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Effect of Essential Oils from Lemongrass and Tahiti Lime Residues on the Physicochemical Properties of Chitosan-Based Biodegradable Films

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Abstract: This work aimed to evaluate the impact of adding two essential oils (EO) from lemongrass (LEO) and Tahiti lime (TLEO) on the physical, mechanical, and thermal properties of chitosan-based biodegradable films. Six film formulations were prepared: two controls with chitosan concentrations of 1% and 1.5% *v*/*w*, two formulations combining the two chitosan concentrations with 1% LEO *v*/*v*, and two formulations combining the two chitosan concentrations with 1% TLEO *v*/*v*. The films' morphological, water affinity, barrier, mechanical, and thermal properties were evaluated. The films' surface showed a heterogeneous morphology without cracks, whereas the cross-section showed a porous-like structure. Adding EO to the films promoted a 35–50% decrease in crystallinity, which was associated with an increase in the elasticity (16–35%) and a decrease in the tensile strength (9.3–29.2 MPa) and Young's modulus (190–1555 MPa) on the films. Regarding the optical properties, the opacity of the films with TLEO increased up to 500% and 439% for chitosan concentrations of 1% and 1.5%, respectively. While the increase in opacity for the films prepared with LEO was 357% and 187%, the reduction in crystallinity also reduced the resistance of the films to thermal processes, which could be explained by the reduction in the enthalpy of fusion. The thermal degradation of the films using TLEO was higher than those where LEO was used. These results were indicative of the great potential of using TLEO and LEO in biodegradable films. Likewise, this work showed an alternative for adding value to the cultivation of Tahiti lime due to the use of its residues, which is in accordance with the circular economy model. However, it was necessary to deepen the study and the use of these essential oils in the preparation of biodegradable films.

Keywords: biopolymers; food packaging; biodegradable films; bio-based material

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1. Introduction

The high demand for plastic packaging derived from petroleum has generated worldwide concern due to the environmental impact that its use can produce. In this sense, the production of biodegradable and ecological packaging becomes an alternative to reduce the impact generated by non-biodegradable packaging since they offer characteristics such as a low cost of production, bioavailability, sustainability, and biodegradability [1]. In the food industry, different materials, such as starch, gelatin, proteins, and chitosan, have been evaluated as raw materials to produce edible films and coatings [2]. Among the materials used for this purpose, chitosan has been one of the most studied due to its different properties, such as its ability to form films, antimicrobial activity, odorless quality, tastelessness, and biodegradability [3]. Other authors have reported successfully preparing biodegradable films and edible coatings from chitosan and its application as packaging in different food