

Development of a Biodegradable Alternative to Single Use Sachets using Agar Extracted from Gracilaria Edulis

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This study aims to address the urgent issue of plastic pollution by creating sustainable alternatives, focusing on biodegradable films made from agar extracted from the seaweed *Gracilaria edulis*, specifically targeting single-use sachets. The study involved extracting agar, creating normal agar film (NAF) and composite films using corn starch (CSC) and beeswax (BC). Mechanical and physical properties including thickness, density, opacity, water vapor permeability, moisture content, and XRD patterns were assessed. Chemical properties were analyzed through FTIR tests, while antimicrobial properties were assessed using the CFU method. A three-week shelf-life assessment was conducted, involving chemical parameters, microbial testing, and sensory evaluation using milk powder samples packed in each film. Highest thickness (0.19 ± 0.09 mm g⁻¹) and highest apparent density (1.39 ± 0.05 g mm⁻³) were reported in CSC film. BC film demonstrated increased opacity (4.86 ± 0.07 Am⁻¹), decreased water vapor permeability ($7.34 \times 10^{-3} \pm 0.11$ gm⁻¹s⁻¹Pa⁻¹) and decreased moisture content (17.83 ± 0.07 %). In XRD patterns, a significant ordered semi-crystalline structure, and in FTIR spectrum, a notable ester peak (1740 cm⁻¹) was observed in BC film. Results from mechanical, physical, chemical, and antimicrobial analyses suggest that incorporating beeswax into agar could enhance crystalline structures, potentially influencing rigidity and barrier properties, thereby extending the shelf life of food products. The study observed efficient antimicrobial properties in the corn starch (CSC) film, while beeswax (BC) was found to preserve milk powder better than other films during shelf-life studies. This offers a promising sustainable alternative for food preservation. Analyzing the storage stability of BC for various food samples will provide deeper insights for future studies.

Keywords: Beeswax, Biodegradable Packaging, Corn Starch, Single-Use Packaging, Seaweed

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