J Bangladesh Agril Univ 16(3): 553–559, 2018 https://doi.org/10.3329/jbau.v16i3.39455

ISSN 1810-3030 (Print) 2408-8684 (Online)

Journal of Bangladesh Agricultural University

Journal home page: http://baures.bau.edu.bd/jbau, www.banglajol.info/index.php/JBAU

Changes in the nutritional composition of Thai pangus (*Pangasianodon hypophthalamus*) pickle during storage at refrigeration temperature

Md. Ismail Hossain, ✉Fatema Hoque Shikha and Khaleda Akter

Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

ARTICLE INFO OPEN ACCESS

Article history:
Received: 25 November 2018
Accepted: 11 December 2018
Published: 31 December 2018

Keywords:
Fish pickle; *Pangasianodon hypophthalmus*; nutritional composition; refrigeration temperature (5° to 8°C)

Correspondence:
Fatema Hoque Shikha
✉: shikhafh@bau.edu.bd

Abstract

There is relation between nutritional composition of fish products and storage conditions. The present study was designed to prepare pickle from dorsal muscle and whole Thai pangus (*Pangasianodon hypophthalamus*) fish muscle by using different types of food additives and to observe the changes in the nutritional composition, pH and bacterial load of fish pickle during 60 days of storage at refrigeration temperature (5° to 8°C). Mustard oil and soybean oil were used for preparing fish pickle. The quality of fish pickles prepared with either mustard oil or soybean oil, was stable and remained good even after 60 days of storage at refrigeration temperature (5° to 8°C). No bad smell was produced in the pickles. The changes in nutritional composition occurred at this temperature but the rate was slow. Moisture, protein, lipid and pH value decreased as days passed but ash content increased. In case of pickle prepared using soybean oil deterioration rate was higher than the pickle prepared using mustard oil. Bacterial load was higher in soybean oil pickle and also the pickle prepared from whole fish muscle. At this low temperature, bacterial load increased but the rate was slower. Therefore, at refrigeration temperature(5° to 8°C) the pickle remain in acceptable condition quite longer, might be more than 60 days.

Introduction

Pickling is one of the oldest methods of preserving food material. Pickles have been of commercial importance in some developing countries like Korea, where pickles are made out of anchovies, shrimps, squid, oyster and sea urchin. Several workers have studied on the pickles prepared from different fish in India, namely fresh water fish (Chattopadhyay *et al*., 1985), low cost marine fish (Vijayan *et al*., 1989), clams (Yellappa and Chandrasekharan 1989), blood clam (Gupta and Basu, 1985), edible oyster and chunk (Sugumar *et al.*, 1994). Jawahar and Shetty (1994) did a detailed study on the preparation of pickles from crustaceans.

Striped catfish or sutchi catfish (*Pangasianodon hypophthalmus*) is native to the Mekong (Vietnam, Lao Peoples Democratic Republic and Cambodia), Chao Phraya and Mae Klong (Thailand) rivers and also the Ayeyawady basin in Myanmar (Burma). Vietnam dominates production within the native range. The fish is imported by Bangladesh government in 1990 (Sarker, 2000). Thus, the fish is exotic in Bangladesh and locally known as Thai pangus. It was proved that the climate, water and soil conditions of Bangladesh are suitable for Thai pangus production (Ahmed and Hasan, 2007). In addition, the fish can be stocked at a much higher density in culture ponds compared to other species (Ali *et al.*, 2005). In recent years, Thai pangus culture is rapidly increasing in Bangladesh because of simple culture method, high growth rate and high adaptability under stressed condition. But in the peak season, the market price of these fishes often decline due to abundance of their production. The fish would serve as an adequate source of raw material for fish pickle that may provide a good taste and nutrition to the young and outgoing people in cheaper price. A number of studies had been done on the relation between changed in fish muscle and storage time-temperature. Pawar *et al.* (2013) evaluated shelf-life of fish cutlet prepared from catla (*Catlacatla*) stored at -18°C. Result showed a slight reduction in moisture and protein content during 6 months storage period whereas lipid and ash content increased in the same samples. pH value of fish cutlet also slightly increased (from 6.5 to 6.79) throughout the storage period. Roopma *et al*. (2013) investigated the effect of frozen storage on the proximate, biochemical and microbial profile of the muscle of silurid cat fish. Result showed that proximate composition decreased significantly ($P<0.05$) with increase in the duration of frozen period. Total Plate Count (TPC) and pH of fish muscle increased gradually in the study with the increased period of storage at frozen temperature.

So far in Bangladesh there is no literature on the development of pickle from Thai pangus and on the nutritional quality changes of the product sat refrigeration temperature (5° to 8°C). Considering these facts, the present study was conducted to develop pickle from Thai pangus and to know changes in nutritional composition, pH and bacterial load of this product at this

Cite this article

Hossain M.I., Shikha F.H. and Akter K. 2018. Changes in the nutritional composition of Thai pangus (*Pangasianodon hypophthalamus*) pickle during storage at refrigeration temperature. *Journal of Bangladesh Agricultural University*, 16(3): 553–559.

low temperature. The outcomes of this research might help processors to determine optimum processing and storage conditions for pickle prepared from Thai pangus in order to ensure products of premium quality.

Materials and Methods

Duration of the Study

The present study was conducted from April to June 2013 (From January to March, 2013 was trial period), in the laboratories of Fisheries Technology Department of Bangladesh Agricultural University, Mymensingh.

Sources of Samples

The samples (Thai pangus; *Pangasianodon hypophthalamus*) were collected from Kamal- Ranjit (KR) market of Bangladesh Agricultural University, Mymensingh in fresh condition. These were immediately transported to the Fish Processing laboratory of Fisheries Technology Department.

Preparation of Fish Pickle

Ingredients for Fish Pickle: Fish pickle was prepared from the collected fish according to the method described below. Standard recipe for the preparation of pickle and condiment are given in the following Table.

Table 1. Standard Recipe for Fish Pickle Preparation

Ingredient name	Amount	Ingredient name	Amount
Fish muscle	500g	Vinegar	50ml
Chili powder	20g	Black pepper	2g
Turmeric powder	2g	*Pachforon*	5g
Cumin	10g	Sugar	50g
Onion	20g	Salt	30g
Garlic	80g	Tomato sauce	30g
Ginger	10g	Tamarind	20g
Cloves	2g	Sodium benzoate	1g
Mustard oil	150ml		

Fish Pickle Preparation Procedure: The fishes were thoroughly washed with tap water to remove contaminants on the skin. Then the fishes were cut into small pieces (approx. 1 cm^3)using sharp knife and washed with tap water in the laboratory to remove bloods and other contaminants. The pieces were marinated with salt, chili powder and turmeric powder then kept at room temperature (around 32°C) for 30 minutes. The pieces of fish were fried in mustard oil/soybean oil till the fish pieces turn to brown in color. After fraying fish pieces were removed from heating and kept at room temperature (around 32°C).Onion, garlic and ginger paste were fried till the paste become light brown in color. Required amount of cumin powder, pachforon, cloves, salt, sugar, and vinegar were added to mixed masala paste under frying. Fried fish pieces were added to the mixed masala paste and heated till vinegar absorbed. At the end tomato sauce, tamarind mixed water and sodium benzoate were added to the fish-masala mixture. After completion of cooking pickle was cooled at room temperature (around 32°C) and packed in glass bottles During packing care was taken so that there was layer of oil over the contents in the bottles.

Sample Storage:

Prepared pickle samples were stored at refrigeration temperature (5° to 8°C) in 12 glass bottles for around 70 days. Each of the bottles contained 300g pickle. Among these 12 bottles- pickle prepared from dorsal muscle with mustard oil were stored in 3 bottles, pickle prepared from dorsal muscle with soybean oil were stored in another 3 bottles. Pickle prepared from whole fish muscle also stored in 3 + 3 separate bottles for mustard oil and soybean oil.

Quality Analysis

Initially weekly then analysis of the samples were done at each 15 days for 60 days at refrigeration temperature (5° to 8°C). Triplicate samples were taken to carry out the experiment. Proximate composition (moisture, protein, lipid and ash) of fish pickle were tested according to the standard methods described by Association of Official Analytical Chemists (AOAC, 2005).

Determination of pH value

pH was measured at room temperature following the method described by AOAC (2005). At first accurately 5g sample was taken and homogenously mixed in 50 ml distilled water. pH was measured using an electronic pH meter (HANNA pH 211 Microprocessor pH Meter) with a glass electrode using expandable scale.

Determination of APC

The colonies units (CFU) were counted under a Quebec dark field colony counter (Leica, Buffalo. NY. USA) equipped with a guide plate ruled in square centimeters. Plates containing 30-300 colonies were used to calculate bacterial load using following formula:

$$\text{APC (CFI / g)} = \frac{\text{No. of colonies on petridish} \times \text{Dilution factor} \times \text{Vol. of stock solution} \times 10}{\text{Wt. of pickle or condiment sample}}$$

Sensory evaluation

A panel of nine persons of teachers and students of the Department of Fisheries Technology provided the sensory assessments of the products (Nowsad *et al.*, 2000). Sensory evaluation of the fish pickle was conducted according to the grade 9 = Like extremely, 8 = Like very much, 7 = Like moderately, 6 = Like slightly, 5 = Neither like nor dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2 = Dislike very much, 1 = Dislike extremely. Chewiness/Rubberiness were defined as the amount of effort the panelist had to exert in chewing to prepare the sample for swallowing. Color and flavor were evaluated organoleptically.

Statistical Analysis

One-way analysis of variance and the general linear model using Windows for SPSS 9.0 were used to analyze the data. The Duncan's New Multiple Range Test (DMRT) was used to find the significant differences between storage periods.

Results

Biochemical Composition of Fresh Fish

The fish collected from the Kamal-Ranjit market of Bangladesh Agricultural University were fresh and many of them were in live condition. The initial chemical composition of fresh fish samples are shown in the Table 2.

Table 2. Proximate Composition (average value) of the Fresh Thai pangus (*Pangasianodon hypophthalamus*) Muscle

Parameters	Results (%)
Moisture	78.61 ± 0.76
Protein	13.92 ± 0.62
Lipid	4.93 ± 0.12
Ash	2.25 ± 0.06

Changes in the Protein Content of Fish Pickle

Changes in the protein content of fish pickle during storage period of 60 days at refrigeration temperature (5°C to 8°C) are shown in Table 3. Initial protein content was 13.92% in fish muscle. After preparing fish pickle with dorsal muscle using different spices it reached to 19.47% (pickle prepared using mustard oil), 16.15% (prepared using soybean oil)and for pickle with whole fish it reached to 19.07% (pickle prepared using mustard oil), 16.62% (prepared using soybean oil) which remained in acceptable condition even after 60 days of storage. Percent protein content decreased to 17.75, 17.14 and 16.82 on 30^{th},45^{th} and 60^{th}days of storage at this temperature for the pickle prepared with dorsal muscle (Table 3) using mustard oil whereas the values obtained17.91, 18.76 and 19.41 for the pickle prepared using soybean oil. On the other hand, the percent protein content declined to 18.06, 17.55 and 17.06 in the pickle prepared with whole fish muscle using mustard oil at 30^{th}, $45^{th}$and 60^{th} days of storage. On the storage of 30^{th}, 45^{th} and 60^{th} days the values obtained 18.01, 18.33 and 18.52, respectively (Table 3) for the pickle prepared with whole fish muscle using soybean oil indicating a very slower rate of change in the nutritional composition at low temperature.

Changes in the Lipid Content of Fish Pickle

During storage period of 60 days the changes in the percent lipid content of fish pickle at refrigeration temperature (5°C to 8°C) are shown in Table 4. The initial lipid content of fresh fish was 4.93%. After preparing fish pickle with dorsal muscle adding different spices it reached to 7.57% (pickle prepared using mustard oil), 10.28% (prepared using soybean oil) and for pickle with whole fish it reached to 22.59% (pickle prepared using mustard oil), 25.58% (prepared using soybean oil) which remained in acceptable condition even after 60 days of storage. Percent lipid content decreased to 6.69, 6.51 and 6.40 on 30^{th}, 45^{th} and 60^{th} days of storage at this temperature for the pickle prepared with dorsal muscle (Table 4) using mustard oil whereas the values obtained 8.68, 8.30 and 8.79 for the pickle prepared using soybean oil. On the other hand, the percent lipid content declined to 20.93,20.54 and 20.17 in the pickle prepared with whole fish muscle using mustard oil at 30^{th}, $45^{th}$and 60^{th} days of storage. At the storage of 30^{th}, 45^{th} and 60^{th}days the values obtained 24.42, 24.09 and 23.77, respectively for the pickle prepared with whole fish muscle using soybean oil (Table 4).

Changes in the Moisture Content of Fish Pickle

Changes in the moisture content of fish pickle during storage period of 60 days at refrigeration temperature (5°C to 8°C) are shown in Table 5. Initial moisture content was 78.61% in fish body. After preparing fish pickle with dorsal muscle adding different spices it decreased to 57.25% (pickle prepared using mustard oil), 51.41% (prepared using soybean oil) and for pickle with whole fish it reached to 56.69% (pickle prepared using mustard oil), 51.81% (prepared using soybean oil). Percent protein content decreased to 56.36, 54.26 and 51.06 on 30^{th}, 45^{th} and 60^{th} days of storage at this temperature for the pickle prepared with dorsal muscle (Table 5) using mustard oil whereas the values obtained 51.14, 52.64 and 53.84 for the pickle prepared using soybean oil. On the other hand, the percent protein content declined to 56.52, 54.82 and 52.71 in the pickle prepared with whole fish muscle using mustard oil at 30^{th}, 45^{th} and 60^{th} days of storage. On the storage of 30^{th}, 45^{th} and 60^{th} days the values obtained 51.53, 53.23 and 54.13, respectively (Table 5) for the pickle prepared with whole fish muscle using soybean oil.

Changes in the Ash Content of Fish Pickle

During storage period of 60 days the changes in the percent lipid content of fish pickle during at refrigeration temperature (5°C to 8°C)are shown in Table 6. The initial ash content of fresh fish was 2.25%. After preparing fish pickle with dorsal muscle adding different spices it increased to 4.31% (pickle prepared using mustard oil), 4.21% (prepared using soybean oil) and for pickle with whole fish it reached to 4.25% (pickle prepared using mustard oil), 4.36% (prepared using soybean oil). Percent lipid content reached to 4.49, 4.79 and 4.88 on 30^{th}, 45^{th} and 60^{th} days of storage at this temperature for the pickle prepared with dorsal muscle (Table 6) using mustard oil whereas the values obtained 4.45, 4.51 and 4.57 for the pickle prepared using soybean oil. On the other hand, the percent lipid content increased to 5.43, 6.06 and 6.47 in the pickle prepared with whole fish muscle using mustard oil at 30^{th}, 45^{th} and 60^{th} days of storage. At the storage of 30^{th}, 45^{th} and 60^{th} days the values obtained 6.34, 6.79 and 7.14, respectively for the pickle prepared with whole fish muscle using soybean oil (Table 6).

Table 3. Changes in the Protein Content (%) of Fish Pickle (Dorsal and Whole Fish Muscle) during Storage Period of 60 days at Refrigeration Temperature (5°C to 8°C)

Days	Protein Content (%)			
	Dorsal Muscle		Whole Fish Muscle	
	Mustard oil	Soybean oil	Mustard oil	Soybean oil
0	19.47 ± 0.19	16.15 ± 0.49	19.07 ± 0.26	16.62 ± 0.42
7	19.16 ± 0.28	16.71 ± 0.35	18.79 ± 0.19	17.07 ± 0.32
15	18.60 ± 0.16	17.41 ± 0.33	18.48 ± 0.31	17.62 ± 0.14
30	17.75 ± 0.33	17.91 ± 0.18	18.06 ± 0.15	18.01 ± 0.22
45	17.14 ± 0.21	18.76 ± 0.21	17.55 ± 0.13	18.33 ± 0.17
60	16.82 ± 0.23	19.41 ± 0.28	17.06 ± 0.49	18.52 ± 0.14

*mean value ± standard deviation of 3 individual measurement

Table 4. Changes in the Lipid Content (%) of Fish Pickle (Dorsal and Whole Fish Muscle) during Storage Period of 60 days at Refrigeration Temperature (5° to 8°C)

Days	Lipid Content (%)			
	Dorsal Muscle		Whole Fish Muscle	
	Mustard oil	Soybean oil	Mustard oil	Soybean oil
0	7.57±0.29	10.28±0.14	22.59 ± 0.13	25.58 ± 0.08
7	7.32±0.11	9.93±0.19	22.09 ± 0.08	25.20 ± 0.07
15	6.97±0.09	9.24±0.03	21.34 ± 0.11	24.78 ± 0.14
30	6.69±0.13	8.68±0.21	20.93 ± 0.15	24.42 ± 0.21
45	6.51±0.08	8.30±0.17	20.54 ± 0.07	24.09 ± 0.09
60	6.40±0.06	8.79±0.07	20.17 ± 0.21	23.77 ± 0.11

*mean value ± standard deviation of 3 individual measurement

Table 5. Changes in the Moisture Content (%) of Fish Pickle (Dorsal and Whole Fish Muscle) during Storage Period of 60 days at Refrigeration Temperature (5°C to 8°C)

Days	Moisture Content (%)			
	Dorsal Muscle		Whole Fish Muscle	
	Mustard oil	Soybean oil	Mustard oil	Soybean oil
0	57.25 ± 1.20	51.41 ± 0.87	56.69 ± 0.69	51.81 ± 0.75
7	49.09 ± 0.88	50.00 ± 0.72	48.25 ± 0.53	50.66 ± 0.78
15	52.71 ± 0.72	49.81 ± 0.95	50.48 ± 0.74	49.46 ± 0.74
30	56.36 ± 0.75	51.14 ± 0.55	56.52 ± 0.66	51.53 ± 0.59
45	54.26 ± 0.81	52.64 ± 0.77	54.82 ± 0.77	53.23 ± 0.66
60	51.06 ± 0.69	53.84 ± 0.85	52.71 ± 0.81	54.13 ± 0.61

*mean value ± standard deviation of 3 individual measurement

Table 6. Changes in the Ash Content (%) of Fish Pickle (Dorsal and Whole Fish Muscle) during Storage Period of 60 days at Refrigeration Temperature (5°C to 8°C)

Days	Ash Content (%)			
	Dorsal Muscle		Whole Fish Muscle	
	Mustard oil	Soybean oil	Mustard oil	Soybean oil
0	4.31 ± 0.07	4.21 ± 0.09	4.25 ± 0.11	4.36 ± 0.07
7	4.42 ± 0.03	4.28 ± 0.08	4.81 ± 0.09	5.13 ± 0.05
15	4.45 ± 0.06	4.37 ± 0.03	4.92 ± 0.07	5.75 ± 0.03
30	4.49 ± 0.04	4.45 ± 0.07	5.43 ± 0.03	6.34 ± 0.02
45	4.79 ± 0.10	4.51 ± 0.02	6.06 ± 0.06	6.79 ± 0.12
60	4.88 ± 0.16	4.57 ± 0.07	6.47 ± 0.10	7.14 ± 0.09

*mean value ± standard deviation of 3 individual measurement

Changes in the pH Value of Fish Pickle

The changes in the pH value of fish pickle during storage period of 60 days at refrigeration temperature (5°C to 8°C) are shown in Table 7. After preparing fish pickle with dorsal muscle with on 1st day pH value obtained 4.54 (pickle prepared using mustard oil), 4.91(prepared using soybean oil) and for pickle with whole fish it was4.60 (pickle prepared using mustard oil), 4.43 (prepared using soybean oil). The pH value decreased to 4.28, 4.25 and 4.19 on 30th, 45th and 60th days of storage at this temperature for the pickle prepared with dorsal muscle (Table 7) using mustard oil whereas the values obtained 4.47, 4.26 and 4.16 for the pickle prepared using soybean oil. On the other hand, the pH valueobtained4.41, 4.32 and 4.21 in the pickle prepared with whole fish muscle using mustard oil at 30th, 45th and 60th days of storage. On the storage of 30th, 45thh and 60th days the values declined to4.21, 4.18 and 4.05, respectively (Table 7) for the pickle prepared with whole fish muscle using soybean oil.

Changes in the Bacterial Load of Fish Pickle

Changes in bacterial load in fish pickle during storage period of 60 days at refrigeration temperature (5°C to 8°C)are shown in Table 8. After preparing fish pickle with dorsal muscle on 1st day the bacterial load was 2.5×10^3 CFU/g (pickle prepared using mustard oil), 5.0×10^3 (prepared using soybean oil) and for pickle with whole fish it was 3.7×10^5 (pickle prepared using mustard oil), 4.2×10^5 (prepared using soybean oil). The bacterial load reached to 6.2×10^5, 7.5×10^5 and 6.1×10^6on 30th, 45th and 60thdays of storage at this temperature for the pickle prepared with dorsal muscle (Table 8) using mustard oil whereas the values obtained 9.0×10^5, 7.2×10^6 and 9.5×10^7 for the pickle prepared using soybean oil. On the other hand, the bacterial load obtained 6.7×10^7, 7.2×10^8 and 8.2×10^8 in the pickle prepared with whole fish muscle using mustard oil at 30th, 45th and 60th days of storage. At the storage of 30th, 45th and 60th days the values reached to 7.2×10^8, 8.4×10^9 and 9.5×10^8, respectively (Table 8) for the pickle prepared with whole fish muscle using soybean oil. The result showed that bacterial load is larger in the pickle prepared using soybean oil than that of prepared using mustard oil.

Sensory Evaluation

The results of changes in sensory quality attributes of fish pickles during storage refrigeration temperature (5°C to 8°C) are shown in Table 9. The sensory attributes changed with the progress of storage period. The prepared pickles remained more or less in acceptable condition even after 60 days of storage though the muscle became littler harder with the lapse of time. Fish pickle prepared by using mustard oil was more accepted than soybean oil by panelists. They almost equally accepted the fish pickles prepared from both dorsal muscle and whole fish muscle.

Table 7. Changes in pH value of Fish Pickle (Dorsal and Whole Fish Muscle) during Storage Period of 60 days at Refrigeration Temperature (5°C to 8°C)

Days	pH Value			
	Dorsal Muscle		Whole Fish Muscle	
	Mustard oil	Soybean oil	Mustard oil	Soybean oil
0	4.54 ± 0.29	4.91 ± 0.03	4.60 ± 0.32	4.43 ± 0.07
7	4.41 ± 0.33	4.73 ± 0.25	4.54 ± 0.12	4.36 ± 0.09
15	4.30 ± 0.09	4.65 ± 0.08	4.51 ± 0.17	4.31 ± 0.18
30	4.28 ± 0.16	4.47 ± 0.03	4.41 ± 0.19	4.21 ± 0.27
45	4.25 ± 0.08	4.26 ± 0.08	4.32 ± 0.29	4.18 ± 0.25
60	4.19 ± 0.05	4.16 ± 0.03	4.21 ± 0.08	4.05 ± 0.33

*mean value ± standard deviation of 3 individual measurement

Table 8. Changes in Bacterial load (CFU/g) of Fish Pickle (Dorsal and whole Fish Muscle) during Storage Period of 60 days at Refrigeration Temperature (5° to 8°C)

Days	Bacterial load (CFU/g)			
	Dorsal Muscle		Whole Fish Muscle	
	Mustard Oil	Soybean Oil	Mustard Oil	Soybean Oil
0	2.5×10^3	5.0×10^3	3.7×10^5	4.2×10^5
7	4.0×10^3	8.0×10^4	4.2×10^5	5.3×10^7
15	5.0×10^4	5.0×10^5	5.2×10^6	6.4×10^8
30	6.2×10^5	9.0×10^5	6.7×10^7	7.2×10^8
45	7.5×10^5	7.2×10^6	7.2×10^8	8.4×10^8
60	6.1×10^6	9.5×10^7	8.2×10^8	9.5×10^8

Table 9. Changes in Sensory Quality Attributes of Fish Pickle (Dorsal and Whole Fish Muscle) during Storage Period of 60 days at Refrigeration Temperature (5° to 8°C)

Pickle Type	Storage period (Day)	Color	Flavor	Texture	General acceptability
Dorsal Muscle+ Mustard Oil	0	9	9	9	9
	7	9	8	9	9
	15	9	8	8	9
	30	8	8	8	8
	45	8	7	7	7
	60	8	7	7	7
Dorsal Muscle+ Soybean Oil	0	8	8	9	8
	7	8	7	7	8
	15	8	7	7	7
	30	7	7	7	7
	45	7	7	7	7
	60	7	6	6	7
Whole Fish Muscle+ Mustard Oil	0	9	9	9	9
	7	9	8	8	9
	15	8	8	8	9
	30	8	8	7	8
	45	8	7	7	8
	60	8	7	`7	7
Whole Fish Muscle+ Soybean Oil	0	8	8	8	8
	7	8	7	7	8
	15	8	7	7	8
	30	8	7	6	7
	45	7	7	6	7
	60	7	6	6	7

N.B 9 = Like extremely, 8 = Like very much, 7 = Like moderately, 6 = Like slightly, 5 = Neither like nor dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2 = Dislike very much, 1 = Dislike extremely.

Discussion

The changes in the nutritional composition, pH and bacterial loadin the pickles prepared both with dorsal and whole fish muscle either using mustard or soybean oil, occurred very slowly at refrigeration temperature (5–8°C).In this case, the texture of the pickles became harder and the taste changed. Sanni *et al.* (2002) studied microflora and chemical composition of momoni, a Ghanaian fermented fish condiment. Average values of 5.8×10^{7}–4.1×10^{8}CFU/g was obtained for the microbial count. The chemical constituents of fermented fish condiment were a moisture content of 50%, protein values of 16.8–21.9%, and a pH of above 6.0. Hossain *et al.* (2005) evaluated physicochemical changes in Thai pangus muscle during ice storage in an insulated box. Results showed that immediately after death the pH of fish muscle was around 7.0. After 14 days of storage, pH value decreased gradually to 5.98. Jezek and Buchtova (2011) monitored pH changes in frozen (-18°C) fish muscle. The pH of fresh fish muscle samples was calculated 6.29 ± 0.16. In the first three months of storage, pH decreased insignificantly to 6.25 ± 0.12 and increased again to reach 6.34 ± 0.11 by month six. After nine months, a significant ($P < 0.05$) decrease in pH to 6.22 ± 0.10 was observed. Gandotra *et al.* (2012) investigated the effect of low temperature (-12±2°C) preservation on the chemical and microbial profile of fish muscle (*Labeorohita*). The study result revealed that- the proximate composition decreased significantly ($P < 0.05$) and the microbial count increased gradually throughout the storage period. A significant quality loss in fish muscle during frozen storage observed. Consequently, fish remain free from spoilage for longer duration. Aberoumand (2013) studied freezing impact on nutrient quality in some selected fresh fish muscle in Iran. The fishes were stored at -18°C and the study was conducted for a period of 60 days. Result showed that moisture, protein, lipid and ash content decreased during storage. The study concluded that frozen storage leads to a loss of nutrient quality in fishes during the processing. Sharaf (2013) studied the influence of freezing fish at -18°C in a domestic refrigerator on the biochemical composition of the muscles. The chemical analysis of the muscles of the studied fish recorded high values of protein, fat and ash contents and moisture for the fresh samples and there was a significant ($P<0.05$) decrease at the end of the eight weeks of freezing fish. The findings of all these studies more or less support the obtained results from the present study.

Conclusion

At refrigeration temperature (5°C to 8°C) the quality of the pickles was cooperatively better and remained in acceptable condition even after 60 days of storage.

Moisture, protein, lipid and pH value decreased as days passed but the ash content increased. Deterioration rate was higher in the pickles prepared using soybean oil than the pickles prepared using mustard oil and also the pickle prepared with whole fish muscle. Therefore, at refrigeration temperature pickle may remain in acceptable condition more than 60 days.

Acknowledgements

This research was funded by Bangladesh Agricultural University Research System.

References

Aberoumand, A. 2013. Impact of freezing on nutritional composition of some less known selected fresh fishes in Iran. International Food research Journal, 20 (1): 347–350.

Ahmed, N. and Hasan, M. R. 2007: Sustainable Livelihoods of Pangus Farming in Rural Bangladesh. Aquaculture Asia Magazine, 5–11.

Ali M. Z., Hossain M. A, and Mazid, M. A. 2005. Effect of mixed feeding schedules with varying dietary protein levels on the growth of sutchi catfish, Pangasius hypophthalmus (Sauvage) with silver carp, Hypophthalmichthys molitrix (Valenciennes) in ponds. Aquaculture Research, 36: 627–634. https://doi.org/10.1111/j.1365-2109.2005.01262.x

AOAC, 2005. Official Methods of Analysis. Association of Official Analytical Chemists International, 18th edition, Washington (D. C.).

Chattopadhyay, A., Bhattacharyya, K. and Bandyopaddhyay, S. K. 1985: Development of pickled products from low cost fresh water fishes, In: Harvest and Post Harvest Technology of Fish, pp. 611-4, Society of Fisheries Technologists of India, Cochin, India.

Gandotra, R., Koul, M., Gupta, S. and Sharma, S. 2012. Change in proximate composition and microbial count by low temperature preservation in fish muscle of Labeo rohita (Ham-Buch). Journal of Pharmacy and Biological Sciences, 2(1): 13–17. https://doi.org/10.9790/3008-0211317

Gupta S.S. and Basu, S. 1985: Pickle from blood clam (Anadara granosa) meat, Fisheries Technology. 22(2): 109–11.

Hossain, M.I., Islam M.S., Shikha, F.H., Kamal, M, Islam M.N. 2005: Physicochemical changes in Thai pangus (Pangasius sutchi) muscle during ice-storage in an insulated box. Pakistan Journal of Biological Sciences. 8(6): 798–804. https://doi.org/10.3923/pjbs.2005.798.804

Jawahar, A.T, Shetty, T.M.R. 1994: Effect of Sodium Benzoate on the fermentative fish pickle, Fisheries Technology. 3 (1): 48–51.

Jezek, F. and Buchtova. H, 2011: Monitoring of physicochemical changes in frozen fish muscle tissue. Agriculturae Conspectus Scientificus, 76(3): 201–204.

Pawar, P.P., Pagarkar, A.U., Rathod, N. B, Patil, S. S. and Mahakal, B.V. 2013. Effect of frozen storage on biochemical and sensory quality changes of fish cutlets, made from freshwater fish catla (Catla catla). African Journal of Biotechnology, 11(30): 7751–7755.

Roopma, G., Gupta, V., Meenakshi, K. and Sweta, G. 2013. Quality changes in the muscles of Wallago attu during frozen storage (-12±2°C) conditions. Research Journal of Animal, Veterinary and Fishery Sciences, 1(5): 16–20.

Sanni, A.I., Asiedu, M., and Ayenor, G.S. 2002. Microflora and chemical composition of Momoni, a Ghanaian fermented fish condiment. Journal of Food Composition and Analysis. 15(5): 577–583. https://doi.org/10.1016/S0889-1575(02)91063-X

Sarker, M.T. 2000. Pangus Chash Babosthapana (In English: Management of Pangus Culture). Department of Fisheries, Bangladesh. pp. 25.

Sharaf. M.M. 2013. Influence of domestic freezing on the biochemical composition and mineral content of fish muscles. Egyptian Academic Journal of Biological Sciences, 5(1): 11–16. https://doi.org/10.21608/eajbsz.2013.13506

Sugumar, G., Jayasekharan and Jayachandran, P. 1994. Pickles from edible oyster (Crassostrea madrasensis). Fishery Technology, 31(1): 72–74.

Vijayan P.K., Balachandran, K.K. and Surandran, P.K. 1989. Preparation of pickle from low cost fish in Roce. Trends in Processing Low Cost Fish, pp. 40-4, Society of Fisheries Technologists of India, Cochin, India.

Yellappan and Chandrasekhar, T.C. 1989. Preparation of clam pickle using organic acids. In: Recent Trends in Processing Low Cost Fish, pp.130-133, Society of Fisheries Technologists of India, Cochin, India.