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Effects of Plasma Technology in Biodegradable Films for Food Packaging

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Abstract : Biodegradable films for food packaging have gained growing attention due to environmental pollution caused by synthetic films and the interest in the better use of resources from nature. Important research advances were made in the development of materials from proteins, polysaccharides, and lipids. However, the commercial use of these new generation of sustainable materials for food packaging is still limited due to their low mechanical and barrier properties that could compromise the food quality and safety. Thus, strategies to improve the performance of these materials have been tested, such as chemical modifications, incorporation of reinforcing structures and others. Cold plasma is a versatile, fast and environmentally friendly technology. It consists of a partially ionized gas containing free electrons, ions, and radicals and neutral particles able to react with polymers and start different reactions, leading to the polymer degradation, functionalization, etching and/or cross-linking. In the present study, biodegradable films from fish protein prepared through the casting technique were plasma treated using an AC glow discharge equipment. The reactor was preliminary evacuated to ~7 Pa and the films were exposed to air plasma for 2, 5 and 8 min. The films were evaluated by their mechanical and water vapor permeability (WVP) properties and changes in the protein structure were observed using Scanning Electron Microscopy (SEM) and X-ray diffraction (XRD). Potential cross-links and elimination of surface defects by etching might be the reason for the increase in tensile strength and decrease in the elongation at break observed. Among the times of plasma application tested, no differences were observed when higher times of exposure were used. The X-ray pattern showed a broad peak at 2θ = 19.51º that corresponds to the distance of 4.6Å by applying the Bragg's law. This distance corresponds to the average backbone distance within the α-helix. Thus, the changes observed in the films might indicate that the helical configuration of fish protein was disturbed by plasma treatment. SEM images showed surface damage in the films with 5 and 8 min of plasma treatment, indicating that 2 min was the most adequate time of treatment. It was verified that plasma removes water from the films once weight loss of 4.45% was registered for films treated during 2 min. However, after 24 h in 50% of relative humidity, the water lost was recovered. WVP increased from 0.53 to 0.65 g.mm/h.m².kPa after plasma treatment during 2 min, that is desired for some foods applications which require water passage through the packaging. In general, the plasma technology affects the properties and structure of fish protein films. Since this technology changes the surface of polymers, these films might be used to develop multilayer materials, as well as to incorporate active substances in the surface to obtain active packaging.

Keywords : fish protein films, food packaging, improvement of properties, plasma treatment
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