



Chitosan-based coating and film for food packaging application

Authors: Chierici Serena¹, Cigognini Ilaria Maria¹, Zurlini Chiara¹, Bergamaschi Monica¹, Simoncini Nicoletta¹, Previdi Maria Paola¹, Franceschini Barbara¹

¹Stazione Sperimentale per l'Industria delle Conserve Alimentari, Viale F. Tanara 31/A, 43121 Parma, Italy; +3905021795216; serena.chierici@ssica.it

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Introduction

Due to consumer demand for preservative free foods, researchers focused on new natural materials with film-forming capabilities and antimicrobial properties, which help improve food safety and shelf life. Chitosan offers real potential for applications in the food industry; it has been classified as a GRAS (Generally Recognised As Safe) by the US FDA in 2001. [1] Chitosan is a polysaccharide obtained by the deacetylation of chitin, which is the principal component of the crustaceans and insects exoskeletons and cell walls of fungi. Compared to other polymers, chitosan has numerous advantages, such as biocompatibility, biodegradability and non-toxicity. [2] Technically, it has a number of functional properties including antimicrobial and antioxidant activities, film-forming ability, texturizing and binding actions. [3]

Experimental

The studies carried out focused on the formulation of chitosan-based coatings and bioactive films for food application, specifically for fresh fish and meat products in order to verify their antimicrobial and antioxidant properties, thus allowing an extension of the shelf life. The formulation of these coatings was performed using chitosan of both animal (i.e. shrimps) and vegetal (i.e. mushrooms) origin. The chitosan from shrimps was purchased on the market, while the chitosan from mushrooms was extracted within the PROLIFIC project. The chitosan-based coatings were formulated identifying the best concentration of the components in order to obtain the best film-forming ability and antimicrobial properties. The application of the coatings was carried out using different techniques (i.e. casting, dipping, spray) depending on the food product to be tested and the packaging material used. Shelf life evaluation was performed on selected food products.



Fig.1: Anchovies, fish burgers and pork burgers uncoated (a, c, e) and coated with chitosan coating (b, d, f)



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Results and Discussion

The research carried out in the SSICA laboratories started with the commercial shrimp chitosan to apply on different fish products as fish fillets and fish burgers. Several tests on the chitosan solubilisation were performed to identify the best formula in terms of ingredients concentrations and film-forming ability. The formulated coating was composed of 1% w/v of chitosan in acetic acid solution (0.5% v/v) and glycerol as plasticizer. This formula was applied by dipping technique on the fish fillets, while the fish burgers were sealed between two chitosan-based films prepared with the casting technique. These two products were packaged at pilot scale, simulating the industrial packaging process, and stored at 4°C up to 20 days for shelf life evaluation. The coated fish samples resulted better preserved than the uncoated ones since an inhibitory effect produced by chitosan on total and Gram Negative bacteria was measured. In addition, the chitosan film showed better performances compared to the control in terms of reduction of off-flavor compounds, in maintaining the texture and the color properties of the food product.

These very positive results encouraged further studies on this molecule to be carried out, specifically, the chitosan of mushroom origin was tested for the preparation of an alternative food packaging for meat products. This topic was investigated within the PROLIFIC project in collaboration with the partners of the Consortium. The coating solutions were prepared using a chitosan extract from mushroom by-products. The optimized formula was applied on bioplastic substrate to produce a bilayer material and applied on the burgers for the shelf life evaluation. The preliminary results showed that some improvements in the application technique are needed in order to meet the requirements of food packaging materials.

Conclusions

The researches carried out on chitosan as starting molecule for the formulation of coating for food packaging application proved to be very promising when applied directly in contact with fish products. The application of chitosan as coating and bioactive film was effective in reducing microbial spoilage and extending the shelf life of the tested products.

The application of the chitosan coating solution on biopolymer require further studies to achieve the best application parameters and performance for meat products. In the view of a scale up, this application could be valuable as a larger scale of material could be produced.

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Biography

Dr. Serena Chierici graduated in Chemistry at the University of Pavia in 2014.

She is a researcher at SSICA Packaging Department since 2015. She deals with European Projects (BiocopacPlus, AgriMax and ECOFUNCO) focusing on the valorization of food processing wastes, in particular of tomato by-products. She is also involved in the study and evaluation of the packaging materials in terms of shelf-life and hygienic-sanitary compliance.