

Research

The Investigation of Bio-Preservative Properties in *Plukenetia volubilis* L. (Sacha Inchi) Seeds Protein Extract For Food Spoilage Prevention

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ABSTRACT

The importance of food quality and safety has long been recognized by the food industry to cater to food spoilage. Food spoilage is caused by the loss of food quality from its original organoleptic qualities due to chemical and biological spoilage processes that may impact customer acceptance. This research aimed to evaluate the potential of Sacha inchi seeds protein as a multifunctional food preservative in controlling chemical (oxidation) and biological (microbial and protease activity) food spoilage. The antioxidant capacity revealed that the Sacha inchi seed protein has $73.72 \pm 0.70\%$ inhibition towards oxidation with the total phenolic content detected at the concentration of $463.13 \pm 0.51 \mu\text{g/mL}$ in the protein extract. The tested food spoilage bacteria (*Escherichia coli* and *Micrococcus luteus*) and fungus (*Colletotrichum gloeosporioides*) were susceptible to Sacha inchi seed protein showing its potential antimicrobial properties. The Sacha inchi protein extract ($46.65 \mu\text{g/mL}$ & $23.28 \mu\text{g/mL}$) shows a significant inhibition for *E. coli* (30.5 mm) and *M. luteus* (33 mm), respectively, which indicated its effectiveness. Sacha inchi seed protein also displayed potential antifungal activities by suppressing the growth of *C. gloeosporioides* at inhibitory concentration percentages (IC%) of $1.5 \pm 0.12\%$, $5.85 \pm 3.89\%$ and $5.90 \pm 1.98\%$ after 2, 3 and 4-days of incubation, respectively. The caseinolytic plate assay revealed that Sacha inchi seed protein showed inhibition of trypsin digestion on casein with reduced inhibition diameter from 1.9 ± 0.00 cm (negative control) to 1.05 ± 0.00 cm. Following the effective protein separation by SDS-PAGE, zymography analysis revealed that a prominent protein band at 25 kDa showed protease inhibitory activity. This research contributes insights into the potential application of Sacha inchi seed extract as a bio-preservative in the food industry to combat food spoilage and it is aligned with SDG 2 for zero hunger.

Key words: Antioxidant, antimicrobial activity, bio-preservative, food spoilage protease inhibitory

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INTRODUCTION

Food spoilage refers to the loss of food quality from its original organoleptic qualities observed during processing and storage which involves the process of undesirable changes in the physical, chemical, and organoleptic properties of the food (Onyeaka & Nwabor, 2016). The changes can be any undesired change in the natural color, taste, or texture of the food items, rendering them unfit for consumption due to the loss of quality and nutritional value (Karanth *et al.*, 2023).

The rate of food spoilage is influenced by intrinsic and extrinsic factors. The extrinsic factors that can cause food spoilage include temperature, pH, water availability, the presence of spoilage microorganisms such as bacteria, fungi, and yeast, and the processing methods (Odeyemi *et al.*, 2020). The intrinsic factors that contribute to food deterioration are the endogenous enzymes; lipases and proteases and chemical reactions; browning and oxidation that occur naturally within the food item (Pellissery *et al.*, 2020). These factors affect the food shelf life by reducing the quality, safety, and visual appeal. Food spoilage can be a