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Popular Article

Application of Chitosan as a Food Preservation

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Introduction

Chitosan is a sugar that comes from the outer skeleton of shellfish with crab, lobster, and shrimp. It refers to one of the most abundant natural polysaccharides in nature (Lavall et al., 2007). Chitosan can be mainly obtained from the marine crustacean's shells (Arbia et al., 2013). Atlantic Canada offers a great source of different marine crustaceans, i.e., shrimp, lobster, crab, etc. that can be utilized for the extraction of chitosan. Aquaculture industries in Atlantic Canada are growing fast to meet current demand of chitosan. Chitosan is a fibrous substance that reduces the fat and cholesterol level in body absorbs from the foods. It helps for blood clot when applied to wounds. It is also important as medicine and drug manufacturing. People are uses chitosan for high blood pressure, high cholesterol, obesity, wound healing and many other purposes. Chitosan can be utilized for many purposes and also developing various formulations (Fatehi et al., 2010). Chitosan-based edible coatings can also be used as carriers of food ingredients such as antimicrobials, texture enhancers and nutraceuticals to improve the quality, safety and functionality of the food. Edible coating without disturbing sensory and nutritional properties of food (Martins et al., 2014). So, chitosan is used as preservatives in food.

Application of Chitosan in Food

Chitosan is widely applicable in dairy and food industry. Some of the applications of chitosan are given below: -

1. Edible coatings/films

The chitosan is widely used as an edible coating of the food product and they are intended to protect the food. Edible coatings/films are used to a protective barrier in dairy and food and it can be also consumed along with the coated product (Kerch, 2015). The applications of chitosan as a food preservative, the creation of a moisture and gas barrier is leaded to weight loss and also respiration rate reductions with a resulting delay in spoilage of food, which will extend the shelf-life of the food product (Chien *et al.*, 2007).

Water vapor permeability (WVP) and oxygen permeability (OP) both are the barrier properties to determine the ability to protect the foods from the environment (Valencia-Chamorro *et al*., 2011). Edible chitosan films are good barriers for permeation of oxygen (O_2), even as exhibiting relatively low water vapour barrier quality (Khan *et al*., 2012). Coating/films preparation has long been used for preservation of tomatoes, apples, citrus fruits and cucumbers. Chitosan coated tomatoes were prohibited from attacks of *Aspergillus spp*., *Penicillium spp*., *Rhizopus stolonifer* and *Botrytis cinerea* (El Ghaouth *et al*., 1992). The gram-positive and gram-negative bacteria are sensitive to antimicrobial activity of chitosan. Chitosan has also the ability to control some fungal diseases, which deteriorate fruits quality during storage condition (Romanazzi *et al*., 2013). Similarly, chitosan coating was also found to be effective to enhance the quality of firmness, delay ripening and reduce browning of peach (Ma *et al*., 2013).

2. Chitosan derivatives

Amino groups of chitosan are suitable for modified to impart essential properties and characteristic biological functions to chitosan. Chemical modification of chitosan has a functional property (Islam *et al*., 2017). In chemical modification, the unique amino group's properties involve the chemical reactions such as acetylation, quaternization, reactions with aldehydes and ketones, alkylation, chelation of metals, etc. resulting to a variety of products exhibiting the different properties such as antibacterial, anti-fungal, anti-viral, non-toxic, anti-acid, non-allergenic, biocompatibility and biodegradability. The low molecular weight of chitosan has better preservative and antioxidant properties than that of high molecular weight (Elbarbary and Mostafa, 2014). Therefore, chitosan and its derivatives have solubility in acetic acid which has intrinsic antimicrobial activity. There are some of the compounds such as organic acids, inorganic compounds, inorganic nanoparticles, essential oils and composites enhance the antimicrobial activity of chitosan.

3. Irradiated chitosan

Different types of irradiated chitosan coatings were used for enhancing the shelf life and improving quality of food. The effect of coating with irradiated crab and shrimp chitosan ($MW=5.14\times10^4$) and un-irradiated crab chitosan ($MW=2.61\times10^5$) on postharvest preservation of mangos (Abbasi, 2009) and results showed effectiveness at an considerable level. The effect of control as well as irradiated chitosan was observed on the fruits-spoiling fungi such as colletotrichum gleosporioides. The application of irradiated chitosan was effective on preservation of food with limiting the growth of fungi without affecting ripening characteristics of foods (Oyervides-Muñoz *et al*., 2017).

4. Chitosan Based Formulations

Chitosan based preservative are used for extend the shelf life of food. Chitosan preservative was determined the synergistic activity with sulfamethoxazole, a sulfonamide antimicrobial agent (Lal *et al*., 2013). Chitosan is also used to potentiate the antimicrobial activity for other preservatives. Chitosan mixed with ethanol, wax and organic materials, improved the protecting effect on grapes fruits from gray mold as compared to the application of chitosan alone (Romanazzi *et al*., 2017). Some of the inorganic compounds such as calcium gluconate in combination with chitosan helped the structural integrity of food for maintaining firmness of foods in addition to reducing fungal incidences (Kou *et al*., 2014). Calcium gluconate is used at concentration level of 0.5% with 1.0% or 1.5% with chitosan showed that the better antifungal activity than chitosan only. The antimicrobial activity and minimum inhibitory concentration of chitosan glucose complex used as novel preservative and also found effective against common spoilage microorganisms for foods like Psudomonas, S. aureus, B. cereus and E. coli (Jiang *et al*., 2012). Chitosan-glucose complex was found for antioxidant and antimicrobial activity and also promising novel preservative for various foods.

5. Toxicity of chitosan

Chitosan is a non-toxic, biologically compatible polymer (Kean and Thanou, 2010). Chitosin is use for dietary applications in many countries and it has been approved by the Food and Drug Administration (FDA) for use in wound dressings.

Conclusion

Chitosan, due to containing amino groups to interact with microbial cell walls when applied to dairy and food, causes kill the bacteria and fungi through cell lysis mechanisms. Chitosan can be interactions with selective microorganisms, and the chitosan-based formulations have been activity of chitosan for food preservation. Chitosan shown to be an effective natural antimicrobial agent based upon the electrostatic mechanism, and control of respiration rate, weight loss and water loss, without affecting odour, taste and palatability of skinned and fresh cut foods. The polymeric nature of chitosan is structurally tuned for utilizing antimicrobial activity against microorganisms and also produce a protective barrier on foods. Irradiation is a good choice for producing low molecular weight chitosan for gives oligo-chitosan and also influences the deacetylation without leaving any chemical residues. Radiation is also a good sterilization effect for food preservation. Chitosan can be produced cost effectively with a high degree of deacetylation using new green technology. It was concluded that the chitosan is considered as costs effective, environmental impact and especially industrial methods.

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