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Research Article

EFFECT OF STORAGE TEMPERATURES ON THE QUALITY OF PINK PERCH SURIMI

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ABSTRACT

A detailed investigation on microbiological, biochemical and organoleptic quality changes in frozen surimi of pink perch (Nemipterus japonicus) stored at ambient (25±5°C), refrigerated (5±3 °C) and at frozen temperatures (-10±2 °C), was carried out. Bacterial count, trimethylamine and total volatile nitrogen values increased with storage time while, organoleptic score decreased. Nutrient contents and gel strength of surimi decreased while, moisture and whiteness increased with storage period. Results indicated that at ambient temperature, frozen surimi can be stored only for about 8 hrs, while at refrigerator temperature up to 5 days and at frozen temperature up to 60 days.

Keywords: Pink pearch, minced meat, surimi, frozen storage

INTRODUCTION

Fish processing industries in India concentrated on production of frozen prawns from the beginning because of lucrative export market for prawns, which resulted only limited attention towards utilization of other varieties of fish and shellfish. In the past few years, the fish processing industries attempted to convert less valued fish into minced meat which is the raw material for various ready-to-cook and ready-to-eat products. The minced fish meat is stored and exported in the form of Surimi. Surimi is a washed, refined fish mince by incorporating small percentage of sucrose, sorbitol and phosphates which appear to act as cryoprotectants [1]. Surimi provided great opportunity for preparation of high quality food products. It also provides a means of utilization of underutilized fishes, which have no market value as whole fish or fillet. Croaker, pink perch, ribbonfishes, small soles etc. were used for production of minced meat.

Several attempts have been made to study the quality changes in surimi and surimi based products of different fish species. Studies on frozen storage of surimi containing microbial transglutaminase made from walleye pollock, white croaker, big eye, lizard fish, large head hair tail, hachibiki and sardine was conducted by [2]. Correlation of chemical parameters in cod surimi was investigated by [3]. Similarly the changes in surimi of white hake (Urophycis tenuis) were studied [4]. Bacterial profile of fresh and spoiled surimi from Johnius dussumieri at refrigerated storage was reported [5]. The effect of quality changes during iced storage on the gel properties of lizard fish surimi was studied [6].

However, very little work is available on quality changes in frozen surimi of pink perch (Nemipterus japonicus). The present paper deals with changes occurring in surimi of pink perch at ambient, refrigerated and frozen temperatures in relation to microbiological, biochemical and organoleptic characteristics.

MATERIALS AND METHODS

Fresh pink perch was procured from the local fish market and transported in iced condition to the processing laboratory. After dressing, cleaning and washing using chilled water the meat picking was done with the help of stamping type fish meat separator. Later the meat was minced and surimi was prepared by incorporating cryoprotectants such as sugar 5% and sodium tripolyphosphate 0.2%. Surimi samples weighing 1Kg each were packed in Polyethylene bags and 30 such packs were made. They were divided into 3 groups viz; Group-1: Ten samples for storing at room temperature (25±5°C), Group-2: Ten samples for refrigerated temperature (5±3°C), while Group-3: Ten samples for frozen temperature (-10 ±2 °C). The samples at room temperature were analysed initially at three hours interval and thereafter at an interval of two hrs, while samples at refrigerated and frozen temperatures were analysed after one and ten days of storage respectively for microbiological, biochemical and organoleptic characteristics.

Microbiological examination for total plate count and estimates of non-protein nitrogen, free-alpha amino nitrogen, total volatile nitrogen and trimethylamine nitrogen were carried out as per standard methods [7],[8]. Organoleptic scoring was done according to the American Society for Testing Materials [9]. An experienced taste panel consisting of ten members conducted organoleptic evaluation. Scores were given on the scale ranging from 10 to 1, 10 for extremely good and 1 for extremely spoiled meat. Proximate composition of surimi for estimation of protein, lipid, ash and moisture contents was done as per [10]. Gel strength and whiteness of surimi were estimated by the Japanese standard test procedures [11],[12]. Electronic rheometer was used for determination of gel strength. The heat induced gels were cut into 3 cm height cylindrical specimens. The breaking force and breaking distance were determined with a 5.0 mm diameter spherical head plunger to press into one end of each specimen by a rheometer. The breaking force (g) and breaking distance (mm) were displayed on the respective screens of rheometer and gel strength expressed in g x cm. Whiteness measurement of gelled surimi samples were carried out with a portable colorimeter and expressed in degree.

RESULTS AND DISCUSSION

Data on bacteriological, bio-chemical and organoleptic changes of pink perch surimi stored at three different temperatures are presented in Tables 1 to 3. At ambient temperature, the total plate count of bacteria increased from 1.23 X 103 to 2.5 X 106 in 14 hrs (Table 1).

The high water and protein contents of surimi with neutral pH is an ideal medium for bacterial growth. The optimum growth of bacteria is reported at temperature of 25±5°C but they have the ability to grow at refrigerated temperatures also at lower rate [13]. Others reported an increase in TPC count of surimi from 1.4 x 102 to 6 x 103 during storage at room temperature (28° C) [14]. The organoleptic score in the present investigation fell from 10 to 3 while non-protein nitrogen, total volatile nitrogen, trimethylamine nitrogen and free alpha amino nitrogen values increased from 39.4 to 57.73, 6.10 to 10, 0.8 to 15.12 and 3.57 to 5.50 mg% respectively.

Table1: Changes in quality of pink perch surimi at ambient temperature (25±5°C).

Duration (Hrs)	Promimate composition				Microbiological		Biochemical						Organoleptic		
	Moisture	Protein	Fat	Ash	TPC (cfu/g)	OP	TN g%	NPN mg%	TVN mg%	TMAN mg%	pH	AAN mg%	Organoleptic Score	Gel. Strength (Gm. cm)	Whiteness (Degree)
0	76.56	20.83	0.25	1.55	1.23×10^3	Nil	3.33	39.46	6.1	0.88	7.27	3.57	10	211.07	59.6
3	77.82	19.52	0.34	1.61	1.34×10^3	Nil	3.12	41.25	6.4	1.05	7.27	3.89	0.8	100.12	59.6
6	79.71	18.19	0.43	1.65	1.50×10^5	Nil	2.98	43.33	6.6	1.16	7.12	4.53	7	53.46	60.1
8	80.27	17.56	0.51	1.68	2.08×10^5	Nil	2.86	45.16	7.1	3.35	7.03	4.81	6.5	18.68	62.5
10	83.43	16.88	0.65	1.73	5.8×10^5	Nil	2.75	49.54	8.2	6.15	6.83	5.08	5	15.24	63.1
12	84.01	15.94	0.74	1.75	1.0×10^6	Nil	2.55	54.71	8.6	9.86	6.75	5.31	4	11.22	64.33
14	84.08	15.82	0.81	1.78	2.5×10^6	Nil	2.43	57.73	10	15.12	6.13	5.56	3	No	65.23

TPC: Total Plate Count; OP: Other pathogen such as *Streptococcus. Staphylococcus, E-coli* and *Salmonella* TN: Total Nitrogen; NPN: Non-protein Nitrogen; TVN : Total Volatile Nitrogen, TMAN: Trimethyl Amine Nitrogen. AAN: Alpha-Amino Nitrogen

Table2: Changes in quality of pink perch surimi at regrigerated temperature (5±3°C).

Duration (Hrs)	Promimate composition				Microbiological		Biochemical						Organoleptic		
	Moisture	Protein	Fat	Ash	TPC (cfu/g)	OP	TN g%	NPN mg%	TVN mg%	TMAN mg%	pH	AAN mg%	Organoleptic Score	Gel. Strength (Gm. cm)	Whiteness (Degree)
0	76.5	20.83	0.25	1.55	1.23×10^3	Nil	3.33	39.42	6.1	0.88	7.27	3.57	10	211.07	59.6
1	79.5	19.92	0.35	1.65	1.49×10^3	Nil	3.18	41.25	6.5	1.12	7.01	3.95	9	133.89	60.1
2	81.0	18.75	0.48	1.72	1.80×10^3	Nil	3.16	42.35	6.7	2.57	6.2	4.63	8	125.55	60.3
3	81.3	17.81	0.56	1.75	3.50×10^4	Nil	2.85	43.54	7.5	3.41	6.02	4.95	8.5	117.79	60.6
4	82.1	16.44	0.71	1.78	2.90×10^5	Nil	2.63	45.15	8.4	4.35	5.37	5.21	7	101.23	61.2
5	83.2	15.69	0.79	1.81	3.01×10^5	Nil	2.51	48.28	9.5	9.53	4.79	5.41	6.5	59.69	62.4
6	85.0	15.12	0.91	1.83	4.70×10^6	Nil	2.42	51.26	10	16.5	4.53	5.65	5	44.03	62.3

TPC: Total Plate Count; OP: Other pathogen such as Streptococcus. Staphylococcus, E-coli and Salmonella TN: Total Nitrogen; NPN: Non-protein Nitrogen; TVN : Total Volatile Nitrogen, TMAN: Trimethyl Amine Nitrogen. AAN: Alpha-Amino Nitrogen

Table3: Changes in quality of pink perch surimi at frozen temperature (-10±2°C).

Duration (Hrs)	Promimate composition				Microbiological		Biochemical						Organoleptic		
	Moisture	Protein	Fat	Ash	TPC (cfu/g)	OP	TN g%	NPN mg%	TVN mg%	TMAN mg%	pH	AAN mg%	Organoleptic Score	Gel. Strength (Gm. cm)	Whiteness (Degree)
0	76.5	20.83	0.25	1.55	1.21×10^3	Nil	3.33	39.43	6.1	0.85	7.27	3.57	10	211.07	59.6
1	74.3	19.70	0.33	1.63	3.26×10^4	Nil	315	41.31	6.47	1.16	7.07	3.91	8	200.11	60.8
2	75.5	18.43	0.45	1.68	4.22×10^4	Nil	2.95	43.45	6.5	2.34	7.08	4.55	7	185.75	61.5
3	76.4	17.68	0.53	1.72	5.34×10^4	Nil	2.83	45.13	6.9	4.47	7.09	4.93	6	166.97	62.4
4	78.9	16.56	0.68	1.75	1.0×10^5	Nil	2.65	49.62	8.2	7.25	6.96	5.56	5	158.93	67.2
5	79.1	16.25	0.75	1.78	2.5×10^5	Nil	2.64	53.84	9.2	8.77	6.93	5.35	4	120.22	62.5
6	80.2	15.77	0.85	1.81	4.7×10^5	Nil	2.51	55.55	11.1	9.85	6.52	5.55	3	100.16	63.6
7	83.2	14.71	0.92	1.85	6.5×10^6	Nil	2.35	58.61	13.4	15.23	5.76	5.48	2	80.24	61.4

TPC: Total Plate Count; OP: Other pathogen such as Streptococcus. Staphylococcus, E-coli and Salmonella TN: Total Nitrogen; NPN: Non-protein Nitrogen; TVN : Total Volatile Nitrogen, TMAN: Trimethyl Amine Nitrogen. AAN: Alpha-Amino Nitrogen

The increased activities of proteolytic enzymes and bacteria are reported to be responsible for sharp increase of non-protein nitrogen (NPN), free alpha amino nitrogen, total volatile nitrogen (TVN) and trimethylamine nitrogen (TMA) and to certain extent due to action of trimethylamine oxide (TMAO) oxyductase on the product [5], [15]. The autolytic degradation products such as total volatile nitrogen (TVN), trimethylamine (TMA) and free alpha amino acid in whole fish and headed/gutted fish increased as the storage time increased [6]. Martinez et al. (1987) It was suggested that both TVN and TMA are indicators of the gel strength as long as the decrease in quality is due to aging of raw materials [3].

Gel strength decreased from 211.07 to 11 g cm in 12 hrs. The gradual reduction in gel strength may be due to acidic nature of glucano-delta lactone [14]. It was also observed that breaking force and deformation of surimi gels, prepared from both whole and headed/gutted fish, decreased when storage time increased [6]. It was elucidated that ice storage (>6 days) of threadfin bream surimi could lead to reduced gel strength due to conformational changes [16]. The gel forming ability of surimi of various fish species like walleye pollock, white croaker, big eye, lizard fish, large head hair tail, hachibiki and sardine were found to gradually decrease during frozen storage [17], similar to present findings. However, whiteness showed increasing trend. In case of proximate composition of surimi, moisture, fat and ash values gradually increased as spoilage progressed due to activities of proteolytic enzymes, while protein content showed opposite trend. The decrease in the protein content can be attributed to leaching out of the soluble components especially water soluble proteins and urea [18]. Therefore, at ambient temperature, surimi can be preserved up to 8 hrs.

In the present investigation at refrigerator temperature, it was observed that surimi could be preserved up to 5 days as the total plate count was observed higher than the permissible limit (5 lakhs colony forming unit/g, [19] on sixth day (Table 2). [20] reported an increase in the bacterial count of shark surimi stored at chilling temperature (5±3°C). An increase in TPC during storage of mullet surimi at 2° C was noticed [21]. Similarly increase in TPC between 104 to 106 cfu/gm during refrigerated storage (10°C) have been reported [22]. Non protein nitrogen, total volatile nitrogen, trimethylamine nitrogen and free alpha amino nitrogen values also increased from 39.4 to 51.2, 6.10 to 10.0, 0.8 to 16.50 and 3.57 to 5.65 mg%, while values of total nitrogen and pH decreased as spoilage progressed. The decrease in pH of the surimi, (Table 1 to 3) may be attributed to breakdown of protein of the fish body, biochemical and physiological changes taking place in the muscles with the release of phosphoric and lactic acids. Both these acids contribute to lowering of pH [23]. [14], [22] have reported decrease in pH of surimi during refrigerated storage. Gel strength of surimi decreased from 211.07 to 44.03 g cm in six days while whiteness, moisture content and nutrients like fat and ash had indicated steep increase.

Surimi of pink perch was observed to be acceptable for 60 days at deep freezer temperature

(-10±2°C). The pattern of spoilage was similar to that stored at refrigerator temperature. The bacterial count reached beyond safe limit of 5 lakhs colony forming unit/g, [19] after 60th day (6.5 x 106cfu/g) and values of non-protein nitrogen, total volatile nitrogen, trimethylamine nitrogen and free alpha amino nitrogen increased with the spoilage (39.40 to 58.60, 6.10 to 13, 0.8 to 15 and 3.57 to 5.48 mg% respectively). Gel strength decreased, while whiteness improved as storage period progressed. Protein level decreased from 20.83 to 15.70% in the same period, while moisture, fat and ash had shown increasing trend (76.5 to 83.2, 0.25 to 0.92 and 1.55 to 1.85% respectively).

The amount of Trimethylamine (TMA) is widely used as an index of spoilage in the fish. Trimethylamine (TMA) nitrogen and total volatile nitrogen (TVN) were negligible in fresh surimi, while these increased gradually as spoilage advanced. In the present study, it can be concluded that frozen surimi of pink perch can be safely stored for 8hrs, 5 days and 60 days at ambient, refrigerated and frozen temperatures respectively.

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REFERENCES

1. Hastings RJ, Keay JN, Young KW. The properties of surimi and kamaboko gels from nine British species of fish. Int. J. Food. Sci. Technol. 1990; 25: 281-294.
2. Ofstad R, Grahl EM, Solberg C. Blue whiting surimi: Processing and quality. FTFI – RAPP. Trondheim – Norway Fiskeriteknol. – Forskningslnst. 1990; 38 pp.
3. Martinez I, Eide O, Ofstad R. Correlation of chemical parameters in cod mince and surimi with the surimi quality. In: Kramer DE, Liston J, Editors. Proc. Intl. Symp. Seafood Quality Determination. Alaska; 1987; 15: 389-401.
4. Bligh EG, Spencer K. Surimi studies on white hake (Urophycis tenuis). Proc. Twelth annual conference of the tropical and subtropical Fisheries Technological Society of the Americas, Florida University, Gainesville, USA; 1988; 672 pp.
5. Abraham JT, Sugumar G, Sukumar D, Jeyachandran P. Bacterial profile of fresh and spoiled fish mince from Johnius dussumieri at refrigerated storage. Fish. Technol. 1992; 29: 53-56.
6. Tueksuban J. Effect of quality changes during iced storage of lizard fish on surimi gels. 3rd Regional IMT-GT UNINET Conference on Land development and Sustainable Bioresources, Medan, Indonesia; 2000.
7. FDA. Bacteriological Analytical Manual. Association of Official Analytical Chemists. 1978.
8. Conway EJ, Byrne A. An absorption apparatus for the micro determination of certain volatile substances. Biochem J. 1933; 27: 419.
9. ASTM. Manual of Sensory Testing Methods, 1968; 434 pp.
10. AOAC. Official Methods of the Association of Official Analytical Chemists. 1990;1298 pp.
11. Shimizu Y. Surimi quality. In: Okada M, Kinumaki T, Yokozeki M, editors. Shinpan Gyoniku-neriseihin, Koseisha-Koseikaku. Tokyo, Japan 1981.
12. Lee CM. Surimi process technology. Food Technol. 1984; 38:69.
13. Himelbloom BH, Lee JS Microbiology and HACCP in surimi manufacturing. In: Park JW, editor. Surimi and Surimi Seafood, Marcel Dekker, Inc., New York; 2000; 500pp.
14. Hegde G, Chandrasekhar TC, Dora KC. Quality changes of fish sausage incorporated with potato starch powder at room temperature. Fish.Technol. 1992; 29: 136-139.
15. George C, Gopakumar K. Spoilage changes in the muscle of crab, Scylla serrata stored at three different temperatures. Proc. 1st Indian Fisheries Forum, Asian Fisheries Society, Mangalore; 1987; p.347-349.
16. Yongsawatdigul J. Biochemical changes of threadfin bream during ice storage and their effects on thermal denaturation patterns. School of Food Technology, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand; 2001.
17. Atsumi T, Wakameda A, Noguchi SF. Frozen storage of surimi containing microbial transglutaminase made from various kinds of fish species. Fish. Sci. 1995; 61(3): 458-463.
18. Ashok Kumar K, Ravishankar CN, Badonia R, Solanki KK. Quality changes in whale shark (Rhinodon typus, Smith) meat during storage in ice. Fish. Technol. 2000; 37 (1): 15-18.
19. Anon. Government of India notification and specifications for frozen fish products. 1985.
20. Boynes DT. Shelf life studies of fish sausage (Carcharihinus limabtu). M.F.Sc. Thesis, St. Augustine (Trinidad and Tobags), 1989; 182 pp.
21. Daley LH, Deng JC, Oblinger JL. Stability of refrigerated mullet sausages. J. Food. Sci., 1979: 44 : 883 – 891.
22. Chandrasekhar TC, Prabhu RM, Krishnamurty BV. Relative merits of oleoresins and dried spice powders in preservation of fish sausages, Proc. 1st Indian Fisheries Forum, Asian Fisheries Society, Mangalore, 1988; p. 427-430.
23. Govindan TK. Fish Processing Technology. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi; 1985; 245pp.