Abstract

Although the use of conventional packaging materials such as plastics and its derivatives are effective for food preservation, they generate serious problems for the environment and consumer health. The growing demand of consumers to reduce the environmental impact caused by the use of non-biodegradable materials had a great influence to the interest in the development of biodegradable films and coatings. This fact is added to the current trend of consuming safe, good quality and ready-to-eat products, being minimally processed (MP) fruits and vegetables that have undergone a fast increase because they provide health benefits. However, the MP products show a quick quality deterioration and shelf life reduction. In this context, the biopolymers are an alternative source for the development of materials due to their biodegradability. The chitosan (Ch) is a promising biopolymer for use as packaging. It is biodegradable, biocompatible, has very good ability to form semipermeable films, has antimicrobial and antioxidant capacity. Additionally, active packaging has more interesting due to their potential to provide benefits in quality and food safety. Quercetin (Q) is a known natural antioxidant that can be incorporated into the packaging material.

The aim of this thesis was to obtain biodegradable films based in modified Ch with Q, and to study their physico-chemical, mechanical, microbiological, and barrier properties for use in the preservation of MP vegetables during storage.

Native Ch characterization was performed at an initial stage. It was made by determining the degree of deacetylation (DDA) and molecular weight

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(MW). Ch derivatization was made by the chloroperoxidase enzyme (CPO) which reacts with the flavonoid modifying it into the related quinone, highly reactive to Ch. Chemical characterization of the derivatized molecule was made by determining the content of polyphenols and antioxidant capacity by scavenging $O_2^{\bullet-}$ and $^{\bullet}OH$. Ch and Ch-Q based films were prepared according to the method proposed by Bourbon et al. 2011, with some modifications. Physicochemical properties such as thickness, density, transparency, opacity, moisture content and solubility in water were evaluated. Also, they were studied antioxidant capacity by scavenging $O_2^{\bullet-}$ and $^{\bullet}OH$, mechanical properties such as stress (TS) and strain at maximum load (E), and oxygen (O_2), carbon dioxide (CO_2) and water vapor barrier properties. Furthermore, the antimicrobial ability against *Escherichia coli* and *Staphylococcus aureus* was investigated. Finally, the stability of coated MP carrots (*Daucus carota* L) was evaluated by studying the antimicrobial activity during refrigerated storage against mesophilic and psychrophilic microorganisms, total coliforms, *E. coli*, *S. aureus*, and fungi and yeasts. In addition, the antioxidant capacity was evaluated by determining the ascorbic acid (AA) and β-carotene content of samples coated with Ch and Ch-Q based film forming solution.

Results indicate that the incorporation of Q in the polymeric matrix, through the Ch-Q adduct formation, modified the films properties. The use of Ch derivatized by Q, yielded coatings with better properties, especially with regard to thickness, density, optical, antimicrobial, and antioxidant

properties, and capability barrier to O_2 and CO_2. The TS was increased due to the greatest degree of polymer crosslinking because Ch matrix-Q interactions. In addition, greater affinity with water than films had managed, increase the value of E; nevertheless, this effect was reduced because of the higher strength and stiffness of the polymeric film structure.

Microbiological results of in vitro and coated carrots, indicate that biodegradable Ch-Q based films, with a concentration of 1% (w / v), are a feasible alternative in control of the microorganisms evaluated. The incorporation of Q resulted in a synergistic effect with Ch, controlling the microbiota present in the MP vegetable.

The presence of Q had a positive influence on the antioxidant effect showed by functionalized molecule of Ch and film. Structural characteristics of Q had been decisive to increase the antioxidant activity. Regarding to the evaluation of the stability of MP carrots samples, a protective effect against loss of β-carotene was obtained; however, the content of AA was decreased at least 70%, could not be determined if any treatment had protective effect on this vitamin.

According to these results, this type of coating is suitable for application to MP carrots improving quality and increasing their shelf life. It shows a high potential to be used as alternative packaging material or supplementary to the synthetic materials. However, it is possible to continue working to optimize certain properties, such as water vapor permeability.