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Physicochemical and Bioactive Characterization of Bee Wax and Pollen-Based Films for Cheese Preservation

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Palavras Chave: Active edible film, Apis mellifera L., Cheese preservation

Highlights

Revolutionary natural packaging (Beeswax + Pollen bioactive films: Naturally inhibits microbes, blocks 96% of UV radiation, and extends cheese shelf life with potent antioxidants.

Resumo/Abstract

Cheese, due to its highly perishable nature, requires efficient and bioactive packaging to maintain its microbiological, physicochemical, and sensory quality during storage[1]. Given the toxicological risks associated with chemical preservatives, natural alternatives have been gaining interest[2]. This study aimed to develop and characterize an active biofilm based on beeswax (Apis mellifera L.) and pollen as a natural solution for cheese preservation. Three film formulations (CPG4, CPG5, CPG6) were prepared using beeswax, glycerol, and pollen in varying proportions. The components were dissolved at temperatures ranging from 60 to 80 °C, cast into Petri dishes, and subsequently dried and conditioned at 35 °C in an oven. The films were characterized for their physicochemical (pH, thickness, folding endurance, UV/Vis's barrier and opacity, moisture content, and solubility) and bioactive properties. The films exhibited distinct properties: an acidic pH and uniform thickness, with CPG5 being the thickest. Flexibility varied with the glycerol-to-wax ratio, with CPG4 being the most flexible. CPG6 stood out for its maximum UV protection (96.06%) and low solubility, while all formulations exhibited antioxidant activity and complete antimicrobial efficacy, attributed to pollen compounds and barrier properties. The developed biofilms combine physicochemical stability and promising antimicrobial bioactivity. Their natural formulation makes them viable candidates for the active packaging of cheese, although their mechanical strength requires further optimization.

Fig. 1. Schematic diagram of biofilm

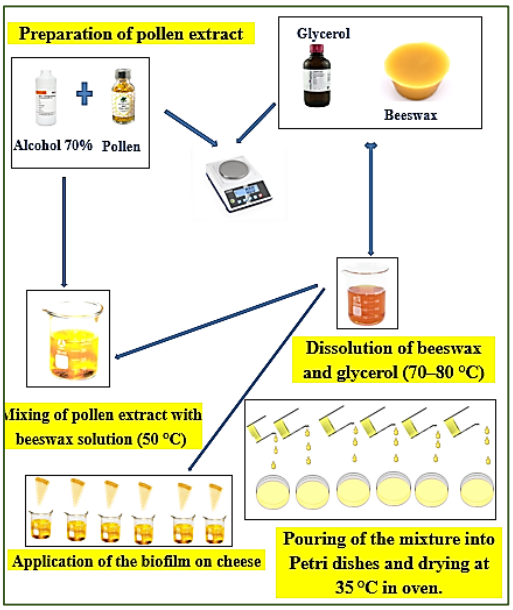
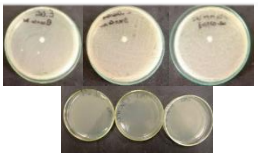


Table 1. Physicochemical and bioactive properties of the films.

Biofilm	pH	Thickness (mm)	Folding endurance	Transparency	Opacity	Moisture Content (%)	Solubility (%)	DPPH (%)
CPG4	5.60	0.46	6.67	7.25	1.25	0.92	1.29	22.31
CPG5	5.75	0.62	5.67	5.74	1.22	2.24	0.40	21.27
CPG6	5.80	0.50	3.67	6.27	1.41	0.96	0.56	23.95

Fig. 2. Complete absence of bacterial growth.



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