ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

RESEARCH ARTICLE

Effect of Edible Film Glazing to Physico-Chemical, Microbial and Sensory Attributes of Frozen *Pangasius* Fillet

N. P. Minh[1,*], P. X. Mai[2], N. T. T. Trang[3]

1. *Faculty of Food Technology - Biotech, Dong A University, Da Nang City, Vietnam.*
2. *Can Tho University, Can Tho City, Vietnam.*
3. *Kien Giang University, Kien Giang Province, Vietnam.*

***Corresponding Author: N. P. Minh**

Abstract

Pangasius is a type of catfish that is endemic to the waters of Mekong basin in south-east Asia, belongs to the family Pangasiidae. It is generally processed to frozen fillets for domestic consumption and also exported to Europe and USA. Freezing and cold storage is an efficient method which preserves taste and nutritional value. Glazing is a process used to reduce undesirable drying or dehydration of fish during frozen or cold storage. Objective of the current research studied the feasibility of edible coating in maintaing and preserving the chemical, microbial and sensory attributes of frozen *Pangasius* fillet. The frozen *Pangagius* fillets were glazed by different formulas (N_0: control or glazing with clean water; N_1: 3% w/w chitosan and glycerol; N_2: 3% w/w whey protein concentrate and glycerol; N_3: 3% w/w alginate an glycerol; N_4: 3% w/w carrageenan). The chemical quality was based on the analyzed results of ammonia (μNH_3/g) and pH; biogenic amines such as putrescine (mg/kg), cadaverine (mg/kg), histamine (mg/kg), spermine (mg/kg), spermidine (mg/kg); lipid oxidation or malondialdehyde value (mg/kg); microorganism such as Total plate count (cfu/g), *Enterobacteriaceae (*cfu/g*), Coliform* (cfu/g), *E. coli* (cfu/g), *Staphylococus* (cfu/g), *Listeria* (cfu/g), *Salmonella* (cfu/g), *Vibrio* (cfu/g); sensory score. All treated frozen *Pangagius* fillets were tested after 12 months of storage. Results revealed that the incorporation of 3% w/w chitosan and glycerol in ice-glazing could inhibit microbial spoilage and lipid oxidation and therefore maintain the freshness of *Pangasius* fillet during frozen storage. Under the optimal conditions, the shelf-life of *Pangasius* fillet could be extended up to 12 months at −18 °C. The study indicated that the combination treatment with edible coating could be commercially utilized to maintain the freshness and prolong the shelf-life of frozen *Pangasius* fillet.

Keywords: *Frozen, Pangasius fillet, Glazing, chitosan, Glycerol, Whey protein concentrate, Alginate, carrageenan.*

Introduction

Basa, (*Pangasius* bocourti) a freshwater fish, has been increasingly produced and consumed due to its taste and useful nutrients. Vietnam is the largest producer of catfish such as Basa and Sawai (*Pangasius hypophthalmus*) [1]. *Pangasius* is one of world's fastest growing fresh water species in aquaculture [2]. *Pangasius* is now traded to well over 100 countries worldwide as skinless and bone fewer fillets popularly along with portions, steaks, fillets and its added value products [3]. The industry has expanded in terms of production and trade [4]. *Pangasius* fillets are affordable substitute for white fleshed fishes in the western market with ever increasing acceptability and popularity, usually *Pangasius* is served to the European market as skinned and boneless frozen fillets [5]. The *Pangasius* attains body weight of 1.2 to 1.3kg rapidly within a short span of 6 months but usually harvested after 8 months depending on marketability [6]. Characterised by tender and white flesh, absence of fishy odour, firm cooked texture and high nutritive value with excellent sensory attributes has expanded consumer preference for *Pangasius* [7]. Recently, the market of the frozen catfish fillet has been increasing due to its desirable qualities such as easily digestible protein [8]. There is great scope to increase the consumption by developing different value added products

from *Pangasius* due to a mild flavor, white flesh color, firm cooked texture, low fat content [1], easily digestible protein [9] and nutritional properties beneficial for human health [10]. Fillets were characterised by high moisture levels and low crude protein and lipid contents.

Total lipids were characterised by low cholesterol levels, high percentages of saturated fatty acids of total fatty acid and low percentages of polyunsaturated fatty acids of total fatty acids, which were mainly represented by linoleic acid of total polyunsaturated fatty acids. The mineral composition was characterised by high sodium content, probably partially due to the sodium tripolyphosphate used to retain moisture. As regards safety aspects, the quality of the samples analysed was good, with low residue levels of mercury, organochlorine pesticides and polychlorinated biphenyls.

The best method of preserving of seafood is freezing and storing at low temperatures. If properly frozen, seafood retains quality and flavour. Frozen seafood products are imperative since fish products are one of the most highly traded food commodities [11].

Freezing is a means to prevent fish quality deterioration during transportation, storage, retail display, or consumption. The deterioration caused by microbial and enzyme activity can be limited effectively under frozen storage [12]. However, discoloration and destruction of texture caused by the denaturation of proteins and lipid oxidation still occurred during frozen storage [13, 14].

Upon thawing, there is a loss of fluid from the flesh of any fish product, which is explained by the denaturation of protein during the freezing process, which causes the protein to lose its water-binding capacity. Drip loss, or the release at water during thawing, implies nutrient loss. Little drip loss occurs when the products are frozen quickly and stored properly, but if not, excessive drip loss can occur and render making the products unfit for consumption.

One problem encountered by producers of both fresh and frozen seafood is dehydration of product and so the product must be protected from dehydration. Two protective methods are used, usually in combination: glazing and packaging. One particular established technology generally applied during freezing and frozen storage of seafood is the application of a layer of ice on the surface of a frozen product, referred to as ice-glazing [15]. Good packaging prevents the circulation of air over the surface of the product and protects the moisture in the surface layers of the product [16]. The final quality depends on the quality of seafood at the time of freezing as well as other factors during freezing, glazing, cold storage and distribution [17].

Biochemical reactions for example lipids oxidation, reactions due to activities of the fish's own enzymes, and the metabolic activities of microorganisms due to deterioration of food. These activities cause to a short shelf life in fish and other seafood products. Edible coatings from polysaccharides, proteins, and lipids can increase the shelf life of the foods due to their functioning as solute, gas, and vapor barriers.

Biofilm defined a thin continuous layer of polymers on food surfaces which protect food products against the many factors/located on food surface and makes them more difficult to decline. There were several notable researches mentioned to application of biofilms in seafood. The effects of several natural chemicals incorporated alone or in combination in traditional water ice-glazing on the freshness and shelf-life of Pacific saury during frozen storage at -18 °C were investigated.

Pacific sauries were subjected to individual quick freezing followed immediately by dipping into cold tap water (control) or solutions containing nisin, chitosan, phytic acid (single-factor experiment) or their combinations for 10 s at 1 °C and then packaged in polypropylene bags before frozen storage at -18 °C.

The storage duration tested was up to 12 months. Ice-glazing treatments with individual chemicals could significantly ($P < 0.05$) inhibit the accumulation of thiobarbituric acid-reactive substances (TBARS), total volatile basic nitrogen (TVB-N) and histamine as well as the increase in bacterial total viable count (TVC) compared with controls, while the combination treatments gave even better effects [18].

The effect of an edible coating (EC) with 1.5% chitosan as an additive, on common carp (Cyprinus carpio) fillet, was determined evaluating the biochemical, physicochemical, textural, microbiological, and nutritional characteristics periodically during its storage in the freezer (-18°C), observing a decrease in the rate of biochemical reactions related to degradation, hydroperoxides content (HPC) (0.8324 nM hydroperoxides/mg of protein versus 0.5540 nM/mg with regard to the EC sample), as well as protein carbonyl content (PCC) (0.5860 nM versus 0.4743 nM of reactive carbonyl groups/mg of protein of noncoated material), keeping properties for a longer period of time, and a lower protein solubility (7.8 mg of supernatant protein/mg of total protein versus 6.8 mg/mg) and less loss of moisture (8% less, with regard to EC); for the nutritional characteristics of the fillet, lysine is the limiting amino acid in the sample without EC, while leucine is the limiting amino acid for the EC sample.

According to microbial growth, the count was 2.2×10^5 CFU/g of sample in mesophiles versus 4.7×10^4 in the EC sample. The results indicate that the use of EC added with chitosan maintains the quality of the product regarding lipid and protein oxidation until fourth month of storage, maintaining moisture content without variation for at least 3 months, and inhibits microbial growth up to 2 logarithmic units, during five months of frozen storage [19]. A work aimed at evaluating the effect of water glazing and edible coatings of 0.5% w/v and 1.5% w/v chitosan on quality parameters of frozen fish. Samples coated with 1.5% w/v chitosan performed better in maintaining the color of the salmon and controlling microbial contamination of frozen and thawed samples [20]. The aim of this work was to study the feasibility of edible coating in maintaing and preserving the chemical, microbial and sensory attributes of frozen *Pangasius* fillet

Material and Method

Material

Frozen *Pangasius hypophthalmus* fillets were prepared as follow: Whole Alive Fish -> Slaughterring -> Blood Removing -> Filleting -> De-skinning -> Trimming (Fat Removing; Red Meat Removing; Belly-Flap Removing) -> Freezing -> Glazing -> Packing -> Cold Store. They were free of antibiotic residue to ensure food safety. Whole alive fish were collected from An Giang province, Vietnam.

Figure 1: Frozen *Pangasius* fillet

Researching Method

Effect of Edible Film Glazing to Chemical Quality of Frozen Pangasius Fillet during Storage

At the glazing step (before packing and after freezing), the frozen *Pangagius* fillets were glazed by different formulas (N0: control or glazing with clean water; N_1: 3% w/w chitosan and glycerol; N_2: 3% w/w whey protein concentrate and glycerol; N_3: 3% w/w alginate an glycerol; N_4: 3% w/w carrageenan). The chemical quality was

based on the analyzed results of ammonia ($\mu NH_3/g$) and pH; biogenic amines such as putrescine (mg/kg), cadaverine (mg/kg), histamine (mg/kg), spermine (mg/kg), spermidine (mg/kg); lipid oxidation or malondialdehyde value (mg/kg). All treated frozen *Pangagius* fillets were tested after 12 months of storage.

Effect of Edible Film Glazing to Microbial Quality of Frozen Pangasius Fillet during Storage

At the glazing step (before packing and after freezing), the frozen *Pangagius* fillets were glazed by different formulas (N0: control or glazing with clean water; N_1: 3% w/w chitosan and glycerol; N_2: 3% w/w whey protein concentrate and glycerol; N_3: 3% w/w alginate and glycerol; N_4: 3% w/w carrageenan). The microbial quality was based on the analyzed results of Total plate count (cfu/g), *Enterobacteriaceae (*cfu/g*), Coliform* (cfu/g), *E. coli* (cfu/g), *Staphylococus* (cfu/g), *Listeria* (cfu/g), *Salmonella* (cfu/g), *Vibrio* (cfu/g). All treated frozen *Pangagius* fillets were tested after 12 months of storage.

Effect of Edible Film Glazing to Sensory score of Frozen Pangasius Fillet during Storage

At the glazing step (before packing and after freezing), the frozen *Pangagius* fillets were glazed by different formulas (N0: control or glazing with clean water; N_1: 3% w/w chitosan and glycerol; N_2: 3% w/w whey protein concentrate and glycerol; N_3: 3% w/w alginate and glycerol; N_4: 3% w/w carrageenan). The sensory quality was based on the analyzed results of appearance or freeze-burn trace. All treated frozen *Pangagius* fillets were tested after 12 months of storage.

Physico-chemical, Microbial and Sensory Evaluation of Frozen *Pangasius* Fillet during Storage

Ammonia ($\mu NH_3/g$) was determined according to the colorimetric method. The pH values were measured by using a digital pH meter. Biogenic amines such as putrescine (mg/kg), cadaverine (mg/kg), histamine (mg/kg), spermine (mg/kg), spermidine (mg/kg) were determined based on reversephase HPLC. Malondialdehyde value (mg/kg) was determined using the distillation method and a 2-thiobarbituric acid. Microorganism such as Total plate count (cfu/g), *Enterobacteriaceae (*cfu/g*), Coliform* (cfu/g), *E. coli* (cfu/g), *Staphylococus* (cfu/g), *Listeria* (cfu/g), *Salmonella* (cfu/g), *Vibrio* (cfu/g) were determined by 3M-Petrifilm. The sensory score regarding to freeze-burn trace was carried out by selected panel of judges (9 members) rated on a nine point hedonic scale.

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

Effect of Edible Film Glazing to Chemical Quality of Frozen *Pangasius* Fillet during Storage

The deterioration of fish meat during frozen storage depends on many factors such as fish species, storage temperature, time, and enzymatic degradation [21, 22]. Denaturation and aggregation of muscle proteins during frozen storage are associated with the formation of disulfide and the interaction of lipid oxidation products with proteins [11].

Denaturation induced by frozen storage contributed to the decrease in the protein solubility of fish meat. The oxidation of lipid also takes place easily and limits the shelf life of fish during frozen storage [14]. Lipid oxidation is of great concern to the food industries and consumers since it contributes to the development of poor color, odor, and texture as well as reduced nutritional value.

The lipid components of postmortem fish muscle tissue are prone to oxidation because fatty acids of fish lipids are much more unsaturated than those of mammals and birds. Quality changes and muscle discoloration related to lipid oxidation of some fish species have been reported [23, 24].

At the glazing step (before packing and after freezing), the frozen *Pangagius* fillets were glazed by different formulas (N_0: control or glazing with clean water; N_1: 3% w/w chitosan and glycerol; N_2: 3% w/w whey protein concentrate and glycerol; N_3: 3% w/w alginate an glycerol; N_4: 3% w/w

carrageenan). The chemical quality was based on the analyzed results of ammonia ($\mu NH_3/g$) and pH; biogenic amines such as putrescine (mg/kg), cadaverine (mg/kg), histamine (mg/kg), spermine (mg/kg), spermidine (mg/kg); lipid oxidation or malondialdehyde value (mg/kg). All treated frozen *Pangagius* fillets were tested after 12 months of storage. Results revealed in table 1. From table 1, formula (N_1) gave the best result to maintain the chemical quality of frozen *Pangasius* fillet during storage.

Table 1: Effect of edible film glazing to chemical quality of frozen *Pangasius* fillet during storage

Glazing	Before storage	After 12 months of storage				
		N_0	N_1	N_2	N_3	N_4
Ammonia ($\mu NH_3/g$)	0.22 ± 0.01^{d}	0.78 ± 0.01^{a}	0.23 ± 0.02^{d}	0.29 ± 0.01^{c}	0.36 ± 0.03^{bc}	0.42 ± 0.00^{b}
pH	6.15 ± 0.02^{c}	6.29 ± 0.03^{a}	6.16 ± 0.03^{c}	6.18 ± 0.02^{bc}	6.20 ± 0.01^{b}	6.23 ± 0.03^{ab}
Putrescine (mg/kg)	0.84 ± 0.00^{d}	1.34 ± 0.02^{a}	0.84 ± 0.00^{d}	0.87 ± 0.03^{bc}	0.85 ± 0.02^{c}	0.89 ± 0.01^{b}
Cadaverine (mg/kg)	0.34 ± 0.01^{d}	1.16 ± 0.00^{a}	0.34 ± 0.01^{d}	0.38 ± 0.00^{bc}	0.36 ± 0.01^{c}	0.41 ± 0.02^{b}
Histamine (mg/kg),	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Spermine (mg/kg)	0.45 ± 0.01^{d}	1.22 ± 0.03^{a}	0.46 ± 0.02^{cd}	0.51 ± 0.01^{bc}	0.48 ± 0.03^{c}	0.61 ± 0.03^{b}
Spermidine (mg/kg)	1.70 ± 0.02^{d}	2.45 ± 0.01^{a}	1.72 ± 0.00^{cd}	1.84 ± 0.01^{b}	1.79 ± 0.02^{bc}	1.75 ± 0.01^{c}
Malondialdehyde value (mg/kg)	1.20 ± 0.03^{d}	2.68 ± 0.00^{a}	1.23 ± 0.01^{cd}	1.37 ± 0.02^{bc}	1.41 ± 0.00^{b}	1.31 ± 0.02^{c}

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%). N0: control or glazing with clean water; N1: 3% w/w chitosan and glycerol; N2: 3% w/w whey protein concentrate and glycerol; N3: 3% w/w alginate an glycerol; N4: 3% w/w carrageenan)

A study evaluated the chemical quality parameters regarding frozen *Pangasius hypophthalmus* specimens from Vietnam. The proximate composition, pH, ammonia, biogenic amines (BAs), total mercury (Hg), malondialdehyde (MDA), and polyphosphate were determined. The moisture, protein, lipid and ash values were between 83.83-85.59, 12.51-14.52, 1.09-1.65, and 0.76-2.38 g 100 g-1, respectively.

Fraud by excessive polyphosphate addition was detected in 30% of the samples whereas Hg above the recommended limit was observed in 50% of the samples. With regard to compounds from the degradation process, low concentrations of individual BAs and pH values were found in this study and ranged from 5.88 to 6.18, except for samples with polyphosphate >1 g 100^{-1} (pH > 7.00) were observed in the present study.

However, ammonia concentration indicated that a degradation process initiated in 80% of the samples (0.12-0.34 NH3 g^{-1}) and 20% of the samples (1.87-1.94 µg NH3 g^{-1}) were in an advanced deterioration process. Furthermore, MDA values (1.21-7.88 mg kg^{-1}) suggested some failures, mainly during transportation and/ or storage [25]. Biogenic amines are formed in fish after their death, due to decarboxylation of amino acids. Those reactions are mediated by exogenous decarboxylation enzymes, produced by bacteria growing in the fish flesh or through endogenous decarboxylation enzymes, which occur naturally in fish muscle [26, 27]. The biogenic amines intoxication is mostly related to histamine poisoning.

The symptoms of such intoxication usually occur shortly after consumption of meal and last for few hours. The most common clinical manifestations of histamine poisoning are diarrhea, nausea, vomiting, rash, headaches, edema, hypotension, flushing and palpitations [28].

Although the histamine formation is more closely related to scombroid fish species, the research performed on fish fillets acquired from restaurants in Czech Republic showed that the hazard of histamine poisoning associated with consumption of *Pangasius* fillets imported to European Union is real [29].Guimarães et al [30].Evaluated the chemical quality parameters regarding frozen P. hypophthalmusfillets from Vietnam. The authors reported presence of mercury (Hg) and malondialdehyde (MDA) hazardous compounds in more than 50% of studied samples along with detrimental compounds. Suggested the need for quality control points in production chain to promote product standardization for safer food supply chain. Mohan et al [31].

Assessed the effectiveness of O_2 scavenger on shelf life of *Pangasius* catfish steaks during chilled storage. Results showed that O_2 scavenger reduced the oxygen content by 99.58% within 24h in packages. O_2 scavenger packaged steaks maintained chemical (pH, TVB-N, TMA-N, TBA and PV), physical (drip loss and water holding capacity), microbial (total mesophilic and psychrotrophic counts),

sensory qualities and lipid oxidation was reduced significantly, which extended the

shelf life of steaks upto 20 days in comparison to air pack which had half the life 10 days. The effect of chitosan on shelf life of restructured fish products from *Pangasius* (*P. hypophthalmus*) surimi during chilled storage were studied by Jeyakumari et al [2].

In which restructured products were prepared from *Pangasius* surimi by incorporation of chitosan subjected to qualities analysis under chilled storage and results from the study indicated that chitosan coating could be used as a natural ingredient to prevent lipid oxidation in surimi based food systems for the development of novel healthy fish products. Physicochemical changes of Basa fish (*Pangasius* bocourti) fillet during frozen storage at-20°C for 0-20 weeks were studied.

The content of thiobarbituric acid reactive substances (TBARS) of fish samples suddenly increased when the samples were stored longer than 8 weeks. The increase in TBARS value of the fish fillet was concomitant with the increase in value (yellow color). Marked decreases in Ca^{2+}-ATPase activity, sulfhydryl content, and protein solubility of the fish fillet after 8 weeks of storage were observed.

Those decreasing values were well correlated with the increasing of disulfide bond content and surface hydrophobicity content. Increases in sheer force of fish meat during storage were also observed. The results indicated that frozen storage at -20°C affected on Basa fillet qualities, especially after 8 weeks of storage [32].

Effect of Edible Film Glazing to Microbial Quality of Frozen *Pangasius* Fillet during Storage

Edible coatings can improve the quality of fresh, frozen, and processed seafood products [33]. At the glazing step (before packing and after freezing), the frozen *Pangagius* fillets were glazed by different formulas (N0: control or glazing with clean water; N_1: 3% w/w chitosan and glycerol; N_2: 3% w/w whey protein concentrate and glycerol; N_3: 3% w/w alginate and glycerol; N_4: 3% w/w carrageenan).

The microbial quality was based on the analyzed results of Total plate count (cfu/g), *Enterobacteriaceae (*cfu/g*), Coli form* (cfu/g), *E. coli* (cfu/g), *Staphylococus* (cfu/g), *Listeria* (cfu/g), *Salmonella* (cfu/g), *Vibrio* (cfu/g). All treated frozen *Pangagius* fillets were tested after 12 months of storage. Results revealed in table 2. From Table 2, formula (N_1) also gave the best result to maintain the microbial quality of frozen *Pangasius* fillet during storage.

Table 2: Effect of edible film glazing to microbial quality of frozen *Pangasius* fillet during storage

Glazing	Before storage	After 12 months of storage				
		N_0	N_1	N_2	N_3	N_4
Total plate count (cfu/g)	$1.2x10^3$ $\pm0.01^d$	$2.3x10^4$ $\pm0.02^a$	$0.6x10^3$ $\pm0.00^e$	$1.6x10^3$ $\pm0.03^{bc}$	$1.7x10^3$ $\pm0.02^b$	$1.4x10^3$ $\pm0.00^c$
Enterobacteriaceae *(*cfu/g*)*	$2.2x10^1$ $\pm0.02^d$	$6.17x10^2$ $\pm0.03^a$	$0.8x10^1$ $\pm0.01^e$	$2.4x10^1$ $\pm0.02^{bc}$	$2.7x10^1$ $\pm0.03^b$	$2.3x10^1$ $\pm0.02^c$
Coliform (cfu/g)	$1.7x10^1$ $\pm0.00^d$	$3.4x10^2$ $\pm0.02^a$	$0.5x10^1$ $\pm0.03^e$	$2.1x10^1$ $\pm0.00^{bc}$	$2.4x10^1$ $\pm0.02^b$	$1.9x10^1$ $\pm0.03^c$
E. coli (cfu/g)	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Staphylococus (cfu/g)	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Listeria (cfu/g)	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Salmonella (cfu/g)	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Vibrio (cfu/g)	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected

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%). N0: control or glazing with clean water; N1: 3% w/w chitosan and glycerol; N2: 3% w/w whey protein concentrate and glycerol; N3: 3% w/w alginate an glycerol; N4: 3% w/w carrageenan)

Microbiological contamination is one of the most important spoilage mechanisms in fish deterioration. The research performed by Tong Thi, et al[34].Showed that frozen fillets from *Pangasius* processed in Vietnam can be contaminated with *Escherichia coli, Staphylococcus aureus* and even *Vibrio cholera*, despite the fact, that the processing plant had implemented food safety management systems, such as HACCP, BRC

and IFS. Some research indicated that those bacteria can also be present in *Pangasius* flesh [35, 36]. Kumari et al [37].Developed *Pangasius* steaks by sous-vide technology with its process optimization.

Results suggested suitable combination of chitosan and spices. Which enhanced antimicrobial and oxidative stability. Chitosan concentration of 1.08 %, temperature of 70.93° C and cooking time of 16.48 min as optimised conditions for sousvide processing of *Pangasius* steaks.

Effect of Edible Film Glazing to Sensory Score of Frozen *Pangasius* Fillet During Storage

Edible coatings can help prevent physical damage, enhance appearance, and reduce microbial growths so that they can be a cost-effective alternative to the modified atmosphere packaging [38]. At the glazing step (before packing and after freezing), the frozen *Pangagius* fillets were glazed by different formulas (N0: control or glazing with clean water; N_1: 3% w/w chitosan and glycerol; N_2: 3% w/w whey protein concentrate and glycerol; N_3: 3% w/w alginate and glycerol; N_4: 3% w/w carrageenan). The sensory quality was based on the analyzed results of appearance or freeze-burn trace. Results revealed in table 3. From table 3, formula (N_1) also gave the best result to maintain the sensory attribute of frozen *Pangasius* fillet during storage.

Table 3: Effect of edible film glazing to sensory attribute of frozen *Pangasius* fillet during storage

Glazing	Before storage	After 12 months of storage				
		N_0	N_1	N_2	N_3	N_4
Sensory score	8.85 ± 0.01^{a}	8.21 ± 0.01^{c}	8.83 ± 0.02^{a}	8.79 ± 0.01^{ab}	8.74 ± 0.03^{ab}	8.70 ± 0.00^{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%). N0: control or glazing with clean water; N1: 3% w/w chitosan and glycerol; N2: 3% w/w whey protein concentrate and glycerol; N3: 3% w/w alginate an glycerol; N4: 3% w/w carrageenan)

Even frozen, seafood remains a sensitive product that loses its quality during storage due to the exudate, lipid oxidation, and cold burn. In order to reduce these problems, processing industries use technological procedures, such as the glazing process [39]. Glazing is a widespread method that wraps the seafood in a thin layer of ice, protecting the product from oxygen and dehydration, and promoting an increase in shelf life [40, 15, 41, 42].

A research compared the effect of chitosan solutions on frozen salmon preservation with that of water glazing. For this purpose, three chitosan solutions (0.25%, 0.50% and 0.75% w/v) and water were applied in different amounts (6%, 8% and 11% of coated fillet weight) directly on the surface of frozen salmon.

In order to accelerate the deterioration processes, salmon was stored during 14 weeks at 5 C. Microbial and chemical indices were used to assess deterioration during storage and the coating stability was evaluated through weight loss measurements.

The results obtained showed that chitosan coatings can be a good barrier to protect frozen fish from deterioration. Microbial growth, assessed by total viable counts (TVC), and total volatile basic nitrogen (TVB-N) were maintained below the maximum limits recommended which are 5 10^5 CFU/g and 35 mg nitrogen/100 g fish, respectively. The use of 0.50% and 0.75% chitosan solutions generally demonstrated to be more efficient in preventing salmon weight loss [20].

Conclusion

Pangasius hypophthalmus is a freshwater fish in Mekong river. *Pangasius* fillets are value added product made by separating meat from thorns, skins and other unwanted material which is then frozen stored. Fillets are advantageous as they are easily processed and consumed food materials as a whole. They also require very less storage space due to their flat shape, which makes them easy to stack.

Preparing and marketing value added fillets from *Pangasius* fish is more economical and easy. Glazing is a process used to reduce undesirable drying or dehydration of fish during frozen or cold storage. Excessive drying during frozen storage results in freezer burn and a decrease in fish quality.

Adequate glazing of fish fillets prior to frozen storage protects the final product from

dehydration, oxidation and quality loss. Excessive glazing on the other hand may significantly affect the economic value and end user satisfaction of frozen fish fillets. 3% w/w chitosan and glycerol was appropriated for glazing frozen *Pangasius* fillet for 12 months in cold storage.

References

1. Orban E, Nevigato T, Di Lena G, Masci M, Casini I, Gambelli L, Caproni R (2008) New trends in the seafood market. Sutchi catfish (Pangasius hypophthalmus) fillets from Vietnam: nutritional quality and safety aspects. Food Chemistry, 110(2): 383-389.
2. Jeyakumari A, George Ninan, Joshy CG, Parvathy U, Zynudheen AA, Lalitha KV (2016) Effect of chitosan on shelf life of restructured fish products from Pangasius (Pangasianodon hypophthalmus) surimi during chilled storage. J. Food Sci. Technol., 53(4): 2099-2107.
3. Thi ANT, Noseda B, Samapundo S, Nguyen BL, Broekaert K, Rasschaert G, Devlieghere F (2013) Microbial ecology of Vietnamese Tra fish (Pangasius hypophthalmus) fillets during processing. International journal of food microbiology, 167(2): 144-152.
4. N Rathod, AU Pagarkar, KH Pujari, PE Shingare, SB Satam, GG Phadke, BV Gaikwad (2018) Status of valuable components from Pangasius: A Review. International Journal of Current Microbiology and Applied Sciences, 7(4): 1-15.
5. Noseda B, Islam MT, Eriksson M, Heyndrickx M, Reu KD, Langenhove HV, Devlieghere F (2012) Microbiological spoilage of vaccum and modified atmosphere packaged Vietnames Pangasisu hypophthalmus fillets. Food Microbiol., 30: 408-419.
6. Gurung, S, Shrestha, S, Karki J (2016) Value chain of Pangasius (Pangasius hypopthalmus) in Rupandehi and Nawalparasi districts of Nepal. Int. J. Life. Sci. Scienti. Res., 2(6): 712- 728.
7. Rao BM, Murthy NL, Prasad MM (2013) Shelf life of chill stored Pangasius (Pangasianodon hypophthalmus) fish fillets: effect of vacuum and polyphosphate. Indian J. Fish., 60(4): 93-98.
8. D Wang, Y-HP Hsieh (2016) The use of imported Pangasius fish in local restaurants. Food Control, 65: 136-142.
9. Thammapat P, Raviyan P, Siriamornpun S (2010) Proximate and fatty acids composition of the muscles and viscera of Asian catfish (Pangasius bocourti). Food Chemistry, 122(1): 223- 227.
10. Usydus Z, Szlinder-Richert J, Adamczyk M, Szatkowska U (2011) Marine and farmed fish in the Polish market: Comparison of the nutritional value. Food Chemistry, 126(1): 78-84.
11. Y Kobayashi, JW Park (2017) Biochemical and physical characterizations of fish protein isolate and surimi prepared from fresh and frozen whole fish, LWT 77: 200-207.
12. Q Liu, B Kong, J Han, Q Chen, X He (2014) Effects of superchilling and cryoprotectants on the quality of common carp (Cyprinus carpio) surimi: microbial growth, oxidation, and physiochemical properties. LWT - Food Science and Technology, 57(1): 165-171.
13. S Benjakul, N Sutthipan (2009) Muscle changes in hard and soft shell crabs during frozen storage. LWT - Food Science and Technology, 42(3): 723-729.
14. A Thanonkaew, S Benjakul, W Visessanguan, EA Decker (2008) The effect of antioxidants on the quality changes of cuttlefish (Sepia pharaonis) muscle during frozen storage. LWT - Food Science and Technology, 41(1): 161-169.
15. Vanhaecke L, Verbeke W, Brabander HF (2010) Glazing of frozen fish: Analytical and economic challenges. Analytica Chimica Acta, 672: 40-44.
16. Hülya Turan, Yalçın Kaya, Ibrahim Erkoyuncu (2003) Effects of glazing, packaging and phosphate treatments on drip loss in rainbow trout (Oncorhynchus mykiss W., 1792) during frozen storage. Turkish Journal of Fisheries and Aquatic Sciences, 3: 105-109.
17. Tania Manso, Luis Teixeira, Paula M, Reis Correia (2013) Frozen fish: Control of glazing operation. International Scholarly and Scientific Research & Innovation, 7(7): 600-604.

18. Haibo Luo, Weihua Wang, Wei Chen, Haiqing Tang, Li Jiang, Zhifang Yu (2018) Effect of incorporation of natural chemicals in water ice-glazing on freshness and shelf-life of Pacific saury (Cololabis saira) during −18 °C frozen storage. Journal of the Science of Food and Agriculture, 98(9): 3309-3314.

19. Ana Gabriela Morachis-Valdez, Leobardo Manuel Gómez-Oliván, ImeldaGarcía-Argueta, María Dolores Hernández-Navarro, Daniel Díaz-Bandera, and Octavio Dublán-García (2017) Effect of chitosan edible coating on the biochemical and physical characteristics of carp fillet (Cyprinus carpio) stored at-18°C. International Journal of Food Science, Article ID 2812483, 10.

20. Nuno Soares, Tânia Filipa S Mendes, António Augusto Vicente (2013) Effect of chitosan-based solutions applied as edible coatings and water glazing on frozen salmon preservation – A pilot-scale study. Journal of Food Engineering, 119(2): 316-323.

21. C Kong, H Wang, D Li (2016) Quality changes and predictive models of radial basis function neural networks for brined common carp (Cyprinus carpio) fillets during frozen storage. Food Chemistry, 201: 327-333.

22. L Shi, T Yang, G Xiong (2018) Influence of frozen storage temperature on the microstructures and physicochemical properties of pre-frozen perch (Micropterus salmoides). LWT, 92: 471-476.

23. S Rawdkuen, A Jongjareonrak, S Benjakul, S Chaijan (2008) Discoloration and lipid deterioration of farmed giant catfish (Pangasianodon gigas) muscle during refrigerated storage. Journal of Food Science, 73(3): 179-184.

24. S Kunnath, M Lekshmi, MK Chouksey, N Kannuchamy, V Gudipati (2015) Textural quality and oxidative stability of restructured Pangasius mince: effect of protein substrates mediated by transglutaminase. Journal of Food Science and Technology, 52(1): 351-358.

25. Carlos Frederico Marques Guimarães, Eliane Teixeira Mársico, Maria Lúcia Guerra Monteiro, Môsar Lemos, Sergio Borges Mano, Carlos Adam Conte Junior (2016) The chemical quality of frozen Vietnamese Pangasius hypophthalmus fillets. Food Science & Nutrition, 4(3): 398-408.

26. Halász A, Baráth Á, Simon-Sarkadi L, Holzapfel W (1994) Biogenic amines and their production by microorganisms in food. Trends in Food Science & Technology, 5: 42-49.

27. Santos MHS (1996) Biogenic amines: their importance in foods. International Journal of Food Microbiology 29: 213-231.

28. Lehane L, Olley J (2000) Histamine fish poisoning revisited. International Journal of Food Microbiology, 58: 1-37.

29. Buňka F, Budinský P, Zimáková B, Merhaut M, Flasarová R, Pachlová V, Kubáň V and Buňková L (2013) Biogenic amines occurrence in fish meat sampled from restaurants in region of Czech Republic. Food Control, 31: 49-52.

30. Guimarães CFM, Mársico ET, Monteiro MLG, Lemos M, Mano SB, Junior CAC (2015) The chemical quality of frozen Vietnamese Pangasius hypophthalmus fillets. Food Sci. & Nutri. Published by Wiley Periodicals, Inc. 1-11.

31. Mohan CO, Chandragiri NR, Teralandur KS (2008) Effect of O_2 scavenger on the shelf-life of catfish (Pangasius sutchi) steaks during chilled storage. J. Sci. Food Agric., 88:442-448.

32. Pornpimol Sriket, Thamarak La-ongnual (2018) Quality changes and discoloration of basa (Pangasius bocourti) fillet during frozen storage. Journal of Chemistry, Article ID 5159080, 7.

33. Zeinab Noorihashemabad, Seyed Mehdi Ojagh, Alireza Alishahi (2015) A comprehensive surviving on application and diversity of biofilms in seafood. International Journal of Biosciences, 6(3): 15-30.

34. Tong Thi A, Jacxsens L, Noseda B, Samapundo S, Nguyen B, Heyndrickx M, Devlieghere F (2014) Evaluation of the microbiological safety and quality of Vietnamese Pangasius hypophthalmus during processing by a microbial assessment scheme in combination with a self-assessment questionnaire. Fisheries Science, 80: 1117-1128.

35. Noorlis A, Ghazali F, Cheah YK, Tuan Zainazor T, Tunung R, Pui C, Nishibuchi

M, Nakaguchi Y, Son R, Ponniah J, Tang J (2011a) Prevalence and quantification of Vibrio species and Vibrio parahaemolyticus in freshwater fish at hypermarket level. International Food Research Journal, 18: 689-695.

36. Noorlis A, Ghazali F, Cheah YK, Tuan Zainazor T, Wong W, Tunung R, Pui C, Nishibuchi M, Nakaguchi Y and Son R (2011b) Antibiotic resistance and biosafety of Vibrio cholerae and Vibrio parahaemolyticus from freshwater fish at retail level. International Food Research Journal, 18: 1523-1530.
37. Kumari N, Singh CB, Kumar R, Xavier KM, Lekshmi M, Venkateshwarlu G, Balange AK (2016) Development of Pangasius steaks by improved sous-vide technology and its process optimization. Journal of Food Science and Technology, 53(11): 4007- 4013.
38. Wenjiao F, Yongkui Z, Pan D, Yuwen Y (2013) Effects of chitosan coating containing antioxidant of bamboo leaves on qualitative properties and shelf life of silver carp during chilled storage. Czech J. Food Sci., 31: 451-456.
39. Gonçalves AA, Gindri Jr, CSG (2009) The effect of glaze uptake on storage quality of frozen shrimp. J. Food Eng., 90: 285-290.
40. Gonçalves AA, Ribeiro JLD (2008) Optimization of the freezing process of red shrimp (Pleoticus muelleri) previously treated with phosphates. Int. J. Refrig., 31: 1134-1144.
41. Soares NM, Mendes TS, Vicente AA (2013) Effect of chitosan-based solutions applied as edible coatings and water glazing on frozen salmon preservation-A pilot-scale study. J. Food Eng., 119: 316-323.
42. Solval KM, Rodezno LAE, Moncada M (2014) Evaluation of chitosan nanoparticles as a glazing material for cryogenically frozen shrimp. LWT - Food Sci. Tech., 57: 172-180.

