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Effect of Microwave on Physical, Mechanical and Microstructure Characteristics of Chitosan Film Incorporated with Anthocyanin

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Structured Abstract

Background: Attaining sustainable progress in the food packaging sector necessitates the utilization of renewable natural resources for the development of multifunctional packaging materials. Chitosan stands out as one of the most promising biopolymers in this context, characterized by non-toxic, biodegradable, and eco-friendly properties.

Methods: In this study, a film foundation was established by combining chitosan with acetic acid, glycerol, and beeswax. This chitosan complex was then homogeneously blended with anthocyanin, leading to the development of a film through the solvent casting method. Microwave treatment was subsequently applied to the chitosan-based film to enhance its packaging quality. The primary objective of this investigation is to assess the impact of microwave treatment on the physical, mechanical, and microstructure characteristics of chitosan film incorporated with anthocyanin.

Results: This study found that increasing the duration of microwave treatment did not significantly affect the thickness of the films. However, it notably enhanced the water solubility of the chitosan-anthocyanin film (57.10%), induced a decrease in the color intensity of anthocyanin, making it more yellowish (L*: 77.997, a*: -1.143, b*: 18.783), and exhibited excellent transparency (0.695 A/mm) after 120 seconds of microwave treatment ($p<0.05$). Chitosan-anthocyanin films treated with microwaves for 60 seconds demonstrated the highest tensile strength (0.333 MPa) compared to untreated films, as well as films treated for 30 seconds and 120 seconds. This suggests that polymer fibers reorganize and efficiently release residual tension only up to 60 seconds. The attenuated total reflectance (ATR) spectrum indicated an interaction between anthocyanin and chitosan in the chitosan-anthocyanin films after microwave treatment. At 60 seconds, the crystallinity index of the chitosan-anthocyanin film was the highest (8.75%) compared to other films, which was attributed to its elevated tensile strength. This suggests that microwave treatment allows for the stiffening of films for a duration up to 60 seconds. The increased strength of the films is attributed to enhanced intermolecular forces resulting from a regular repeating atomic structure. The scanning electron microscopy (SEM) results revealed that after 120 seconds of microwave treatment, the film exhibited a noticeable improvement in its surface structure, becoming smoother and denser.

Conclusion: In summary, the chitosan-anthocyanin film treated with a 120-second microwave session exhibited excellent performance as an edible film.

Keywords: Anthocyanin, Chitosan Film, Microwave

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