CPQ Nutrition (2019) 3:3
Mini-Review

Application of Bioactive Compounds on Active Packaging and Edible Coating

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Received: 29 September 2018

Published: 19 March 2019

Keywords: *Bioactive Compounds; Edible Films; Antimicrobial Packaging*

Abstract

The active packaging refers to the incorporation of certain additives into packaging material or within packaging containers in order to maintain and extend the shelf life of the product. It has emerged as an exciting area in the food technology that provides the preservative benefits on a wider range of food products. The primary aim of this technology is the maintenance of sensory quality and shelf life extension whilst at the same time maintaining nutritional properties and ensuring microbial safety. Bioactive compounds are extra nutritional constituents that typically occur in small quantities in foods. A wide range of natural antioxidants such as ascorbic acid, tocopherol, plant extracts and essential oils have been incorporated into the edible coating in order to increase their bioactivity. The coating containing added antioxidants increase the shelf life of the food and develop an eco- sustainable and cost competitive products.

Introduction

Nowadays, potential use of bioactive compounds in active packaging system and edible coating are getting more attention from packaging industries due to the increasing consumer demands for minimally processed and preservative free food products [1]. The addition of antioxidants in edible films and coatings can complement value to the food packaged products by increasing their shelf life and to develop eco- sustainable and cost competitive products. Since synthetic antioxidants are associated with the possible toxic effects hence their application has been avoided in the foods [2]. The various sources of the bioactive compounds are given in Table 1. The bioactive substance such as phenolic compounds, phytoestrogens, carotenoids, organosulphur compounds, plant sterols, monoterpenes, soluble dietary fibres, plant extracts, essential oils, prebiotics, bateriocins, enzymes are mainly suitable for the incorporation into the package wall [3-5].

Table 1: *Sources of bioactive agents*

Source	Bioactive agents
Essential oils	Betel oil Cinnamon oil Clove oil
Flavonoids	Catechin Rutin Quercetin
Animal derived peptides	Lactoferrin Hepcidin Milk protien hydrolysates Dermaseptin
Plant derived	Soy protien hydrolysate Corn protien hydrolysate
Enzymes	Glucose oxidase and catalase Alcohol oxidase and catalase lactase

Applications of Bioactive Compounds

The bioactive substances can be incorporated into packaging materials by any of the following methods [6]

1. Direct application of bioactive edible coatings to the food.
2. Incorporation of bioactive substances directly into the package wall.
3. Incorporation of bioactive substances into a sachet included in the package.
4. Coating of the packaging materials with a matrix that serves as a carrier of the bioactive substances.

During the manufacturing of bioactive films, following factors should be taken into considerations:

1. Characteristics of specific antimicrobial substance and specific food .
2. Chemical nature of packaging material, process conditions and residual antioxidant activity

3. Interaction of the various additives with the packaging film matrix.

4. External environmental conditions such as temperature and relative humidity.

5. Physical characteristics of the packaging material.

The coating containing added antioxidants increase the shelf life of the food. Application of antioxidants in edible coatings also reduces the browning in various foods [7]. The added antioxidants also help to preserve food, inhibit browning of food and reduce the undesirable effects of nutrients oxidation [8,9].

Antimicrobial packaging films are also used for the inhibition of pathogenic microorganisms. The major potential food application of antimicrobials include some sensitive foods like fresh products such as fruits and vegetables, bakery products, meat and fish products, dairy products [10].

Application of various natural additives, particularly having antimicrobial properties in the development of active packaging systems and edible films has been studied in various commodities such as fresh cut broccoli, grapes, fish, against listeria and fish spoilage bacteria. The shelf life of perishable fresh foods could be improved by 20 percent by the use of new active compounds. Active packaging also minimizes losses from spoilage and could increase the useful life of product by one or two additional days [11].

Alvarez *et al.* (2013) [12] studied the antimicrobial efficiency of chitosan coating enriched with bioactive compounds on minimally processed broccoli. The application of chitosan alone or enriched with bioactive compound resulted in a significant reduction in mesophilic and psychrotrophic counts. Also, the antimicrobial action of chitosan was improved with the addition of bioactive compounds. The enriched coatings controlled presence of *E. coli* and *L. monocytogenes* in broccoli besides controlling the presence of various microorganisms.

Dos Santos *et al.* (2012) [13] evaluated the application of coating composed of chitosan and *Origanum vulagare* L. essential oil to control *Rhizopus stolonifer* and *Aspergillus niger* in grapes. The combined application of coating preserved the quality of grapes as measured by their physical and chemical attributes. The sensory attributes were also improved throughout the storage life.

Ponce *et al.* (2008) [14] conducted studies on antimicrobial and antioxidant activities of edible coatings enriched with natural plant extracts. The susceptibility of the native micro flora of butternut squash and *Listeria monocytogenes* was analyzed by using (a) film-forming solutions (chitosan, carboxymethyl cellulose and casein), (b) oleoresins (olive, rosemary, onion, capsicum, cranberry, garlic, oreganum and oreganum + carvacrol 5%) and (c) film-forming solutions enriched with oleoresins. The enrichment of rosemary and olive in chitosan improved the antioxidant protection of minimally processed squash. It could also prevents the quality loss in fruits and vegetables by inhibiting the browning reactions.

Iturriaga *et al.* (2012) [15] tested the antimicrobial activity of twelve different natural extracts against the fish spoilage bacteria (*Pseudomonas fluorescens* and *Aeromonas hydrophila/caviae*) and *Listeria innocua.* For this purpose, oregano and thyme essential oils and citrus extract were selected. Among these, citrus extract was selected and incorporated into different biopolymer film forming solutions due to its greater inhibitory effect against L. innocua. They proposed the use of these edible films in future preservation of fresh fish fillets.

Li *et al.* (2012) [16] evaluated the coating effects of tea polyphenol and rosemary extract combined with chitosan on the quality of large yellow croaker (*Pseudosciaena crocea*). The solution of tea polyphenol (0.2%, w/v) and Rosemary extract (0.2%, w/v) was used for dip pretreatment, and chitosan (1.5% w/v) was used for the coating. The two dip treatments combined with chitosan coating could effectively maintain the quality at refrigerated storage.

Conclusion

Incorporation of natural extracts together with vitamin C and E, represent a promising approach for the development of edible films with improved bioactive, physicochemical properties and applications. recent advancements have focused on delaying oxidation and controlling moisture migration, microbial growth, respiration rates and volatile flavors and aromas. Since the antioxidant activity of the coating with added bioactive compounds can decrease with time, controlled delivery studies of bioactive compounds in coatings should be performed.

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