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Research Article

Nutritional quality assessment of three commonly consumed dry fishes in Bangladesh.

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Abstract

Dried fish is arguably one of the most commonly consumed food items in Bangladeshi dishes, as well as in South East Asia and Africa. The present study aims to investigate the nutritional profile of the three most commonly consumed dry fishes namely Loittya *(Harpodon nehereus)*, Chhuri *(Trichiurus lepturus)* and Chepa *(Puntius sophore)* in Bangladesh. Samples were collected from the six largest dry fish wholesale markets. According to the data, each of the three dried fishes contains a significant amount of protein, ranging from 39.29 ± 0.94% to 49.40 ± 0.40%. Loittya had the highest fat content (16.80±0.08%), while Chhuri had the lowest (11.72 ± 0.36%). The ash content ranges from 11.68±0.16% to 18.37 ± 0.17%, indicating that all three dried fishes are rich in minerals such as calcium (Ca), phosphorus (P), iron (Fe), and magnesium (Mg). The baseline data revealed that dry fish is an excellent source of beneficial nutrients, which could play a promising role in the prevention of various life-threatening diseases caused by malnutrition.

1. Introduction

The fisheries sector of Bangladesh plays a very important role in the national economy, accounting for 3.57 % of the national GDP (Gross Domestic Product) and approximately 26.50 % of agricultural GDP [1]. Over the last ten years, fisheries growth has been fairly consistent, averaging 5.38% per year. This sector grew at a more or less consistent rate, ranging from 7.32% in 2009-2010 to 4.04% in 2013-2014 [2]. More than 2% Bangladeshi export value comes from the inland Fisheries section. Fish supplements account for approximately 60% of Bangladeshi people's daily animal protein intake [3]. Over 17 million people, including approximately 1.4 million women, rely on the fisheries sector for a living through fishing farming, fish handling, and processing [3].

Among the fish product, dry fishes provide protein with fewer calories than other foods such as beef. Fish that is dried, and weighs 100 grams contains approximately 80% of protein but only 300 calories. Most dried fish are low in salt and cholesterol, but high in essential vitamins and minerals. It is also low in saturated fat, which has been linked to heart and blood pressure problems. It also has important micronutrients such as iodine, zinc, copper, selenium, and calcium [4].

The proximate composition is another important criterion to standardize the fish quality which influences both the keeping quality and technological characteristics of the fish. The main chemical components such as water, crude protein, lipid have the greatest influence on nutritive value, the functional properties, sensory quality and shelf life. As a result, information on the nutritive value and food quality of the products is equally important for proper product utilization. Despite this, the biochemical composition of Bangladeshi dried fish has also been reported [4-10]

Nonetheless, the nutritional composition of different dried fish products from different regions of Bangladesh varied significantly. Therefore, it is a dire need to ensure the nutritional value as well as food quality of the dried fish products. As a result, the current study aimed to assess the proximate and nutritional composition of some collected dried fish collected in Bangladesh through laboratory analyses.

2. Materials and methods

2.1. Samples Collection

The dry fishes (three types) were collected from six different market areas namely Cox's Bazar, Chittagong, Laxmi Bazar, New Market, Shwapno Super Shop (Dhanmondi) and Jatrabari in Bangladesh. The samples are locally known as Loittya (*Harpadon nehereus,* English : Bombay duck), Chepa (*Puntius sophore,* English: Pool barb) and Chhuri (*Trrichiurus lepturus,* English: Ribbon fish). The collected fish samples were packed in a sterile zipper bag to avoid contamination and transported to the laboratory and stored at 4 °C until investigations.

2.2. Sample preparation

The dry fishes were chopped into small pieces using a cleaned stainless-steel knife and ground (Preethi Steel Max MF-212, Preethi Kitchen Appliances Pvt. Ltd. India) to produce a homogenous powder. The dry fish powder was then kept in a different portion in the zipper bag for further analyses.

2.3. *Chemicals and Glassware*

All the chemicals analysis was carried out by supplied reagent grade chemicals (E-Merck Germany). Glassware was Borosil grade (Pyrex, England.).

***2.4.** Equipment*

The minerals and biochemical profiles were employed by sophisticated instruments namely Auto Kjeldahl system (KjeltecTM 2300 Foss Tecator AB, Hoganas, Sweden), Soxtec System (HT6, TecatorAB, Hoganas, Sweden), Muffle furnace (JSMF-45HT, Korea), Moisture analyzer (Phoenix Instrument, BM-60, Germany), Electric Balance (AS 220.R2, Poland).

2.5. Proximate composition analysis

The proximate composition has been done by following the methods described in the association of official Analytical Chemist (AOAC) (2000). The moisture content (1 g homogenized sample (HS)) was determined by using moisture analyzer (Phoenix Instrument, BM-60, Germany); Estimation of total protein was made by Kjeldahl method (KjeltecTM 2300 Foss Tecator AB, Hoganas, Sweden). Afterwards, protein conversion factor 6.25 was multiplied by the nitrogen content for the conversion of total nitrogen into total protein. For crude fat determination 0.5g sample was weighed and Soxhlet extraction method was applied for estimation using petroleum ether (AOAC, 2012). After the extraction the sample was evaporated at 105°C. Ash content was determined using Muffle furnace (JSMF-45HT, Korea) at 600°C for 6 hours. [11-12].

2.6. Estimation of mineral contents

Mineral contents (Ca, Fe, P and Mg) of the dry fish were determined by Atomic Absorption Spectrophotometer (AA-7000, Shimadzu, Kyoto, Japan) followed by the AOAC methods [11]. According to the method, 5 g. of each sample was weighed in an acid-washed crucible and then dried at 105 ^{0}C for 24 h. After that, the samples were digested overnight at 55 ^{0}C. Later on, 5 mL of 65% nitric acid (HNO_3) was added to the sample and boiled for 2 min. and cooled at room temperature. The cooled solution was filtered through Whatman filter paper (No. 41) and made the volume to 25 mL. The solution was then sent to the instrument laboratory for AAS analysis.

2.7. Statistical Analyses

All the analyses were done in triplicates. Hence, the data presented here as mean ± standard deviation of the three measurements calculated using SPSS 22.0 for windows (SPSS, Chicago, IL, USA).

3. Results and discussion

The proximate and mineral composition of three dry fish species (Loittya, Cheap and Chhuri) were investigated from the six collected areas (Table 1-6).

3.1 Proximate composition:

In the proximate analysis (Table 1-3), the highest percent of moisture content was observed at Jatrabari (21.59±0.21%), New market (27.82±0.19) and Laxmi Bazar (26.60±0.15) for Loittya, Chepa and Chhuri respectively. Whereas the lowest were observed at Laxmi Bazar (12.57±0.24), Shopno Super Shop (25.99±0.19) and Cox's Bazar (24.09±0.17). The moisture content was reported to be 29.14% [13] which is quite high based on the current results. It was also reported that the moisture content of Chepa *(P. sophore)* was 31.35% [14], which is slightly higher than the present study. Again, the moisture content (25.68%) [13] of Chhuri *(T. lepturus)* was found to be approximately similar to the present study. In comparison with three fish species, Chepa had the highest moisture content while Loittya had the lowest. In the case of ash content, the highest amount was observed at Cox's Bazar (18.37±0.17% and 15.67±0.51%) for Loittya and Chhuri and Chittagong (18.09±0.16%) for Chepa. In the contrary, the lowest amount was measured at Jatrabari (12.38±0.05 and 12.46±0.11) for Loittya and Chhuri and New market, (11.68±0.16) for Chepa dry fish samples. The highest protein values were estimated to be 49.40±0.40 for Loittya at Chittagong, 43.17±0.17 for Chepa at New market and 46.51±0.53 for Chhuri at Shwapno super Shop. The lowest protein content ranged from 44.89±0.08 to 38.44±0.39 with Jatrabari (for Chepa) having the lowest. Our findings exceeded the reported protein content of Loittya (Bombay duck) (40.92% to 41.615%) [15].

Table 1: Proximate analysis (%) of dry fishes of Loittya *(Harpadon nehereus)*

Area	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Energy (Kcal/100gm)
New market	20.70±0.12	17.11±0.31	46.73±0.11	12.82±0.11	2.65±0.19	319.09±1.26
Shwapno super Shop	13.73±0.06	16.68±0.12	48.42±0.47	15.87±0.25	5.30±0.56	364.67±1.34
Laxmi Bazar	12.57±0.24	15.91±0.14	49.00±0.45	16.25±0.21	6.27±0.46	374.53±2.72
Chittagong	14.11±0.11	15.85±0.61	49.40±0.40	14.78±0.23	5.85±0.35	361.04±1.80
Cox's Bazar	15.36±0.44	18.37±0.17	48.56±0.52	14.65±0.12	3.06±0.19	344.96±2.69
Jatrabari	21.59±0.21	12.38±0.05	44.89±0.08	16.80±0.08	4.33±0.12	354.73±0.77

Table 2: Proximate composition of dry fishes of Chepa (*Puntius sophore*)

Area	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Energy (Kcal/100gm)
New market	27.82±0.19	11.68±0.16	43.17±0.17	13.54±0.60	3.78±0.58	315.75±3.78
Shwapno super Shop	25.99±0.19	17.00±0.09	40.43±0.41	12.16±0.25	4.42±0.58	294.50±2.61
Laxmi Bazar	26.42±0.43	16.09±0.13	39.94±0.20	14.18±0.22	3.37±0.55	306.63±2.25
Chittagong	27.16±0.51	18.09±0.16	39.71±0.37	12.63±0.06	2.42±0.31	287.64±1.12
Cox's Bazar	26.31±0.10	17.19±0.17	39.29±0.94	15.28±1.12	1.92±0.42	308.02±6.39
Jatrabari	26.60±0.09	17.28±0.34	38.44±0.39	16.08±0.52	1.61±0.28	310.52±2.40

Table 3: proximate composition of dry fishes of Chhuri (*Trichiurus lepturus*)

Area	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Energy (Kcal/100gm)
New market	24.44±0.33	14.84±0.08	44.31±0.70	14.37±0.46	2.04±0.77	320.85±3.39
Shwapno super Shop	26.38±0.46	12.68±0.06	46.51±0.53	11.72±0.36	2.72±0.77	308.38±1.34
Laxmi Bazar	26.60±0.15	12.46±0.50	41.39±0.39	16.07±0.65	3.48±0.55	330.22±2.45
Chittagong	25.56±0.13	14.15±0.56	42.64±0.03	14.37±0.53	3.27±0.20	319.04±4.34
Cox's Bazar	24.09±0.17	15.67±0.51	42.43±0.64	14.50±0.53	3.31±0.84	319.53±4.81
Jatrabari	25.72±0.13	12.46±0.11	44.93±0.38	12.71±0.36	4.18±0.32	317.03±2.40

Another study reported that the protein content of Chepa was 54.07%, which was higher than the current study [14]. The protein content of Chhuri (64.51%) was also reported [13] to be higher than the current study. Furthermore, the fat content of Loittya, Chepa and Chhuri was also estimated, in which Jatrabari (16.80±0.08 and 16.08±0.52) and Laxmi Bazar (16.07 ± 0.65) having the highest amounts. However, the lowest amount was calculated for New market (12.82±0.11) and Shwapno super Shop (12.16±0.25 and 11.72±0.36). The mean percentage of lipid was reported for Loittya was 7.48% [16], which was found to be lower than the present investigation. Another study showed that fat content of Chepa was 29.34% [14], which is nearly double that of the current study. In addition, the fat content of Chhuri fish was estimated to be 7.22 to 9.05 % [17] which is lower than the current study. Among the three fish samples, Laxmi Bazar (6.27±0.46 % for Loittya) had the highest carbohydrate content followed by Shwapno super Shop (4.42±0.58 % for Chepa) and Jatrabari (4.18 ± 0.32 % for Chhuri). Whereas the lowest amount was observed in New market (2.65±0.19 % for Loittya, 2.04±0.77 % for Chhuri) and Jatrabari (1.61 ± 0.28 % for Chepa). The Food energy is a calculated value based on the other proximate parameters. Loittya had the highest converted energy content (374.53 ± 2.72 Kcal/100g) and Chepa had the lowest (315.75±3.78 Kcal/100g).

3.2 Elemental Compositions

In the elemental analyses (Table 4-6), Ca was the most predominant element followed by Mg, Fe and P of the analyzed samples. Ca (3636.54±0.64 mg/100g) and Mg

Table 4: Minerals composition of dry fishes of Loittya *(H. nehereus)* (mg/100gm)

Area	Calcium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)	Magnesium (mg/100g)
New market	1508.75±5.28	54.68±0.34	12.71±0.09	98.57±0.20
Shwapno super Shop	931.70±0.17	60.68±0.26	14.47±0.13	74.50±0.18
Laxmi Bazar	2288.69±0.18	122.53±0.27	64.57±0.08	113.42±0.33
Chittagong	2529.71±0.13	152.75±0.10	204.51±0.13	127.85±0.12
Cox's Bazar	1425.35±0.26	84.43±0.12	14.31±0.08	87.68±0.13
Jatrabari	1118.91±0.18	60.86±0.10	16.61±0.14	81.68±0.02

Table 5: Minerals composition of dry fishes of Chepa (*Puntius sophore*) mg/100gm

Area	Calcium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)	Magnesium (mg/100g)
New market	2952.92±11.36	102.72±0.08	18.27±0.22	212.63±0.07
Shwapno super Shop	2922.87±0.16	110.02±0.27	51.38±0.48	204.51±0.22
Laxmi Bazar	3636.54±0.64	115.35±0.63	34.10±0.19	262.42±0.53
Chittagong	1650.57±0.21	85.83±0.55	189.77±0.17	103.47±0.17
Cox's Bazar	1860±0.46	95.62±0.09	176.41±0.82	142.73±0.14
Jatrabari	3211.41±0.52	109.82±0.64	26.59±0.60	217.54±0.10

Table 6: Minerals composition of dry fishes of Chhuri (*Trichiurus lepturus*) mg/100gm

Area	Calcium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)	Magnesium (mg/100g)
New market	1590.42±0.57	72±0.29	10.40±0.22	134.58±0.19
Shwapno super Shop	1977.73±0.62	108±0.06	191.73±0.06	163.58±0.19
Laxmi Bazar	2954.49±0.52	150±0.30	33.63±0.10	231.67±0.25
Chittagong	2768.59±0.49	148±0.24	34.60±0.19	201.52±0.47
Cox's Bazar	2062.59±0.07	36±0.30	16.77±14.52	167.59±0.19
Jatrabari	2849.46±0.57	119±0.21	105.36±0.28	206.36±0.17

(262.42±0.53 mg/100g) were estimated as the highest concentration in Chepa fish from Laxmi Bazar followed by iron (204.51±0.13 mg/100g) and Phosphorus 152.75±0.10 mg/100g) in Loittya from Chittagong. In contrast, Ca (931.70±0.17 mg/100g) and Mg (74.50±0.18 mg/100g) were found in the least amount at Shwapno super Shop in Loittya. Similarly, Loittya and Chhuri had the lowest levels of P (54.68±0.34 mg/100g) and Fe (10.40±0.22 mg/100g) at New market respectively. When compared to the collected samples, Chepa had the highest Ca and Mg content. Furthermore, Fe and P were estimated as the highest amount in Chhuri fish. On the other hand, the Ca content was 370 mg/100g and P content was 832 mg/100g of Loittya, indicating that the Ca content is higher and P is lower than the reported data [18]. Besides, Ca (840.1±22.6 mg/100g) and Mg (31.9±6.4%) were reported to be lower amount than in the previous study for Chepa [19]. In the other investigation, Ca and Fe were reported as 200.113±0.27 mg/100g and 3.559±0.2 mg/100g respectively for Chhuri fish [20] which accounted for much lower value than the current study. The lower value could be attribute to the higher moisture content of the analyzed samples. The variations of proximate parameters between the different collection areas and fish samples could be due to the geographical regions and processing conditions.

4. Conclusions

The current study shows that dry fishes have potential in providing essential nutrient constituents thus ensuring combat the malnutrition in Bangladesh. As a result, consumers in both developed and developing countries want to include dried fish in their daily diets because they are palatable, inexpensive, and nutritious. As a tropical country, the relative humidity causes microbial growth, lowering the quality of dried fish products. Moreover, open sun dry system leads to the contamination of dust, sands and other poisonous particles which brings down the shelf life of the dried fish. It is important to assess the food significance and economic value since it is an integral part of food habit as a traditional dish. This study would provide insight into the nutritional value of the dry fishes which could assist policymakers in developing necessary strategies and guidelines to improve product quality. This would eventually boost the dry fish trade, including exports to promising foreign markets. However, it demands a future investigation to assess the heavy metal in the mentioned dried fishes and an endeavor is indispensable to evaluate microbial contamination from the sources.

Authors' contributions

Md. Zia Uddin Al Mamun contributes through the proximate and minerals composition analyses, data interpretation, and preparation of the manuscript in accordance with his expertise. Md. Moshfekus Saleh-E-In and Rahima Akter Sathee and Sarmina Yeasmin have had their praiseworthy roles in manuscript preparation and data analysis. Dr. Md. Abdus Satter Miah and Mohajira Begum designed and supervised the overall findings of this work. All authors read and approved the final manuscript.

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Availability of data and materials

All data will be made available on request according to the journal policy.

Conflicts of interest

There is no potential conflict of interest to describe.

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