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Proximate Composition of Three Commercially Available Marine Dry Fishes (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*)

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ABSTRACT

Dry fish is very common and low cost food stuff among the South-east Asian people. The nutritional aspect of dry fish is higher than the fresh fish. Dry fish is not only consumed by human but also used in fish and poultry feed formulation. The general purpose of this study is to determine the proximate composition of three available marine dry fishes namely Bombay duck (*Harpodon nehereus*), Sin croaker (*Johnius dussumieri*) and Ribbonfish (*Lepturacanthus savala*). Major nutrient compositions like protein, lipid, carbohydrate, moisture and ash were estimated in two different season, winter and monsoon , respectively. The results of this study is revealed that the mean percentages of protein, lipid, carbohydrate, ash and moisture content of these species ranged between 52.44-71.32, 4.92-8.64, 0-3.71, 4.68-6.72 and 14.15-33.28%, respectively. The protein and lipid content were found relatively higher in amount from the dry fish samples collected in winter season compare with monsoon season. Negative correlations were found between moisture and protein content of most of the dry fish species collected in monsoon season ($r = -0.98$; $r = -0.96$, and $r = -0.95$, $p<0.05$ for Bombay duck, Sin croaker and Ribbonfish, respectively). However, the findings are showed that marine dry fishes are highly nutritive and could be a substitute of other protein sources such as fresh fish, chicken, beef etc.

Key words: Proximate composition, dry fish, Bombay duck, sin croaker, ribbonfish

INTRODUCTION

Dry fish is a very favourite food item among the people of South-east Asian countries and has a good market demand besides fish and seafood products. It is low cost dietary protein source and used as a substitute of fish at the scarcity of fresh fish in Bangladesh (Khan and Khan, 2002) and many other countries. Fish products contain most important nutritional components and serves as a source of energy for human beings (Koffi-Nevry *et al*., 2011; Sutharshiny and Sivashanthini, 2011). Fish is rich in vitamin and minerals for both young and old age consumers (Edem, 2009; Koffi-Nevry *et al*., 2011; Moghaddam *et al*., 2007). About 15% of fishes are cured for mass people consumption at the scarcity of fresh fishes in Bangladesh (Khan and Khan, 2001). People do not like some marine fish species to consume as fresh fish but they like to eat dry fish of these species. Dry fish consumption is a part of our culture and it is consumed all over the world for its taste and aroma. However, dry fish is available throughout the year because it can be kept for longer time without any conservation.

At present, people are more aware about health and nutritional issues (Hossain *et al*., 2008; Bhuiyan *et al*., 2008) and they concern about the nutritional value of the food items when they buy food items for their household. A number of studies found that higher income people are more concern about nutritious food intake in Bangladesh (Ahamed, 2009; Siddique, 2011). Improved knowledge in nutrition has showed how diet can influence human health directly (Jonsson *et al*., 2007). With the increasing of education level of the people in rural area, consumers are now more concern about the nutritional value of the food items. In the developing countries due to social inequality, some consumers have higher purchasing power conscious about health issues regarding intake of food (Petrovici *et al*., 2004). On the other hand, 33% of the children from rural area are suffering on malnutrition (Choudhury *et al*., 2000) that is under the poverty.

Proximate biochemical analysis provides information on the nutritional value of a particular organism used as a source of food (Zafar *et al*., 2004). A number of study on proximate composition of different marine fishes were found in the literature (Azim, 1982; Banu *et al*., 1985; Bhuiyan, 1992; Islam and Joadder, 2005; Sattar, 1993; Gheyasuddin *et al*., 1980; Rahaman *et al*., 1982; Rubbi *et al*., 1987; Sutharshiny and Sivashanthini, 2011; Stirling, 1972; Tawfik, 2009); but in the context of dry fish, very few relevant studies on biochemical composition of marine dry fishes has been done. As far the concern of the researcher, this study will be the first of its kind to explore the nutritional status of some available marine dry fishes in Bangladesh.

The main objective of this study is to determine the proximate composition of some marine dry fishes to understand the nutritional status of Bombay duck (*Harpodon nehereus*), Sin croaker (*Johnius dussumieri*) and Ribbonfish (*Lepturacanthus savala*). During the monsoon season dry fish absorbs a lot of moisture from the air. Therefore, the second objective of this study is to investigate the differences of proximate composition of dry fishes between winter (dry) and monsoon (wet) season in Bangladesh.

MATERIALS AND METHODS

Sampling: Samples from Chaktai, Asadgonj, Firingi Bazaar, Reajuddin Bazaar of Chittagong was collected. Three mostly available species of dry fishes namely Bombay duck (*Harpodon nehereus*), Sin croaker (*Johnius dussumieri*) and Ribbonfish (*Lepturacanthus savala*) were collected from each market in the winter (December-February) and Monsoon (June-August), 2006-2007. Samples chosen for this study were produced by sundry and storage period was within six months.

Sample preparation: For the analysis sample was taken accurately and each sample was crushed by mortar and pestle. The samples were analyzed for protein, fat, moisture and ash and in each case, three replies were maintained.

Estimation of protein: The usual Kjeldahl method was followed to determine the amount of protein in the dried fish muscle and head portion of the body. For this analysis, 0.5 g proteinous substances were weighed in a filter paper and into a Kjeldahl flask and 25-30 mL conc. H_2SO_4 and 2.5 g of digestion mixture ($CuSO_4$ and trace SiO_2) were added into the flask. Then the content of the flask was digested until the color becomes greenish blue or blue. The digested materials were then diluted by adding distilled water which in turn distilled over by the slow adding of 40% NaOH solution. The end point is indicated by previously added phenolphthalein. Ammonia thus distilled 4% boric acid solution which was finally titrated with standard HCl (0.1 N). The percentage of gross proteinous nitrogen was nitrogen was calculated out by the following formula:

$$N\ (\%) = (\text{Volume HCl} \times \text{Normality HCl} \times 0.014 \times 100)/\text{Weight of sample (g)}$$

$$\text{Protein}\ (\%) = \%\text{of nitrogen} \times 6.25\ (\text{conversion factor})$$

Estimation of lipid: Lipid content was estimated by the Soxhlet method. Frist of all weight of the empty tumble was taken. Then it was weighed with the sample. Difference of these two weights gives the weight of the sample. Then the sample was placed in a Soxhlet extractor previously set. Fats were extracted with petroleum ether. After ensuring complete extraction, petroleum ether was evaporated and the residue was dried to a constant weight at 105°C. The following calculation was used to determine the amount of lipid content in the dry fish samples:

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

Estimation of carbohydrate: The percentage of carbohydrate was calculated by simply subtracts the total percentage of protein, fat, moisture and ash from 100. The following equation was used to determine the amount of carbohydrate:

$$\text{Carbohydrate}\ (\%) = 100 - \%\ \text{of (Protein+Fat+Moisture+Ash)}$$

Estimation of moisture: Moisture was determined by drying the sample at +105°C in an oven. By subtraction, the moisture was calculated. For determining moisture, Aluminum dish was cleaned, dried and then the constant weight of the dish was taken. Sample was placed in the dish and weight was taken. Difference between two weights, weight of the sample was ascertained. Then the dish with sample was put in a controlled oven and was dried at 105°C until the constant weight was achieved. The following equation was used to determine the moisture content of the dry fish sample:

$$\text{Moisture}\ (\%) = \frac{\text{Weight of the sample - Weight of the dried sample}}{\text{Weight of the sample}} \times 100$$

Estimation of ash content: Ash was determined by muffling the sample at 6000-7000°C to dry ash. By subtraction ash content was determined. Firstly clean porcelain crucibles were heated in a muffle furnace at 6000°C and crucibles were then weighted until a constant weight was obtained. The sample with the crucible was weighed and recorded. The sample were ignited at 6000°C for 6 h or until the residue was uniformly grayish to white. Afterwards crucibles were transferred to the desecrator to cool them at room temperature for few minutes. Heating, desiccating, weighing, were repeated till a constant weight was obtained. Final constant weights of the crucibles were recorded. The following equation was used to determine the ash content of the dry fish samples:

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

Data analysis: To find out the mean percentage, standard deviation and correlation matrix, Statistical Package for Social Science (SPSS Version 19.0) was used in this study.

RESULTS AND DISCUSSION

Proximate composition: The proximate compositions of three marine dry fishes (Bombay duck, Sin croaker and Ribbonfish) were done in the laboratory to investigate the mean percentages of protein, lipid, carbohydrate, moisture and ash content. The mean percentage of protein, lipid, carbohydrate, moisture and ash of Bombay duck *(Harpodon nehereus),* Sin croaker (*Johnius dussumieri*) and Ribbonfish (*Lepturacanthus savala*) is presented in Table 1. The results show that the mean percentage of protein, lipid, carbohydrate and ash from Bombay duck were 57.03, 7.48, 2.15 and 6.72% in winter season and 52.44, 6.34, 1.72 and 4.83% in monsoon season, respectively. Sin croaker was found to be contained 57.62% of protein, 5.41% of lipid, 3.71% of carbohydrate and 6.01% of Ash content in winter season and 53.05% of protein, 4.92% of lipid, 3.21% of carbohydrate and 5.13% of Ash in monsoon season , respectively. Compare with another two species, the mean percentage of protein and lipid was found at a higher amount in Ribbonfish. The mean percentage of protein, lipid, moisture and ash of Ribbonfish were recorded 71.32, 8.64, 14.15 and 4.68% in winter and 68.79, 8.28, 17.23 and 4.80% in monsoon season, respectively. The higher percentage of moisture 24.87% (in winter) and 33.28% (in monsoon) were found from Bombay duck and 22.77% (in winter) and 30.44% (in monsoon) were found from Sin croaker samples.

Protein: In the present study, protein level in the analyzed (Bombay duck, Sin croaker and Ribbonfish) samples were varied from 52.44 -71.32% where fresh fishes contain 16-20% of protein of the total weight. According to According to Love, (1970), principal composition of fish is 16-21 protein, 0.2-5 lipid, 0-0.5 carbohydrate and 66-81% water. Protein content in fresh haddock is about 17-19% but in dried haddock the protein content is about 75.80% (Jonsson *et al.*, 2007). Bhuiyan (1992) observed 55.8-75.9% protein in dried Bombay duck and Sin croaker , respectively. Rahaman *et al.* (1982) observed average 55.75-64.49% protein in dried marine fishes. Gheyasuddin *et al.* (1980) found 79.32-85.49% protein in dried fishes. However, these studies were not indicated any specific species. However, the findings of this study shows that the average protein level obtained from our freshly stored dry fishes are very close with the previous studies.

Lipid: The mean percentages of lipid of three types of marine dry fish samples were varied from 4.92-8.64%. Bhuiyan (1992) observed 6.84-9.21% lipid in dried Bombay duck and Sin croaker samples. Rubbi *et al.* (1987) reported that the lipid content ranging from 0.45-15.51% in dried marine fishes which is very close with the present investigation. Lovern (1950) reported that the variation in lipid content could be influenced by the variation of species, diet, temperature, salinity, selective mobilization and distribution. In the correlation matrix, it is found that lipid is negatively correlated with moisture content in monsoon season ($r = -0.90$, $p<0.01$ for Bombay duck and $r = -0.98$, $p<0.05$ for Ribbonfish, respectively) (Table 2B).

Table 1: Proximate composition of three different marine dry fish (Mean percentage±SD)

	Winter season					Monsoon season				
Dry fish species	Protein	Lipid	Carbohydrate	Moisture	Ash	Protein	Lipid	Carbohydrate	Moisture	Ash
Bombay duck	57.03±1.47	7.48±0.52	2.15±0.46	24.87±2.96	6.72±0.97	52.44±1.85	6.34±0.56	1.72±0.15	33.28±1.89	4.83±0.15
Sin croaker	57.62±1.03	5.41±0.35	3.71±0.52	22.77±2.29	6.01±0.55	53.05±1.91	4.92±0.38	3.21±0.32	30.44±2.45	5.13±0.42
Ribbonfish	71.32±0.67	8.64±0.25	0.00±0.00	14.15±0.57	4.68±0.31	68.79±1.56	8.28±0.70	0.00±0.00	17.23±1.42	4.80±0.24

Table 2A: Correlation matrix among the constituents of three dry fish samples collected in winter season

	Winter season				
Samples	1	2	3	4	5
Bombay duck					
Protein	-				
Lipid	-0.546	-			
Carbohydrate	0.682	-0.586	-		
Moisture	-0.932*	0.626	-0.793	-	
Ash	0.957**	-0.610	0.633	-0.956**	-
Sin croaker					
Protein	-				
Lipid	-0.121	-			
Carbohydrate	0.173	0.266	-		
Moisture	-0.668	-0.500	-0.410	-	
Ash	0.812*	-0.269	0.060	-0.669	-
Ribbonfish					
Protein	-				
Lipid	0.562	-			
Carbohydrate	.[a]	.[a]	.[a]		
Moisture	-0.505	-0.314	.[a]	-	
Ash	-0.171	0.088	.[a]	0.382	-

Sample: **Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed) and [a]cannot be computed because at least one of the variables is constant

Table 2B: Correlation matrix among the constituents of three dry fish samples collected in monsoon season

	Monsoon season				
Samples	1	2	3	4	5
Bombay duck					
Protein	-				
Lipid	0.880*	-			
Carbohydrate	0.182	-0.025	-		
Moisture	-0.983**	-0.898*	-0.206	-	
Ash	0.415	0.795	-0.236	-0.463	-
Sin croaker					
Protein	-				
Lipid	0.029	-			
Carbohydrate	0.629	-0.317	-		
Moisture	-0.964**	-0.035	-0.672	-	
Ash	0.594	0.698	-0.132	-0.507	-
Ribbonfish					
Protein	-				
Lipid	0.933**	-			
Carbohydrate	.[a]	.[a]	.[a]		
Moisture	-0.954**	-0.982**	.[a]	-	
Ash	0.427	0.313	.[a]	-0.276	-

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed) and [a]cannot be computed because at least one of the variables is constant

Carbohydrate: In the present study, carbohydrate level in the analyzed (Bombay duck, Sin croaker and Ribbonfish) samples were varied from 0-3.71%. Bhuiyan (1992) observed 0.2-0.88% carbohydrate in dried Bombay duck and Sin croaker samples. Stirling (1972) found 1.0-12.5% carbohydrate in the liver of dried fish samples.

Moisture: Moisture levels in the analyzed samples were found ranged between 14.15-33.28%. Bhuiyan (1992) observed 6.9-14.2% moisture in dried Bombay duck and Sin croaker. The present study has some dissimilarity with above author, the reason of this dissimilarity is that the previous study was conducted on fresh fishes and they analyzed the sample after drying. Therefore, the moisture level was highly reduced. In the present study, we have collected freshly stored dry fish and sample were not dried before analyze. Sometimes, the fisher does not dry the fishes properly due to loss of weight. This might be another reason for obtaining this higher amount of moisture content in these samples. Therefore, the moisture content of the present study was relatively higher in the samples collected in monsoon season. In the monsoon season the average humidity is very high in Bangladesh. The stored dry fish absorb huge amount of moisture from the air and increase the moisture level. From the correlation matrix it is observed that moisture is negatively correlated with protein in winter season ($r = -0.93$, $p<0.01$ for Bombay duck species) (Table 2A) and in monsoon ($r = -0.98$, $p<0.05$; $r = -0.96$, $p<0.05$ and $r = -0.95$, $p<0.05$ for Bombay duck, Sin croaker and Ribbonfish , respectively) (Table 2B). It means that 1 unit relative increase of moisture can reduce 1 unit of protein content in these stored dry fish samples.

Ash: The residue without water and volatile constituents are containing carbon dioxide, oxides of nitrogen and water as known ash. In the present study, ash level in the analyzed (Bombay duck, Sin croaker and Ribbonfish) dried samples were varied from 4.68-6.72%. Gheyasuddin *et al.* (1980) found 4.56-9.98% ash content in some marine dried fish samples which are in close quarters with the present investigation. Positive correlation between ash and protein was found in the samples collected in winter season ($r = 0.96$, $p<0.05$ for Bombay duck and $r = 0.81$, $p<0.01$ for Sin croaker, respectively) (Table 2A).

CONCLUSION

The present study is revealed that the marine dry fishes have very good nutritional value. Higher amount of protein and fat content of dry fishes make it highly nutritious. The protein and lipid concentration of these selected dry fishes were much higher than the fresh fish. The results explore that the protein and lipid content is comparatively lower with increasing of moisture content in monsoon season. Therefore, this study recommended that necessary steps should be taken for moisture control of dry fish products by air tied packing to protect from nutritional deterioration.

RECOMMENDATIONS FOR FUTURE RESEARCH

This study only focuses on three commercially important marine dry fishes. Further research should cover most of the common marine dry fishes. Besides protein, lipid, carbohydrate etc. essential amino acids, fatty acids and minerals should be included in further studies to investigate the nutritional value of marine dry fishes.

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