

ABSTRACT

The aim of this work was the preparation and characterization of biodegradable films with antimicrobial and/or antioxidant properties, using chitosan (CH). In order to modulate their properties and enhance their functionality, CH was combined with other polymer matrices: wheat starch (WS), polyvinyl alcohol (PVA) and polylactic acid (PLA). Moreover, essential oils (EO) of thyme (Th) or basil (B), α -tocopherol (Tp) and citric acid (CA) were incorporated.

The effect of homogenization treatment of the film-forming dispersions (FFD) on CH films with EO at different proportions was evaluated. In the FFD, microfluidization led to a droplet size reduction, a surface charge increase and a viscosity decrease. Furthermore, this treatment intensified all the effects caused by EO addition on the mechanical properties of the films, due to the induced close contact polymer oil. At low EO proportion, microfluidization improved the water vapor barrier properties, although it had no significant impact on the oxygen permeability. These films played a protective role against

oxidation of pork fat. Although EO addition caused an increase in oxygen permeability, lower rates of oxidation were observed in samples covered with CH-EO films (especially at high relative humidity), which is probably due to the specific antioxidant effect of the EO components. Chitosan films effectively controlled the microbial spoilage when applied on minced pork meat, but the incorporation of EO did not improve this antimicrobial activity.

CH was incorporated in WS films in different proportions. As CH proportion was increased, both the viscosity and stability of the FFD were increased. The addition of CH in major proportion resulted. CH and WS appeared to be highly compatible, and homogeneous film structures were observed. The increase of CH proportion gave rise to films with improved mechanical properties, since CH seemed to inhibit starch retrogradation. WS:CH films caused a reduction of the microbial load when applied on minced pork meat samples.

Antioxidant agents were incorporated (essential oil of thyme and basil, citric acid and α -tocopherol) in WS (80%):CH (20%)

blend films. These films showed a heterogeneous microstructure due to the immiscibility of components, mainly those formulated with α -tocopherol, which showed phase separation. This was associated with a rougher surface, lower gloss and, in the case of α -tocopherol, a more intense yellow hue. On the other hand, antioxidant incorporation resulted in a transparency increase and an oxygen permeability decrease. CA caused an increase in the elastic modulus and a decrease in the extensibility of the films.

The incorporation of CH in PVA matrices resulted in highly homogeneous films, which is due to the compatibility of the two polymers. As CH was incorporated, the films became more resistant and rigid, but less extensible. A reduction of the crystallinity degree, an increase in thermal stability and a reduction of the UV light transmission were observed. Moreover, these films showed antimicrobial activity when applied to minced pork meat samples.

CH was incorporated in a PLA matrix by extrusion. CH addition did not affect the thermal behavior of the blend films, nor the crystallinity degree of PLA. Both polymers were incompatible.

The CH particle size reduction minimized its negative impact on the mechanical properties and water vapor permeability. Their application to minced pork meat demonstrated that the antimicrobial properties of the films were improved when CH was incorporated.