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Study of the physicochemical properties of hass avocado oil encapsulated by complex coacervation

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ABSTRACT

This study aimed to encapsulate Hass avocado (*Persea americana* Mill. cv. Hass) oil through complex coacervation using a gelatin:sodium alginate (NaAlg) mixture and assess the physicochemical properties of the resulting encapsulates. Turbidity, z-potential, and efficiency analyses indicated that the optimal conditions for oil encapsulation were a pH value of 4.0 and a gelatin:NaAlg solids ratio of 3:1. Coacervates formed with lower concentrations of solids exhibited superior morphologies compared to those obtained with higher concentrations. Encapsulation yield ranged from 34.7 to 86.8%, and the encapsulation efficiency ranged between 57.4 and 92.2%. Furthermore, the samples demonstrated low water activity (ranging from 0.01 to 0.36) and moisture content (2.18–9.25%), showcasing the high microbiological stability of the powder. Overall, the encapsulates displayed low hygroscopicity (<15%), suggesting enhanced technological stability for the product over time. Additionally, they exhibited good thermal stability, with degradation initiation temperatures surpassing 190 °C. This study highlights the technological potential of complex coacervation as a method to encapsulate Hass avocado oil. This approach offers a promising and viable alternative to use this material in various industrial applications.

1. Introduction

Avocado (*Persea americana* Mill.) is a tropical and subtropical crop belonging to the Lauraceae family cultivated in more than 60 countries (FAO, 2023; Yahia & Woolf, 2011). According to the FAO, in 2021, the world production of avocado was 8.81 Mt, with Mexico (27.7%), Colombia (11.1%), Peru (8.8%), Indonesia (7.6%), and the Dominican Republic (7.2%) as the main producers with a participation of more than 50% of total global production (FAO, 2023). Among the various commercial varieties of avocado, the Hass variety stands out as the most relevant worldwide, covering 95% of the US market and 65% of the European market (Ford, Spagnuolo, Kraft, & Bauer, 2023; Naamani, 2007). Its great acceptance and importance are due to distinctive characteristics such as its thick skin, high productivity, and sensory and nutritional qualities, facilitating its transport, storage, and commercialization (Araújo, Rodriguez-Jasso, Ruiz, Pintado, & Aguilar, 2018). Hass avocado pulp represents an important source of fiber, vitamin K, folate, pantothenic acid, minerals (mainly copper and potassium), bioactive compounds (primarily phenolic compounds, carotenes, and phytosterols), and lipids (Ford et al., 2023; Viera et al., 2023). Despite the growth in Hass avocado production and its exceptional nutritional quality, certain factors, such as mechanical damage, dry matter content, and fruit color, among others, have the potential to cause the rejection of the fruit for export, contributing to the increase in postharvest losses (Ramírez-Gil, López, & Henao-Rojas, 2020). Studies such as the one of (Benítez Franco et al., 2021)Benítes et al. (2021) have reported that postharvest losses during Hass avocado export can reach up to 60%. This high loss rate highlights the need to implement strategies to mitigate these losses or repurpose the resulting biomass effectively.

Oil extraction from avocado fruits for industrial use emerges as a fundamental strategy to mitigate postharvest losses. Studies have estimated that the lipid fraction of Hass avocado fruit can amount to 31% on

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