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RESEARCH ARTICLE

Effectiveness of Edible Coating, Preservation Temperature and Packaging to the Rancidity and Proteolytic Activity in Dried Mudskipper (*Pseudapocryptes Elongatus*)

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Abstract

Mudskipper (*Pseudapocryptes elongatus*) has become a high value species in the markets of Mekong Delta, Viet Nam. Mudskipper aquaculture has potential for coastal aquaculture development and is an alternative to shrimp farming in the Mekong Delta. In terms of nutritional quality of fish, sometimes dry fish have higher quality standards compared to fresh fish. *P. elongatus* aquaculture has developed rapidly to supply the high demand of domestic consumers. Consumption of dried mudskippers fishes has increased during recent years as consumers have become more aware of its nutritional benefits and of the health concerns associated with other meat products. However the dry-salted mudskippers are not stable at normal preservation by rancidity and proteolytic activity because they have too much oil as well as protease enzyme in their abdomen. Edible coating provide a replacement and fortification of the natural layers at the product surfaces to prevent moisture losses, gas aromas and solute movements out of the food, while selectively allowing for controlled exchange of important gases. Biodegradability, barrier properties, biocompatibility, and edibility as well as being nontoxic and non-polluting are a few advantages of edible films and coatings over plastic packages. Preservation temperature and packaging method also influenced to rancidity and proteolytic activity in the dried mudskippers (*Pseudapocryptes elongatus*). Objective of the current research studied the feasibility of sodium alginate coating in preservation of dried mudskipper (*Pseudapocryptes elongatus*). The dried mudskippers were treated by different concentration of sodium alginate (1.0%, 1.5%, 2.0%, 2.5%, 3. 0%). The effectiveness of sodium alginate coating was based on quality changes of dried mudskippers such as lipid oxidation: Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg); proteolytic changes: total volatile base (TVB-N, mg N/100 g) nitrogen content and trimethylamine (TMA, mg N/100 g). All treated samples were monitored during 12 months of storage at ambient temperature in 3 months of interval sampling. Results revealed that the coating of 2.5% w/w sodium alginate, 4^{o}C in vaccum bag could control microbial spoilage and lipid oxidation of the dried mudskippers. By this approach, the dried mudskippers (*Pseudapocryptes elongatus*) are stable at normal environment for 12 months. The study indicated that the edible coating could be commercially utilized to prolong the shelf-life of this oil fish. The improvement in the quality of the seafood products is achieved through inhibition of proteolytic reaction, reduction of lipid oxidation reduction and enhancement of sensorial attributes.

Keywords: *Pseudapocryptes elongatus, Sodium alginate, Proteolytic reaction, Lipid oxidation, Shelf-Life.*

Introduction

Mudskippers (*Pseudapocryptes elongatus*) are widely distributed in the brackish water, rivers, creeks and lagoons and are usually seen during low tide. Mudskipper (*P. elongatus*) is a potential species for coastal aquaculture and easy to farm in intensive or semi-intensive systems during rainy season in the Soc Trang province (Vietnam). The mudskipper (Pseudapocryptes elongatus) inhabits the mudflats of estuaries and tidal zones of rivers [1].

Mudskippers are euryhaline, air-breathing and amphibious species that live on mudflat areas, which imposes environmental challenges by tidal oscillations, extreme shifts and habitat conditions [2].

According to Murdy [3], *P. elongatus* has the capacity to breathe air through its gills, by modified buccopharyngeal and opercular epithelia, and through its skin, but lacks the ability to survive for short periods out of water. *P. elongatus* migrates to the sea to

spawn later in the year after onset of the wet season. *P. elongatus* is remarkably euryhaline and able to survive in salinities ranging from freshwater to 50 ppt. *P. elongatus* is an herbivore, feeding mainly on pennate diatoms [4]. Mudskippers absorb and accumulate many different pollutants released into the coastal environment by industrial, agricultural, domestic and transportation activities. They play an important role in benthic ecology as they prey small crustaceans and graze diatoms and algae from mudflats [5]. Mudskipper population also showed a correlation with mangrove ecosystems which is the primary habitat of mudskippers. Mudskipper can be farmed in diversified culture systems such as monoculture, rotation with shrimp, or integrated with shrimp and mud crab culture.

Mudskippers are important for their biological and eco-toxicological studies and recognized as potentia bio-indicator in environmental monitoring and assessments of coastal waters and tropical or subtropica soft bottom intertidal systems. Mudskippers are very sensitive to ambient environment and this potentia would be beneficial for new researches on this species especially its ecological importance in detectin pollution levels in coastal water ecosystems [6].

Mudskippers are also consumed as food and in preparation of traditional medicines. Mudskipper's flesh can have high nutritive value [7, 8]. It is rich in protein and contains all the essential amino acid in the right proportions and it also contains a good selection of minerals. The fisheries and aquaculture sector is a vital source of livelihoods, nutritious food and economic opportunities.

Fish and fishery products are among the most important agricultural commodities [9]. This species is considered as an alternative species to shrimp farming in rainy season. They are good sources of proteins, macro-nutrients, minerals and some vitamins. The mineral elemental levels and vitamins of this species is a function of the availability preferential accumulation. Aquaculture of *P. elongatus* in the Soc Trang province (Vietnam) has developed rapidly during the past decade due to relatively high demand and high market value [10].

Alginates are naturally occurring, indigestible polysaccharides commonly produced by and refined from various genera of brown algae. Alginate is widely used in various industries such as food, beverage, textile, printing, and pharmaceutical as a thickening agent, stabilizer, emulsifier, chelating agent, encapsulation, swelling, a suspending agent, or used to form gels, films, and membrane [11, 12]. Sodium alginate is the most common salt of alginate [13].

Alginate-based edible coatings and films attract interest for improving/maintaining quality and extending the shelf-life of fruit, vegetable, meat, poultry, seafood, and cheese by reducing dehydration (as sacrificial moisture agent), controlling respiration, enhancing product appearance, improving mechanical properties [14]. Fish processing, especially freezing, has a significant impact on final product quality attributes which are mostly associated with changes in chemical composition and the degradation of muscle proteins.

Functional properties of fish proteins and sensory quality, such as loss of protein solubility, emulsifying capacity, water binding capacity, thaw drip, and texture scores are mostly affected by postharvest handling and the method of preservation. Due to the action of enzymes present in fish products or microbial activities nitrogen compounds such as trimethylamine-N-oxide (TMAO) are degraded to ammonia, formaldehyde and trimethylamine (measured as TMA-N).

These may cause protein aggregation, thus reducing the proteins' ability to bind water [15]. At death, the pH value begins to decrease due to formation of lactic acid from glycogen by a series of enzymatic reaction in the tissues. Certain critical enzymes, particularly phosphofructokinase, are inhibited and pH drops as pyruvate is shunted to lactic acid.

This triggers the release of proteolytic enzymes like cathepsins. Enzymes from spoilage microorganisms produce a wide variety of volatile compounds causing off-flavors. The combined total amounts of ammonia (NH_3) and TMA in fish is measured as the total volatile base (TVB-N) nitrogen content of the fish and is commonly used as an estimate of spoilage. With the increase of

spoilage bacteria after death in fish, a subsequent increase in TMAO reduction to TMA take places. On the other hand, the increase in the TVB-N is mainly caused by the formation of TMA, which is prevalent in spoiled fish that have TMAO (mainly in marine pelagic fish) and is the most common cause of fishy odor. Aeromonas spp., psychrotolerant Enterobacteriaceae, Photo bacterium phosphoreum, Shewanella putrefaciens-like organisms and *Vibrio* spp. are the bacteria that are able to reduce TMAO to TMA [16].

Rancidity is a problem in oily fish associated primarily with frozen and dried storage. Indeed, the shelf-life of frozen oily fish usually ends with the onset of rancid flavors. In canned fish the total elimination of O_2 during processing is sufficient to give these products a shelf-life of many years. In the living animal the ingestion and regeneration of antioxidants prevents excessive oxidative deterioration of important biological components.

Post-mortem, the protective systems become depleted and are unable to regenerate themselves. Thus, the edible muscle tissues of fish are liable to react with O_2 in the presence of air. Generally the preliminary products of fatty acid oxidation (lipid hydroperoxides) do not have a flavor impact and are measured as peroxide value. Volatile secondary oxidation products derived from the breakdown of these lipid hydroperoxides are believed to lead to rancid flavors and aromas. At the same time, an increase in free fatty acid (FFA) lipolysis resulting from the enzymatic hydrolysis of esterified lipids also occurs in fish tissue post-mortem.

The rate of hydroperoxide formation correlates with lipid oxidation in its early stages. Aldehydes, ketones and similar compounds are the secondary products which form as the hydroperoxides react. The reactions lead to aldehydes and other products that can be measured using the thiobarbituric acid (TBARS) test [17].

There were several notable researches mentioned to application of sodium alginate coating in fishes to control oxidation and proteolytic change. Coating with sodium alginate combined with guarantee showed a significant shelf life extension to about 160 h compared with 57 h for unpackaged oysters [18].

Heydari et al [19].Investigated the effect of sodium alginate incorporating horsemint (Monarda punctate) essential oil on the quality of bighead carp fillets during refrigerated storage. This system significantly ($P < 0.05$) retarded the spoilage of the fillets and extended their shelf-life as measured using TVB-N content and lipid oxidation. This coating also reduced the microbial contamination about 1.5 logs CFU/g. Hamzeh, A., & Rezaei, M [20].

Studied the effects of sodium alginate on quality of ainbow trout (*Oncorhynchus mykiss*) fillets stored at 4 ± 2°C. Seyfzadeh, M. et al [21].Examined the chemical, microbiological and sensory evaluation of gutted Kilka coated with whey protein based edible film incorporated with sodium alginate during frozen storage.

In Vietnam, the mudskipper *P. elongatus* is a high value species and has high potential for coastal aquaculture in the Mekong Delta. *P. elongatus* aquaculture has developed rapidly to supply the high demand of domestic consumers. However there was not any research mentioned to the investigation of sodium alginate coating to the dried mudskippers (*Pseudapocryptes elongatus)* as well as the effect of storage temperature and packaging method to lipid oxidation and proteolytic activity.

The aim of this current work was to study the application of sodium alginate coating, storage temperature and method of packaging in maintaining product quality of dried mudskippers (*Pseudapocryptes elongatus).* Coatings can serve as carriers of antioxidative substances to protect against discoloration, degradation and oxidative rancidity.

Material and Method

Material

Mudskipper (*Pseudapocryptes elongatus)* fishes were naturally collected from Vinh Chau district, Soc Trang province, Vietnam. After collecting, they must be kept in ice chest below 4°C and quickly transferred to laboratory for experiments. They were washed and sanitized under washing tank having 30 ppm chlorine with a support of air bubble blowing to remove foreign matters.

Besides black tiger shrimps we also used other material during the research such as chlorine, salt, whey protein isolate, cacboxymethyl cellulose, corn protein, and gelatin.

Lab utensils and equipments included digital weight balance, Rotronic, stomacher, incubator, colony counter, and dry oven.

Figure 1: Mudskippers (*Pseudapocryptes elongatus*)

Researching Method

Lipid Oxidation of Dried Mudskippers (Pseudapocryptes elongatus) by Sodium Alginate Coating during Preservation

Raw mudskippers (*Pseudapocryptes elongatus)* were treated with 2.5% salt, 1.2% sugar, 0.1% monosodium glutamate, 0.25% garlic extract, 0. 3 % honey in 20 minutes. After that they were dried at 55°C to 12% moisture content. Different concentrations of sodium alginate were examined (1.0%, 1.5%, 2.0%, 2.5%, 3.0%) were examined on the dried mudskippers. Lipid oxidation was estimated by Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg). All treated samples were monitored during 12 months of storage at ambient temperature in 3 months of interval sampling.

Proteolytic Changes of Dried Mudskippers (Pseudapocryptes elongatus) by Sodium Alginate Coating during Preservation

Raw mudskippers (*Pseudapocryptes elongatus)* were treated with 2.5% salt, 1.2% sugar, 0.1% monosodium glutamate, 0.25% garlic extract, 0.3% honey in 20 minutes. After that they were dried at 55°C to 12% moisture content.

Different concentrations of sodium alginate were examined (1.0%, 1.5%, 2.0%, 2.5%, 3.0%) were examined on the dried mudskippers. Proteolytic change was estimated by the total volatile base (TVB-N, mg N/100 g) nitrogen content and trimethylamine (TMA, mg N/100 g). All treated samples were monitored during 12 months of storage at ambient temperature in 3 months of interval sampling.

Physico-chemical, Microbial and Sensory Evaluation of Dried Shrimp during Storage

Peroxide value (mEqO2/ kg) was determined using the CDR Food Lab® instrument. Thiobarbituric acid (mg maloaldehyde/ kg) was measured by 1, 1, 3, 3-tetraethoxypropane [22]. Standard methods recommended by Food and Agriculture Organization of the United Nations (FAO, 1986) were used for the determination of total volatile base (TVB-N, mg N/100 g) and trimethylamine (TMA, mg N/100 g).

Statistical Analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Lipid Oxidation and Proteolytic Change of Dried Mudskippers (*Pseudapocryptes elongatus*) by Sodium Alginate Coating during Preservation

Raw mudskippers (*Pseudapocryptes elongatus)* were treated with 2.5% salt, 1.2% sugar, 0.1% monosodium glutamate, 0.25% garlic extract, 0.3% honey in 20 minutes. After that they were dried at 55°C to 12% moisture content. Different concentrations of sodium alginate were examined (1.0%, 1.5%, 2.0%, 2.5%, 3.0%) were examined on the dried mudskippers. Lipid oxidation was estimated by Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg).

Proteolytic change was estimated by the total volatile base (TVB-N, mg N/100 g) nitrogen content and trimethylamine (TMA, mg N/100 g). All treated samples were monitored during 12 months of storage at ambient temperature in 3 months of interval sampling. Results from table 1 and 2 revealed that 2.5% sodium alginate coating could control rancidity in dried mudskippers during 12 month storage.

Table 1: Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg), Total volatile base (TVB-N, mg N/100 g) nitrogen content and Trimethylamine (TMA, mg N/100 g) in dried mudskippers (*Pseudapocryptes elongatus*) by different concentration of sodium alginate coating (1.0%, 1.5%, 2.0%, 2.5%, 3.0%) after 3 months of storage

Sodium alginate concentration	Peroxide value (mEqO2/ kg)	Thiobarbituric acid (mg maloaldehyde/ kg)	TVB-N (mg N/100 g)	TMA (mg N/100 g)
Control	1.45±0.03^{a}	0.84±0.03^{a}	42.31±0.05^{a}	39.43±0.04^{a}
1.0%	0.67±0.01^{b}	0.27±0.02^{b}	31.05±0.08^{b}	24.28±0.02^{b}
1.5%	0.42±0.02^{bc}	0.24±0.01^{bc}	28.40±0.04^{bc}	20.79±0.07^{bc}
2.0%	0.37±0.01^{c}	0.21±0.04^{c}	27.93±0.06^{c}	17.22±0.01^{c}
2.5%	0.29±0.00^{cd}	0.17±0.02^{cd}	26.42±0.02^{cd}	15.69±0.02^{cd}
3.0%	0.26±0.02^{d}	0.15±0.01^{d}	25.91±0.04^{d}	14.73±0.03^{d}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Table 2: Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg), Total volatile base (TVB-N, mg N/100 g) nitrogen content and Trimethylamine (TMA, mg N/100 g) in dried mudskippers (*Pseudapocryptes elongatus*) by 0.25% sodium alginate coating during preservation

Storage (months)	Peroxide value (mEqO2/ kg)	Thiobarbituric acid (mg maloaldehyde/ kg)	TVB-N (mg N/100 g)	TMA (mg N/100 g)
0	0.18±0.02^{c}	0.02±0.01^{c}	11.05±0.03^{c}	5.34±0.02^{c}
3	0.29±0.00^{b}	0.17±0.02^{b}	26.42±0.02^{b}	15.69±0.02^{b}
6	0.31±0.01^{ab}	0.19±0.01^{ab}	27.13±0.02^{ab}	16.22±0.03^{ab}
9	0.33±0.00^{ab}	0.23±0.01^{ab}	27.48±0.04^{ab}	16.94±0.01^{ab}
12	0.34±0.02^{a}	0.24±0.03^{a}	27.94±0.01^{a}	17.25±0.04^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Lipid Oxidation and Proteolytic Change of Dried Mudskippers (*Pseudapocryptes elongatus*) by Preservation Temperature during Preservation

Raw mudskippers (*Pseudapocryptes elongatus)* were treated with 2.5% salt, 1.2% sugar, 0.1% monosodium glutamate, 0.25% garlic extract, 0.3% honey in 20 minutes. After that they were dried at 55^{o}C to 12% moisture content. 2.5% sodium alginate coating was applied for all samples. Different preservation temperature were examined (4^{o}C, 12^{o}C, 20^{o}C, 28^{o}C) were examined on the dried mudskippers. Lipid oxidation was estimated by Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg). Proteolytic change was estimated by the total volatile base (TVB-N, mg N/100 g) nitrogen content and trimethylamine (TMA, mg N/100 g). All treated samples were monitored during 12 months of storage at ambient temperature in 3 months of interval sampling. Results from table 3 and 4 revealed that preservation temperature 4^{o}C could control rancidity in dried mudskippers during 12 month storage

Table 3: Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg), Total volatile base (TVB-N, mg N/100 g) nitrogen content and Trimethylamine (TMA, mg N/100 g) in dried mudskippers (*Pseudapocryptes elongatus*) by different concentration of preservation temperature (4^{o}C, 12^{o}C, 20^{o}C, 28^{o}C) after 3 months of storage

Preservation temperature (^{o}C)	Peroxide value (mEqO2/ kg)	Thiobarbituric acid (mg maloaldehyde/ kg)	TVB-N (mg N/100 g)	TMA (mg N/100 g)
4	0.06±0.02^{c}	0.06±0.03^{c}	19.36±0.09^{d}	11.05±0.04^{d}
12	0.17±0.00^{b}	0.11±0.02^{b}	22.15±0.11^{c}	12.47±0.02^{c}
20	0.21±0.03^{ab}	0.14±0.01^{ab}	24.47±0.05^{b}	13.81±0.06^{b}
28	0.29±0.00^{a}	0.17±0.02^{a}	26.42±0.02^{a}	15.69±0.02^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Table 4: Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg), Total volatile base (TVB-N, mg N/100 g) nitrogen content and Trimethylamine (TMA, mg N/100 g) in dried mudskippers (*Pseudapocryptes elongatus*) by preservation temperature (4^{o}C) during 12 months of storage

Storage (months)	Peroxide value (mEqO2/ kg)	Thiobarbituric acid (mg maloaldehyde/ kg)	TVB-N (mg N/100 g)	TMA (mg N/100 g)
0	0.02±0.01^{d}	0.03±0.01^{c}	11.64±0.03^{d}	8.65±0.02^{d}
3	0.06±0.02^{c}	0.06±0.03^{bc}	19.36±0.09^{c}	11.05±0.04^{c}
6	0.15±0.00^{b}	0.13±0.00^{b}	21.04±0.02^{b}	12.27±0.03^{b}
9	0.19±0.01^{ab}	0.21±0.01^{ab}	21.25±0.01^{ab}	13.11±0.01^{ab}
12	0.23±0.00^{a}	0.26±0.01^{a}	21.32±0.00^{a}	13.86±0.00^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Lipid Oxidation and Proteolytic Change of Dried Mudskippers (*Pseudapocryptes elongatus*) by Packaging Method during Preservation

Raw mudskippers (*Pseudapocryptes elongatus)* were treated with 2.5% salt, 1.2% sugar, 0.1% monosodium glutamate, 0.25% garlic extract, 0.3% honey in 20 minutes. After that they were dried at 55°C to 12% moisture content. 2.5% sodium alginate coating and 4°C of storage were applied for all samples. Different packaging styles (normal, vaccum) were examined on the dried mudskippers. Lipid oxidation was estimated by Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg). Proteolytic change was estimated by the total volatile base (TVB-N, mg N/100 g) nitrogen content and trimethylamine (TMA, mg N/100 g). All treated samples were monitored during 12 months of storage at ambient temperature in 3 months of interval sampling. Results from table 5 and 6 revealed that vaccum packaging could control rancidity in dried mudskippers during 12 month storage.

Table 5:Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg), Total volatile base (TVB-N, mg N/100 g) nitrogen content and Trimethylamine (TMA, mg N/100 g) in dried mudskippers (*Pseudapocryptes elongatus*) by different packaging method (normal and vaccum) after 3 months of storage

Packaging method	Peroxide value (mEqO2/ kg)	Thiobarbituric acid (mg maloaldehyde/ kg)	TVB-N (mg N/100 g)	TMA (mg N/100 g)
Normal	0.06±0.02^{c}	0.06±0.03^{bc}	19.36±0.09^{c}	11.05±0.04^{c}
Vaccum	0.02±0.01^{b}	0.01±0.01^{b}	6.05±0.07^{b}	4.13±0.02^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Table 6: Peroxide value (mEqO2/ kg), Thiobarbituric acid (mg maloaldehyde/ kg), Total volatile base (TVB-N, mg N/100 g) nitrogen content and Trimethylamine (TMA, mg N/100 g) in dried mudskippers (*Pseudapocryptes elongatus*) by vaccum during 12 months of storage

Storage (months)	Peroxide value (mEqO2/ kg)	Thiobarbituric acid (mg maloaldehyde/ kg)	TVB-N (mg N/100 g)	TMA (mg N/100 g)
0	0.01±0.00^{b}	0.00±0.00^{c}	2.19±0.02^{d}	1.44±0.01^{d}
3	0.02±0.01^{b}	0.01±0.01^{c}	6.05±0.07^{c}	4.13±0.02^{c}
6	0.05±0.00^{ab}	0.04±0.01^{b}	7.24±0.03^{b}	5.42±0.02^{b}
9	0.06±0.00^{ab}	0.09±0.01^{ab}	7.85±0.03^{ab}	6.07±0.01^{ab}
12	0.08±0.00^{a}	0.11±0.00^{a}	8.03±0.01^{a}	6.44±0.03^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Dehydration preserves fish by destroying enzymes and removing the moisture necessary for bacterial and mold growth. The deterioration or spoilage of fish flesh is particularly due to bacteria. Fatty fish cannot be dehydrated by ordinary dehydration process, and is not possible to store it in the usual way. Fish oils or fats are drying oils, which rapidly absorb oxygen from the air and harden just as paints harden on exposure to air [10].

Lipid oxidation is one of the major problems in the salted fish. Lipid oxidations negative affect the taste, odor and color of salted fish. One way of extending the shelf life and quality of a salted fish is by vacuum packaging. Vacuum packaging is a way for delaying lipid oxidation (auto oxidation) because of limiting oxygen molecule [23].

Vacuum packaging with chitosan-based edible films significantly reduced trimethylamine and total volatile basic nitrogen and growth of total mesophilic and total psychrophilic aerobic bacterial counts ($P<0.05$) during cold storage at 4°C. Prolonging in shelf life by about 20 days was observed [24].Qiu et al [25].Studied the effects of chitosan and different organic acid on fresh Japanese sea bass fillets. They showed that the TVB-N of the fish fillet samples increased with microorganism growth. Their growth decreased with the treatments and the TVBN also decreased [25]. Cai et al [26].

Evaluated the effects of e-polylysine (PL), sodium alginate (SA) and e-polylysine/sodium alginate (PLSA) treatments on the quality characteristics of Japanese sea bass (Lateolabrax japonicus) during refrigerated storage. They showed that the TVB-N of PL, SA and PLSA treatments were lower than that of the control during storage and the differences became more pronounced in the latter periods of storage ($P < 0.05$) [26].

The effectiveness of edible chitosan coating on the quality changes of Indian oil sardines (Sardinella longiceps) was studied by Mohan et al [27].

They used the volatile bases TMA-N and TVB-N as indices of spoilage. Untreated samples showed a significantly ($P < 0.05$) higher increase in TMA-N and TVB-N on day 5 than those samples treated with chitosan [27]. Rodriguez-Turienzo et al [17].Indicated that whey protein based coatings delayed lipid oxidation of salmon fillets measured using both peroxide values and TBARS. They were helpful with frozen fish with low or high fat including retaining the fish sensory properties sensitive to lipid oxidation [17].

Oxidation rates have been reduced by using different antioxidant (e.g., vitamin C and tea polyphenols) in coatings [28]. The previously discussed work of Li et al. (2013) and Duan et al [29].Are examples of this. The TBARS values after the addition of cinnamon leaf essential oil, vitamin E and other natural antioxidants (i.e., grape seed extracts and tea polyphenols) in chitosan coatings did not provide significant additional antioxidant effects (P-0.05). The chitosan coatings and packaging might have been sufficient to retard lipid oxidation in lingcod (*Ophiodon elongates*) fillets [30]. The work of Kim et al [31].With DMM showed that it had sufficient antioxidant activity to lower TBARS.

Conclusion

Lipid oxidation is responsible for rancidity, development of off-flavors, and the loss of fat soluble vitamins and pigments in many foods, especially in dehydrated foods.

The elimination of oxygen from foods can reduce oxidation, but the oxygen concentration must be very low to have an effect. Lipid oxidation and proteolytic activities accounts for major changes in mudskipper (*Pseudapocryptes elongatus*). Edible coatings are a promising preservation technology for dried fish because they provide good barrier against spoilage and pathogenic microorganisms, limit the lipid oxidation.

The films gas barrier properties contribute to extended shelf life because physicochemical changes, such as color, texture, and moisture, may be significantly minimized. Edible films have been successfully applied as edible material in films and coatings for the quality preservation of different sea foods. The current research showed that 2.5% w/w sodium alginate, $4^{o}C$ in vaccum packaging were appropriated for coating the dried mudskippers for 12 months of storage at ambient temperature.

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