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Changes in the Nutritional Composition of Fish Condiment Prepared from Thai Pangus (*Pangasianodon hypophthalmus*) During Storage at Low Temperature for Longer Period

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Abstract: Fish condiment prepared from Thai Pangus (*Pangasianodon hypophthalmus*) to observe the quality changes of the product at refrigeration (5°C to 8°C) and freezing (-20°C to -18°C) temperature from November 2013 to October 2014. Moisture content (%) decreased at refrigeration and frozen temperature from 53.57 to 43.56 and 54.11 to 42.33, respectively from initial month of storage to final month of storage. Similarly, protein content (%) decreased from 24.05 to 18.31 and 23.96 to 16.97, respectively throughout the storage period. Lipid content (%) increased up to seven month of storage and then decreased gradually at refrigeration temperature while at freezing temperature it increased gradually during the whole storage period. Ash content (%) increased from 4.53 to 7.91 and 4.34 to 8.25 at refrigeration and frozen storage, respectively. Aerobic plate count (APC) increased to 4.5×10^{7} CFU g^{-1} from 4.8×10^{4} CFU g^{-1} at refrigeration temperature whereas at frozen storage it decreased to 6.9×10^{2} CFU g^{-1} from 4.5×10^{4} CFU g^{-1}. The study suggested that condiment preparation from Thai Pangus could be a way to food security through supplying value added products.

Key words: Nutritional Composition · *Pangasianodon hypophthalmus* · Preservation · Value-Added Product

INTRODUCTION

Fish processing involves primarily the application of preservation techniques and value-adding in order to retain quality, improve taste, increase shelf life and easy access to market. Innovations and improvements in processing, storage, distribution, marketing and food science and technology have facilitated the trade and consumption of an expanded variety of species and product forms. Fishery products are extreme source of nutrition account for almost 17% of the global population's animal protein intake [1]. More than one billion people like fish and fishery products as the most important animal-source food in diets [2]. There is a growing demand for value-added products due to social and cultural changes [3]. Researchers worldwide have discovered that regular consumption of fish and fishery products can reduce the risk of various diseases and disorders.

The climate, water and soil conditions of Bangladesh are suitable for Thai Pangus production [4]. In addition, the fish can be stocked at a much higher density in culture ponds compared to other species [5]. But in the peak season, the market price of Thai Pangus often decline due to abundance of their production. Therefore, the fish would serve as an adequate source of raw material for fish condiment that may provide a good taste and nutrition to the young and outgoing people in cheaper price.

Fish condiment preparation is a safe and easy method of putting up fish for short term storage. Condiment have been of commercial importance in some developing countries like Korea, where condiments are made out of freshwater fish (Common carp, silver carp and cat fishes), anchovies, shrimps, squid, oyster, sea urchin etc. Low cost available fish like Thai Pangus will pave the way for proper utilization particularly during the peak season of harvesting through condiment preparation and marketing. Therefore, the present work designed to generate information on the changes in biochemical and microbiological composition of fish condiment stored in kitchen refrigerator.

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MATERIALS AND METHODS

Sample Collection and Experimental Condition: Fresh Thai Pangus (*Pangasianodon hypophthalmus*) fishes were collected from Kamal- Ranjit (KR) Market of Bangladesh Agricultural University (BAU), Mymensingh. Total 10 fishes were collected having weight from 1.0 to 1.2 kg. The fishes were immediately transported to the Fish Processing and Quality Control Laboratory, BAU and kept at ambient temperature (22-25ºC) in trays.

The experiments were carried out in the laboratories of Department of Fisheries Technology, Faculty of Fisheries, BAU for a period of 12 months from November 2013 to October 2014.

Sample Preparation

Ingredients for Fish Condiment: Fish condiment was prepared from the collected fish according to the method described below. Standard recipe for the preparation of condiment is given in the following table (Table 1).

Fish Condiment Preparation: The detail procedure of fish condiment preparation method developed in the laboratory is as follows (Figure 1 and Figure 2).

Sample Storage: Condiments were stored at refrigeration compartment and freezer compartment in glass bottles in a domestic refrigerator for quality analysis. At refrigeration compartment storage temperature varied between 5°C and 8°C whereas at freezer compartment the temperature varied from -20°C to -18°C.

Quality Analysis: Monthly analyses of the samples were done. Triplicate samples were taken to carry out the experiment. Proximate composition (Moisture, protein, lipid and ash) of fish condiment were tested according to the standard methods described by Association of Official Analytical Chemists [6].

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 statistically significant 30-300 colonies were used to calculate bacterial load using following formula [6]:

$$APC(CFU/g) = \frac{\text{No. of colonies on petridish} \times \text{Dilution factor} \times \text{Vol. of stock} \times 10}{\text{Weight of condiment sample (g)}}$$

Statistical Analysis: Data from different biochemical measurements were subjected to statistical analysis. The statistical analysis package SPSS 11.5 (SPSS Inc, Chicago, IL, USA) was used to calculate mean and standard deviation of the values. Relevant graphs were prepared using Microsoft Office Excel 2007 version.

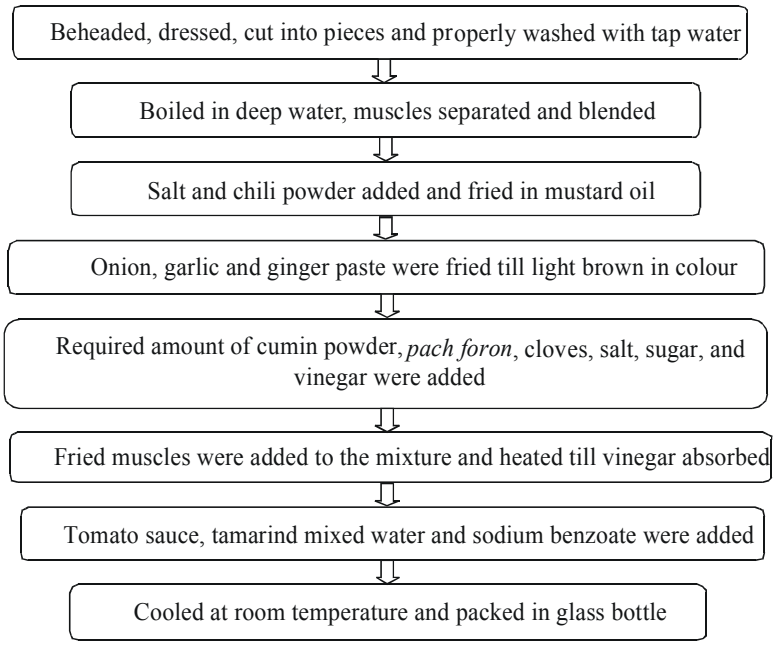

Fig. 1: Flow diagram of fish condiment preparation

Fig. 2: Fish condiment preparation

Table 1: Standard recipe for fish condiment preparation

Ingredients	Amount for Fish Condiment	Ingredients	Amount for Fish Condiment
Fish muscle	500g	Mustard oil	80ml
Chili powder	30g	Vinegar	50ml
Turmeric powder	5g	Black pepper	2g
Cumin	10g	*Pach foron*	5g
Onion	30g	Sugar	50g
Garlic	20g	Salt	30g
Ginger	10g	Tomato sauce	30g
Cloves	2g	Tamarind	20g
		Sodium benzoate	1g

RESULTS AND DISCUSSION

Changes in Proximate Composition

Moisture Content (%): Moisture content of fish condiment under refrigeration and frozen storage condition was found 53.57±0.268% and 54.11±0.350% respectively in the 1st month of storage. After that moisture content of fish condiment decreased slowly under both storage conditions throughout the storage period (Figure 3). Average moisture content of fish condiment at refrigeration and frozen temperature was reached 43.56±0.101% and 42.33±0.102%, respectively after 12 month of storage.

In the present study decreasing rate in the moisture content was higher at frozen temperature than condiment stored at refrigeration temperature. This is due to the rate of dehydration during storage. The decrease in moisture content was attributed to the sublimation of ice in frozen storage and drip loss during thawing process [7, 8]. The results of the present study are favoured by the findings of Arannilewa *et al.* [9] and Aberoumand [10] who proposed that decrease in moisture is due to condensation of water during frozen storage.

Protein Content (%): Average protein content of fish condiment stored at refrigeration and frozen temperature was decreased with the increase of storage period (Figure 4). At refrigeration storage condition, average protein content was 24.05±0.863%, 23.93±0.085%, 23.61±0.041%, 23.17±0.125%, 22.84±0.040%, 22.45±0.041%, 22.03±0.127%, 21.32±0.043%, 20.82±0.079%, 20.27±0.105%, 19.48±0.075% and 18.31±0.179% from 1st to 12th month of storage, respectively. In case of frozen storage condition, protein content from 1st to 12th month was 23.96±0.151%, 23.28±0.065%, 22.43±0.173%, 21.30±0.160%, 20.91±0.102%, 20.37±0.092%, 19.71±0.111%, 19.25±0.094%, 18.54±0.120%, 17.79±0.055%, 17.41±0.115% and 16.97±0.083%, respectively.

In the present study, protein content of fish condiment was higher immediately after processing. According to Garcia-Arias *et al.* [11] the increase in protein content found in cooked fish fillets is due to the reduction in moisture. Aberoumad and Pourshafi [12] observed that the lower the percentage of water the greater the protein content of fish and fishery products. Protein loss during frozen storage of fish was reported by researchers [10, 13, 14].

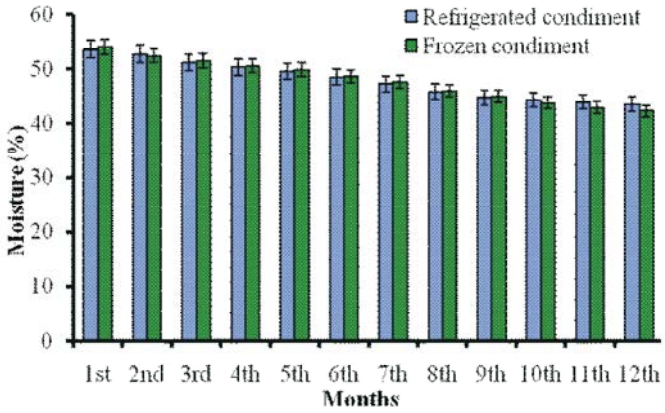

Fig. 3: Changes in moisture content (%) of fish condiment

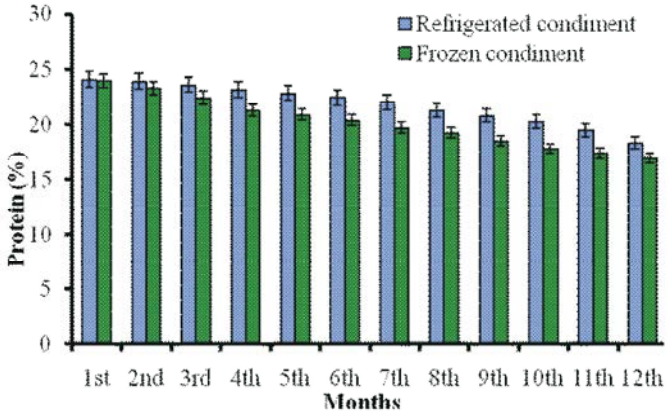

Fig. 4: Changes in protein content (%) of fish condiment

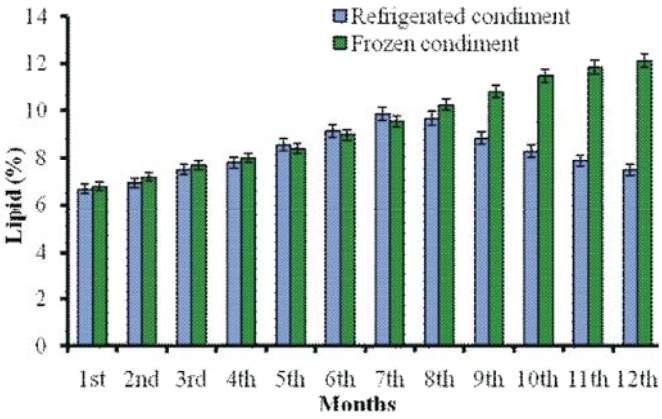

Fig. 5: Changes in lipid content (%) of fish condiment

Lipid Content (%): Lipid content of fish condiment under refrigeration and frozen storage temperature was found 6.68±0.101% and 6.79±0.025% respectively in the 1st month of storage (Figure 5). After that, in case of refrigeration storage condition, lipid content increased gradually from 2nd month of storage to 7 th month and then decreased slowly to final month of storage. At frozen storage temperature, lipid content of fish condiment increased gradually throughout the storage period, reached at 12.12±0.073% after 12 months.

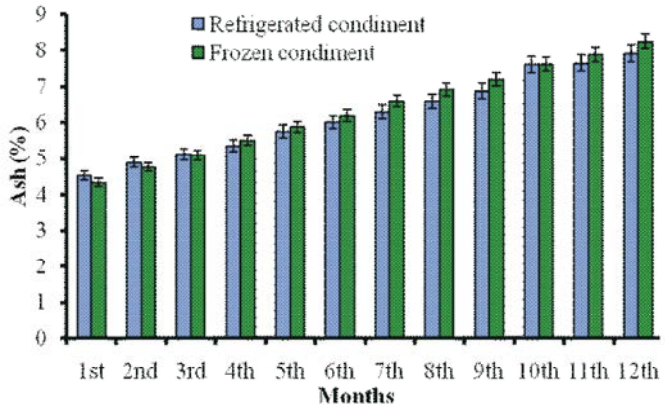

Fig. 6: Changes in ash content (%) of fish condiment

Table 2: APC of fish condiment at refrigeration and frozen storage

	APC of Fish Condiment (CFU g^{-1})	
Month	Refrigerated Condiment	Frozen Condiment
1st	4.8×10^4	4.5×10^4
2nd	9.0×10^4	7.9×10^3
3rd	2.3×10^5	6.4×10^3
4th	6.7×10^5	4.8×10^3
5th	7.9×10^5	4.0×10^3
6th	1.4×10^6	2.9×10^3
7th	3.6×10^6	1.5×10^3
8th	5.2×10^6	1.0×10^3
9th	8.4×10^6	9.7×10^2
10th	1.0×10^7	8.5×10^2
11th	3.4×10^7	7.3×10^2
12th	4.5×10^7	6.9×10^2

In fish condiment lipid content increased gradually with the increase of storage period. Increase of lipid content can be attributed to the oil penetration after water is partially lost by evaporation [15]. In the study, lipid content started to decrease after seven month of storage at refrigeration temperature. A significant loss in total lipid during storage at low temperature observed [10, 16]. Oxidation of lipid is claimed for the loss which is the major cause of deterioration of fishery products [17, 18].

Ash Content (%): In case of refrigeration storage condition, from first month of storage to final month of storage average ash content of fish condiment was recorded as 4.53±0.047%, 4.90±0.055%, 5.11±0.056%, 5.36±0.035%, 5.75±0.051%, 6.00±0.083%, 6.29±0.083%, 6.58±0.097%, 6.88±0.055%, 7.60±0.281%, 7.64±0.097% and 7.91±0.047%, respectively (Figure 6). Average ash content of fish condiment at frozen storage condition was 4.34±0.049%, 4.77±0.092%, 5.09±0.095%, 5.50±0.045%, 5.88±0.108%, 6.19±0.037%, 6.59±0.085%, 6.91±0.080%, 7.20±0.050%, 7.60±0.104%, 7.88±0.085% and 8.25±0.075%, respectively from 1st to 12th month.

High level of ash content in fish condiment was found immediately after processing. This is due to moisture loss in the processed fish condiment during frying and cooking through evaporation [19]. Present study found that ash content in fish condiment stored at refrigeration and frozen temperature increased gradually throughout the storage period. This trend of ash is related to reduction in moisture content throughout the storage period [20]. The lower the percentage of moisture the higher the percentage of ash content of fish condiment.

Changes in APC of Fish Condiment: In the present study, aerobic plate count (APC) of fish condiment showed inverse relation during storage period at refrigeration and frozen temperature. At refrigeration temperature, APC of fish condiment was increased slowly from 1st to 12th month of storage. On the contrary in frozen storage condition APC of fish condiment decreased slowly from first month to final month of storage (Table 3).

At refrigeration temperature APC in fish condiment increased gradually. A temperature of 4°C or lower is considered to be a safe refrigeration temperature. The samples were stored within this temperature. Bacterial load does not exceed the permissible limit recommended by ICMSF [21]. Fungal attack observed in fish condiment after seven month of storage. In case of freezing of fish condiment, bacterial load decreased gradually because of frozen temperature that completely inhibits bacterial growth. By halting the metabolic activity of such microorganisms present in and on the fish condiment, freezing stops this type of spoilage.

CONCLUSION

The outcomes of the present research will help processors to determine optimum processing and storage conditions for condiment prepared from Thai Pangus in

order to ensure products of premium quality. This study has immense importance to satisfy consumer's query relating to and how long fish condiment can be stored without any deterioration in domestic refrigerator for the betterment of the public health. Thai Pangus farmers will get the actual benefit due to processing of diversified value added products.

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