World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:17, No:05, 2023

Development of Polylactic Acid Insert with a Cinnamaldehyde-Betacyclodextrin Complex for Cape Gooseberry (Physalis Peruviana L.) Packed

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Abstract : The cape gooseberry is a climacteric fruit; Colombia is one of the principal exporters in the world. The environmental condition of temperature and relative moisture decreases the titratable acidity and pH. These conditions and fruit maturation result in the fungal proliferation of Botrytis cinerea disease. Plastic packaging for fresh cape gooseberries was used for mechanical damage protection but created a suitable atmosphere for fungal growth. Beta-cyclodextrins are currently implemented as coatings for the encapsulation of hydrophobic compounds, for example, with bioactive compounds from essential oils such as cinnamaldehyde, which has a high antimicrobial capacity. However, it is a volatile substance. In this article, the casting method was used to obtain a polylactic acid (PLA) polymer film containing the beta-cyclodextrin-cinnamaldehyde inclusion complex, generating an insert that allowed the controlled release of the antifungal substance in packed cape gooseberries to decrease contamination by Botrytis cinerea in a latent state during storage. For the encapsulation technique, three ratios for the cinnamaldehyde: beta-cyclodextrin inclusion complex were proposed: (25:75), (40:60), and (50:50). Spectrophotometry, colorimetry in L*a*b* coordinate space and scanning electron microscopy (SEM) were made for the complex characterization. Subsequently, two ratios of tween and water (40:60) and (50:50) were used to obtain the polylactic acid (PLA) film. To determine mechanical and physical parameters of colourimetry in L*a*b* coordinate space, atomic force microscopy and stereoscopy were done to determine the transparency and flexibility of the film; for both cases, Statgraphics software was used to determine the best ratio in each of the proposed phases, where for encapsulation it was (50:50) with an encapsulation efficiency of 65,92%, and for casting the ratio (40:60) obtained greater transparency and flexibility that permitted its incorporation into the polymeric packaging. A liberation assay was also developed under ambient temperature conditions to evaluate the concentration of cinnamaldehyde inside the packaging through gas chromatography for three weeks. It was found that the insert had a controlled release. Nevertheless, a higher cinnamaldehyde concentration is needed to obtain the minimum inhibitory concentration for the fungus Botrytis cinerea (0.2g/L). The homogeneity of the cinnamaldehyde gas phase inside the packaging can be improved by considering other insert configurations. This development aims to impact emerging food preservation technologies with the controlled release of antifungals to reduce the affectation of the physico-chemical and sensory properties of the fruit as a result of contamination by microorganisms in the postharvest stage.

Keywords : antifungal, casting, encapsulation, postharvest
Conference Title : ICFAE 2023 : International Conference on Food and Agricultural Engineering
Conference Location : Barcelona, Spain
Conference Dates : May 22-23, 2023