonio de Almeida Pinto - Member / Rafael Lipinski Paes - Member / LUIS GUSTAVO CARDOSO - Member / PATRIZIA RAGGI ABDALLAH - Coordinator.
Financier(s): Prefeitura Municipal de Rio Grande - Grant.

2022 - Current

Biomassas aplicadas na obtenção de produtos agrícolas de valor agregado

Description: Esta proposta envolve a utilização de resíduos agrícolas aplicados a obtenção de biocarvão e de extrato pirolenhoso que serão aplicados como regulador de crescimento, bioherbicida, biofertilizante, antioxidante e antibactericida. Dessa forma, esses resíduos que normalmente são descartados de forma incorreta, poderão ser utilizados na sua totalidade na obtenção destes materiais que possuem valor agregado. É importante enfatizar que essa proposta envolve pesquisadores de diferentes EIS (FURG, UFSM, UFPEL), assim como a Empresa SEMINARE (Algaagro Soluções Agrícolas Ltda) que possui estrutura física adequada para a realização dos testes agronômicos e a EMATER/RS que auxiliará na mobilização dos agricultores que receberão cursos de capacitação para a obtenção dos produtos de valor agregado. Destaca-se que esse projeto atua na fronteira do conhecimento no que tange estudos relacionados a química dos matérias, química analítica, agronomia, controle de qualidade de produtos e química ambiental, apresentando desta forma elevada capacidade de inovação científica uma vez que engloba formação de recursos humanos, diferentes áreas e expertises; bem como inovação tecnológica uma vez que possibilita a geração de produtos e métodos simples e de baixo custo. Destaca-se também que esta proposta apresenta elevado impacto social uma vez que faz uso de tecnologias que envolvem materiais ambientalmente corretos, de fácil acesso e que muitas vezes são resíduos ambientais. Desta forma, a aprovação e execução desta proposta contribuirá para o equilíbrio entre desenvolvimento econômico, social e preservação ambiental assim como para a melhoria da oferta de produtos e serviços essenciais para uma parcela significativa da população brasileira..
Situation: In progress; Nature: Research.
Participant students: Graduation: (4) / Academic master's degree: (1) .

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / Luiz Antonio de Almeida Pinto - Coordinator / DIAS, DAIANE - Member.
Financier(s): FUNDACAO DE AMPARO A PESQUISA DO ESTADO DO RIO GRANDE DO SUL - Grant.

2022 - Current

Estratégias multidisciplinares no desenvolvimento da Química Tecnológica e Ambiental

Description: O projeto contempla, dentre seus objetivos e metas, desenvolver, caracterizar e aplicar materiais a: 1) tecnologias de monitoramento ambiental; 2) modelos e sistemas moleculares para compostos com aplicação biológica e tecnológica e; 3) modificações de superfícies em tecnologias de produção verdes..
Situation: In progress; Nature: Research.

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / Vania Rodrigues de Lima - Member / Luiz Antonio De Almeida Pinto - Member / Ednei Gilberto Primel - Member / Carlos Francisco Ferreira de Andrade - Member / Felipe Kessler - Member / Daiane Dias - Coordinator / Rodolfo Carapelli - Member / Juliano Rosa de Menezes Vicenti - Member / bruno meira - Member / Jaqueline Garda Buffon - Member / Marcos Alexandre Gelesky - Member / Fernanda Trombetta da Silva -

Member / Carla Weber Scheeren - Member / Alex Fabiani Claro Flores - Member / Carlos Roberto de Menezes Peixoto - Member / Cristina Benincá - Member / Fábio Ferreira Gonçalves - Member / Gilber Ricardo Rosa - Member / Gilberto Fillmann - Member / Marcelo de Godoi - Member / Marcelo Gonçalves Montes D'Oca - Member.
Financier(s): Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Grant / Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Scholarship.

2021 - 2024

OBTENÇÃO DE LIPÍDIOS APOLARES A PARTIR DA MICROALGA MARINHA Nannochloropsis oculata, UTILIZANDO EXTRAÇÃO SUPERCRÍTICA

Description: Diversos métodos de captura e armazenamento de CO2 atmosférico têm sido experimentados e avaliados quanto à sua sustentabilidade. Dentre os métodos estudados a sequestração biológica baseada em microalgas é uma alternativa promissora, uma vez que as mesmas possuem um crescimento rápido e com elevada taxa fotossintética. Paralelamente, as microalgas são consideradas, mundialmente, uma das principais tendências tecnológicas, com o potencial de ser usado em alimentos, cosméticos e produtos farmacêuticos. Elas são ricas em ômega-3 (PUFA), como os ácidos eicosapentaenoico (EPA, C20:5 n-3) e docosaexaenoico (DHA, C22: 6 n-3). A extração de lipídios de fontes naturais é geralmente realizada usando solventes orgânico tóxicos. Entretanto, o interesse de incorporação de seus extratos lipídicos em produtos alimentícios ou suplementos alimentares para as indústrias nutracêuticas e farmacêuticas exigem o uso de solventes seguros, e atóxicos. Entre estes, o dióxido de carbono supercrítico tem sido considerado uma alternativa para extração de substâncias de alto valor agregado de diversas matrizes. O objetivo geral deste projeto é a obtenção de lipídios apolares a partir da microalga marinha Nannochloropsis oculata, utilizando extração supercrítica. As microalgas serão secas utilizando secador tradicional de bandejas e liofilizador. As amostras de microalga in natura e secas serão caracterizadas em relação a umidade, teor de lipídios (totais e apolares) e perfil graxo. Os estudos da extração supercrítica serão realizados por delineamento experimental fatorial 32 utilizando a temperatura e a pressão como fatores. Serão avaliadas as características dos produtos obtidos, quanto ao perfil graxo e rendimento. Posteriormente serão obtidas as curvas cinéticas de extração, em diferentes temperaturas, ajustando os dados cinéticos de extração aos modelos de pseudoprimeira ordem e Brimberg. A energia de ativação na operação de extração será determinada por Arrhenius e os dados termodinâmicos de variação de entalpia, entropia e energia de Gibbs da operação serão determinados utilizando o método de Vant Hoff. As caracterizações dos óleos obtidos nas diferentes condições citadas, serão realizadas com base nas análises de perfil graxo, usando cromatografia gasosa e ressonância magnética nuclear entre outras análises. Por fim será realizado um estudo de viabilidade técnica e econômica do processo de extração do óleo utilizando fluído supercrítico..
Situation: Completed; Nature: Research.

Members: Tito Roberto Sant'Anna Cadaval Junior - Coordinator.
Financier(s): Conselho Nacional de Desenvolvimento Científico e Tecnológico - Scholarship.

2020 - 2024

Nanosul

Description: Em virtude de sua localização geográfica e antecedentes históricos, a FURG tem vocação Institucional direcionada ao reconhecimento, por meio da criação e difusão do conhecimento, da importância dos Sistemas Costeiros e oceânicos, já que nestes sistemas é onde ocorre uma das maiores produções naturais de matéria orgânica do nosso planeta. Neste cenário de grandes possibilidades de desenvolvimento industrial, social e ambiental, a presente proposta visa apresenta o ?cluster? de laboratórios da Instituição com atuação na área de nanotecnologia, com ênfase nas áreas de Química Multidisciplinar, Farmácia e Farmacologia, e Toxicologia. O histórico da Instituição na prospecção de compostos bioativos e de aplicação tecnológica no ambiente marinho tem propiciado um grande potencial de transferência de tecnologia na área nano e a oferta de prestação de serviços à sociedade pelo uso de sua estrutura e pela capacidade técnica instalada. A atuação do Laboratório NanoSul está de acordo com Instrução Normativa MCTIC N 11 de 02 de agosto de 2019 e será no âmbito da FURG, a qual conta com um projeto de desenvolvimento Institucional cadastrado no sistema da Universidade, SISPROJ, a partir de um convênio com a FAURG (Fundação de Apoio à Universidade do Rio Grande), o que possibilita à FAURG emitir nota fiscal e pagamentos pelos serviços, em especial os externos. Neste sentido, todos os centros e as restantes instalações possuem características multi-usuários, sendo rotineiramente utilizadospor pesquisadores da FURG e de outras instituições públicas e privadas nacionais e estrangeiras. Na Instituição existem competências bem desenvolvidas pelos integrantes da proposta na área de alimentos e materiais da indústria alimentícia, utilizando polímeros obtidos de fontes naturais (ex: quitosana, pectina, alginato). Desta forma, a utilização de matéria prima oriunda do mar possibilitou gerar suplementos nanoencapsulados visando seu uso na saúde humana e, também, na Aquacultura, sendo priorizadas ações que visam o uso seguro dos nanomateriais através da aplicação de testes de toxicidade padronizados. Neste último ponto cabe salientar que integrantes da proposta têm participado na iniciativa europeia NanoReg, que teve como objetivo padronizar os ensaios para avaliação da toxicidade potencial de diferentes tipos de nanomateriais. Este exercício de intercalibração internacional permitiu o desenvolvimento de habilidades para executar ensaios de toxicidade em condições aceitas internacionalmente, o que gera confiabilidade dos dados toxicológicos obtidos, permitindo uma avaliação precisa do potencial risco ambiental do nanomateriais. Na área da saúde têm se buscado odesenvolvimento de novas formas farmacêuticas para tratamento de doenças neurodegenerativas (Alzheimer e doença de Parkinson), doenças negligenciadas (Tuberculose), AVC hemorrágico, problemas de pele, como melhora na cicatrização e o tratamento de queimaduras, entre outros. Além disso, nos últimos anos têm surgido na

camarão, lagosta e caranguejo. A conversão da quitina em quitosana pode ser realizada por meio de uma hidrólise alcalina, podendo ocasionar uma desacetilação incompleta, e também em uma despolimerização de extensões variáveis, resultando em quitosanas com diferentes graus de desacetilação e diferentes massas moleculares, o que determina suas aplicações. O objetivo do presente trabalho consiste na utilização da quitosana, produzida a partir de resíduos da indústria pesqueira, como agente adsorvente no tratamento dos efluentes. O trabalho consiste na utilização da quitosana (na forma de pó e de filme polimérico) como agente adsorvente no tratamento de efluentes contendo corantes e íons metálicos presentes nas indústrias de alimentos, metalúrgicas, químicas e de petróleo e seus derivados..
Situation: In progress; Nature: Research.

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / Luiz Antonio de Almeida Pinto - Coordinator.

Development projects

2024 - Current

Estudo de Viabilidade Técnica e Econômica (EVTE) da cadeia produtiva de óleo de pescado

Description: Nos últimos anos, o consumo de produtos alimentícios oriundos da pesca aumentouexpressivamente, devido ao seu reconhecimento como um componente chave para umadieta equilibrada e um estilo de vida saudável. Uma das consequências do aumento doprocessamento do pescado é o aumento da geração de resíduos. Dentre os resíduosgerados no beneficiamento do pescado estão cabeças e vísceras, os quais sãoconsiderados uma fonte rica em ácidos graxos insaturados da família - Ômega 3. Oconsumo desses compostos tem sido estudado pela comunidade científica, devido aosdiversos benefícios, sendo essenciais para o desenvolvimento e funcionalidade dedeterminados órgãos e para algumas respostas bioquímicas e fisiológicas do organismo[1]. Devido à importância nutricional e farmacêutica desses ácidos graxos insaturados,cresce o interesse no desenvolvimento de processos que visam a extração e o refino desteóleo de resíduos de pescado [2].O Projeto de Educação Ambiental Fortalecimento da Organização Comunitária (PEA-FOCO)é desenvolvido na área de abrangência do campo de Peregrino, na Bacia de Campos, comouma medida de mitigação exigida pelo licenciamento federal conduzido pelo InstitutoBrasileiro Ibama. Este projeto busca identificar e desenvolver lideranças, por meio decursos para mulheres, conhecidas como educadoras populares, atuando junto aoMinistério da Pesca para proporcionar o reconhecimento profissional de mulheres dascomunidades de pescadores, tirando-as da invisibilidade na cadeia da pesca. O projetovisa contribuir para a integração das mulheres e para o reconhecimento de seu papel eatuação nos espaços econômico, social e ambiental da região, respeitando as relações deinterdependência próprias da vida comunitária. Com isso se torna importante fortalecer aorganização comunitária e a geração de emprego e renda.Atualmente, o

PEA FOCO atua em 3 regiões: Norte Fluminense, Região dos Lagos e Regiãode Campos, nas cidades de São Francisco de Itabapoana, São João da Barra, Cabo Frio,Armação dos Búzios e Arraial do Cabo.Neste contexto, a produção de óleo de pescado a partir da utilização do resíduo dobeneficiamento do pescado apresenta-se como alternativa para geração de emprego erenda na região.O EVTE é uma etapa crucial no processo de tomada de decisão sobre aviabilidade de um projeto na medida que são considerados diversos aspectos técnicoscomo recursos, processos, capacidades e qualidade da matéria-prima e produto. Alémdisso, são avaliados os aspectos econômicos, como os custos de investimento, os custosoperacionais, a estimativa de receitas e os fluxos de caixa esperados [3]. A presentepesquisa se propõe a realizar um estudo de viabilidade técnica e econômica (EVTE) dacadeia produtiva de óleo de resíduo do pescado das três regiões de atuação do projetoPEA FOCO.
Situation: In progress; Nature: Development.

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / Rafael Lipinski Paes - Coordinator / Jorge Marques Jr - Member / PINTO, L. A. A - Member / IGANSI, ANDREI V. - Member / Nauro da Silveira Jr - Member / MICHELE DA CRUZ LARROSSA - Member.

2024 - Current

TriboGirls Aprovado na Chamada CNPq/MCTI/MMulheres n 31/2023

Description: Projeto Aprovado em 1 lugar na chamada MMulheres n31/2023 do CNPq!O TriboGirls Tribologia Verde, Biotribologia e Engenharia de Superfícies foi submetido à Chamada CNPq/MCTI/MMulheres n 31/2023 e aprovado! Este projeto é uma ação interinstitucional que reúne 7 universidades brasileiras e o Inmetro com o objetivo de promover o interesse, formação e protagonismo de meninas e mulheres em áreas como ciências exatas e engenharias, em especial a Tribologia.A FURG,campus Carreiros, juntamente com o IFRS Rio Grande fundamenttou três subprojetos:- Avaliação da durabilidade de motores abastecidos por biocombustíveis;- Utilização de lubrificantes verdes em sistemas mecânicos;- Utilização de lubrificantes verdes em usinagem.O projeto vai oferecer 7 bolsas na seguinte modalidade:- Bolsas de Iniciação Científica Júnior (ICJ) para alunas das escolas do IF Rio GrandeA nossa missão é: fazer da tribologia uma área multidisciplinar e historicamente dominada por homens um campo de inclusão e inovação.
Situation: In progress; Nature: Development.

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / HENARA LILLIAN COSTA MURRAY - Coordinator / FELIPE, C.A.S. - Member.

2017 - 2020

Estudo do processo de obtenção de coagulantes

Description: O DEPC é um departamento da CORSAN subordinado à Superintendência de Tratamento-SUTRA pertencente à Diretoria de Operações-DOP que produz sulfato de alumínio

o qual é obtido utilizando como matéria prima ácido sulfúrico e bauxita (fonte de alumínio). Devido a mudança da bauxita utilizada, torna-se necessário estudar as alterações no processo devido à presença desta nova matéria prima. Além disso, a utilização de materiais rochosos à base de ferro e não de alumínio podem ser empregados para a formação de coagulantes férricos, os quais podem ser utilizados no tratamento de esgoto. A obtenção e aplicação deste novo coagulante também torna-se interessante para a empresa a fim de flexibilizar suas possibilidades de aquisição de matéria prima..
Situation: Completed; Nature: Development.
Participant students: Secondary technical education: (1) Graduation: (3) / Academic master's degree: (3) / Doctorate: (2) .

Members: Tito Roberto Sant'Anna Cadaval Junior - Coordinator / FRANTZ, TUANNY S. - Member / Luiz Carlos dos Santos - Member / Hosana T. Oliveira - Member / Amália F. Franco - Member / Jorge Marques Jr - Member / Luiz A. A. Pinto - Member / ARABIDIAN, VIVIANE C. - Member / JOÃO VAZ DE VAZ - Member.
Financier(s): Companhia Riograndense de Saneamento - Cooperation.

2016 - 2018

DESENVOLVIMENTO E VALIDAÇÃO DE PRODUTOS OBTIDOS A PARTIR DE RESÍDUOS DA INDÚSTRIA PESQUEIRA NA REGIÃO SUL - RS

Description: A degradação ambiental e a falta de modernização da indústria da pesca foram fatores que contribuíram para a queda do número de empreendimentos e da produção de pescado no RS. A qualidade do pescado e a inovação para a maximização do aproveitamento do recurso natural são as necessidades da indústria da pesca e da pesca artesanal de Rio Grande e região. Desta forma, o desenvolvimento e validação de produtos de interesse industrial e comercial obtidos a partir de resíduos da indústria pesqueira é uma alternativa econômica e sustentável ao setor..
Situação: Em andamento; Natureza: Desenvolvimento..
Situation: Completed; Nature: Development.
Participant students: Graduation: (1) / Academic master's degree: (17) / Professional master's degree: (11) / Doctorate: (7) .

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / Pinto, L.A.A. - Member / Ednei Gilberto Primel - Coordinator / Carlos Francisco Ferreira de Andrade - Member / Felipe Kessler - Member / Daiane Dias - Member / Rodolfo Carapelli - Member.
Financier(s): Secretaria de Desenvolvimento Econômico, Ciência e Tecnologia - Other.

2015 - 2018

Fortalecimento da Indústria da Pesca e Pesca Artesanal da Região Sul Através da Inovação Tecnológica Integrada a Responsabilidade Ambiental

Description: Fortalecer a indústria do pescado da região sul através da prestação de serviço de análise de qualidade do pescado, caracterização do efluente, orientação para o tratamento do mesmo, avaliação da eficiência

do tratamento e desenvolver e/ou aperfeiçoar metodologias para utilização dos resíduos da indústria de pescado e da pesca artesanal para a produção de gelatina, filmes biopoliméricos e óleo de alto valor agregado a partir destes resíduos, visando diminuir danos ambientais causados por tratamentos inadequados desses resíduos e agregando valor aos mesmos..
Situation: Completed; Nature: Development.
Participant students: Secondary technical education: (1) Graduation: (15) / Academic master's degree: (7) .

Members: Tito Roberto Sant'Anna Cadaval Junior - Member / Luiz Antonio de Almeida Pinto - Member / Ednei Gilberto Primel - Coordinator / Carlos Francisco Ferreira de Andrade - Member / Monicia Wallner-Kersanach - Member / Felipe Kessler - Member / Daiane Dias - Member / Rodolfo Carapelli - Member / Tatiana Walter - Member / Karina Kammer Attisano - Member.
Financier(s): Secretaria de Desenvolvimento Econômico, Ciência e Tecnologia - Other.

Member of editorial board

2018 - Present

Scientific Journal: Environmental Science and Pollution Research

Member of advisory committee

2020 - 2021

Development agency: Université Paris

Scientific journal referee

2016 - Present

Journal: Environmental Science and Pollution Research International

2018 - Present

Journal: COLLOIDS AND SURFACES A-PHYSICOCHEMICAL AND ENGINEERING ASPECTS

2018 - Present

Journal: JOURNAL OF ENVIRONMENTAL CHEMICAL ENGINEERING

2018 - Present

Journal: Desalination and Water Treatment

2018 - Present

Journal: INTERNATIONAL JOURNAL OF BIOLOGICAL MACROMOLECULES

2018 - Present

Journal: Adsorption Science and Technology

2018 - Present

Journal: RSC Advances

2019 - Present

Journal: Industrial & Engineering Chemistry Research

2019 - Present

Journal: Journal of Hazardous Materials (Print)

2019 - Present

Journal: Chemical Engineering and Processing: Process Intensification

2019 - Present

Journal: Environmental Engineering Science

2020 - Present

Journal: SN Applied Sciences

2019 - Present

Journal: Chemical Engineering and Processing - Process Intensification

2019 - Present

Journal: Arabian Journal of Chemistry

2021 - Present

Journal: Materials Today Sustainability

2021 - Present

Journal: Journal of The Electrochemical Society

2021 - Present

Journal: Journal of Colloid And Interface Science

2021 - Present

Journal: Nanocomposites

2020 - Present

Journal: Journal of Molecular Liquids

2020 - Present

Journal: CHEMOSPHERE (0045--653)

2020 - Present

Journal: MOLECULES

2023 - Present

Journal: Sustainable Chemistry for the Environment

Areas of Expertise

1.

Major Area: Engineering / Área: Chemical Engineering / Subarea: Processos de Separação.

2.

Major Area: Engineering / Área: Sanitary Engineering / Subarea: Tratamento de Águas de Abastecimento e Residuárias/Specialty: Técnicas Avançadas de Tratamento de Águas.

3.

Major Area: Exact and Earth Sciences / Área: Chemistry / Subarea: Físico-Química/Specialty: Termodinâmica Química.

Languages

English

Comprehends Well, Speaks Reasonably, Reads Well, Writes Reasonably.

Spanish

Comprehends Reasonably, Speaks Little, Reads Reasonably, Writes Reasonably.

Portuguese

Comprehends Well, Speaks Well, Reads Well, Writes Well.

Scientific, Technological, Artistic and Cultural Production

Bibliographical Production

Citations

Web of Science

Total of articles: 93 Total of citations: 2903 Date: 24/09/2025

Cadaval, Tito R. S.

SCOPUS

Total of articles: 94 Total of citations: 3345 Date: 28/06/2025

Santana Cadaval, Tito Roberto Cadaval, T. R.S. Cadaval, Tito Roberto Santana Cadaval, Tito R.S., Cadaval Junior, Tito Roberto Sant Anna, Sant'Anna Ca[illegible]l, Tito Roberto, Sant'Anna Cadaval,

SSESSMENT

FURG is among the seven Brazilian universities that have risen in the world ranking.

The institution climbed 33 positions in the CWUR 2025 ranking, which lists 53 Brazilian universities among the best in the world.

by Tammie Faria Sandri
Published: June 2, 2025, 10:09 AM
Last modified: June 2, 2025, 10:16 AM

The Federal University of Rio Grande (FURG) is among the seven Brazilian universities that have risen in the world rankings released this Monday morning, December 2nd, by the Center for World University Rankings (CWUR).

The CWUR 2025 ranking places the institution at position 1644, along with six other Brazilian universities that also moved up in the rankings. In total, 53 Brazilian universities are among the best in the world in the ranking, which evaluated 21,462 institutions worldwide.

When evaluating the results, the president of CWUR considered that Brazil is well represented among the best universities in the world, although the decline in the performance of the majority (87%) of Brazilian academic institutions is alarming. CWUR points to limited financial support in recent years and the consequent weakening of research performance as a factor contributing to this decline. Even so, more than 20 Brazilian universities are in the top 5% globally, and 53 are among the top 10%.

The ranking considers, among other things, indicators based on academic performance, alumni employability, faculty qualifications, and scientific output. In this 2025 edition, the methodology considered 74 million data points to classify the institutions.

The seven Brazilian institutions that rose in the ranking were:

Federal University of Rio de Janeiro (from 401st to 331st)
State University of Campinas (from 370th to 369th)
University of Brasília (from 836th to 833rd)
Federal University of Mato Grosso do Sul (from 1396th to 1367th)
Federal Technological University of Paraná (from 1465th to 1455th)
Federal University of Rio Grande (from 1677th to 1644th)
Federal University of Triângulo Mineiro (from 1868th to 1836th)

The complete list is available on the CWUR website: https://cwur.org/2025.php

About CWUR

Based in Saudi Arabia, CWUR is dedicated to global assessments of the quality of higher education institutions, considering, among other performance factors, the number of faculty and alumni who have received high-level awards. As a consulting organization, CWUR provides policy advice, strategic insights, and consulting services to governments and universities to improve educational and research outcomes.

Exhibit H - Final merit determination

STATE UNIVERSITY OF SANTA CATARINA

Center for Agro-Veterinary Sciences

The President of the State University of Santa Catarina, in the exercise of his duties and in view of the completion of the

Master's Academic Program in Forest Engineering
Field of Study: Forest Engineering

on July 29, 2022, confers the degree of

Master in Forest Engineering upon

ALICE NERI DA SILVA SOUSA

Brazilian, from the State of Rondônia,
born on August 8, 1996, identity card no. 1226601 – SSP/RO

and grants this Diploma so that she may enjoy all legal rights and prerogatives.

Florianópolis, November 10, 2022.

Dilmar Baretta
President

Alice Neri da Silva Sousa

André Thaler Neto
Dean

439

STATE UNIVERSITY OF SANTA CATARINA - UDESC

Recognized by Ministerial Ordinance MEC No. 893, of 11/11/1985, published in the Federal Official Gazette on 11/26/1985 – Section I, p. 17,243.
Maintaining Entity:
STATE UNIVERSITY OF SANTA CATARINA FOUNDATION
CNPJ No.: 83.891.283/0001-36

GRADUATE PROGRAM

MASTER'S ACADEMIC PROGRAM IN FOREST ENGINEERING

Recognized by State Decree No. 1,101, of 08/03/2012, published in the Official Gazette of the State of Santa Catarina on 08/06/2012

Recognition MEC/CAPES

Ratified by the CNE (MEC Ordinance No. 656, of 05/22/2017, published in the Federal Official Gazette on 05/23/2017, Section I, p. 31)

STATE UNIVERSITY OF SANTA CATARINA

DIPLOMA registered under No. SS - 6.540, in accordance with Article 48 of Federal Law No. 9.394, of December 20, 1996

Florianópolis (SC), 11 / 29 / 2022.

Elaine Cristina C. Zanette

Elaine Cristina Casagrande Zanette
Coordinator of Diploma and Certificate Registration

Dilmar Baretta
President

440

I, André Vinícius Inacio Penna Mello, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: October 1, 2025.

UNIVERSIDADE DO ESTADO DE SANTA CATARINA

CENTRO DE CIÊNCIAS AGROVETERINÁRIAS - CAV

O Reitor da Universidade do Estado de Santa Catarina,
no uso de suas atribuições e tendo em vista a conclusão do

Curso de Mestrado Acadêmico em Engenharia Florestal

Área de Concentração: Engenharia Florestal

em 29 de julho de 2022, confere o título de

Mestra em Engenharia Florestal a

ALICE NERI DA SILVA SOUSA

nacionalidade brasileira, natural do Estado de Rondônia,
nascida em 08 de agosto de 1996, carteira de identidade n.º 1226601 - SSP/RO

e outorga-lhe o presente Diploma a fim de que possa gozar de todos os direitos e prerrogativas legais.

Florianópolis, 10 de novembro de 2022.

Dilmar Baretta
Reitor

Alice Neri da Silva Sousa

André Thaler Neto
Diretor Geral

442

UNIVERSIDADE DO ESTADO DE SANTA CATARINA – UDESC

Reconhecida pela Portaria Ministerial MEC N° 893, de 11.11.1985, publicada no Diário Oficial da União em 26.11.1985 – Seção I, p. 17.243.
Mantenedora:
FUNDAÇÃO UNIVERSIDADE DO ESTADO DE SANTA CATARINA
Nº do CNPJ: 83.891.283/0001-36

CURSO DE PÓS-GRADUAÇÃO

MESTRADO ACADÊMICO EM ENGENHARIA FLORESTAL

Reconhecido pelo Decreto Estadual nº 1.101, de 03/08/2012, publicado no Diário Oficial do Estado de Santa Catarina, em 06/08/2012.

Reconhecimento MEC/CAPES

Homologado pelo CNE (Port. MEC nº 656, de 22/05/2017, publicada no DOU em 23/05/2017, seç, 1 p.31).

UNIVERSIDADE DO ESTADO DE SANTA CATARINA

DIPLOMA registrado sob o nº SS - 6.540, de acordo com o Artigo 48 da Lei Federal nº 9.394, de 20 de dezembro de 1996.

Florianópolis (SC), 29 / 11 / 2022.

Elaine Cristina C. Zanette

Elaine Cristina Casagrande Zanette
Coordenadora de Registro de Diplomas e Certificados

Dilmar Baretta
Reitor

FEDERATIVE REPUBLIC OF BRAZIL
STATE OF SANTA CATARINA
State University of Santa Catarina - UDESC
Center for Agro-Veterinary Sciences - CAV/UDESC

MASTER'S ACADEMIC PROGRAM IN FOREST ENGINEERING

A C A D E M I C T R A N S C R I P T

Alice Neri da Silva Sousa

INSTITUTION

UDESC - State University of Santa Catarina
Avenida Madre Benvenuta, 2037 – Itacorubi Neighborhood - 88035901 - Florianópolis - SC
Recognized by Ordinance No. 893 - MEC, of 11/11/1985, published in the Federal Official Gazette on 11/26/1985

CAV/UDESC - Center for Agro-Veterinary Sciences
Avenida Luís de Camões, 2090 - Conta Dinheiro Neighborhood - 88520000 - Lages - SC

PROGRAM

Program: MASTER'S ACADEMIC PROGRAM IN FOREST ENGINEERING

MEC Recognition – MEC Ordinance No. 656, of 05/22/2017, published in the Federal Official Gazette on 05/23/2017.
Recognized by State Decree No. 1.101, published in the Official Gazette of the State of Santa Catarina on 08/06/2012.

PERSONAL INFORMATION

Student's Name: Alice Neri da Silva Sousa
Registration Number: MEF0120207
Filiation: Carlos Clay Oliveira Sousa and Jeane Neri da Silva Sousa
Date of Birth: August 8, 1996
Place of Birth: Ji-Paraná/RO - BRAZIL
Identity Card: 1226601
Issuer: SSP - RO
CPF: 022.358.792-33

PREVIOUS DEGREE

Bachelor's Degree in Forest Engineering
Federal University of Acre
Date of Completion or Graduation: 12/18/2019

ADMISSION INFORMATION

Admission: 08/04/2020
Status: Completed on 07/29/2022
Advisor: MARTHA ANDREIA BRAND, PhD.
Field of Study and/or Research Line: Forest Engineering
Proficiency: ENGLISH - READING COMPREHENSION - 05/21/2021

THESIS

BIOENERGY IN TRADITIONAL POPULATIONS OF THE AMAZON: RESIDUAL BIOMASS OF THE FRUITS AND CHARCOAL OF Attalea tessmannii (COCÃO) Burret
Defense: 07/29/2022
Status: Approved

FEDERATIVE REPUBLIC OF BRAZIL
STATE OF SANTA CATARINA
State University of Santa Catarina - UDESC
Center for Agro-Veterinary Sciences - CAV/UDESC

MASTER'S ACADEMIC PROGRAM IN FOREST ENGINEERING

A C A D E M I C T R A N S C R I P T

Alice Neri da Silva Sousa

Courses	CR	CH	Grade	Term	Result
Applied Regression Analysis in Forest Engineering ANDRE FELIPE HESS, PhD	4	60	A	2020/2	Passed
Thesis - MEF	6	90		2020/2	In Progress
Scientific and Research Methodology MARTHA ANDREIA BRAND, PhD	2	30	A	2020/2	Passed
Experimental Statistical Methods Applied to Forest Engineering	4	60	D	2020/2	In Progress
Wood Quality and Forest Products I POLLIANA D ANGELO RIOS, PhD	3	45	A	2020/2	Passed
Seminars I LUCIANA MAGDA DE OLIVEIRA, PhD	1	15	A	2020/2	Passed
Energy and Development MARTHA ANDREIA BRAND, PhD	3	45	A	2021/1	Passed
Experimental Statistical Methods Applied to Forest Engineering MARCOS FELIPE NICOLETTI, PhD MARCIO CARLOS NAVROSKI, PhD	4	60	C	2021/1	Passed
Reconstituted Wood Panels ALEXSANDRO BAYESTORFF DA CUNHA, PhD POLLIANA D ANGELO RIOS, PhD	2	30	A	2021/1	Passed
Wood Quality and Forest Products II ALEXSANDRO BAYESTORFF DA CUNHA, PhD	3	45	A	2021/2	Passed
Seminars II LUCIANA MAGDA DE OLIVEIRA, PhD	1	15	A	2021/2	Passed
Silviculture Applied to Commercially Important Species MARCIO CARLOS NAVROSKI, PhD	3	45	A	2021/2	Passed
Thesis - MEF	6	90		2022/1	Passed
Teaching Internship	2	30	A	2022/1	Passed
Key: CR=Credits, CH=Workload.	**34**	**510**			

Total Credits Completed: 34	Total Workload Completed: 510

Qualifying Exam Date: 02/25/2022

GRADE EQUIVALENCIES AND CREDIT VALUE

A = 9,0 to 10,0;
B = 8,0 to 8,9;
C = 7,0 to 7,9;
D = Below 7,0;
AC = Credit transfer from a course taken outside UDESC;
R = Failed due to attendance;
I = Incomplete.
AC, R, and I = No grade assigned.
Credit Value in Workload: 1 Credit = 15 class hours

I, André Vinícius Inacio Penna Mello, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: October 1, 2025.

REPÚBLICA FEDERATIVA DO BRASIL
ESTADO DE SANTA CATARINA
Universidade do Estado de Santa Catarina - UDESC
Centro de Ciências Agroveterinárias - CAV/UDESC

MESTRADO ACADÊMICO EM ENGENHARIA FLORESTAL

H I S T Ó R I C O E S C O L A R

Alice Neri da Silva Sousa

INSTITUIÇÃO

UDESC - Universidade do Estado de Santa Catarina
Avenida Madre Benvenuta, 2037 - Bairro Itacorubi - 88035901 - Florianópolis - SC
Reconhecida pela Portaria Número 893 - MEC, de 11/11/1985, publicada no DOU em 26/11/1985

CAV/UDESC - Centro de Ciências Agroveterinárias
Avenida Luís de Camões, 2090 - Bairro Conta Dinheiro - 88520000 - Lages - SC

CURSO

Curso: MESTRADO ACADÊMICO EM ENGENHARIA FLORESTAL

Reconhecimento MEC - Portaria MEC N.º 656, de 22/05/2017, publicada no DOU em 23/05/2017.
Reconhecido pelo Decreto Estadual nº 1.101, publicado no Diário Oficial do Estado de Santa Catarina em 06/08/2012.

DADOS PESSOAIS

Nome do Aluno: Alice Neri da Silva Sousa
Número de Matrícula: MEF0120207
Filiação: Carlos Clay Oliveira Sousa e Jeane Neri da Silva Sousa
Nascimento: 08 de agosto de 1996
Naturalidade: Ji-Paraná/RO - BRASIL
Carteira de Identidade: 1226601
Expedidor: SSP - RO
CPF: 022.358.792-33

TITULAÇÃO ANTERIOR

Bacharelado em Engenharia Florestal
Universidade Federal do Acre
Data da Conclusão ou Colação de Grau: 18/12/2019

DADOS DO INGRESSO

Ingresso: 04/08/2020
Situação: Concluído em 29/07/2022
Orientador: MARTHA ANDREIA BRAND, Dra.
Área de Concentração e/ou Linha de Pesquisa: Engenharia Florestal
Proficiência: INGLÊS - COMPREENSÃO DE TEXTO - 21/05/2021

DISSERTAÇÃO

BIOENERGIA EM POPULAÇÕES TRADICIONAIS DA AMAZÔNIA: BIOMASSA RESIDUAL DOS FRUTOS E CARVÃO VEGETAL DA ESPÉCIE Attalea tessmannii (COCÃO) Burret
Defesa: 29/07/2022
Situação: Aprovado

REPÚBLICA FEDERATIVA DO BRASIL
ESTADO DE SANTA CATARINA
Universidade do Estado de Santa Catarina - UDESC
Centro de Ciências Agroveterinárias - CAV/UDESC

MESTRADO ACADÊMICO EM ENGENHARIA FLORESTAL

HISTÓRICO ESCOLAR

Alice Neri da Silva Sousa

Disciplinas	CR	CH	Conceito	Sem	Resultado
Análise de Regressão Aplicada à Engenharia Florestal ANDRE FELIPE HESS, Dr.	4	60	A	2020/2	Aprovado
Dissertação - MEF	6	90		2020/2	Cursando
Metodologia Científica e da Pesquisa MARTHA ANDREIA BRAND, Dra.	2	30	A	2020/2	Aprovado
Métodos Estatísticos-Experimentais Aplicados à Engenharia Florestal	4	60	D	2020/2	Reprovado Nota
Qualidade da Madeira e Produtos Florestais I POLLIANA D ANGELO RIOS, Dra.	3	45	A	2020/2	Aprovado
Seminários I LUCIANA MAGDA DE OLIVEIRA, Dra.	1	15	A	2020/2	Aprovado
Energia e Desenvolvimento MARTHA ANDREIA BRAND, Dra.	3	45	A	2021/1	Aprovado
Métodos Estatísticos-Experimentais Aplicados à Engenharia Florestal MARCOS FELIPE NICOLETTI, Dr. MARCIO CARLOS NAVROSKI, Dr.	4	60	C	2021/1	Aprovado
Painéis Reconstituídos de Madeira ALEXSANDRO BAYESTORFF DA CUNHA, Dr. POLLIANA D ANGELO RIOS, Dra.	2	30	A	2021/1	Aprovado
Qualidade da Madeira e Produtos Florestais II ALEXSANDRO BAYESTORFF DA CUNHA, Dr.	3	45	A	2021/2	Aprovado
Seminários II LUCIANA MAGDA DE OLIVEIRA, Dra.	1	15	A	2021/2	Aprovado
Silvicultura Aplicada a Espécies de Interesse Comercial MARCIO CARLOS NAVROSKI, Dr.	3	45	A	2021/2	Aprovado
Dissertação - MEF	6	90		2022/1	Aprovado
Estágio em Docência	2	30	A	2022/1	Aprovado
Legenda: CR=Créditos, CH=Carga horária.	**34**	**510**			

Total de Créditos Concluídos: 34	Total de Carga Horária Concluída: 510

Data do Exame de Qualificação: 25/02/2022

EQUIVALÊNCIAS DE CONCEITOS E VALOR DO CRÉDITO

A = 9,0 a 10,0;
B = 8,0 a 8,9;
C = 7,0 a 7,9;
D = Inferior a 7,0;
AC = Aproveitamento de crédito em disciplina cursada fora da UDESC;
R = Reprovado por frequência;
I = Incompleto.
AC, R e I = Não possuem atribuição de nota.
Valor do Crédito em Carga Horária: 1 Crédito = 15 h/a

FEDERATIVE REPUBLIC OF BRAZIL
MINISTRY OF EDUCATION

FEDERAL UNIVERSITY OF ACRE

The Vice President, acting on behalf of the President's Office of the Federal University of Acre, in the exercise of his duties and in view of the completion of the ***Bachelor of Science in Forest Engineering*** *on December 18, 2019, and the degree conferral on February 21, 2020, awards the degree of* ***Bachelor of Science in Forest Engineering*** *to* ***Alice Neri da Silva Sousa****, born on August 8, 1996,* ***Brazilian*** *nationality, from the State of* ***Rondônia****, holder of Identification Document No.* ***1226601****, issued by* ***SESDC-RO****, to whom this Diploma is granted, so that she may enjoy all legal rights and privileges.*

Rio Branco – AC, March 18, 2020.

Josimar Batista Ferreira
Vice President, acting on behalf of the President's Office

Alice Neri da Silva Sousa
Graduate

Grace Gotolip Cabral
Acting Vice President for Undergraduate Studies

Patrícia Gomes Ribeiro Amorim
Program Coordinator

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MINISTRY OF EDUCATION
Federal University of Acre
Federal University of Acre Foundation

CNPJ: 04.071.160/0001-37

Reaccredited by Ministerial Ordinance/MEC No. 315 of March 8, 2017, published in the Federal Official Gazette No. 47, Section 1, page 29, of March 9, 2017

Bachelor's Degree Program in Forest Engineering

Program accredited by MEC/SERES Ordinance No. 921 of December 27, 2018, published in the Federal Official Gazette on 12-28-2018.

Diploma registered under No. 242, Book No. 01/2020, Page 61, on 03/18/2020, by delegation of authority from the Ministry of Education, pursuant to Law No. 9,394 of December 20, 1996, and Decree No. 9.235 of December 15, 2017.

Process No. 23107.900109/2020-16

Rio Branco-AC, March 18, 2020.

Alyne Azevedo Monteiro Barbosa
Coordinator of Diplomas and Certificates
Ordinance No. 2069/2018

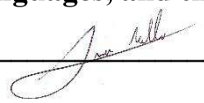
Eliana da Silva Campêlo
Director of the Academic Records and Control Center
Ordinance No. 1981/2012 – Delegation Act: Ordinance No. 1427/2019

COPY: 1st Copy.

450

020734

I, André Vinícius Inacio Penna Mello, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.



Date: October 30, 2025.

REPÚBLICA FEDERATIVA DO BRASIL
MINISTÉRIO DA EDUCAÇÃO

UNIVERSIDADE FEDERAL DO ACRE

452

O Vice-Reitor, no exercício da Reitoria da Universidade Federal do Acre, no uso de suas atribuições e tendo em vista a conclusão do Curso de **Bacharelado em Engenharia Florestal**, em 18 de dezembro de 2019, e a colação de grau em 21 de fevereiro de 2020, confere o título de **Bacharela em Engenharia Florestal** a **Alice Neri da Silva Sousa**, nascida em 8 de agosto de 1996, nacionalidade **Brasileira**, natural do Estado de **Rondônia**, portadora do Documento de Identificação nº **1226601**, expedido pela **SESDC-RO**, a quem outorga o presente Diploma, a fim de que possa gozar de todos os direitos e prerrogativas legais.

Rio Branco-AC, 18 de março de 2020.

Josimar Batista Ferreira
Vice-Reitor, no exercício da Reitoria

Grace Gotolip Cabral
Pró-Reitora de Graduação, em exercício

Alice Neri da Silva Sousa
Diplomada

Patrícia Gomes Ribeiro Amorim
Coordenadora do Curso

REPÚBLICA FEDERATIVA DO BRASIL
ORDEM E PROGRESSO

MINISTÉRIO DA EDUCAÇÃO
Universidade Federal do Acre
Fundação Universidade Federal do Acre

CNPJ: 04.071.106/0001-37

Recredenciada pela Portaria Ministerial/MEC nº 315, de 08/03/2017, publicada no D.O.U. nº 47, Seção 1, pág. 29, de 09/03/2017

Curso de Bacharelado em Engenharia Florestal.

Curso Reconhecido pela Portaria MEC/SERES nº 921, de 27-12-2018, publicada no D.O.U., de 28-12-2018.

Diploma registrado sob o nº 242, livro nº 01/2020, folha 61, em 18/03/2020, por delegação de competência do Ministério da Educação, nos termos da Lei nº 9.394, de 20 de dezembro de 1996, e do Decreto nº 9.235, de 15 de dezembro de 2017.

453

Processo nº: 23107.900109/2020-16

Rio Branco-AC, 18 de março de 2020.

Alyne Azevedo Monteiro Barbosa
Coordenadora de Diplomas e Certificados
Portaria nº 2069/2018

Eliana da Silva Campêlo
Diretora do Núcleo de Registro e Controle Acadêmico
Portaria nº 1981/2012 - Ato de Delegação: Portaria nº 1427/2019

VIA: 1ª Via.

020734

Logo

MINISTRY OF EDUCATION
Federal University of Acre
Academic Records and Control Center

Stamp

ACADEMIC TRANSCRIPT

IDENTIFICATION

Name: Alice Neri da Silva Sousa

Registration: 20150330040
Place of Birth: Ji-Paraná **State:** RO
Nationality: Brazilian **Date of Birth:** 08/08/1996

DOCUMENTS

Document Type	Document Number	Issuing Authority	State
CPF	022.358.792-33	SRF	
Identity Card	1226601	SESDC	RO
Voter ID	0173982623/64-003-0237	TRE	AC

ACADEMIC RECORD

Institution: Federal Institute of Education, Science, and Technology of Rondônia
Place: Ji-Paraná **State:** RO **Completion:** 2015

ADMISSION METHOD

Admission Method: Selection Process – SISU **Period:** 1st Semester of 2015

UNDERGRADUATE PROGRAM

Bachelor's Degree in Forest Engineering

Recognized by MEC/SERES Ordinance No. 921, of 12/27/2017, published in the Federal Official Gazette on 12/28/2018

Program Completion Date: 12/18/2019 **Graduation Date:** 02/21/2020

NOTES

This Academic Transcript is valid only when bearing the stamp and signature of the responsible authority.
The student participated as a graduate in the ENADE, held on November 24, 2019.

----//signature//----

Jeconias Galvão de Freitas Lima
Coordinator of Academic Records and
Control /NURCA/UFAC
Ordinance No. 2.303/2012

Endorsed by:

----//signature//----

Eliana da Silva Campelo
Director of the Academic Records and
Control Center
Ordinance No. 1981/2012

Rio Branco, July 22, 2020

Logo

MINISTRY OF EDUCATION
Federal University of Acre
Academic Records and Control Center

ACADEMIC TRANSCRIPT

Name: **20150330040 – Alice Neri da Silva Sousa**
Program: **Bachelor's Degree in Forest Engineering**

Courses		Class Hours	Grade	Status	Waiver
Complementary Activities					
2nd Semester of 2019					
33	Complementary Activities	200	*****	Aprov. Est	*
Required Courses					
1st Semester of 2015					
CCET329	Calculus	90	8,00	Passed	
CCBN194	Physics IX	75	6,50	Passed	
CCBN265	Introduction to Forest Science	45	8,15	Passed	
CCBN831	Plant Morphology and Systematics	60	5,99	Passed	
CCBN021	Organic Chemistry III	60	6,20	Passed	
CCBN226	Drawing Techniques	45	9,05	Passed	
CCBN051	Zoology	45	8,00	Passed	
2nd Semester of 2015					
CCBN054	Vascular Plant Anatomy	60	7,15	Passed	
CCBN212	General Ecology III	45	8,22	Passed	
CCET205	Basic Statistics	60	8,20	Passed	
CCET323	Computer Science Applied to Agricultural Sciences	45	9,38	Passed	
CCBN834	Meteorology and Climatology	60	9,80	Passed	
CCBN835	Microbiology Applied to Agricultural Sciences	60	6,00	Passed	
CCBN052	Analytical Chemistry	60	8,38	Passed	
CCET225	Topography VI	60	8,70	Passed	
1st Semester of 2016					
CCET244	Rural Constructions I	60	6,68	Passed	
CCBN350	Forest Ecology	60	8,22	Passed	
CCBN305	Basic Forest Entomology	60	8,15	Passed	
CCBN324	Experimentation Applied to Agricultural Sciences	60	8,63	Passed	
CCBN058	Plant Physiology	60	*****	Aprov. Est	*
CCBN290	Genetics	60	6,39	Passed	
CCBN310	Soil Genesis, Morphology, and Physics	75	5,96	Passed	
2nd Semester of 2016					
CCBN315	Wood Anatomy	45	9,28	Passed	
CCBN338	Dendrology	60	9,60	Passed	
CCBN330	Applied Forest Entomology	60	5,55	Passed	
CCBN842	Forest Extension	45	9,00	Passed	
CCBN419	Scientific Initiation	45	8,00	Passed	
CCBN323	Forest Machinery and Mechanization	60	8,19	Passed	
CCBN062	Forest Pathology II	75	5,94	Passed	
1st Semester of 2017					
CCBN072	Forest Biometry	60	10,00	Passed	
CCBN066	Soil Classification, Conservation, and Use	60	5,12	Passed	
CCBN071	Forest Fires	45	9,15	Passed	
CCBN366	Wildlife Management	60	8,25	Passed	
CCBN065	Forest Improvement II	60	8,02	Passed	

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Logo

MINISTRY OF EDUCATION
Federal University of Acre
Academic Records and Control Center

Stamp

ACADEMIC TRANSCRIPT

Name: **20150330040 – Alice Neri da Silva Sousa**
Program: **Bachelor's Degree in Forest Engineering**

Courses		Class Hours	Grade	Status	Waiver
CCBN063	Wood Properties	45	8,20	Passed	
CCBN345	Soil Chemistry and Fertility	75	8,30	Passed	
CCBN415	Forest Seeds	60	5,60	Passed	
2nd Semester of 2017					
CCBN843	Forest Biotechnology II	60	7,98	Passed	
CCET230	Wood Constructions	60	9,15	Passed	
CCBN839	Forest Economics	60	6,75	Passed	
CCBN363	Forest Inventory	60	8,00	Passed	
CCBN838	Mechanical Wood Processing	45	9,00	Passed	
CCBN840	Technology of Non-Timber Forest Products	45	8,70	Passed	
CCBN837	Forest Nurseries	45	8,00	Passed	
1st Semester of 2018					
CCBN846	Marketing of Forest Products and Services	60	*****	Aprov. Est	*
CCBN847	Geoprocessing	60	8,00	Passed	
CCBN849	Management of Native Forests	60	*****	Aprov. Est	*
CCBN848	Management of Conservation Units II	45	*****	Aprov. Est	*
CCBN404	Forest Planning and Administration	45	7,65	Passed	
CCBN844	Forest Energy Resources	45	7,35	Passed	
CCBN418	Wood Drying and Preservation	45	7,88	Passed	
CCBN845	Silvicultural Systems	45	9,18	Passed	
2nd Semester of 2018					
CCBN856	Environmental Impact Assessment II	45	*****	Aprov. Est	*
CCBN383	Forest Exploitation and Transportation	60	8,00	Passed	
CCBN436	Watershed Management	60	8,00	Passed	
CCBN850	Management of Planted Forests	60	8,18	Passed	
CCBN854	Forest Policy and Legislation	60	9,00	Passed	
CCBN851	Agroforestry Systems	45	8,00	Passed	
1st Semester of 2019					
CCBN853	Marketing of Forest Products and Services	30	8,75	Passed	
CCBN852	Degraded Area Recovery	45	8,00	Passed	
2nd Semester of 2019					
CCBN427	Supervised Internship	180	9,00	Passed	
CCBN855	Undergraduate Thesis	90	10,00	Passed	
CCBN456	Environmental Expert Assessment	45	*****	Aprov. Est	*
	Elective Courses				
2nd Semester of 2017					
CCBN884		45	10,00	Passed	
2nd Semester of 2018					
CCBN885		45	8,45	Passed	

----//signature//----

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Logo

MINISTRY OF EDUCATION
Federal University of Acre
Academic Records and Control Center

ACADEMIC TRANSCRIPT

Name: **20150330040 – Alice Neri da Silva Sousa**
Program: **Bachelor's Degree in Forest Engineering**

Courses	Class Hours	Grade	Status	Waiver
Courses from Other Programs				
2nd Semester of 2017				
CCBN877	45	10,00	Passed	
Courses Used for Credit Transfer				
1st Semester of 2016				
CCBN318	75	7,80	Passed	
1st Semester of 2018				
CCBN421	60	7,10	Passed	
CCBN392	60	9,00	Passed	
CCBN401	75	8,25	Passed	
2nd Semester of 2018				
CCBN386	60	8,65	Passed	

Status Key
Aprov. Est - Passed by transfer of credits
Passed - Passed

Student's GPA: 08.0900	**Credits Earned/Required**	**Program Hours Completed/Required**
Complementary Activities	0/0	200/200
Required Courses	174/174	3660/3660
Elective Courses	4/4	90/90
Total Credits/Hours:	178 178	3950 3950

Transfer Institution 7 – Bachelor's Degree in Forest Engineering
Student Status **Graduated**

*** This course was approved as a result of curriculum adjustment**

----//signature//----
Jeconias Galvão de Freitas Lima
Coordinator of Academic Records and Control /NURCA/UFAC
Ordinance No. 2.303/2012

----//signature//----
Eliana da Silva Campelo
Director of the Academic Records and Control Center
Ordinance No. 1981/2012

Page: 4

I, André Vinícius Inacio Penna Mello, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: October 30, 2025.

MINISTÉRIO DA EDUCAÇÃO
Universidade Federal do Acre
Núcleo de Registro e Controle Acadêmico

HISTÓRICO ESCOLAR

IDENTIFICAÇÃO

Nome : Alice Neri da Silva Sousa

Matrícula : 20150330040
Naturalidade : Ji-Paraná **UF:** RO
Nacionalidade : Brasileira **Nascimento:** 08/08/1996

DOCUMENTOS

Tipo Documento	Número Documento	Órgão Emissor	UF
CPF	022.358.792-33	SRF	
Carteira de Identidade	1226601	SESDC	RO
Título de Eleitor	0173982623/64-003-0237	TRE	AC

ESCOLARIDADE

Estabelecimento: Inst. Federal de Educação, Ciência e Tecnologia de Rondônia
Local: Ji-Paraná **UF:** RO **Conclusão:** 2015

FORMA DE INGRESSO

Forma de Ingresso: Processo Seletivo - SiSU **Período:** 1° Semestre de 2015

CURSO SUPERIOR

Bacharelado em Engenharia Florestal

Reconhecido pela Portaria MEC/SERES nº 921, de 27-12-2018, publicada no D.O.U., de 28-12-2018.

Data da Conclusão do Curso : 18/12/2019 **Data da Colação de Grau:** 21/02/2020

OBSERVAÇÕES

O presente Histórico Escolar somente terá validade quando constarem o carimbo e assinatura do responsável.
Estudante participou como concluinte do ENADE, realizado no dia 24 de novembro de 2019.

Jeconias Galvão de Freitas Lima
Coord. de Registro e Controle
Acadêmico/NURCA/UFAC
Portaria nº 2.383/2012

Visto:
Eliana da Silva Campelo
Diretora do Núcleo de Registro e
Controle Acadêmico
Portaria nº 1981/2012

Rio Branco, 22 de Julho de 2020

MINISTÉRIO DA EDUCAÇÃO
Universidade Federal do Acre
Núcleo de Registro e Controle Acadêmico

HISTÓRICO ESCOLAR

Nome: 20150330040 - Alice Neri da Silva Sousa
Curso: Bacharelado em Engenharia Florestal

Disciplinas	Horas Aula	NT/Conc	Situação	Dispensa
Atividades Complementares				
2° Semestre de 2019				
33 Atividades Complementares	200	*****	Aprov. Est	*
Disciplinas Obrigatórias				
1° Semestre de 2015				
CCET329 Calculo	90	8,00	Aprovado	
CCBN194 Fisica IX	75	6,50	Aprovado	
CCBN265 Iniciação à Ciência Florestal	45	8,15	Aprovado	
CCBN831 Morfologia e Sistemática Vegetal	60	5,99	Aprovado	
CCBN021 Quimica Orgânica III	60	6,20	Aprovado	
CCET226 Técnicas de Desenho	45	9,05	Aprovado	
CCBN051 Zoologia	45	8,00	Aprovado	
2° Semestre de 2015				
CCBN054 Anatomia de Plantas Vasculares	60	7,15	Aprovado	
CCBN212 Ecologia Geral III	45	8,22	Aprovado	
CCET205 Estatistica Básica	60	8,20	Aprovado	
CCET323 Informática aplicada às Ciências Agrárias	45	9,38	Aprovado	
CCBN834 Meteorologia e Climatologia	60	9,80	Aprovado	
CCBN835 Microbiologia Aplicada às Ciências Agrárias	60	6,00	Aprovado	
CCBN052 Quimica Analitica	60	8,38	Aprovado	
CCET225 Topografia VI	60	8,70	Aprovado	
1° Semestre de 2016				
CCET244 Construções Rurais I	60	6,68	Aprovado	
CCBN350 Ecologia Florestal	60	8,22	Aprovado	
CCBN305 Entomologia Florestal Básica	60	8,15	Aprovado	
CCBN324 Experimentação Aplicada às Ciências Agrárias	60	8,63	Aprovado	
CCBN058 Fisiologia Vegetal	60	*****	Aprov. Est	*
CCBN290 Genética	60	6,39	Aprovado	
CCBN310 Gênese, Morfologia e Física do Solo	75	5,96	Aprovado	
2° Semestre de 2016				
CCBN315 Anatomia da Madeira	45	9,28	Aprovado	
CCBN338 Dendrologia	60	9,60	Aprovado	
CCBN330 Entomologia Florestal Aplicada	60	5,55	Aprovado	
CCBN842 Extensão Florestal	45	9,00	Aprovado	
CCBN419 Iniciação Cientifica	45	8,00	Aprovado	
CCBN323 Máquinas e Mecanização Florestal	60	8,19	Aprovado	
CCBN062 Patologia Florestal II	75	5,94	Aprovado	
1° Semestre de 2017				
CCBN072 Biometria Florestal	60	10,00	Aprovado	
CCBN066 Classificação, Conservação e Uso do Solo	60	5,12	Aprovado	
CCBN071 Incêndios Florestais	45	9,15	Aprovado	
CCBN366 Manejo de Fauna Silvestre	60	8,25	Aprovado	
CCBN065 Melhoramento Florestal II	60	8,02	Aprovado	

escaneado

MINISTÉRIO DA EDUCAÇÃO
Universidade Federal do Acre
Núcleo de Registro e Controle Acadêmico

HISTÓRICO ESCOLAR

Nome: 20150330040 - Alice Neri da Silva Sousa
Curso: Bacharelado em Engenharia Florestal

Disciplinas	Horas Aula	Nt/Conc	Situação	Dispensa
CCBN863 Propriedades da Madeira	45	8,20	Aprovado	
CCBN345 Química e Fertilidade do Solo	75	8,30	Aprovado	
CCBN415 Sementes Florestais	60	5,60	Aprovado	
2° Semestre de 2017				
CCBN843 Biotecnologia Florestal II	60	7,98	Aprovado	
CCET230 Construções em Madeira	60	9,15	Aprovado	
CCBN839 Economia Florestal	60	6,75	Aprovado	
CCBN363 Inventário Florestal	60	8,00	Aprovado	
CCBN838 Processamento Mecânico da Madeira	45	9,00	Aprovado	
CCBN840 Tecnologia de Produtos Florestais Não Madereiros	45	8,70	Aprovado	
CCBN837 Viveiros Florestais	45	8,00	Aprovado	
1° Semestre de 2018				
CCBN846 Comercialização de Produtos e Serviços Florestais	60	*****	Aprov. Est	*
CCBN847 Geoprocessamento	60	8,00	Aprovado	
CCBN849 Manejo de Florestas Nativas	60	*****	Aprov. Est	*
CCBN848 Manejo de Unidades de Conservação II	45	*****	Aprov. Est	*
CCBN404 Planejamento e Administração Florestal	45	7,65	Aprovado	
CCBN844 Recursos Energéticos Florestais	45	7,35	Aprovado	
CCBN418 Secagem e Preservação de Madeira	45	7,88	Aprovado	
CCBN845 Sistemas Silviculturais	45	9,18	Aprovado	
2° Semestre de 2018				
CCBN856 Avaliação de Impactos Ambientais II	45	*****	Aprov. Est	*
CCBN383 Exploração e Transporte Florestal	60	8,00	Aprovado	
CCBN436 Manejo de Bacias Hidrográficas	60	8,00	Aprovado	
CCBN850 Manejo de Florestas Plantadas	60	8,18	Aprovado	
CCBN854 Política e Legislação Florestal	60	9,00	Aprovado	
CCBN851 Sistemas Agroflorestais	45	8,00	Aprovado	
1° Semestre de 2019				
CCBN853 Marketing de Produtos e Serviços Florestais	30	8,75	Aprovado	
CCBN852 Recuperação de Áreas Degradadas	45	8,00	Aprovado	
2° Semestre de 2019				
CCBN427 Estágio Curricular Supervisionado	180	9,00	Aprovado	
CCBN855 Monografia de Conclusão de Curso	90	10,00	Aprovado	
CCBN456 Perícia Ambiental	45	*****	Aprov. Est	*

Disciplinas Optativas

2° Semestre de 2017				
CCBN884 Tecnologia de Celulose e Papel	45	10,00	Aprovado	
2° Semestre de 2018				
CCBN885 Materiais Reconstituídos de Madeira	45	8,45	Aprovado	

escampêlo

MINISTÉRIO DA EDUCAÇÃO
Universidade Federal do Acre
Núcleo de Registro e Controle Acadêmico

HISTÓRICO ESCOLAR

Nome: 20150330040 - Alice Neri da Silva Sousa
Curso: Bacharelado em Engenharia Florestal

Disciplinas	Horas Aula	Nt/Conc	Situação	Dispensa
Disciplinas de Outros Cursos				
2° Semestre de 2017				
CCBN877 Pericia Ambiental	45	10,00	Aprovado	
Disciplinas utilizadas para Aproveitamento				
1° Semestre de 2016				
CCBN318 Fisiologia Vegetal	75	7,80	Aprovado	
1° Semestre de 2018				
CCBN421 Comercialização de Produtos Florestais	60	7,10	Aprovado	
CCBN392 Manejo de Unidades de Conservação e Áreas Protegidas	60	9,00	Aprovado	
CCBN401 Manejo Sustentável de Florestas Tropicias	75	8,25	Aprovado	
2° Semestre de 2018				
CCBN386 Avaliação de Impactos Ambientais	60	8,65	Aprovado	

Legenda das Situações

Aprov. Est - Aprovado por aproveitamento
Aprovado - Aprovado

Coeficiente do Aluno: 08,0900	Crédito Vencido / Exigido	Carga Horária Vencida / Exigida
Atividades Complementares	0/0	200/200
Disciplinas Obrigatórias	174/174	3660/3660
Disciplinas Optativas	4/4	90/90
Total Créditos/Carga Horária:	178 178	3950 3950

Local Dispensa 7 - Bacharelado em Engenharia Florestal

Situação do Aluno Formado

*** A presente disciplina foi aproveitada em decorrência de adaptação curricular.**

Jeconias Galvão de Freitas Lima
Coord. de Registro e Controle
Acadêmico/NURCA/UFAC
Portaria nº 2.303/2012

Eliana da Silva Campêlo
Diretora do Núcleo de Registro e
Controle Acadêmico
Portaria nº 1981/2012

30th Chemistry Meeting of the Southern Region

Governance and Sustainability: The Contributions of Chemistry to the new agendas

CERTIFICATE

We certify that the work **Evaluation of the Effect of Electrochemical Activations on Chemically Modified Carbon Paste Electrodes with Biochar for the Determination of Ibuprofen by Voltammetry**, authored by Gabriel Moraes Marin, Enedina Sena Alves de Lima, Tito Roberto Sant'Anna Cadaval Junior, Alice Neri da Silva Sousa, Prof. Luiz Pinto and Daiane Dias, was submitted to the **30th Chemistry Meeting of the Southern Region - SBQ South**, held from 11/20/2024 to 11/22/2024, in Blumenau-Santa Catarina.

Prof. Dr. Lizandra Maria Zimmermann
General Coordinator of the Event

Blumenau, Nove

Organizer: Graduate Program in Chemistry | FURB Regional University of Blumenau | SBQ - SC

Support: fapesc Foundation for Research and Innovation Support of the State of Santa Catarina | CFQ/CRQS System

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: October 1, 2025.

30º Encontro de Química da Região Sul

Governança e Sustentabilidade: As contribuições da Química com as novas agendas

CERTIFICADO

Certificamos que o trabalho **Avaliação do efeito das ativações eletroquímicas em eletrodos de pasta quimicamente modificados com biochar na determinação de ibuprofeno por voltametria** de autoria de Gabriel Moraes Marin, Enedina Sena Alves de Lima, Tito Roberto Sant'Anna Cadaval Junior, Alice Neri da Silva Sousa, Prof. Luiz Pinto e Daiane Dias, foi submetido no **30º Encontro de Química da Região Sul - SBQ Sul**, realizado de 20 a 22/11/2024, em Blumenau-SC.

464

Profa. Dra. Lizandra Maria Zimmermann
Coordenadora Geral do Evento

Blumenau, novembro de 2024.

Realização: Programa de Pós-Graduação em Química – FURB – SBQ - SC

Apoio: fapesc – Sistema CFQ/CRQs

30th Chemistry Meeting of the Southern Region

Governance and Sustainability: The Contributions of Chemistry to the new agendas

CERTIFICATE

We certify that the work **Mega Porous Structure of Chitosan with Carbon Nanotubes for Determining the Effect of pH on Drug Adsorption in an Aqueous System**, authored by Keli Arruda da Silva, Alice Neri da Silva Sousa, Debora Pez Jaeschke, Nauro Silveira Junior, Tito Roberto Sant'Anna Cadaval Junior and Prof. Luiz Pinto, was submitted to the **30th Chemistry Meeting of the Southern Region - SBQ South**, held from 11/20/2024 to 11/22/2024, in Blumenau-Santa Catarina.

Prof. Dr. Lizandra Maria Zimmermann
General Coordinator of the Event

Blumenau, Nov

Organizer: Graduate Program in Chemistry | FURB Regional University of Blumenau | SBQ - SC

Support: fapesc Foundation for Research and Innovation Support of the State of Santa Catarina | CFQ/CRQS System

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.

Date: October 1, 2025.

30º Encontro de Química da Região Sul

Governança e Sustentabilidade: As contribuições da Química com as novas agendas

CERTIFICADO

Certificamos que o trabalho **Estrutura Mega Porosa de Quitosana com Nanotubos de Carbono para Determinação do Efeito do pH na Adsorção de Fármaco em Sistema Aquoso** de autoria de Keli Arruda da Silva, Alice Neri da Silva Sousa, Debora Pez Jaeschke, Nauro Silveira Junior, Tito Roberto Sant'Anna Cadaval Junior e Prof. Luiz Pinto, foi submetido no **30º Encontro de Química da Região Sul - SBQ Sul**, realizado de 20 a 22/11/2024, em Blumenau-SC.

467

Profa. Dra. Lizandra Maria Zimmermann
Coordenadora Geral do Evento

Blumenau, novembro de 2024.

Realização: Programa de Pós-Graduação em Química – FURB – SBQ - SC

Apoio: fapesc – Sistema CFQ/CRQs

Exhibit I - Personal Documents

NOTARY OFFICE AND CIVIL REGISTRY OF NATURAL PERSONS
CASSINO
RIO GRANDE/RS
----//Signature//----
Notary and Registrar
Valdecir Rodrigues Vieira
Notary and Registrar

FEDERATIVE REPUBLIC OF BRAZIL
CIVIL REGISTRY OF NATURAL PERSONS

BIRTH CERTIFICATE

NAME

ALICE NERI DA SILVA SOUZA

CPF

022.358.792-33

REGISTRATION

096297 01 55 1996 1 00110 222 0071666 06

DATE OF BIRTH (IN FULL)	DAY	MONTH	YEAR
AUGUST EIGHTH, NINETEEN NINETY-SIX	**08**	**08**	**1996**

TIME OF BIRTH	CITY OF BIRTH
03:00 PM	**JI-PARANÁ - RONDÔNIA**

CITY OF REGISTRATION AND FEDERATION UNIT	PLACE, CITY OF BIRTH AND FEDERATION UNIT	SEX
JI-PARANÁ - RONDÔNIA	**SANTA MONICA HOSPITAL AND MATERNITY, JI-PARANÁ - RONDÔNIA**	**FEMALE**

FILIATION

CARLOS CLAY OLIVEIRA SOUSA AND JEANE NERI DA SILVA SOUSA, HE WAS BORN IN ALCOÇABA/BAHIA, SHE WAS BORN IN PORTO VELHO/RONDÔNIA

GRANDPARENTS

DEODETE CORDEIRO DE SOUSA, ANITA OLIVEIRA SOUSA, JUVENAL FERREIRA DA SILVA AND ALBERTINA NERI DA SILVA

TWIN	NAME AND REGISTRATION OF THE TWINS
NO	

DATE OF REGISTRATION (IN FULL)	LIVE BIRTH REGISTRATION NUMBER
AUGUST THIRTEENTH, NINETEEN NINETY-SIX	**NO RECORD**

ANNOTATIONS / NOTES TO BE ADDED

IN THE MARGIN OF THE RECORD, THE INCLUSION OF THE CPF IS NOTED. 2ND COPY. FEES: R$22.74, FUJU: R$4.55, SEAL: R$1.44, FUNDEP: R$0.91, FUNDIMPER: R$1.71, FUMORPGE: R$0.68, TOTAL = R$32.03.

REGISTRATION NOTES

NO RECORD.

I certify that, on May 31, 2024, this certificate was issued by the Civil Registry Information Center, and the authenticity of its digital signature, according to the ICP-Brasil standard, was verified by me.
Certificate drawn up by JOSIANE BASILIO NERES - CLERK of Natural Persons of Ji-Paraná - 1st Subdistrict, who electronically signed it on May 27, 2024, under the terms of Provision No. 46/2015 of the National Justice Council.

Civil Registry Office of Natural Persons
Ji-Paraná - 1st Subdistrict - Rondônia
Luzia Regly Muniz Corilaço - Registrar
Rua Pedro Teixeira, 1417 - Centro - ZIP Code: 76900-062
Email: primeiro.oficio.jipa@outlook.com
Phone: (69) 34215588

The content of this certificate is true. I certify.

----//signature//----

Rio Grande - Cassino District
Nathalia Xavier Vignoli - Authorized Clerk
Amount received for the electronic certificate: R$32.03
Amount received for the materialization: R$51.40

Judiciary - State of Rondônia
Digital Inspection Seal
E4AAJ11527-25D45
Check the validity at:
http://www.tjro.jus.br/consultaselo/

Notarial and Registral Digital Inspection Seal
(State Law No. 12,692/2006)
Digital Seal: **0489.04.2300003.04649**
The validity of the digital seals can be verified
on the website of the Court of Justice: www.tjrs.jus.br

ARPENBRASIL AA 032000617 BRP
NATIONAL ASSOCIATION OF NATURAL PERSONS REGISTRARS

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.


_____ Date: September 30, 2025.

TABELIONATO DE NOTAS E RCPN DE CASSINO RIO GRANDE/RS Tabelião e Registrador Me. Valdecir Rodrigues Vieira Tabelião e Registrador

REPÚBLICA FEDERATIVA DO BRASIL

REGISTRO CIVIL DAS PESSOAS NATURAIS

CERTIDÃO DE NASCIMENTO

NOME

ALICE NERI DA SILVA SOUSA

CPF: 022.358.792-33

MATRÍCULA

096297 01 55 1996 1 00110 222 0071666 06

DATA DE NASCIMENTO (POR EXTENSO): OITO DE AGOSTO DE UM MIL E NOVECENTOS E NOVENTA E SEIS

DIA: 08 | MÊS: 08 | ANO: 1996

HORA DE NASCIMENTO: 15H 00MIN

NATURALIDADE: JI-PARANÁ-RO

MUNICÍPIO DE REGISTRO E UNIDADE DA FEDERAÇÃO: JI-PARANÁ-RO

LOCAL. MUNICÍPIO DE NASCIMENTO E UF: HOSPITAL E MATERNIDADE SANTA MÔNICA, JI-PARANÁ-RO

SEXO: FEMININO

FILIAÇÃO: CARLOS CLAY OLIVEIRA SOUSA E JEANE NERI DA SILVA SOUSA, ELE NATURAL DE ALCOBAÇA/BA, ELA NATURAL DE PORTO VELHO/RO.

AVÓS: DEODETE CORDEIRO DE SOUSA, ANITA OLIVEIRA SOUSA, JUVENAL FERREIRA DA SILVA E ALBERTINA NERI DA SILVA

GÊMEOS: NÃO

NOME E MATRÍCULA DOS GÊMEOS:

DATA DO REGISTRO (POR EXTENSO): TREZE DE AGOSTO DE UM MIL E NOVECENTOS E NOVENTA E SEIS

NÚMERO DA DNV/DECLARAÇÃO DE NASCIDO VIVO: SEM INFORMAÇÃO

AVERBAÇÕES / ANOTAÇÕES À ACRESCER: À MARGEM DO TERMO CONSTA A INCLUSÃO DO CPF. 2ª VIA. EMOLUMENTOS: R$22,74, FUJU: R$4,55, SELO: R$1,44, FUNDEP: R$0,91, FUNDIMPER: R$1,71, FUMORPGE: R$0,68, TOTAL = R$32,03.

ANOTAÇÕES DE CADASTRO: SEM INFORMAÇÕES.

Certifico que, em data de 31 de Maio de 2024, foi materializada esta certidão enviada pela Central de Informações do Registro Civil, sendo a autenticidade de sua assinatura digital padrão ICP-Brasil por mim conferida.

Certidão lavrada por JOSIANE BASILIO NERES - ESCREVENTE do Registro Civil das Pessoas Naturais de Ji-Paraná - 1º Subdistrito , o(a) qual assinou eletronicamente aos 27 de Maio de 2024, nos termos do Provimento nº 46/2015 do Conselho Nacional de Justiça.

Oficial de Registro Civil das Pessoas Naturais
Ji-Paraná - 1º Subdistrito - RO
Luzia Regly Muniz Corilaço - Oficial
Rua Pedro Teixeira, 1417 - Centro - CEP: 76900-062
E-mail: primeiro.oficio.jipa@outlook.com
Tel: (69) 34215588

O Conteúdo da Certidão é verdadeiro. Dou Fé,

Rio Grande - Distrito de Cassino
Nathalia Xavier Vignoli - Escrevente Autorizada
Valor recebido pela certidão eletrônica: R$ 32,03
Valor recebido pela materialização: R$ 51,40

Poder Judiciário do Estado de Rondônia
Selo Digital de Fiscalização
E4AAJ11527-25D45
Confira validade em
http://www.tjro.jus.br/consultaselo/

Selo Digital de Fiscalização Notarial e Registral
(Lei Estadual nº 12.692/2006)
Selo Digital: **0489.04.2300003.04649**
A validade dos selos digitais poderá ser consultada no site do Tribunal de Justiça: www.tjrs.jus.br

ARPEN BRASIL AA 032000617 BRP
ASSOCIAÇÃO NACIONAL DOS REGISTRADORES DE PESSOAS NATURAIS

Assinatura do titular / *Signature du titulaire* / *Bearer's signature* / *Firma del titular*

REPÚBLICA FEDERATIVA DO BRASIL

GK672273

Este passaporte deve ser assinado pelo titular, salvo em caso de incapacidade.

Ce passeport doit être signé par le titulaire, sauf en cas d'incapacité.

This passport must be signed, except where the bearer is unable to do so.

Este pasaporte debe ser firmado por el titular, salvo en caso de incapacidad.

PASSAPORTE
PASSPORT

REPÚBLICA FEDERATIVA DO BRASIL

TIPO / *TYPE* **P**

PAÍS EMISSOR / *ISSUING COUNTRY* **BRA**

PASSAPORTE Nº / *PASSPORT No.* **GK672273**

SOBRENOME / *SURNAME*
DA SILVA SOUSA

NOME / *GIVEN NAMES*
ALICE NERI

NACIONALIDADE / *NATIONALITY*
BRASILEIRO(A)

DATA DO NASCIMENTO / *DATE OF BIRTH*
08 AGO/AUG 1996

CPF / *PERSONAL NUMBER*
022358792-33

SEXO / *SEX*
F

NATURALIDADE / *PLACE OF BIRTH*
JI-PARANÁ/RO

FILIAÇÃO / *FILIATION*
CARLOS CLAY OLIVEIRA SOUSA

JEANE NERI DA SILVA SOUSA

DATA DE EXPEDIÇÃO / *DATE OF ISSUE*
09 JAN/JAN 2025

AUTORIDADE / *AUTHORITY*
DPF/RGE/RS

VALIDO ATÉ / *DATE OF EXPIRY*
08 JAN/JAN 2035

P<BRADA<SILVA<SOUSA<<ALICE<NERI<<<<<<<<<<<<<

GK672273<3BRA9608085F3501081022358792 33<<<06

FEDERATIVE REPUBLIC OF BRAZIL

63.611.099/0001-88
CIVIL REGISTRY OFFICE
OF NATURAL PERSONS
Avenida Marechal Rondon, No. 537
(Centro) - ZIP Code 78934
JI-PARANÁ - RONDÔNIA

STATE OF RONDÔNIA
JUDICIAL DISTRICT OF JI-PARANÁ

CITY OF JI-PARANÁ
HEAD DISTRICT

REGISTRY OFFICE COMENDADOR HERMENEGILDO

Hermenegildo Trindade Fernandes
REGISTRAR

BIRTH CERTIFICATE

I CERTIFY that on page 182 of book A -103, under Order No. 67,385 the birth record of "/STEFANO BONIFACTO RANZULLA/" was drawn up. male, born on the ninth (09) of April (04), Nineteen Ninety-four (1994). - at 11:59 AM at the Municipal Maternity Hospital, in this city.

son of STEFANO RANZULLA, born in Cáceres - Mato Grosso.

and Ms. REGINA MARIA BONIFACIO, born in Nova Aurora - Paraná.

Paternal grandparents are "ANEZIO RANZULLA"

and Ms. "LEDA DA SILVA RANZULLA"

and maternal grandparents "SEBASTIÃO JOSÉ BONIFACIO"

and Ms. "MARIA LUIZA DA SILVA"

The record was drawn up on October eleventh (11), 1994 the declarant being the registrant's own father.

and the witnesses were those listed in the record.

.x. .x.

Notes: The registration was made under the terms of Article 46 of Law 6,015 of 12/31/1973. He is the couple's first child in order of birth. Mother's age: 20 years.

.*.

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.*.

.*.

The above is true and I certify.

Ji-Paraná, October (10) 11, 199 4

FEES CHARGED: R$ 15.15
(Art. 14 - Law No. 6,015 of 12/31/73)

EST: Cr$ 0.75

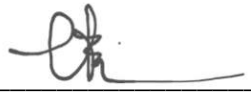
TUJU: Cr$ 0.75

JUDICIAL DISTRICT OF JI-PARANÁ – RONDÔNIA
HERMENEGILDO TRINDADE FERNANDES
Civil Registry Registrar
CPF 006.597.292-15

-----//Signature//----

REGISTRAR

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.


_____ Date: October 1, 2025.

REPÚBLICA FEDERATIVA DO BRASIL

63.611.099/0001-88
CARTÓRIO DE REGISTRO CIVIL
DAS PESSOAS NATURAIS
Av. Marechal [illegible], Nº 537
(centro) - CEP [illegible]
JI-PARANÁ — RO

ESTADO DE RONDÔNIA
COMARCA DE JI-PARANÁ

CIDADE DE JI-PARANÁ
DISTRITO DA SEDE

CARTÓRIO COMENDADOR HERMENEGILDO

Hermenegildo Trindade Fernandes
OFICIAL

CERTIDÃO DE NASCIMENTO

CERTIFICO que, às fls. 182 do Livro A - 103, sob Nº de Ordem 67.385 foi lavrado o assento do nascimento de "/STEFANO BONIFACIO RANZULLA/"

do sexo masculino, nascid o no dia nove (09) de Abril (04) de mil novecentos e noventa e quatro (1.994).

- às 11:59 horas, em Maternidade Municipal, nesta cidade.

filh o de STEFANO RANZULLA, nat. de Cáceres - MT.

e de Dona REGINA MARIA BONIFACIO, nat. de Nova Aurora - PR.

Sendo avós paternos "ANEZIO RANZULLA"

e Dona "LEDA DA SILVA RANZULLA"

e avós maternos "SEBASTIÃO JOSÉ BONIFACIO"

e Dona "MARIA LUIZA DA SILVA"

O assento foi lavrado em 11 de Outubro (10) de 1.994 tendo sido declarante O próprio pai do registrando.

e serviram de testemunhas As constantes no têrmo.

.x. .x.

Observações: Registro feito nos têrmos do Art. 46 da Lei 6.015 de 31 12/73. É o 1º filho do casal na ordem de filiação. Idade da mãe: 20 anos.

.*.
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.*.
.*.

O referido é verdade e dou fé.

Ji-Paraná, 11 de OUTUBRO (10) de 1994.

CUSTAS COBRADAS ~~Cr$~~ R$ 15,15
(art. 14 - Lei Nº 6015 de 31/12/73)

EST. Cr$ 0,75

TUJU Cr$ 0,75

COMARCA DE JI-PARANÁ - RO
HERMENEGILDO TRINDADE FERNANDES
OFICIAL
Registro Civil
CPF. 005.397.292-15

FEDERATIVE REPUBLIC OF BRAZIL
CIVIL REGISTRY OF NATURAL PERSONS

MARRIAGE CERTIFICATE

Current name of the spouses	CPF
STEFANO BONIFACIO RANZULLA	017.654.942-06
ALICE NERI DA SILVA SOUZA	022.358.792-33

Registration
098798 01 55 2025 2 00050 124 0014107 47
Book: B-50 - Page: 124 - Entry: 14107

1st Spouse

	Day	Month	Year
Stefano Bonifacio Ranzulla	09	04	1994

Nationality	Marital Status	City of Birth	State
Brazilian	Single	Ji-Paraná	Rondônia

Filiation
Stefano Ranzulla; Regina Maria Bonifacio

Name adopted
X.X.X.X.X.X.X.X.X.X.X.X.X.X.X.

2nd Spouse

	Day	Month	Year
Alice Neri da Silva Souza	08	08	1996

Nationality	Marital Status	City of Birth	State
Brazilian	Single	Ji-Paraná	Rondônia

Filiation
Carlos Clay Oliveira Souza; Jeane Neri da Silva Souza

Name adopted
X.X.X.X.X.X.X.X.X.X.X.X.X.X.X.

Date of the ceremony or, if applicable, date of conversion of the stable union, date of registration	Day	Month	Year
July Twelfth, Two Thousand Twenty-five	12	07	2025

Property regime
Partial Community of Property

Date of marriage registration	Day	Month	Year
July Twelfth, Two Thousand Twenty-five	12	07	2025

Notes/Annotations
No record.

CNS No. 098798
1st Civil Registry Office of Natural Persons
Registrar: Adriana Azevedo do Amaral
Judicial District: Rio Grande
Rio Grande - Rio Grande do Sul
Rua Carlos Gomes, 566 - Centro Neighborhood
Phone: (53) 3232-9663
Email: c.amaralrg@gmail.com

The content of this certificate is true. I certify.
Rio Grande, August 25, 2025.

----//signature//----

Tauane Emanuele Duarte Dias de Mesquita
Authorized Clerk

Digital Inspection Seal - Notarial and Registral (State Law No. 12,692/2006): **0486.00.2500017.00109**
Certificate: R$ 39.90 - Electronic processing: R$ 6.90 - Seals: R$ 7.30 - Note No. 114344
The validity of the digital seals can be verified on the Court of Justice website: www.tjrs.jus.br – Issuance: T.E.D.D.d.M.

The consultation will be available within 24 hours on the website of the Court of Justice of Rio Grande do Sul:
http://go.tjrs.br/selodigital/consulta
Authentication key for consultation
098798 55 2025 00403443 82

CIVIL REGISTRY OF NATURAL PERSONS -1ST ZONE
REGISTRY OF DEEDS AND DOCUMENTS
CIVIL REGISTRY OF LEGAL ENTITIES
ADRIANA AZEVEDO DO AMARAL
Registrar
RUA CARLOS GOMES, 566, RIO GRANDE/RS

IA 002129782

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.


_____ Date: September 30, 2025.

REPÚBLICA FEDERATIVA DO BRASIL
REGISTRO CIVIL DAS PESSOAS NATURAIS

CERTIDÃO DE CASAMENTO

Nome atual dos cônjuges	Número do CPF
STEFANO BONIFACIO RANZULLA	017.654.942-06
ALICE NERI DA SILVA SOUSA	022.358.792-33

Matrícula
098798 01 55 2025 2 00050 124 0014107 47
Livro:B-50 - Folha:124 - Termo:14107

1º Cônjuge

	Dia	Mês	Ano
Stefano Bonifacio Ranzulla	09	04	1994

Nacionalidade	Estado civil	Município da naturalidade	UF
Brasileira	Solteiro	Ji-Paraná	RO

Genitor(es)
Stefano Ranzulla; Regina Maria Bonifacio

Nome que passou a utilizar
x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.

2º Cônjuge

	Dia	Mês	Ano
Alice Neri da Silva Sousa	08	08	1996

Nacionalidade	Estado civil	Município da naturalidade	UF
Brasileira	Solteira	Ji-Paraná	RO

Genitor(es)
Carlos Clay Oliveira Sousa; Jeane Neri da Silva Sousa

Nome que passou a utilizar
x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.x.

Data da celebração ou, se for o caso, de conversão da união estável, data do registro	Dia	Mês	Ano
Doze de julho de dois mil e vinte e cinco	12	07	2025

Regime de bens
Comunhão Parcial de Bens

Data de registro do casamento	Dia	Mês	Ano
Doze de julho de dois mil e vinte e cinco	12	07	2025

Anotações/Averbações
Nada consta.

CNS nº 098798
1° Ofício do Registro Civil das Pessoas Naturais
Titular do Ofício: Adriana Azevedo do Amaral
Comarca: Rio Grande
Rio Grande - RS
Rua Carlos Gomes, 566 - Bairro Centro
Fone: (53) 3232-9663
E-Mail: c.amaralrg@gmail.com

O conteúdo da certidão é verdadeiro. Dou fé.
Rio Grande, 25 de agosto de 2025.

Tauane Emanuele Duarte Dias de Mesquita
Escrevente Autorizada

Selo Digital de Fiscalização Notarial e Registral (Lei Estadual n.12.692/2006): **0486.00.2500017.00109**

Certidão: R$ 39,90 - Processamento eletrônico: R$ 6,90 - Selos: R$ 7,30 - Nota nº 114344

A validade dos selos digitais poderá ser consultada no site do Tribunal de Justiça: www.tjrs.jus.br - Emissão: T. E. D. D. d. M.

A consulta estará disponível em até 24h no site do Tribunal de Justiça do RS
http://go.tjrs.jus.br/selodigital/consulta
Chave de autenticidade para consulta
098798 55 2025 00403443 82

REGISTRO CIVIL DAS PESSOAS NATURAIS DA 1ª ZONA
REGISTRO DE TÍTULOS E DOCUMENTOS
REGISTRO CIVIL DAS PESSOAS JURÍDICAS
ADRIANA AZEVEDO DO AMARAL
Oficial
RUA CARLOS GOMES, 566 - RIO GRANDE/RS

Indústria Gráfica Brasileira Itda

IA 002129782

FEDERATIVE REPUBLIC OF BRAZIL

63.611.099/0001-88
CIVIL REGISTRY OFFICE
OF NATURAL PERSONS
Avenida Marechal Rondon, No. 537
(Centro) - ZIP Code 78934
JI-PARANÁ - RONDÔNIA

STATE OF RONDÔNIA
JUDICIAL DISTRICT OF JI-PARANÁ

CITY OF JI-PARANÁ
HEAD DISTRICT

REGISTRY OFFICE COMENDADOR HERMENEGILDO

Hermenegildo Trindade Fernandes
REGISTRAR

BIRTH CERTIFICATE

I CERTIFY that on page 182 of book A -103, under Order No. 67,385 the birth record of "/STEFANO BONIFACTO RANZULLA/" was drawn up. male, born on the ninth (09) of April (04), Nineteen Ninety-four (1994). - at 11:59 AM at the Municipal Maternity Hospital, in this city.

son of STEFANO RANZULLA, born in Cáceres - Mato Grosso.

and Ms. REGINA MARIA BONIFACIO, born in Nova Aurora - Paraná.

Paternal grandparents are "ANEZIO RANZULLA"

and Ms. "LEDA DA SILVA RANZULLA"

and maternal grandparents "SEBASTIÃO JOSÉ BONIFACIO"

and Ms. "MARIA LUIZA DA SILVA"

The record was drawn up on October eleventh (11), 1994 the declarant being the registrant's own father.

and the witnesses were those listed in the record.

.x. .x.

Notes: The registration was made under the terms of Article 46 of Law 6,015 of 12/31/1973. He is the couple's first child in order of birth. Mother's age: 20 years.

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.*.

.*.

The above is true and I certify.

Ji-Paraná, October (10) 11, 199 4

FEES CHARGED: R$ 15.15
(Art. 14 - Law No. 6,015 of 12/31/73)

EST: Cr$ 0.75

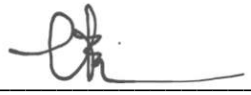
TUJU: Cr$ 0.75

JUDICIAL DISTRICT OF JI-PARANÁ – RONDÔNIA
HERMENEGILDO TRINDADE FERNANDES
Civil Registry Registrar
CPF 006.597.292-15

-----//Signature//----

REGISTRAR

I, Carolina Favero da Silva, telephone number 415 425-2508, mailing address P.O. Box 90487, San Diego, CA 92169, certify that the professional translation of this document from Portuguese to English has been performed by myself, a qualified translator fluent in both languages, and that the following is an accurate and complete translation of the document.


_____ Date: October 1, 2025.

REPÚBLICA FEDERATIVA DO BRASIL

63.611.099/0001-88
CARTÓRIO DE REGISTRO CIVIL
DAS PESSOAS NATURAIS
Av. Marechal [illegible], Nº 537
(centro) - CEP [illegible]
JI-PARANÁ — RO

ESTADO DE RONDÔNIA
COMARCA DE JI-PARANÁ

CIDADE DE JI-PARANÁ
DISTRITO DA SEDE

CARTÓRIO COMENDADOR HERMENEGILDO

Hermenegildo Trindade Fernandes
OFICIAL

CERTIDÃO DE NASCIMENTO

CERTIFICO que, às fls. 182 do Livro A - 103, sob Nº de Ordem 67.385 foi lavrado o assento do nascimento de "/STEFANO BONIFACIO RANZULLA/"

do sexo masculino, nascid o no dia nove (09) de Abril (04) de mil novecentos e noventa e quatro (1.994).

- às 11:59 horas, em Maternidade Municipal, nesta cidade.

filh o de STEFANO RANZULLA, nat. de Cáceres - MT.

e de Dona REGINA MARIA BONIFACIO, nat. de Nova Aurora - PR.

Sendo avós paternos "ANEZIO RANZULLA"

e Dona "LEDA DA SILVA RANZULLA"

e avós maternos "SEBASTIÃO JOSÉ BONIFACIO"

e Dona "MARIA LUIZA DA SILVA"

O assento foi lavrado em 11 de Outubro (10) de 1.994 tendo sido declarante O próprio pai do registrando.

e serviram de testemunhas As constantes no têrmo.

.x. .x.

Observações: Registro feito nos têrmos do Art. 46 da Lei 6.015 de 31 12/73. É o 1º filho do casal na ordem de filiação. Idade da mãe: 20 anos.

.*.
*.
.*.
.*.

O referido é verdade e dou fé.

Ji-Paraná, 11 de OUTUBRO (10) de 1994.

CUSTAS COBRADAS Cr$ R$ 15,15
(art. 14 - Lei Nº 6015 de 31/12/73)

EST. Cr$ 0,75

TUJU Cr$ 0,75

COMARCA DE JI-PARANÁ - RO
HERMENEGILDO TRINDADE FERNANDES
OFICIAL
Registro Civil
CPF. 005.397.292-15

Assinatura do titular / *Signature du titulaire /*
Bearer's signature / Firma del titular

GK6722722

Este passaporte deve ser assinado
pelo titular, salvo em caso de incapacidade.

Ce passeport doit être signé
par le titulaire, sauf en cas d'incapacité.

This passport must be signed,
except where the bearer is unable to do so.

Este pasaporte debe ser firmado
por el titular, salvo en caso de incapacidad.

REPÚBLICA FEDERATIVA DO BRASIL

PASSAPORTE
PASSPORT

REPÚBLICA FEDERATIVA DO BRASIL

TIPO / *TYPE*
P

PAÍS EMISSOR / *ISSUING COUNTRY*
BRA

SOBRENOME / *SURNAME*
BONIFACIO RANZULLA

NOME / *GIVEN NAMES*
STEFANO

NACIONALIDADE / *NATIONALITY*
BRASILEIRO(A)

DATA DO NASCIMENTO / *DATE OF BIRTH*
09 ABR/APR 1994

CPF / *PERSONAL NUMBER*
017654942-06

SEXO / *SEX*
M

NATURALIDADE / *PLACE OF BIRTH*
JI-PARANÁ/RO

FILIAÇÃO / *FILIATION*
STEFANO RANZULLA

REGINA MARIA BONIFACIO

DATA DE EXPEDIÇÃO / *DATE OF ISSUE*
09 JAN/JAN 2025

VÁLIDO ATÉ / *DATE OF EXPIRY*
08 JAN/JAN 2035

P<BRABONIFACIO<RANZULLA<<STEFANO<<<<<<<<<<<<

GK672272<0BRA9404092M3501081017654942O6<<<68


VISTOS / VISAS
REPÚBLICA FEDERATIVA DO BRASIL
ADMITTED
NYC
AUG 29 2025
B2
Until
28 Feb 2026
VISA
UNITED STATES OF AMERICA
Issuing Post Name
PORTO ALEGRE
Control Number
20250980010005
Surname
BONIFACIO RANZULLA
Given Name
STEFANO
Visa Type /Class
R B1/B2
Passport Number
GK672272
Sex
M
Birth Date
09APR1994
Nationality
BRZL
Entries
M
Issue Date
14APR2025
Expiration Date
07APR2035
Annotation
V3345379
VNUSABONIFACIO<RANZULLA<<STEFANO<<<<<<<<<<<<
GK672272<OBRA9404092M3504071B3PTAOBLML840214

For: **STEFANO BONIFACIO RANZULLA**

U.S. Customs and Border Protection
Securing America's Borders

Most Recent I-94

Note to employers, local, state or federal agency granting benefits:
Please visit the CBP I-94/I-95 Website and click on the tab for "Get Most Recent I-94/I-95" to perform a search for the applicant to confirm that the biographic and travel information displayed on this I-94/I-95 printout matches the "Get Most Recent I-94/I-95" returned results for this applicant. Reference the CBP I-94/I-95 Website FAQs.

Admission I-94 Record Number: 699808221A4

Arrival/Issued Date: 2025 August 29

Class of Admission: B2

Admit Until Date: 2026 February 28

Details provided on the I-94 Information form:

Last/Surname: BONIFACIO RANZULLA

First (Given) Name: STEFANO

Birth Date: 1994 April 09

Document Number: GK672272

Country of Citizenship: Brazil

- Effective April 26, 2013, DHS began automating the admission process. An alien lawfully admitted or paroled into the U.S. is no longer required to be in possession of a preprinted Form I-94/I-95. A record of admission printed from the CBP website constitutes a lawful record of admission. See 8 CFR § 1.4(d).
- What to do if someone requests your admission info: If an employer, local, state or federal agency requests admission information, present your admission (I-94/I-95) number along with any additional required documents requested by that employer or agency.
- For security, close your browser after retrieving your I-94/I-95 number.

OMB No. 1651-0111
Expiration Date: 09/30/2025