STUDY OF THE INFLUENCE OF POLYSORBATES ON *Baccharis reticularia* DC. NANOEMULSIONS

Carvalho, A.S.[1*]; Machado, F.P.[1]; Silva, D.S.[1]; Rocha, L.M.[1]; Fernandes, C.P.[1]
[11] *Laboratório de Tecnologia de Produtos Naturais, Universidade Federal Fluminense, Niterói, 24241-000,* RJ, Brazil
**carvalhoalicia@id.uff.br*

Introduction

The plant species *Baccharis reticularia* DC. belongs to the *Asteraceae* family and is popularly known as "alecrim-da-areia", an endemic plant from Brazil. Distributed across the northeast, center-west, southeast, and south regions [1], it can be found in the Restinga de Jurubatiba National Park, located on the north coast of the state of Rio de Janeiro [2], famous for having restinga vegetation. The essential oil of this species is rich in monoterpenes and sesquiterpenes. This genus have been described in the literature to be fungicidal, antibacterial, and antiparasitic [3]. In addition, insecticidal and larvicidal action on *Aedes aegypti* [3] and repellent action on *Tribolium castaneum* [4], were also evaluated.

Oil-in-water nanoemulsions are colloidal systems consisting of nanometer-scale oil droplets dispersed in an aqueous phase. Studies with nanoemulsified essential oils indicate the potential of scale reduction to increase stability and biological activity. A proper strategy for nanoemulsification of oils is the utilization of non-ionic surfactants, such polysorbates. Due to the their amphipathic nature, they reduce the interfacial tension and facilitates the dispersion of the droplets. Respectively, the polysorbate 20 and polysorbate 80 are constituted by monolaurate and monooleate esters of polyoxyethylene sorbitan [5] Moreover, they can form a film around droplets preventing destabilization of the nanoemulsions. Therefore, this work aims to develop new nanoemulsion prototypes for encapsulating *B. reticularia* essential oil by using different polysorbates.

Material and Methods

The essential oil from aerial parts of *B. reticularia* from the Restinga de Jurubatiba National Park was extracted by hydrodistillation during 3h in a Clevenger-type apparatus. Chemical characterization was carried out by gas chromatography coupled with mass spectrometry. The nanoemulsions were obtained by the phase inversion composition method. The aqueous phase (deionized water) was dropped onto the oily phase under agitation. Nanoemulsions were were prepared with the following composition: 90 % (w/w) aqueous phase and 10% (w/w) oil phase. Regarding the oil phase, it was constituted by different proportions polysorbate 20 or polysorbate 80 and *B. reticularia* essential oil as follows: 9/1, 8/2, 7/3, 6/4 and 5/5. The presence of a bluish reflection during macroscopic analysis was considered indicative of the formation of nanostructures [6].

Results and Discussion

The following representative substances were identified in the *B. reticularia* essential oil: α-pinene, β-pinene, β-myrcene, limonene, β-caryophyllene, germacrene B, γ-cadinene, spathulenol and also the diterpene kaurene. The systems that were generated with water and polysorbate 80 were opaque at the 5/5 → 7/3 ratios. This behavior is associated to larger droplets that scatter light, indicating a predominance of droplets above the nanometric scale. However, at 9/1 and 8/2 proportions it was possible to observe transparenc and translucent aspect with bluish reflect. The last is a characteristic associated to the Tyndall Effect in nanostructured systems, such nanoemulsions. When polysorbate 20

was used, the indicative of nanodroplets was only observed in the 9/1 ratio. However, after 24h of preparation, a transition to an opaque aspect was observed. This is probably due to the Ostwald ripening (OR), a destabilization mechanism characteristic of essential oils nanoemulsions. The OR suggests that more hydrophilic components of the oil phase migrate from smaller droplets to larger droplets through the external phase. Probably the higher hydrophilic natyre of polysorbate 20 (hydrophilic lipophilic balance = 16.7) contributed to this destabilization.

Conclusion

It was possible to select polysorbate 80 as the most promising surfactant for obtaining nanoemulsions based on *B. reticularia* essential oil, opening up perspectives for the further use of sorbitan esters as surfactants in order to obtain stable nanoemulsion systems that could be characterized and bioprospected in term of biological activities of this important natural product.

Acknowledgments

I would like to thank the co-authors for helping me with this project. I also thank the Programa Bolsa Desenvolvimento Acadêmico, CNPq, FAPERJ (E-26/210.068/2021 and E-26/210.915/2021)" and CAPES (Finance Code 001) for making it possible.

Bibliographic References

[1] *Baccharis reticularia* in Ficha de Espécies do Sistema de Informação sobre a Biodiversidade Brasileira (SiBBr). [(accessed on 11 September 2023)]; Available online: https://ferramentas.sibbr.gov.br/ficha/bin/view/especie/baccharis_reticularia
[2] Parque Nacional da Restinga de Jurubatiba. [(accessed on 11 September 2023)]; Available online: https://www.icmbio.gov.br/parnajurubatiba/guia-do-visitante.html
[3] Botas, Gisele da S, et al. 'Baccharis Reticularia DC. and Limonene Nanoemulsions: Promising Larvicidal Agents for Aedes Aegypti (Diptera: Culicidae) Control.', *Molecules (Basel, Switzerland)*, 2017, 22, (11), pp. 1990.
[4] Lima, Luana A., et al. 'Nano-Emulsions of the Essential Oil of Baccharis Reticularia and Its Constituents as Eco-Friendly Repellents against Tribolium Castaneum.' *Industrial Crops and Products*, 2021, 162, pp. 113282.
[5] Kerwin, Bruce A. 'Polysorbates 20 and 80 Used in the Formulation of Protein Biotherapeutics: Structure and Degradation Pathways.' *Journal of Pharmaceutical Sciences*, vol. 97, no. 8, 2008, pp. 2924–2935.
[6] Calderó, Gabriela, et al. 'Formation of Polymeric Nano-Emulsions by a Low-Energy Method and Their Use for Nanoparticle Preparation.' *Journal of Colloid and Interface Science*, vol. 353, no. 2, 2011, pp. 406–411.