Innovative Biodegradable Films for Enhanced Food Safety: A Study On Essential Oils

Rutaba Kashif, Arosh Sarfraz, Saniya Tayyab*
*E-mail: saniatayyab23@gmail.com

ABSTRACT

Introduction: Concern about environmental waste due to plastics has spurred interest in the recent trend of biodegradable renewable resources for packaging materials. Some promising alternatives using natural polymers that are biodegradable made from resources like starch that is usually found in plant materials like cassava, corn, potato, and wheat for reduced dependency on non-renewable, non-biodegradable packaging. For this reason, these materials are suitable for green applications of food packaging. Starch is a naturally occurring, low-cost polysaccharide with thermoplastic properties used in the packaging industry. Sago starch is non-toxic, inexpensive, and has the ability to create viscosity in film applications, exhibits good elasticity properties, and versatility in applications for food products. These films should also be resistant to rupture or cracks while exhibiting flexible properties (Tabari, 2018). The use of glycerol and edible starch film infused with aromatic oils, this packaging provides a layer of protection for the food (Sachdeva, 2017). While glycerol is a hydrophilic plasticizer (Mohammad Jouki, 2013), starch serves as a base. A traditional spice choice is clove (*Syzygium aromaticum*) because of its physiological properties, including antiseptic, antibacterial, antioxidant, anti-carcinogenic, pesticidal, and analgesic activity. Clove essential oil is used in the pharmaceutical, active packaging, cosmetics, biomedical, culinary, and sanitary fields (Silva, 2024). A mixture of cinnamon and clove oils can be a good alternative to common chemical preservatives and appears to be successful in active packaging methods (Matan, 2006).

Objective: The objective of this paper was to produce an environmental friendly, antimicrobial biodegradable film in food packaging through the combined use of essential oils, especially cinnamon and clove oils, which are generally known for their antibacterial properties, as the groundwork material. Using essential oils in active packaging is a workable solution to halt the growth of this dangerous fungus and extend the freshness of baked products. (Sachdeva, 2017). These solutions provide long shelf life for perishables, and naturally inhibit the onset of microbiological growth.

Methods: All raw materials were sourced commercially and were food-grade in the formulation of biodegradable films. The dried films were carefully peeled and then conditioned before measuring mechanical strength, surface morphology, and antibacterial properties to use the films for food packaging applications.

Result: In all assessments the biodegradable film showed high performance, the Solubility Test (85 percent solubility with a ±5 percent margin after 24 hours); the Biodegradability Test (complete biodegradation within 2 days); Thickness Measurements (thickness of 0.12 ± 0.01 mm); and Surface Texture Evaluation (smooth, uniform surface that is also free of cracks or air bubbles). Importantly, rapid degradability was realized without compromising its structural integrity or functional stability.

Conclusion: Favorable characteristics in biodegradability, solubility, thickness uniformity, and surface quality supported the ample promise of the developed biodegradable film as a sustainable packaging alternative. These findings indicate that the film would aid in the reduction of plastic waste and food safety by providing an environmentally safe material capable of degrading quickly in the environment.

Keywords: Biodegradable Films, Essential Oils, Food Safety, Antimicrobial Packaging, Starch Based Packaging Films..

REFERENCES

1. Jouki, Mohammad, and N. K. Khazaei. "Effect of Glycerol Concentration on Edible Film Production from Cress Seed Carbohydrate Gum." [Journal Name], 2013, pp. 39–46.
2. Matan, N. "Antimicrobial Activity of Cinnamon and Clove Oils under Modified Atmosphere Conditions." Journal of Food Science and Technology, vol. 60, no. 11, 2006, pp. 180–185.
3. Postharvest Decay. 2014. "Cinnamon Oil Is Another Essential Oil Obtained from Cinnamomum zeylanicum with Cinnamaldehyde as Its Major Active Component."
4. Sachdeva, A. "Antimicrobial Activity of Active Packaging Film to Prevent Bread Spoilage." [Journal Name], July 2017, p. 37.
5. Shanbhag, C., R. Shenoy, P. Shetty, M. Srinivasulu, and R. Nayak. "Formulation and Characterization of Starch-Based Novel Biodegradable Edible Films for Food Packaging." Journal of Food Science and Technology, vol. 60, no. 11, 2023, pp. 2858– 2867. https://doi.org/10.1007/s13197-023-05803-2.
6. Silva, M. V. Clove Essential Oil and Eugenol: A Review of Their Significance and Uses. 2024.
7. Tabari, M. "Characterization of a New Biodegradable Edible Film Based on Sago Starch Loaded with Carboxymethyl Cellulose Nanoparticles." DOAJ: Directory of Open Access Journals, vol. 3, no. 1, 2018, pp. 25–30. https://doi.org/10.22034/nmrj.2018.01.004.
8. Zhang, D., R. Nie, C. Zhang, Y. Wang, L. Wang, T. Chen, and L. Zhao. "Characterization of Biodegradable Food Packaging Films Prepared with Polyamide 4: Influence of Molecular Weight and Environmental Humidity." Food Bioengineering, vol. 1, nos. 3–4, 2022, pp. 276–288. https://doi.org/10.1002/fbe2.12024.