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Exploring the Potential of Pineapple Waste Parts in Agar Film Production: Characterization and Performance Analysis

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Aim:
Agar films have gained attention as biodegradable packaging materials due to their sustainability and versatility. This study explores the potential use of pineapple waste parts (rind, core, and crown) as a renewable source for agar film production. The aim is to investigate the characteristics and performance of agar films incorporating powdered pineapple subproducts for enhanced packaging applications.

Method:
Control agar films were prepared by boiling and stirring a mixture of water, agar (2% w/v), and glycerol (10% w/w of the agar). Pineapple waste parts, including rind, core, and crown, were freeze-dried, ground, sieved (particles with diameter < 250 μm were used), and then incorporated into the film forming solutions by substituting 25% of the agar weight. Each sample film was obtained by pouring 20 g of the solutions into petri dishes (diameter of 9 cm) and dried at 35 °C for approximately 20 hours. The films were kept under ambient conditions and characterized in terms of color (Lab* coordinates), thickness, pH, water activity, moisture content, mechanical properties (tensile strength and elongation at break), and contact angle (for wettability assessment). Additionally, Fourier Transform Infrared Spectroscopy (FTIR) analyses were conducted for further characterization and films comparison.

Results:
When pineapple waste was added to the formulations, color differences increased, especially noticeable in those with crown powder, resulting in darker, more opaque films. Thickness was consistent across all films (0.134 ± 0.096 mm), except for crown-derived ones, significantly thicker (0.322 ± 0.198 mm). Films were equivalent in terms of water activity (0.515 ± 0.013) and moisture content (14.86 ± 0.66%). However, there was variation in pH; agar-control (6.75 ± 0.01) and crown-based films (5.71 ± 0.02) exhibited significantly higher pH values compared to the others (3.73 ± 0.03). Films with pineapple subproducts showed reduced tensile strength and elongation at break compared to the control. Contact angle differences were not significant, suggesting similar wetting behavior. FTIR analysis indicated varied compositions, which may justify the mechanical performance differences.

Conclusion:
Agar films enriched with pineapple subproducts exhibit promising characteristics for potential packaging applications. However, further exploration into their water vapor and oxygen barrier properties is warranted.