UTILIZATION OF AGRICULTURAL WASTE FOR ENVIRONMENTAL FRIENDLY BIODEGRADABLE PACKAGING MATERIALS

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ABSTRACT

Excessive use of petroleum-based plastic packaging causes severe environmental pollution due to the low biodegradability, hence the dire need for sustainable alternatives. Accordingly, large amounts of fruit and vegetable processing wastes generated in Sri Lanka are rich in cellulose but remain underutilized. In this work, an attempt was made to develop and evaluate completely biodegradable packaging material using agricultural waste pulp (AW) in combination with recycled paper waste (PW) pulp. Peels of carrot, orange, mango, papaya, pineapple, tomato, cabbage, and passion fruit were chemically and physically treated through bleaching with 10% NaClO, alkaline digestion using 5% NaOH, and neutralization to extract cellulose fibers, while waste paper was processed to obtain paper pulp. Three formulations were prepared: T_1 (75% AW+25% PW), T_2 (50% AW+ 50% PW), and T_3 (25% AW+ 75% PW), using corn starch as a binder and an Aloe vera, glycerol coating to improve flexibility, barrier properties, and microbial safety. The experiment was based on a Completely Randomized Design with replicates, and the developed sheets were analyzed for different physical, mechanical, chemical, and microbiological properties such as thickness, hardness, basis weight, density, moisture content, water absorption, water solubility, pH, color (L*, a*, and b*), cellulose content, biodegradability (soil burial), and microbial load (TPC and yeast & mold). Significant differences ($p < 0.05$), were observed among the treatments. Among these, T_2 showed the best overall performance with the maximum thickness of 91.16 µm, optimal hardness, balanced density, maximum cellulose content of 59.89%, and the highest biodegradation rate of 9.31% within 10 days, while LDPE did not degrade considerably. T2 also presented moderate moisture properties, pH values close to neutrality, better color distribution, and the lowest microbial load because of the application of the Aloe vera-glycerol layer. The combination of 50% agricultural waste and paper waste presented the optimal composition regarding tensile strength, biodegradability, water resistance, as well as the ability to be used as an ecologically sustainable alternative for packaging made from petroleum-based plastic.

Key words: Agricultural Waste, Biodegradable Packaging, Paper Waste, Sustainable

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