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Development of Chitosan/Whey Protein Hydrolysate Composite Films for Food Packaging Application

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Abstract: There is a significant drive towards the development of edible biocompatible films for food packaging application due to the environmental and health impacts of synthetic packaging materials. This has inspired the exploration of biodegradable natural polymers as packaging materials. To address the instant water disintegration of most natural polymers, polymers with conditional water solubility, such as chitosan (needing acidic conditions for dissolution in water), have gained significant research attention. To this end, chitosan has been blended with different natural proteins, including whey protein isolates, to prepare edible food films. However, consumption of whey protein isolates in their natural form has been proposed in the literature to prolong processing (digestion) time upon consumption. To circumvent this limitation, here we report the development of chitosan/whey protein hydrolysate-based edible films with additional antioxidant properties. The developed films revealed that the inclusion of whey protein hydrolysate improved physicochemical properties and mechanical strength of the films with tensile strength of 26.3 MPa at 1 wt% WPH loading compared to 10.9 MPa in control neat chitosan films (0 wt% WPH). Furthermore, chitosan/whey protein hydrolysate exhibited a significant (whey protein hydrolysate) dose-dependent antioxidant response with a maximum value of 83% DPPH in chitosan/WPH (1 wt%) films assessed using two different antioxidant assays. Based on the results from this study, we envisage the exploration of whey protein hydrolysate-based films for commercial food packaging application in future.

Keywords: chitosan; whey protein hydrolysates; peptides–polysaccharide films; antioxidant; food packaging; films

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1. Introduction

Food spoilage of perishable food products (fruits and vegetables) remains a significant commercial problem which has been one of the key challenges in the global food supply chain of fresh produce [1]. Synthetic polymers, while effective in fresh food packaging, cause significant environmental pollution. In recent years, there has been a drive to explore biopolymer-based fruit coatings as a safe, edible and environmentally friendly packaging material [2–8]. It is believed that biopolymer coatings can even extend the shelf-life of fruits and vegetables.

To this end, chitosan remains the most explored biopolymer showing promising results as food packaging material [2]. Chitosan is a naturally occurring polysaccharide composed of d–glucosamine and N–acetyl–d–glucosamine, which is obtained by the deacetylation of chitin (β-N-acetyl-d-glucosamine polymer) found in the exoskeleton of crustaceans [9–11]. Chitosan is a biodegradable, biocompatible biopolymer with significant antioxidant and antimicrobial properties which drove the interest to explore it for food packaging application [12–15]. However, neat chitosan suffers from low mechanical and thermal stability and