Brazilian Journal of Experimental Design, Data Analysis and Inferential Statistics
BJEDIS

BJEDIS, Rio de Janeiro, Special Edition, v. 03 (1), 2024.
DOI: https://doi.org/10.55747/bjedis.v1i1.62174
ISSN: 2763-6925

Technical Notes **Received 09/11/2023. Revised 30/12/2023. Accepted 20/12/2023. Published 12/01/2024.**

Bioproducts from Waste Vegetable Oil: Perception and Engagement Study for Degreasers Based on Biocoal and Waste Coffee Grounds

Monique Kort-Kamp FIgueiredo[1], Sérgio Thode Filho[1], Raynara Kelly da Silva dos Santos[1], Maria Eduarda da Silva Carneiro[1], Samuel Bibiano da SIlva[1], and Fernando Gomes de Souza Jr[2.3*],

[1]Instituto Federal de Educação, Ciência e Tecnologia do Rio de Janeiro campus Duque de Caxias, Brazil.
[2]COPPE/UFRJ – Programa de Engenharia da Nanotecnologia. Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia Universidade Federal do Rio de Janeiro, Brazil.
[3]IMA/UFRJ – Instituto de Macromoléculas Professora Eloisa Mano, Universidade Federal do Rio de Janeiro, Brazil.

Abstract: Using waste vegetable oil for soap production represents a viable approach to prevent its detrimental release into water bodies and soil, thereby mitigating its adverse environmental effects. The artisanal soap-making process entails minimal investment and expertise, rendering it a straightforward procedure employing readily available inputs and equipment commonly found in everyday life. The principal objective of this study was to develop two bioproducts that address the environmental repercussions of improper disposal of waste vegetable oil, employing a perception and engagement survey of respondents. In conclusion, the derived products, synthesized from waste materials, effectively facilitated the removal of grease-based contaminants frequently encountered in workshops, automotive, and industrial settings, as well as in heavy cleaning applications, whether domestic or institutional.

Keywords: Degreasing**,** Waste Vegetal Oil, Bioproducts, Coffee Grounds, Artificial Intelligence, Computational Tools.

Adherence to the BJEDIS' scope: This study is grounded in applying sensitivity analysis, supported by Machine Learning, to assess the reception of bioproducts developed to ease the environmental repercussions of waste vegetable oil.

*Address correspondence to this author at the Biopolymers & Sensors Lab. / Macromolecules Institute / Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; Tel/Fax: +55-21-3938-7766; E-mail fgsj@ufrj.br

1. PRESENTATION

This study addresses the Brazilian population's extensive utilization of vegetable oils and the associated environmental challenges arising from the improper disposal of residual waste generated during oil processing. The inadequate disposal methods often result in environmental pollution, either through the release of effluents or direct soil contamination. Despite the everyday use of vegetable oils, a consensus on the optimal disposal method for waste vegetable oil has yet to be reached. Currently, the prevailing guidance for disposal suggests storing the waste oil in sealed containers, such as PET bottles, and subsequently disposing of it in household waste. However, this method raises concerns about preventing potential ruptures of containers by compactor trucks during household waste collection, which could lead to contamination of water bodies and soils. This study obtained waste vegetable oil through voluntary donations from residents across various locations within the Municipality of Duque de Caxias, Rio de Janeiro. The collected material was stored in polyethylene bottles and delivered to EcoEduc at the Federal Institute. In the processing laboratory, the donated oil underwent filtration to remove solid waste and was then stored for ten days in a 100L tank for decantation. The production of solid soap was conducted using a simple and cost-effective approach, combining one part NaOH, two parts water, and six parts waste vegetable oil. This process resulted in a uniform physical appearance, texture, pale yellow color, pleasant odor, compressive foam, and an acceptable pH level, even without additional essences or flavorings. Following the initial processing, the production of degreasers was carried out. The process involved dissolving solid soap in water and homogenizing it for 20 minutes to form a semi-solid mass. This mass served as the foundation for two biomaterials, to which residual biocoal powder and waste coffee grounds were added and homogenized for 3 minutes, resulting in a uniform appearance. Additionally, a blind test was conducted on the hands of 15 individuals to evaluate the grease-removing properties of the bioproduct. The sentiment analysis methodology in this research involved assessing participants' perceptions of a soap manufactured from recycled oil by evaluating opinions expressed in interviews.

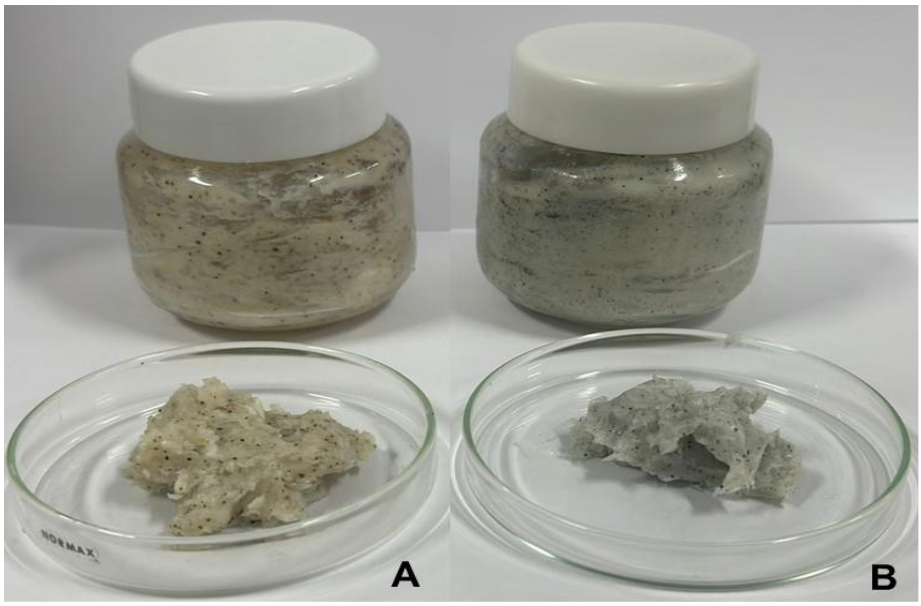

Figure 1. Mass with a semi-solid and sandy physical characteristic, abrasive with exfoliating action (A) Degreaser with waste coffee grounds; (B) Degreaser with biocoal.

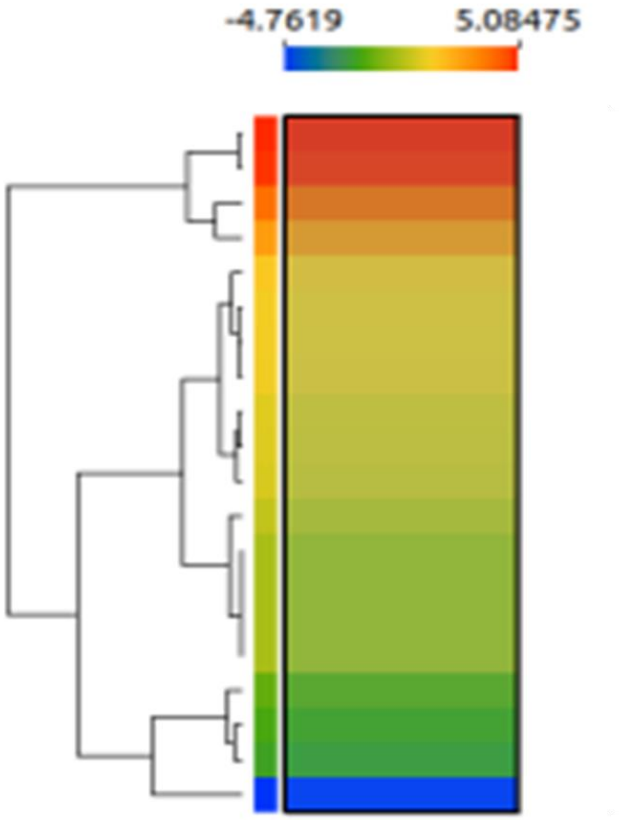

Figure 2. Machine Learning-based sensitivity analysis.

These interviews were transcribed and stored in text files (.txt), where the title variable corresponded to the participant's name, and the language used was Portuguese. The sentiment analysis employed a multilingual method suitable for Portuguese, quantifying the polarity of opinions expressed in the texts. Each text received a sentiment score on a continuous spectrum, ranging from negative to positive, with negative values indicating unfavorable sentiments, values near zero representing neutrality, and positive values reflecting favorable sentiments. So, this methodology enabled a systematic analysis of sentiments expressed in interview texts, employing natural language processing techniques to quantify and visualize the emotional valence of participants' responses. While most participants expressed positive sentiments toward the product, the sentiment analysis model revealed a variety of sentiments, including negative ones. These disparities emphasize the importance of considering words' complete context and semantics in computational sentiment assessments. This study presents a perception and engagement study focusing on developing bioproducts derived from waste vegetable oil, specifically degreasers utilizing biocoal and waste coffee grounds. The research addresses the environmental repercussions of improper waste vegetable oil disposal by utilizing readily available inputs and standard equipment. The bioproducts effectively facilitate the removal of grease-based contaminants in various settings, including workshops, automotive and industrial environments, and heavy cleaning applications in domestic and institutional contexts.

2. CONCLUSION

In conclusion, the bioproducts derived from waste materials have proven to be highly effective in removing grease-based contaminants encountered in various settings, including workshops, automotive environments, industrial facilities, and extensive cleaning applications, whether in domestic or institutional contexts. This study underscores

the practical implications of utilizing waste vegetable oil to produce bioproducts, specifically degreasers based on biocoal and waste coffee grounds. These bioproducts effectively mitigate the adverse environmental consequences associated with improper waste vegetable oil disposal. Furthermore, applying sensitivity analysis supported by machine learning to assess the reception of these bioproducts highlights the potential for integrating computational tools and artificial intelligence in the development of sustainable solutions. The research also emphasizes the viability of the artisanal soap-making process, which utilizes waste vegetable oil, as a straightforward, cost-effective method employing readily available inputs and equipment commonly found in everyday life. Looking forward, future research can explore various avenues. Further investigations may optimize the formulation and composition of bioproducts to enhance their degreasing efficiency across different applications. Evaluating these bioproducts' long-term stability and shelf life is crucial to ensure their practicality and usability over extended periods. Additionally, research efforts can focus on assessing the scalability and commercial viability of the production process, considering factors such as cost-effectiveness, raw material availability, and market demand. Another promising avenue is exploring the potential for using computational tools and artificial intelligence to develop predictive models and optimize bioproduct formulations, thereby enhancing their performance and environmental impact. Furthermore, future studies can investigate using other waste materials or by-products in conjunction with waste vegetable oil to create additional bioproducts with diverse applications and environmental benefits.

CONFLICT OF INTEREST

There is no conflict of interest.

ACKNOWLEDGMENTS

This work was supported by Agência Nacional de Petróleo (PRH 16.1), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq BRICS-STI-5440090/2022-9 and PQ-2022302508/2022-8), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES - Finance Code 001), Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ E-26/210.800/2021(Energy), E-26/211.122/2021 (COVID), E-26/210.511/2021 (ConBraPA2022), e-26/201.154/2021 (CNE) and E-S26/210.080/2023 (Thematic)), and Pró-Reitoria de Pesquisa, Pós-Graduação e Inovação (PROPPI).

REFERENCES

1. Thode Filho, S., de Sena, M. F. M., da Paixão, C. P. S., da Silveira Maranhão, F., & da Silva, E. R. BIOPRODUTOS A PARTIR DO ÓLEO VEGETAL RESIDUAL: DESENGRAXANTES BASEADOS EM RESÍDUOS DE ROCHAS E CARVÃO VEGETAL. **Revista Eletrônica em Gestão, Educação e Tecnologia Ambiental**, p. 19-23. 2014. DOI 10.5902/2236117013804.