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Development of Sodium Alginate-pectin Biodegradable Food Film Incorporated with Benzoic Acid, Sorbic Acid, and Lactic Acid

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Structured Abstract

Background: Currently, extensive research is being undertaken on the development and commercialization of biodegradable materials. This is because there is an increasing problem with plastic packaging contaminating the environment. Moreover, a stunning majority of food-borne illnesses, which affect over 600 million people worldwide, are linked to contaminated food, according to various sources. Hence, this study has been conducted to develop biodegradable films for food packaging using sodium alginate and pectin and to evaluate the physicochemical properties and antimicrobial effects of the incorporation of benzoic, sorbic, and lactic acid (BSLA) in food packaging.

Methods: The development of composite films was performed using the solution casting technique and evaluated for their biodegradability as well as their physicochemical properties such as thickness, moisture content, water vapor permeability (WVP), tensile strength (TS), and Fourier Transform Infrared (FTIR). Analyses of the antimicrobial activity of the films were conducted, including well and agar diffusion assays, Hohenstein challenge tests, and antimicrobial effectiveness in the food system.

Results: Incorporating BSLA resulted in a faster rate of film biodegradation. In the well diffusion assay, 2.0% BSLA inhibited *Salmonella typhi*, a Gram-negative bacterium, with the maximum diameter inhibition zone (26.0±1.0 mm), and *Bacillus cereus*, a Gram-positive bacterium, with the lowest (21.0±0.0 mm), revealing that Gram-negative bacteria were more susceptible to 2.0% BSLA than Gram-positive bacteria. Therefore, 2.0% BSLA was chosen and incorporated with sodium alginate-pectin film. The agar diffusion assay shows the same way as the well diffusion assay, with the highest diameter inhibition zone in Gram-negative bacteria and the lowest diameter inhibition zone in Gram-positive bacteria. In the Hohenstein challenge test, the bacterial growth reduction was also highest in Gram-negative bacteria (69.7%) compared to Gram-positive bacteria (18.47%). In rice with injected *Bacillus cereus* on Day 5, bacterial reduction growth revealed the highest percentage compared to unknown bacteria present. In terms of physicochemical properties, the film thickness and moisture content increased when incorporating 2.0% BSLA, while there was no significant difference in WVP and tensile strength even after incorporating 2.0% BSLA. The obvious FTIR spectrum shifts revealed that BSLA had been included in the sodium alginate-pectin film in the study.

Conclusion: Therefore, sodium alginate and pectin film incorporated with 2.0% BSLA showed great biodegradability, physicochemical properties, and significant antibacterial activity against pathogenic bacteria.

Keywords: Sodium alginate and pectin, BSLA, biodegradable, physicochemical properties, antimicrobial activity

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