CHITOSAN FILMS WITH POTATO PEEL EXTRACT TO EXTEND THE SHELF LIFE OF MEAT

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Abstract – Potato by-products are an important source of biological compounds such as phenolic acids and flavonoids, which are able to reduce free radical levels and microbial growth. The aim of this study was to evaluate the Fourier-transformed infrared (FT-IR) spectra and the mechanical properties of edible chitosan films containing ethanolic-aqueous potato peel extract (PPE). The PPE was subjected to sterilisation (autoclaved at 121 °C during 15 min and gamma irradiated at 20 kGy/h). Chitosan films were created with and without PPE, obtaining three different treatments (chitosan [Q], chitosan and PPE autoclaved (PAuto) and chitosan and PPE irradiated (P20 KGy). The results of the FT-IR spectra of the films with and without PPE showed a pattern of bands characteristic of the chitosan compound (3292 cm^{-1}). The autoclave sterilisation method affected the mechanical properties by reducing the elastic modulus and maximum effort and increasing the elongation values (*P*<0.05), as a result of the high temperatures. In conclusion, edible chitosan films with irradiated PPE have great potential as a new technology for preserving meat and meat products.

Key Words – chitosan films, potato peel extract, mechanical properties, meat preservation.

I. INTRODUCTION

Lipid oxidation and microbial growth are major considerations during the sale of meat and meat products because they can directly affect consumer health and meat quality. In particular, lipid oxidation involves the formation of hydroperoxides and their sub-products (i.e. malondialdehyde), which lead to changes in colour and the development of undesirable flavours or rancidity in meat. In fresh meat, microorganisms multiply rapidly, especially if temperatures during storage are inadequate or hygiene during handling and processing is poor. Several research studies have highlighted that synthetic antioxidant and antibacterial sources can be used as preservatives to reduce lipid oxidation and microbial growth [1, 2]; however, more recently, their use has also been limited because several studies have provided evidence of their potential risks to human health. Other studies have focused on creating active packaging materials that protect food products, such fruits and vegetables, as well as interact with them, for example, by preventing their spoilage [2]. Thus, the objective of this work was to evaluate the FT-IR spectra and mechanical properties of chitosan films with potato peel extract for use in meat preservation.

II. MATERIALS AND METHODS

Potato peels were obtained from La Costeña, S.A. de C.V. To extract the biological compounds, this by-product was first minced. Then, the obtained powder was homogenised during 24 h, and compounds were extracted using an ethanolic-aqueous solution (E:A). The resulting solution was concentrated and lyophilised to obtain potato peel extract (PPE), which was then sterilised by autoclaving (121 °C/15 min) and irradiation (20 kGy/h). The PPE was homogenised with a chitosan (Q) solution at 1%. The chitosan (commercial chitosan, deacetylation degree > 90%; purchased from Sigma-Aldrich) was prepared by mixing during 12 h with an acetic acid solution (0.3 M) at 2500 rpm (chitosan 1%). Afterwards, the chitosan films (P) were created using the pour plate technique in a petri dish (20 mL of solution per 8.9 cm of diameter); subsequently, samples were dried at room temperature until a constant weight was reached.

The FT-IR spectrum and the mechanical properties of films were evaluated [3, 4]. Data were subjected to an analysis of variance and a Tukey test at α=0.05.

III. RESULTS AND DISCUSSION

The results for the FT-IR spectrum of different samples are shown in Figure 1. The presence of OH stretching in hydrogen bonds, indicative of strong inter- and intramolecular interactions of the compound chains, is characterised by a strong, broad band at the 3000–3500 cm^{-1} region [4], which is reflective of the characteristic chitosan band at 3292 cm^{-1}. However, the intensity of absorbance in this region was reduced in samples sterilised by the autoclave method (P<0.05). For all treatments, regardless of sterilisation process, C-O stretching was evidenced by the band at approximately 1018 cm^{-1}. Absorption at 1400 cm^{-1} indicated C-O-O stretching, while absorption at 1536, 1556 and 1626 cm^{-1} is characteristic of a small amount of proteins. The results indicate that PPE incorporation to the chitosan film modified the FT-IR spectra.

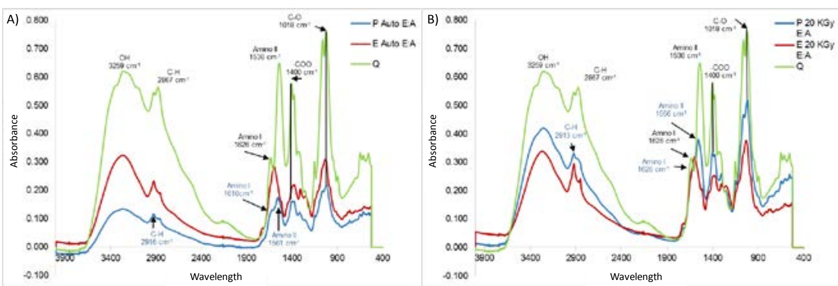

Figure 1. FT-IR of (Q) chitosan, (E) PPE and (P) chitosan film sterilised by autoclaving (A) and irradiation (B).

With respect to mechanical properties, the results show that irradiated PPE added to chitosan films does not affect the elastic modulus and maximum effort values; although elongation and thickness values were affected in all treatments (P<0.05). These results indicate that the autoclave sterilisation method has a film-plasticising effect, the high sterilisation temperatures can be associated with effects on the composition of PPE components (such as carbohydrates and phenolic constituents). With respect sterilisation method used, some additional compounds found in potato by-products, which are characterised for exert antifungical, antibacterial and antioxidant properties [5] can lost by temperature effect, and a combination of these components in edible films could increase their stability.

Table 1. Mechanical properties of chitosan, and chitosan with PPE films.

Treatments	Elastic modulus (MPa)	Maximum effort (MPa)	Elongation (%)	Thickness (mm)
Q	2254.6±165 **b**	35.7±2.4 **b**	3.1±0.3 **b**	0.05±0.004 **a**
P Auto E:A	554.8±30.6 **a**	20.2±1.06 **a**	4.8±0.4 **c**	0.17±0.024 **c**
P 20 KGy E:A	2297.2±187.6 **b**	32.8±3.4 **b**	1.4±0.1 **a**	0.10±0.009 **b**

(Q) Chitosan, (P) chitosan+PPE films, autoclaved (Auto) and irradiated (20 KGy). Different letters (a-c) indicate differences between treatments (P<0.05).

IV. CONCLUSION

In this study, the current findings demonstrated that chitosan films combined with PPE and sterilised by the irradiation method can potentially be used as an alternative method for preserving meat, as their chemical composition was not affected following sterilisation.

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