Original Research Article

CHANGES IN FISH FLAKES PREPARED FROM PANGAS (*Pangasianodon hypophthalmus*) MINCE DURING STORAGE

ABSTRACT

This study was conducted to prepare fish flakes using Pangas (*Pangasianodon hypophthalmus*) mince with wheat flour and other ingredients and to determine the sensory and physicochemical changes of fish flakes during storage. Initially, fish flakes were prepared using 30%, 40% and 50% fish mince. Among the samples, fish flakes containing 50% fish mince (S_3N) gained the highest score in the conducted panel test. During the storage of 9 months at room temperature (28℃ to 32℃) in polythene zipper packets, different properties of S_3N was analyzed at 15- and 30-days intervals. The changes in proximate composition of the sample during storage indicated that only minor alterations occurred in fish flakes. During this study period no remarkable changes observed in the color, flavor, texture of fish flakes. Mold growth on fish flakes samples was not found. Therefore, the findings of this study can be concluded as, popular snack item like fish flakes can be prepared using pangas fish mince incorporation with other ingredients which can be stored at room temperature (28℃- 32℃) in polythene zipper packets for270 days without any major changes in compositional and consumption quality.

Key words: Fish Flakes, Panel test, Hedonic scale, Storage, Sensory, Composition.

1.Introduction:

Fish and fisheries play an important role in the socio-economic development of Bangladesh. This sector also plays a major role in nutritional security, and foreign exchange earnings. It is estimated that freshwater fishes make up more than 6% of the world's annual animal protein supplies for humans (FAO, 2014). It is the major and often the only source of animal protein for low-income families (Briones *et al*., 2004). Fish and fishery products have a unique place in the global fish market due to its mouthwatering taste and flavor. The presence of easily digestible proteins, lipids, vitamins and minerals make it a highly demanded food product. Because of their low energy and high nutritious content, which are essential for growth and better health, consumer usually prefer fish and fishery products. Fresh fish is an extremely perishable food and deteriorates very rapidly at normal temperatures. To extend the shelf life of fish, fish products development is an excellent idea.There are a wide variety of fish available in Bangladesh. Among them, pangas isthe most common, popular and cheapest. The pangas fish has white meat which is appropriate for the production of minced meat products. For these reasons, pangas fish is chosen to develop adelicious fish snack- flakes.

Demand for convenient products has increased due to social and cultural changes in recent years. Development of different value-added products from the fish with higher margin can be

considered as an alternative to increase the profit (Viji *et al.*, 2015).At present, value-added fish minced products will bring immediate benefit to the existing fish processing industries in Bangladesh (Nowsad, 1994). Consumers are always looking for new taste. So, producing flakes from pangas, wheat flour and corn flour will add a new dimension for the consumer. Fish flakes from pangaswhich is not available in Bangladeshpaves an opportunity to introduce the consumers with a new taste. Besides having great health value and taste, pangas flakes can play an important role to popularize pangas to all classes of people.

2.Materials and Method

2.1. Experimental design

The study was conducted in the Fish Processing and quality control laboratory of the department of Fisheries Technology, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. Three samples of fish flakes were prepared incorporating 30%, 40%, 50% pangas mince with other ingredients and the organoleptic preferences, compositional parameters were analyzed. Most likedfish flakes were kept in polythene zipper packets at room temperature (28℃- 32℃) for about 9 months. During this storage period, changes in quality parameters observed at 15 days and 30 days intervals.

2.2. Preparation of fish flakes

Fresh pangasfish (*Pangasianodon hypophthalmus*) was collected from Kamal- Ranjit fish market and transported to the laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. The pangas fish was washed with clean water to remove dirt, sand and other undesirable material. After a series of processes including cleaning, cutting, gutting, then fish were filleted and washed. Fish fillets were then boiled for 30 minutes. Then boiled fillets were minced manually. All the ingredients (Table1) were weighed properly. No fish mince was added in the controlled sample. Then, ingredients were mixed with fish mince to give the prepared dough a semi-liquid form. Then this semi liquid material was steamed. For steaming, banana leaves were spread over a sieve and semi-liquid dough was spread on banana leaf and steamed at 90°-100°C temperature for 5 minutes. After steaming flakes were dried in electric oven at 60°C. Figure 1 illustrates the preparation procedure.

Table 1: Ingredients for Formulation of Fish Flakes of *Pangasiandon hypophthalmus*

Ingredients	CN	S_1 N	S_2 N	S_3 N
Pangas (mince)	0	30	40	50
Wheat flour (g)	84.5	54.5	44.5	34.5
Salt (g)	2.5	2.5	2.5	2.5

White pepper (g)	0.5	0.5	0.5	0.5
Ginger powder (g)	0.5	0.5	0.5	0.5
Baking powder (g)	2	2	2	2
Corn starch (g)	10	10	10	10
water (ml)	150	150	150	150
Total Weight (g)	250	250	250	250

A **B**

C **D**

Figure 1: Preparation of Fish Flakes, A) Prepared Dough, B) Steaming the Flakes, C) Steamed Flakes, D) Dried Flakes

2.3.Proximate Composition:

Proximate analyses of raw fish, dried fish flakes (30%, 40%, 50%fish mince) were checked following the standard procedure (Association of Official Analytical Chemists, 1990).

Moisture content

Moisture content was determined using the following formula:

$$\%\ \text{Moisture} = \frac{\text{Wet sample weight} - \text{Dry sample weight (g)}}{\text{Wet sample weight(g)}} \times 100$$

Ash content

Ash content was calculated using the following formula:

$$\%\ \text{Ash} = \frac{\text{Weight of ash(g)}}{\text{Weight of sample(g)}} \times 100$$

Protein content

The protein estimating formula was:

$$\%\ \text{Nitrogen(N)} = \frac{\text{Titrant use(ml)} \times \text{Strength of titrant} \times \text{Mili equivalent of N}}{\text{Weight of } sample} \times 100$$

$$\%\ \text{of Crude protein} = \%\ \text{of N} \times 6.25$$

Lipid content

Lipid content was measured using the following formula:

$$\%\ \text{Lipid} = \frac{\text{Weight of the lipid(g)}}{\text{Weight of the sample(g)}} \times 100$$

Carbohydrate content

As starch is used in the flakes dough, carbohydrate content of the products was determined. Moisture, lipid, protein, lipid content was summed up and subtracted from 100 to determine carbohydrate content (FAO, 2004).

2.4. Sensory evaluation of fried fish flakes:

The sensory parameters of developed products were evaluated by a testing panel. The panelists were selected from the teachers of the department of Fisheries Technology, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. The panelists were asked to provide appropriate score to each product tested on a 1 to 9 points hedonic scale (Peryam *et al*., 1957). for the characteristics of color, flavor, texture, and overall acceptability of four sample of flakes.

The scale is arranged like as:

9 =like extremely, 8 = like very much, 7 = like moderately, 6 =Like slightly, 5= neither like or dislike, 4 = dislike slightly, 3= dislike moderately 2 = dislike very much and 1 = dislike extremely.

2.5.Storage of fish flakes:

Best preferred sample (dried fish flakes)was packed inpolythene zipper packets to evaluate the condition of the flakes during storage at room temperature (28℃to 32℃) for 9 months.Along this time, proximate composition and overall acceptability of the product were analyzed.

2.5.1. Proximate composition:

Proximate composition of the fish flake was performed according to the techniques described in 2.3.

2.5.2. Overall acceptability

Changes in overall acceptability were checked throughout the storage period. Three randomly chosen person was selected who tested the fish flakes after frying at each 30 days.

2.6. Statistical analysis

Statistical analysis was performed using One way ANOVA test to compare the products' compositional data at 0.05 significance level. Post Hoc test was done by using Tuckey's HSD test. All the tests were carried out by SPSS version 25. Tabulation and Graphical representation of the data was performed by MS Excel (version: 2110).

3.Results and Discussion

3.1.Proximate composition

Fresh fish:

Table 2 represents the data of fresh pangas fish composition.

Table2: Proximate Composition of Pangas Fish

Proximate composition	Value (%)
Moisture	80.96± 0.652
Protein	12.72± .456
Lipid	3.2± 0.768
Ash	1± 0.129

Results are mean± SD

Shikha *et al*., (2014) revealed moisture, protein, lipid, ash of fresh Pangas (*P. hypophthalmus*) was 79.21± 1.43%, 13.17±0.91%, 4±.45%, 1.60±0.24% respectively which strongly supports the

findings of this experiment. On the other hand, Jakhar *et al*., (2012) found 74.57±0.6% moisture,13.60±0.98%protein, 4.98±0.38% lipid and 1.25± 0.28% ash in fresh pangas fish which matches the experimental data too. Begum *et al*., (2012) studied proximate composition of aquarium reared Pangas (*P. hypophthalmus*). The results of the study indicated that the protein percentage was 12.78±0.16%.

Fish flakes:

The four different samples of fish flakes S_1 N (30% pangas mince, 10% corn flour, 54.5% wheat flour), S_2 N (40% pangas mince, 10% corn flour, 44.5% wheat flour), S_3 N (50% pangas mince, 10% corn flour, 34.5% wheat flour), CN(0% pangas mince, 10% corn flour, 84.5% wheat flour) were analyzed for moisture, protein, ash and carbohydrate(Table 3).

Table 3: Proximate Composition of Fish Flakes

Sample	Moisture	Protein	Lipid	Ash	Carbohydrate
S_1 N	5±0.053[a]	16.32±0.231[a]	0.5±0.027[a]	13.53±0.154[a]	65.07±1.273[a]
S_2 N	5.86± 0.178[a]	17.59±0.221[a]	0.9±0.017[a]	19.73±0.123[b]	65.66±0.765[b]
S_3 N	9.24± 0.675[b]	24.56±0.903[b]	3.67±0.366[b]	20.24±0.349[b]	63.22±0.193[c]

Results are mean±SD

Nurul *et al.* (2009) reported moisture content of fish crackers to be 9-12%. Pandey *et al.*, (2020) showed 5-6 % moisture in fish flakes. Huda *et al.*,(2010) found fish crackers moisture content to be between 9.37 to 13.83%. Shikha *et al*. (2020) found fish noodles moisture content ranged from 6.37 to11.94%. The protein content of different samples varies from 16.32% (lowest) for sample S_1 N and 24.56% (highest) for sample S_3 N. This may be due to varied pangas mince used in flakes which is true for the lipid content too. Pandey et.al. (2020) found 10-12 % protein in fish flakes. Shikha *et al*. (2020) found fish noodles protein content ranged from 19.35 to 23.66 %. Khan and Nowsad (2012) prepared protein enriched shrimp crackers from shrimp shell wastes and found protein content 13.6±0.47% to 22.39±0.34%. Kamari and Shabanpour (2013) prepared fish chips in which 16.06± 0.83% protein was found. On the other hand, Huda (2010) found fish commercial crackers wereknown to have lipid contentbetween 0.85 to 3.38%. Shikha *et al*., (2020) found fish noodles lipid ranged from 3.68 to 6.15 %. Khan and Nowsad (2012) found 32.1± 0.61 to 34.7±0.59% lipid in shrimp shell crackers. Pandey *et al*., (2020) reported 1-2% lipid in fish flakes. The ash content of the different flakes samples varied slightly. The lowest value of ash was 13.53% in sample S_1N and the highest value was found 20.24% in sample S_3 N. Khan and Nowsad (2012) reported ash content to be varying from 14.9±0.13% to 19.3±0.19% in shrimp shell crackers. Shikha *et al*. (2020) found fish noodles ash content ranged from 1.49 to 3.00 %. Kamari and Shabanpour (2013)determined ash content of fish chips and reported 5.88± 0.11% ash. Pandey *etal*. (2020) revealed 5-7 % ash to be present in fish flakes.S_3 N is significantly different(P<0.05)from the two other formulated product in case of moisture, protein and lipid whereas, S_2N varied significantly(P<0.05)in ash content. All the three sample were significantly different (P<0.05) on the basis of carbohydrate content.

3.2. Selection of the best sample

In sensory evaluation, a 9-point hedonic testing rate was used on the basis of sensory attributes of flakes such as- appearance, color, taste, flavor and texture.The scale was arranged such that, 9 =like extremely, 8 = like very much, 7= like moderately, 6 = like slightly, 5 = neither like or dislike, 4 = dislike slightly,3= dislike moderately 2 = dislike very much and 1 = dislike extremely (Peryam *et al*., 1957).

Table 4: Likings toward the products in Pannel test

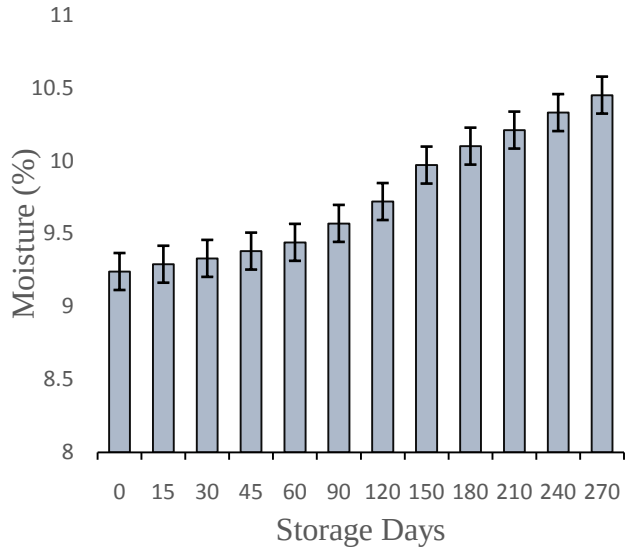
Panel members	**CN**	**S_1N**	**S_2N**	**S_3N**
Member 1	8	9	8	9
Member 2	9	8	6	8
Member 3	8	9	5	9
Member 4	8	7	8	8
Member 5	8	7	8	8
Member 6	8	7	6	7
Member 7	8	6	7	6
Member 8	8	9	9	8
Member 9	7	6	7	8
Member 10	7	9	9	8
Mean ±SD	7.64± 0.568	7.81±1.252	7.27±1.337	7.91±0.876

Where, CN = Control, S_1N= flakes of 30% fish mince, S_2N= flakes of 40% fish mince, S_3N= flakes of 50% fish mince

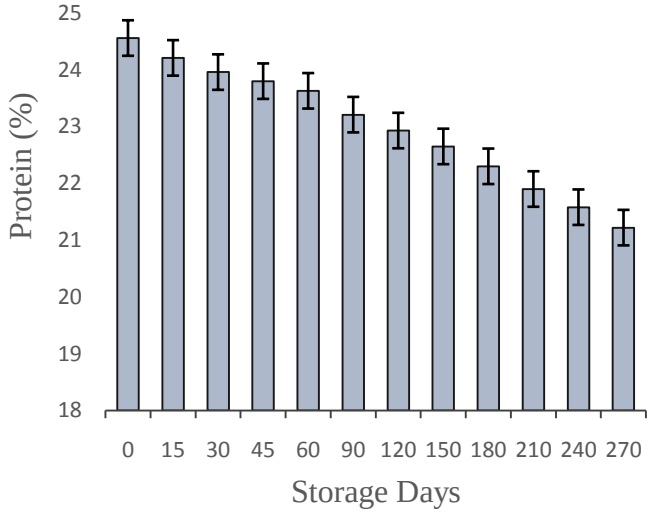
After sensory evaluation by the panelists, sample S_3N (50% fish mince) got the highest score and was selected finally for the storage study.Murlida *et al*., (2012)revealed that the fish flakes formulated with 30% tapioca was the most suitable formulation.

3.3. Effect of storage on sensory properties of flakes prepared from Pangas mince.

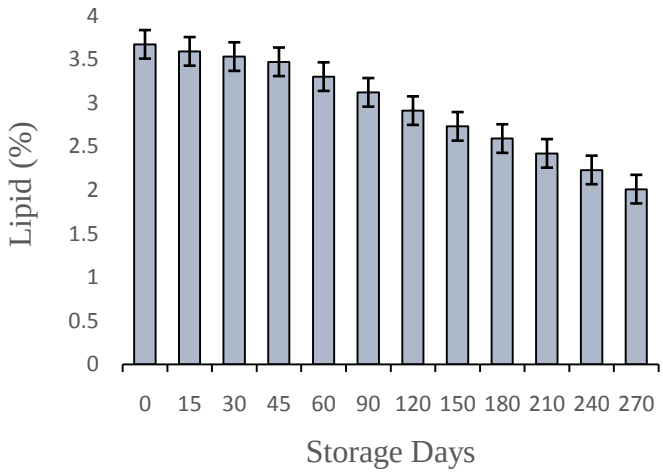
3.3.1. Compositional Changes infish flakes



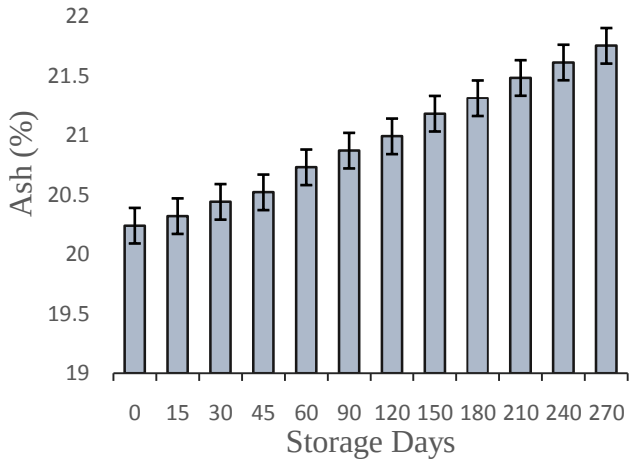
A



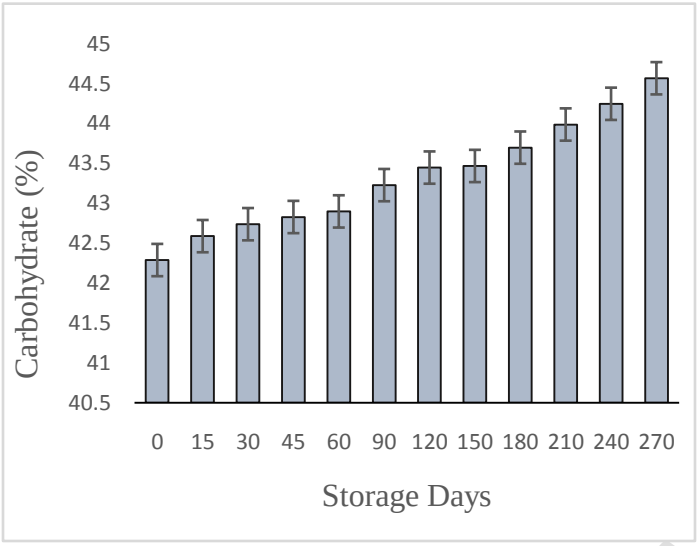
B



C



D



E

Figure 2: Changes in Proximate Composition Throughout the Storage Period, A) Moisture, B) Protein, C) Lipid, D) Ash, E) Carbohydrate

The moisture content was observed at 15 days and 30 days intervals. The moisture content of the flakes sample was 9.24± 0.12% at the 0th day thatincreased to 10.45±0.23% at 270 th day which indicates a very minimal change.Itwas observed by Maisont *et al*.,2021 that the moisture content in jellyfish crackers increased with the storage time for crackers stored at both 35°C and 45°C. The protein content of the fish flakes was 24.56% at 0th day which lowed with storage period and was found 21.22% at 270 th day. Anuja*et al*., 2008 stated that the protein content of fish crackers decreased throughout the storage time. At the end of the storage period, protein content of tilapia crackers was 11.75%.Lipid content lowered from 3.67% to 1.9% throughout the 270 days of storage. Anuja*et al*., 2008 stated that the protein content of fish crackers decreased throughout the storage time. At the end of the storage period protein content of tilapia crackers was 21.52 %. On the contrary, both ash and carbohydrate increased throughout the storage period of 270th days.

3.3.2: Sensory Evaluation of the Fish Flakes:

The sensory evaluation of the prepared fish flakes was conducted regarding the color, flavor, taste and texture (assessed as brittleness), mold growth at 30 days interval for 270 days. There were no remarkable changes of color, flavor and texture throughout the storage days. The color and flavor were very good, and the texture was also crispy after 270thdays observation. Another observation was done for the growth of mold on the sample at 30 days of interval. No mold growth was observed in the samples during the storage period of 270 days. The changes of color, flavor, texture and the overall acceptability of the fish flakes in polythene zipper packets at room temperature are shown in table 5.

Table 5: Sensory Analysis of Fish Flakes (*Pangasindon hypopthalmus*)Throughout the Storage Period

Days	Observation				
	Color	Flavor	Texture	Mold growth	Remarks
0	Very Good	Very Good	Crispy	No	Very Good
30	Very Good	Very Good	Crispy	No	Very Good
90	Very Good	Very Good	Crispy	No	Very Good
120	Very Good	Very Good	Crispy	No	Very Good
180	Very Good	Very Good	Crispy	No	Very Good
210	Very Good	Very Good	Crispy	No	Very Good
240	Very Good	Very Good	Crispy	No	Very Good
270	Very Good	Very Good	Crispy	No	Very Good

Pandey *et al.*, (2020) suggested the storage or shelf life of the fish flakes is around 2 years. Khan and Nowsad (2012) obtained the best textured fish crackers products acceptable in stored at refrigeration temperature (5°C) and at room temperature (28-30ºC) for 90 days shelf life. Tiwari *et al.*, (2020) observed no significant change in taste, texture, crispness, flavor, and overall acceptability in wafers over a period of 90 days in ambient temperature. Neiva *et al.*, (2011) evaluated the quality of fish crackers during a storage period of 180 days at room temperature where he found mold growth within an acceptable limit.

4. Conclusion:

Fish flakes were developed from pangas fish (*P. hypopthalmus*) with various formulas. Laboratory sensory score trials were favorable and encouraging. Processing aquatic species like pangas to produce value-added products by using simple technology not only increases their economic values but also popularizesthese resources. This process can also contribute to poverty alleviation and income generation in the developing countries. Production of fish flakes, apart from increasing people's protein intake, also will result in health improvement. In addition, it has

the potential to support a small regional factory in a developing economy. In this study the selected sample (50%) stored for 9 months for further analysis where no major change in composition,texture, color, flavor was found. No mold growth was noticed in fish flakes during storage. The findings of the present study may help in developing commercial processing technology for effective utilization of pangas fish, especially for manufacturing of flakes. The preparation of flakes from low-cost fish would have a way for proper utilization of this resource particularly during the peak season of harvesting. Scientific knowledge on quality changes in fish flakes during various storage conditions will provide a basis for supplying premium quality products. People of the country will get animal protein at a cheaper price. People of whole country will get a fishery product of different taste. To improve the nutritional quality as well as acceptability of pangas fish-based flakes, this study will surely make an excellent influence.

Ethical statement:

All the participants were informed about the panel test and permission was taken.

5. References

Anuja T. Premakumar K. Gayathiri T. Study on storability of fish cracker. 2008.

AOAC. Association of Official Analytical Chemists. Official Methods of the Association of Official Analytical Chemists. 15th ed. 1990. Arlington, VA, USA.

Begum M, Akter T, Minar MH. Analysis of the proximate composition of domesticated stock of pangas (*Pangasianodon hypophthalmus*) in laboratory condition. Environmental Science and Natural Resources.2012;**5**(1): 69-74. Bengali In: Souvenir of National Fish Fortnight (Matsya Pokkhya) 2005. Department of Fisheries, Dhaka.

Briones M, Dey MM and Ahmed M. The future for fish in the food and livelihoods of the poor in Asia. NAGA, World Fish Center Quarterly. 2004; 27: 48-50.

FAO. Rice is life. Food and Agricultural Organization of the United Nations. 2004. Rome, Italy.

FAO. The state of world fisheries and aquaculture statistics. Opportunities and challenges. 2014.

Huda N, Leng AL, Yee CX, Herpandi. Chemical composition, color and linear expansion properties of Malaysian commercial fish cracker (keropok). Asian Journal of Food and Agro-Industry. 2010;**3**(05):473-482.

Jakhar JK, Pal AK, Reddy DA, Sahu NP, Venkateshwarlu G, Vardia HK. Fatty acids composition of some selected Indian fishes. African Journal of Basic Applied Science. 2012; **4**:155-160.

Kamari S.ShabanpourB. Development and sensory evaluation of silver carp (*Hypophthalmichthys molitrix*) fish-based snack food. World Journal of Fish and Marine. 2013; **5**(6): 670-673.

Khan M, Nowsad AKMA. Development of protein enriched shrimp crackers from shrimp shell wastes. Journal of Bangladesh Agricultural University. 2012; **10**(2): 367–374.

Khan M. Nowsad AKMA. Development of protein enriched shrimp crackers from shrimp shell wastes. Journal of the Bangladesh Agricultural University. 2012; **10**(452-2016-35651): 367-374.

Maisont S. Samutsri W. Phae-Ngam W. Limsuwan P. Development and characterization of crackers substitution of wheat flour with jellyfish. Frontiers in Nutrition. 2021; 8: 772220.

Murlida E, Babji AS, Ayob MK, Maskat MY. Physicochemical properties of sardine (*Sardinella longiceps*) and tilapia (*Oreochromis niloticus*) flakes. 2nd International Seminar on Food & Agricultural Sciences. 2012; 106-110.

Neiva CRP, Machado TM, Tomita RY, Furlan EF, Lemosnato MJ and Bastos DHM. Fish crackers development from minced fish and starch: an innovative approach to a traditional product. Food Science and Technology. 2011; **31**(4): 973-979.

Nowsad AKMA. Raw material for the manufacture of surimi - II. The Bangladesh Observer, March 8 and 9, 1994. Dhaka, Bangladesh.

Nurul H, Boni L, Noryati I. The effect of different ratios of dory fish to tapioca flour on the linear expansion, oil absorption, color, and hardness of fish crackers. International Food Research Journal. 2009; **16**:159-165.

Pandey G, Sukumar D, Pal J, Thriveni K, Deepthi A. Fish flakes: a nutritional snack from low value fish. International Research Journal of Modernization in Engineering Technology and Science. 2020;**2**:230- 232.

Peryam DR, Pilgrim FJ. Hedonic scale method of measuring food preferences. Food technology. 1957.

Shikha FH, Hossain MI, Farzana L. Development of noodles with low-cost silver carp (*Hypophthalmicthys molitrix)* mince. Bangladesh Journal of Fish. 2020; **32**(1**)**:107-114.

Shikha FH. Hossain MI. Rahman MA. Sharma AD. Asadujjaman M. Biochemical composition of farmed Thai pangus (*Pangasianodon hypophthalmus*) collected from Mymensingh district in Bangladesh. Middle East Journal of Scientific Research.2014;**22**(6):928-932.

Tiwari M, Barooah MS, Bordoloi PL. Quality characterization of wafers enriched with fish powder developed from small bony fish. Journal of Aquatic Food Product Technology.2020; 1-14.

Viji P, Somrajan T, George N, Lalitha KV, Zynudheen AA, Binsi PK. Effects of Turmeric treatment and smoking duration on the shelf life of ready-to-cook fillets from sutchi catfish during chill storage. Journal of Food Process Engineering. 2015; 39:472-483.