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The Potential of a Sustainable Active Packaging Solution to Reduce Food Losses in Benin

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Abstract

Food security and food losses are of major concern in sub-Saharan Africa. The reduction of food losses can help to prevent malnutrition. Main reasons for food losses are damage and contamination during harvest, transport, processing, and storage, as well as an accelerated spoilage due to environmental and hygienic conditions. Active packaging solutions can prolong shelf life and increase food safety by inhibiting the growth of spoilage bacteria and pathogens. The implementation of locally produced, sustainable, biobased, and biodegradable packaging solutions is of great interest, especially in developing countries like Benin.

The aim of this study is the development of an active packaging solution made from local biobased materials with an active biogenic coating to reduce food losses in Benin. The active compounds are extracts of local plants with antimicrobial activity. Using the agar well diffusion method, the antimicrobial screening showed that all plant extracts (n=16, 70 % v/v Ethanol, 0.1 g ml⁻¹, 24 hrs., 25°C, 140rpm) are active against *Staphylococcus aureus* and other Gram-positive bacteria. Six plant extracts also showed activity against Gram-negative *Pseudomonas putida* and *Pseudomonas fluorescens*. The minimal bactericidal concentration (MBC) of these extracts identified *Gmelina arborea* (GA) with the lowest MBC of 10 µg ml⁻¹ as most effective against Gram-positive bacteria. Additionally, GA shows lowest MBC of 20 and 50 µg/ml for *P. putida* and *P. fluorescens*. Besides, the total antioxidative capacity of GA was very high with 529.64 mg Teq ml⁻¹ extract and a total phenolic content of 1,876.11 mg GAE l⁻¹ extract. The determination of the antimicrobial activity (ISO 22196) showed a successful integration into the biogenic matrix of beeswax, shea butter, and coconut oil with an antimicrobial activity of 2,53 and a log reduction of > 2 cfu cm⁻² for most bacteria. Matrices as base for this coating can be locally produced materials like paper, banana leaves and cloths.

The results of this research show that the developed biobased active packaging solution; with beeswax, plant oils and antimicrobial agents from Benin; has the potential to increase food safety and reduce food losses. Therefore, it can contribute to the resilience of food security in developing countries.

Keywords: Active packaging, antimicrobial activity, biobased, biodegradable, food loss, food security, sustainability, Western Africa