

Changes of Nutritional Value of Three Marine Dry Fishes (*Johnius dussumieri*, *Harpodon nehereus* and *Lepturacanthus savala*) during Storage

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ABSTRACT

Dry fish is the low cost dietary protein source in Bangladesh. Sometimes dry fishes are kept for a longer period that is the key factor of the deterioration of nutritional value of dry fishes, as they absorb moisture from the surrounding air. The general purpose of this study is to determine the proximate composition of three available marine dry fishes (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) and to investigate the changes of nutritional value of these selected dry fishes with the increasing of storing period. The result of this study shows that the mean percentage of moisture content increased at a significant level with the increasing of storing period. For 2 years storing period the moisture content is increased by 12.77%, 11.89% and 6.69% for the three dry fishes (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala* respectively). The result of this study also shows that the mean percentage of protein (6.35, 7.93 and 4.68), lipid (1.92, 0.67 and 1.13), and carbohydrate (1.70, 1.81 and 0.66) of three dry fishes (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala* respectively) decreased greatly for 2 years storing period. The findings of this study showed that nutritional value of dry fishes deteriorate with the increasing of storage period.

Keywords: Proximate Composition, Marine Dry Fish, Nutritional Value, Bangladesh

1. Introduction

Dry fish is low cost dietary protein source and used as a substitute of fish at the scarcity of fresh fish. About 15% of fishes are cured for mass people consumption at the scarcity of fresh fishes in Bangladesh [1]. It is also a very favourite food item among Bangladeshi people and has a good market demand besides fish and seafood products. Some marine fish species people do not like to consume as fresh fish but they like to eat dry fish of these species. Moreover, dry fish has a storage life of several years and is a great source of protein, essential fatty acids, vitamins and many minerals [2]. So it is consumed all over the world for its nutritional value, taste, and aroma.

In the developed world, people are more concern about the risk and health issues [3]. On the other hand, in the developing countries due to social inequality some consumers have higher purchasing power also conscious about health issues regarding intake of food [4]. Nutrition is an important influencing factor of fish product/seafood

consumption [5,6]. At present, people are aware about health and nutritional issues [7] 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 harmful and health hazardous food intake in Bangladesh [8].

In Bangladesh, sun drying practice starts from September and continuous till April. However this period let to varies with weather condition of the Bay of Bengal. The fishermen of the country isolated coastal islands and its adjacent areas do store their catch by using cheap and easy sun drying practice. Most of the marine fishes landed in remote areas and inlands viz, Afatior chor, Dublar chor, Kutubdia, Khuruskul, Moheskhal, Rangabali, Sonadia, Shahpori, St. Martin and Teknef coast and simply sun dried and a portion is cured.

Dry fish are generally stored in dump warehouses. Sometimes, fisher does not dry fishes properly due to

loss of weight, as they want to make more profit. Therefore, during the monsoon period the dry fish absorb moisture rapidly and become suitable for infestation by beetles and mites [9,10]. Therefore, it is assumed that the nutritional value and the physical properties of dry fish will be deteriorated with the increasing of storage period.

A number of study on proximate composition of different marine fishes were found in the literature [2,11-20]. However, in the context of dry fish, very few relevant studies in explaining the proximate 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 deterioration of nutritional value of dry fishes with the increasing of storage period.

The first objective of this study is to determine the proximate composition of three available marine dry fishes in Bangladesh of different storage period and the second objective is to investigate the changes of nutritional value of these dry fishes during different storage period.

2. Materials and Methods

2.1. Sampling

Samples from Chaktai, Asadgonj, Firingi bazar, Reajuddin Bazar of Chittagong was collected. Three most popular species of dry fishes namely Bombay duck (*Harpodon nehereus*), Sin croaker (*Johnius dussumieri*) and Ribbon fish (*Lepturacanthus savala*) were collected from each market. Four categories of sample chosen for this study were freshly dry fish sample (one month storage period), six months storage sample, one year storage sample and two year storage sample. Storage period was determined by follow up the receiving date of these samples at the warehouse.

2.2. Sample Preparation

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

2.3. 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 gm proteinous substances were weighed in a filter paper and into a Kjeldahl flask and 25 - 30 ml conc. H₂SO₄ and 2.5 gm of digestion mixture (CuSO₄ and trace SiO₂) 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 phenolphthelene. Ammonia thus distilled 4% boric acid solution which was finally titrated with standard HCl (0.1 N). The percentage of gross proteneous nitrogen was nitrogen was calculated out by the following formula:

$$\% \text{ N} = (\text{volume HCl} \times \text{normality HCl} \times 0.014 \times 100) / \text{weight of sample (gm)} \quad (1)$$

$$\% \text{ of protein} = \% \text{ of nitrogen} \times 6.25 \quad (\text{conversion factor}) \quad (2)$$

2.4. 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:

$$\% \text{ of lipid} = (\text{weight of the extracted lipid content} \times 100) / \text{weight of sample} \quad (3)$$

2.5. 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:

$$\% \text{ carbohydrate} = 100 - \% \text{ of (protein + fat + moisture + ash)} \quad (4)$$

2.6. Estimation of Moistures

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 till the constant weight was achieved. The following equation was used to determine the moisture content of the dry fish sample:

$$\% \text{ of moisture} = (\text{weight of the sample} - \text{weight of the dried sample}) / \text{weight of the sample} \times 100 \quad (5)$$

2.7. 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 hours 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:

$$\% \text{ of ash} = (\text{weight of ash/weight of the sample}) \times 100 \quad (6)$$

2.8. Data Analysis

To find out the mean percentage and standard deviation Statistical Package for Social Science (SPSS Version 16.0) was used in this study.

3. Results

3.1. Proximate Composition

The proximate compositions of three marine dry fishes (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) were done for four types of sample. In respect of storage period, samples were divided into four categories; freshly dry fish sample (1 month storage), 6 months storage sample, 1 year storage sample and 2 years storage sample respectively. Mean percentages of protein, lipid, carbohydrate, moisture and ash were determined for these three types of marine dry fish.

3.1.1. *Harpodon nehereus*

The mean percentage of protein, lipid, carbohydrate, moisture and ash of *Harpodon nehereus* is presented in **Table 1**. The results show that the mean percentage of protein, lipid and carbohydrate from freshly stored dry fish to 2 years stored dry fish samples were ranged between 58.33 - 51.98, 7.78 - 5.86 and 4.11 - 2.41 respectively. The higher percentage of moisture (34.99%) was found in 2 years stored sample of *Harpodon nehereus*.

3.1.2. *Johnius dussumieri*

Table 2 is illustrated the mean percentage of protein, lipid, carbohydrate, moisture and ash of *Johnius dussumieri* for four different storage period. Among four groups of sample, freshly stored dry fish samples of *Johnius dussumieri* were found to be contained higher amount of protein (64.39%), lipid (5.54%) and carbohydrate (2.94%). The mean percentage of protein content of *Johnius dussumieri* in freshly stored, 6 months stored, 1 year stored and 2 years stored samples are found 64.39, 62.25, 60.75 and 56.46 respectively. The mean percentage of moisture content of *Johnius dussumieri* is ranged between 20.76 - 32.65 from freshly stored sample to 2 years stored dry fish sample.

3.1.3. *Lepturacanthus savala*

The study shows that the mean percentage of protein in *Lepturacanthus savala* is relatively higher than the other two species. The mean percentage of protein content of *Lepturacanthus savala* in freshly stored, 6 months stored, 1 year stored and 2 years stored samples are found 71.90, 71.01, 69.07 and 67.22 respectively. The results show that the mean percentage of lipid, carbohydrate and ash

Table 1. Proximate composition of *Harpodon nehereus* (Mean percentage + SD) at different storage period.

Storing period	Protein	Lipid	Carbohydrate	Moisture	Ash
Freshly dry fish sample	58.33 ± 0.41	7.78 ± 0.50	4.11 ± 0.49	22.22 ± 0.77	7.56 ± 0.41
6 months storage sample	55.73 ± 0.44	7.17 ± 0.38	3.70 ± 0.42	27.53 ± 0.47	5.87 ± 0.28
1 year storage sample	54.09 ± 0.18	6.83 ± 0.19	2.60 ± 0.21	31.57 ± 0.36	4.91 ± 0.12
2 years storage sample	51.98 ± 0.52	5.86 ± 0.22	2.41 ± 0.28	34.99 ± 0.22	4.76 ± 0.16

Table 2. Proximate composition of *Johnius dussumieri* (Mean percentage + SD) at different storage period.

Storing period	Protein	Lipid	Carbohydrate	Moisture	Ash
Freshly dry fish sample	64.39 ± 0.50	5.54 ± 0.34	2.94 ± 0.49	20.76 ± 0.62	6.37 ± 0.50
6 months storage sample	62.25 ± 0.77	5.28 ± 0.38	2.03 ± 0.55	24.79 ± 0.75	5.65 ± 0.32
1 year storage sample	60.75 ± 0.59	4.97 ± 0.24	1.69 ± 0.42	27.23 ± 0.44	5.36 ± 0.44
2 years storage sample	56.46 ± 0.40	4.87 ± 0.55	1.13 ± 0.39	32.65 ± 0.34	4.89 ± 0.29

content from freshly stored dry fish to 2 years stored dry fish samples were ranged between 7.79 - 6.66, 1.64 - 0.98 and 4.86 - 4.64 respectively for this species. The mean percentage of moisture content was found up to 20.50 in 2 years' storage sample of *Lepturacanthus savala*. The proximate composition of *Lepturacanthus savala* is presented in **Table 3**.

3.2. Changes of Nutritional Value during Storage Time

The study is found that nutritional value of these selected species is decreased due to longer storage period. In case of *Harpodon nehereus*, mean percentage of protein is decreased at 2.60, 4.24 and 6.35; lipid decreased at 0.61, 0.95 and 1.92; and carbohydrate decreased at 0.41, 1.51 and 1.70 with the increasing of storing period (6 months, 1 year and 2 years respectively). The mean percentage of moisture content is increased due to increase of storing period. For 6 months storing period the mean percentage of moisture is increased at 5.31 but for 2 years storing period the moisture content is increased at 12.77. The mean percentage of ash is decreased at 1.69, 2.65 and 2.80 for the 6 months, 1 year and 2 years stored dry fish samples respectively.

The results show that the mean percentage of protein, lipid, carbohydrate and ash content of *Johnius dussumieri* decreased with the increasing of storing period. Only exception was found in moisture content as it is increased with the increasing of storing period. The mean percentage of protein of *Johnius dussumieri* is decreased at 2.14, 3.64 and 7.93; lipid decreased at 0.26, 0.57 and 0.67; and carbohydrate decreased at 0.91, 1.25 and 1.81 with the increasing of storing period (6 months, 1 year and 2 years respectively). To compare with other species, this type of dry fish is found to absorb much more moisture content during longer storage period. The mean percentage of moisture increased from 20.76 to 32.65 in 2 years stored dry fish for this species.

In case of *Lepturacanthus savala*, mean percentage of protein is decreased at 0.89, 2.83 and 4.68; lipid decreased at 0.31, 0.58 and 1.13; and carbohydrate decreased at 0.36, 0.58 and 0.66 in changing of storage period (6

months, 1 year and 2 years respectively). The mean percentage of moisture content is increased due to increase of storing period. For 6 months storing period the mean percentage of moisture is increased at 1.68 but for 2 years storing period the moisture content is increased at 6.69. The mean percentage of ash is decreased comparatively at lower rate than the protein and lipid.

4. Discussion

4.1. Proximate Composition

The proximate compositions of three marine dry fishes (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) were done for four types of sample. In respect of storage period, samples were divided into four categories; freshly dry fish sample (1 month storage), 6 months storage sample, 1 year storage sample and 2 years storage sample respectively. Mean percentages of protein, lipid, carbohydrate, moisture and ash were determined for these three types of marine dry fish.

In the present study, protein level in the analyzed (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) samples were varied from 58.33% - 51.98%, 64.39% - 56.46% and 71.90% - 67.22% respectively during changes of storage period. Bhuiyan (1992) observed 55.8% - 75.9% protein in dried fish sample (*Harpodon nehereus* and *Johnius dussumieri* respectively) [12]. A number of studies have been conducted on freshly stored dry fishes but these studies did not focus on the proximate compositions of longer time stored dry fishes. Rahman *et al.* (1982) observed 55.75% - 64.49% protein level in dried marine fishes [18]. Gheyasuddin *et al.* (1980) found 79.32% - 85.49% protein in dried fishes [14]. However, these studies were not indicated any specific species. However, the findings of this study shows that's the average protein level obtained from our freshly stored dry fishes are very close with the previous studies. The mean percentages of lipid of three types of marine dry fishes (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) samples were varied from 7.78% - 5.86%, 5.54% - 4.87% and 7.79% - 6.66% respectively during changes of storage period. Bhuiyan (1992) ob-

Table 3. Proximate composition of *Lepturacanthus savala* (Mean percentage + SD) at different storage period.

Storing period	Protein	Lipid	Carbohydrate	Moisture	Ash
Freshly dry fish sample	71.90 ± 0.25	7.79 ± 0.11	1.64 ± 0.30	13.81 ± 0.55	4.86 ± 0.28
6 months storage sample	71.01 ± 0.18	7.48 ± 0.27	1.28 ± 0.27	15.49 ± 0.40	4.74 ± 0.24
1 year storage sample	69.07 ± 0.32	7.21 ± 0.12	1.06 ± 0.24	17.95 ± 0.25	4.71 ± 0.29
2 years storage sample	67.22 ± 0.39	6.66 ± 0.23	0.98 ± 0.33	20.50 ± 0.32	4.64 ± 0.38

served 9.21% - 6.84% lipid in dried marine fishes [12]. Rubbi *et al.* (1987) reported that the lipid content ranging from 0.45% - 15.51% in marine fishes which is very close with the present investigation [19]. Lovern (1950) reported that the variation in lipid content was influenced by the variation of species, diet, temperature, salinity, selective mobilization and distribution [21].

In the present study, carbohydrate level in the analyzed (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) samples were varied from 4.11% - 2.41%, 2.94% - 1.13% and 1.64% - 0.98% respectively during changes of storage time. Bhuiyan (1992) observed 0.88% - 0.2% carbohydrate in dried fishes [12]. Stirling (1972) found 1% - 12.5% carbohydrate in the liver of dry fishes [20]. These findings are not very close to the present investigation because the present study is only considered three commercially important dry fishes.

Moisture level in the analyzed (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) dried samples were varied from 22.22% - 34.99%, 20.76% - 32.65% and 13.81% - 20.50% respectively during changes of storage period. The reason is that during the monsoon season, the humidity is much higher than the winter or summer. The dry fish traders keep the dry fish in wet and unhygienic condition and do not control the moisture and air temperature of the warehouse. Bhuiyan (1992) observed 6.9% - 14.2% moisture in dried marine fishes [12]. The present study has some dissimilarities of above author, because present experiment studied different storage time of dry fishes whereas other author only studied fresh dry fishes.

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 (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) dried samples were varied from 7.56% - 4.76%, 6.37% - 4.89% and 4.86% - 4.64% respectively during changes of storage period. Bhuiyan (1992) observed 6.6% - 16.2% ash in dried fishes [12]. Gheyasuddin *et al.* (1980) found 9.98% - 4.56% ash in dry fishes which is in close quarters with the present investigation [14].

4.2. Changes of Nutritional Value during Storage Time

The study is found that the mean percentage of protein and lipid of these selected species (*Harpodon nehereus*, *Johnius dussumieri* and *Lepturacanthus savala*) is decreased up to 7.93 and 1.92 respectively for 2 years storing period. In the present study, it was observed that most of the dry fish samples contained higher amount of moisture, even freshly stored dry fishes also contained 13 -

22 percent of moisture, which might causes bacterial infestation. *Lepturacanthus savala* species (Ribbon fish) absorb less amount of moisture compare with other samples due to their flattened body shape. The higher amount of moisture in freshly stored dry fishes proved that the fishers did not dry the fishes properly during dry fish production due to increase of weight to make more profit. The mean percentage of lipid of these selected species was found at a higher amount in freshly stored dry fish sample but decreased with increase in length of storage. Reduction in lipid content could be attributed to oxidation of poly-unsaturated fatty acids (PUFA) contained in the fish tissue to products such as peroxides, aldehydes ketones and the free fatty acids [22]. However, the rate of fat deterioration was very gradual. Fish oil has been found to be more liable to spoilage than other oils due to their greater number of unsaturated fatty acids [23]. The greater the degree of unsaturation, the greater would be the tendency for fat oxidation (rancidity). There might be high risks of rancidity during prolonged storage conditions due to the fatty nature of fish [22].

5. Conclusion and Recommendations for Future Research

The proximate composition of different marine dry fishes revealed that dry fish have very good nutritional value. The collected samples were very rich in protein, lipid and carbohydrate. However, the nutritional value of dry fishes are greatly deteriorates due to the longer storage. Therefore, the dry fish industries should be kept more precautionary steps during storage of dry fish in the warehouse and in the sales centre. This study only focuses on three commercially important marine dry fish available in Bangladesh. 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 changes of nutritional value of marine dry fishes.

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