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EC NUTRITION
Editorial

Edible Coatings as Means to Maintain Nutritional Quality and Increase Shelf Life of Fish Products

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Received: November 22, 2022; **Published:** November 24, 2022

Fish is a staple food that accounts for around 60%. Fish is the main or only source of animal protein for around 60% of the world's protein supply [1] and more than 30% of Africa's population [2].

Also, fish provides 38% of the total animal protein for Egyptian people [3]. Fish and fish products contain nutritional elements including high biological value proteins that enriched in essential amino acids. Also, Fish contain fat-soluble vitamins, microelements and macroelements which are vital to the health of the human body [4]. Fish consumption is important for health of mothers in the first 100 days of pregnancy and infants in the first 1000 days of infancy [5]. In addition, fish consumption is basically known as useful for brain growth and protects against mental illnesses, cardiovascular diseases and many inflammatory illnesses like asthma, arthritis and bowel illnesses [6,7]. The American Heart Association recommends two servings of fish each week as part of a healthy diet [8].

Fishery products are more perishable than other muscle foods due to the combined action of chemical reaction, lipid oxidation, endogenous enzyme and microbial growth. Fishery products vulnerability is due to their high moisture content and neutral pH, thus providing an ideal medium for microbial growth [9]. Also, chemical reactions and proteolysis triggered by endogenous enzymes is also responsible for softening and moisture loss of fishery products [10]. Therefore, fishery products lose most of their quality attributes during storage, including discoloration, drip loss, protein degradation, and texture softening. Globally, around 10% (10 - 12 million tons per year) of the aquaculture and fishery products are discarded due to spoilage [11]. It is therefore desirable to extend the shelf life of fish and fish products using natural protective coatings that have antibacterial and antioxidant characteristics which respond to consumer desire for more natural, minimally processed products with biodegradable, recyclable, and environmentally friendly food packaging materials [12].

Edible coatings could provide physical protection to protect food products from diverse mechanical, chemical, and microbiological degradation that may be beneficial for seafood. Excellent moisture and oxygen barrier characteristics are vital for edible coatings in seafood packaging. These coatings can carry numerous of additives that impart a variety of functional characteristics in minimally processed foods [13].

Natural materials can be used as coatings such as polysaccharides (cellulose and starch); proteins (gelatin, wheat protein, casein, etc.); and wax [14]. Chitosan (poly-b-(1-4)-D-glucosamine) is a biopolymer formed from the deacetylation of chitin obtained from the exoskeletons of crustaceans and mollusks [15]. Chitosan is relatively insoluble in water but soluble in acid owing to the positive charge on the C_2 of the glucosamine monomer at pH 6 below and it is a nontoxic biodegradable coating and has wide application in maintaining the seafood products owing to antimicrobial and antifungal properties [16].

To increase the efficacy of application of edible coatings on foods, natural plant extracts, particularly essential oils possessing antimicrobial and antioxidant properties, are recommended [17]. Recently, edible coatings are being used to reduce the oil uptake in fried food

products [18]. Moreover, benefits of using of edible coatings include reducing moisture loss during frozen storage, maintaining the color of fresh meat, improving flavor and texture, minimizing lipid oxidation, decreasing spoilage, and decreasing environmental contamination [19].

The effectiveness of coatings made from 10% whey protein isolate combined with different concentrations of oregano and thyme EOs (1% and 3%) under air and MAP conditions against *Pseudomonas* spp., lactic acid bacteria and H_2S producing bacteria in hake fillets was studied [20]. The use of coatings with 1% thyme EO under modified atmosphere packaging (MAP) has revealed the best results against *Pseudomonas* spp., and the one with 3% oregano EO under the MAP revealed the best results against H_2S producing bacteria and lactic acid bacteria. Diverse inhibitory impacts shown by an essential oil against numerous microbes are most possibly due to its chemical composition [21]. The antimicrobial mechanism of action of plant EOs is related to the hydrophobicity of their components [22] that permits them to transfer in the lipids of the bacterial cell membrane and mitochondria, disturbing their structures and making them more penetrable [23], also leakage of ions and intracellular components can occur [24]. The coating that contains of 1% quince seed mucilage combined with 2% thyme oil prolonged the shelf-life of fresh rainbow trout fillets for 12 days [25] and in another study based on 3% gelatin and 1.5% alginate incorporated with 1.5% oregano oil for 6 days [26]. The coating made from 2% chitosan incorporated with 1.5% cinnamon oil increased shelf life by 8 days [27], the other trials made from 1% carrageenan incorporated with 1% lemon EO resulted in prolonging shelf life by 12 days [28]; the coating made from whey protein concentrate/glycerol (l, 2:1) add 6 days [29].

Shelf lives of grass carp and silver carp fillets were prolonged by 13 and 6 days, when coatings made from 2% nanochitosan, respectively [30]. The shelf life of pike-perch fillets was increased by 8 days when coating made from 10% whey protein isolate incorporated with 2.5% lactoperoxidase was applied [31]. Another study [32] found a prolonged in storage period (from 8 to 12 days) of Japanese sea bass fillets when applied coating formulation based on 1.5% chitosan and 0.5% citric acid. Similar results were reported [33] by using a coating made from 1.5% chitosan and 0.2% tea polyphenols to prolong the storage stability of red drum fillets or using a coating formulation made from 10% whey protein isolate incorporated with 3% oregano oil with MAP conditions [33].

A recent study [33] investigated the effect of edible coatings made of chitosan or nanochitosan with or without clove oil on the shelf life of Mullet fish steaks at refrigerated temperature and found that the shelf life of the fish steaks can be prolonged by using natural edible coatings like chitosan, or nanochitosan as compared to control sample. Also, a combination of nanochitosan and clove oil treatment was more effective in improving the chemical, microbiological and sensory characteristics of the fresh fish steaks than other studied treatments during refrigerated storage at 4°C for 24 days. These findings can be a basis for producers to provide the consumer with fresh fish steaks that have good shelf life at refrigerated temperature.

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Volume 17 Issue 12 December 2022