Original Research Article

Comparative Studies of Nutritional, Microbial and Organoleptic Properties of Different Indigenous Dried Fish from Local Market in Bangladesh

Md. Masud Rana[a], Subhash Chandra Chakraborty[b], Abu Saeid[c],*

[a] *Department of Fishing and Post Harvest Technology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh*
[b] *Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh, Bangladesh*
[c] *Department of Food Engineering, NPI University of Bangladesh, Manikganj, Bangladesh*

ARTICLE INFO

ABSTRACT

In this study, ten indigenous dried market fishes were selected to analyze the proximate composition, microbial analysis, and organoleptic properties. Proximate compositions were found to be varied among the species. Moisture content ranged from 15.66% to 35.50%, protein content ranged from 42.06% to 65.78%, lipid content varied from 4.20% to 13.03% and ash content ranged of 5.28% to 18.60%. The results of TVB-N in different fish species ranged from 11.15 mg/100 g to 18.33 mg/100 g with highest in Puti (*Puntius sophore*) whereas lowest in Chanda (*Chanda ranga*) species. The bacterial load of dried fish species ranged from 3.13×10^7 to 3.67×10^8 (CFU/gm) with highest in Katchki (*Corica soborna*) and lowest in Puti (*Puntius sophore*). The sensory evaluation results revealed that Chapila (*Gudusia chapra*) is superior among the other dried fish species with color, flavor and appearance aspect. Overall, Chanda (*Chanda ranga*) was the better quality regarding all parameter among other dried fish species except protein content highest in Churi (*Trichiurus lepturus*) which was significantly different (P≤0.05) from Chanda (*Chanda ranga*) species.

GRAPHICAL ABSTRACT
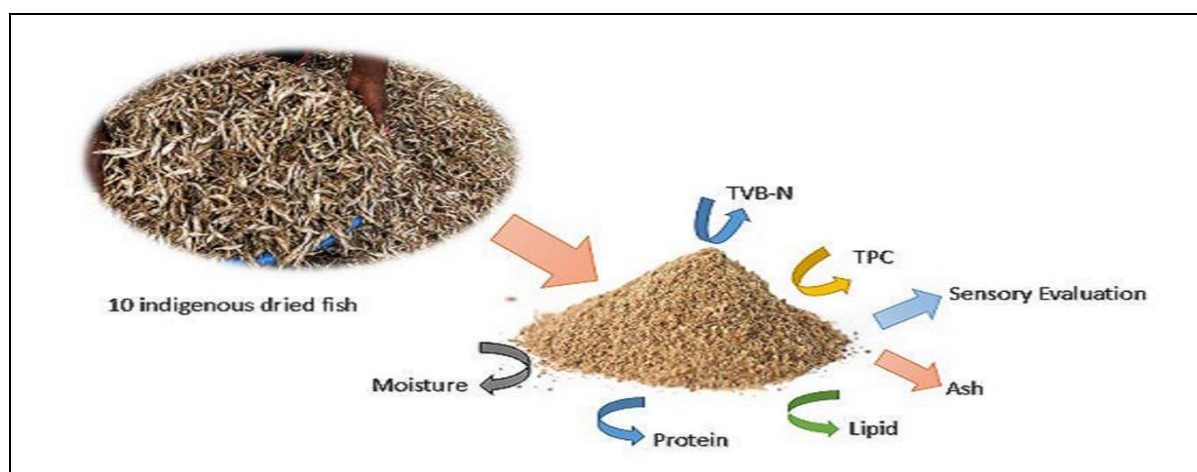
* Corresponding author's E-mail address: saeidfpp.hstu@gmail.com

Introduction

Fish is one of the leading sources of animal protein and valuable in the diet because they provide a good quantity (70% or more) of protein with high biological value, particularly sulphur containing amino acids [1]. The chemical composition of fish flesh including moisture, protein, lipid, ash, carbohydrate and other nutrients like mineral as well as vitamin [2] have the largest impact on the nutritive value, the functional properties, the sensory quality and the storage stability of meat [3]. They possess significant role in nutrition, income, employment and foreign currency earning of the country. Bangladesh earns a significant amount of foreign currency by exporting dried fish and fishery products which ranks third in the export item of fish and fishery products [4]. Bangladesh earned about Taka 3.71 core as foreign currency by exporting about 272 tons of dried fish and fishery products in 2013-2014 [5].

The dried fishery products are prepared from a large number of fish species including marine fish and fresh water fish. Small indigenous fishes are vital because they are valuable source of macro and micronutrients and play a crucial role to provide essential nutrients for the people of Bangladesh [6]. Small indigenous fish like mola, chapila, punti, chanda, batashi possess high nutritional value in terms of proteins and vitamins which are not commonly available from other foods [1].

Dried fish is considered one of the most vital animal protein sources and other essential nutrients component for the maintenance of a healthy body [7]. Moreover, dried fish was highly preferred by the Bangladeshi people of northeastern, central, and coastal areas due to it characteristic taste and flavor. On wet basis, essential nutrients are higher in dried fish as compare to the fresh fishes [8]. The dried fishes are susceptible to the insect attack or sometime microbial spoilage as a result reducing the losses of quality or sometime unfit for consumption. Available reports from the literature suggested that the quality of majority of the traditional sun dried products available in the market are not satisfactory for human consumption and complaint by the consumers about their quality [9]. Therefore, there is a need to regularly monitoring quality and safety of dried fish which are available in the local market.

So, the study of better quality of dried fishes in terms of nutritional profile including protein, lipid, and ash have to be informed to the consumer. This information will help the people to buy good quality of dried fishes and also will increase the consciousness of the people regarding the quality and safety aspect. The purpose of this study was to investigate the various quality parameter of different dried fish species in Bangladesh those included proximate composition, microbial analysis, organoleptic properties and so on.

Experimental

Materials and methods

Sample collection and preparation

Different indigenous dried fishes (whole) as Mola (*Amblypharyngodon mola*), Chapila (*Gudusia chapra*), Batashi (*Pseudeutropius atherinoides*), Puti (*Puntius sophore*), Tengra (*Mystus tengara*), Katchki (*Corica soborna*), Churi (*Trichiurus lepturus*), Taki (*Channa punctatus*), Loita (*Harpadon nehereus*) and Chanda (*Chanda ranga*) were purchased from different market of Dhaka city in Bangladesh. After that, the sample were packed in a polyethylene bag weighed 250 g each and sealed. Then each packet were carried out in the Post-Harvest Technology Laboratory of Sher-e-Bangla Agricultural University, Dhaka and stored at room temperature. Then the samples were grounded with blender (Model: Miyako 320) and powder of each sample was

sieving (mesh size 20 μm) then stored in amber plastic bottle respectively for further analysis.

Proximate composition analysis

Determination of moisture content

AOAC [10] method was used to determine the moisture content of dried fish. Dried fish powder (5 g) was taken in a clean, dry and pre-weighted crucible. Then the crucible was transferred to oven (Model: BST/HAO-1122) and dried at 105 °C for 16 hours. After that it was cooled at desiccator and weighed. Again it was transferred to oven and dried until a constant weight was obtained. Finally it was cooled and weighed. Moisture Content was calculated using the following formula:

$$\% \text{ Moisture } = \frac{W_1 - W_2}{W} \times 100$$

Here,

W_1 = weight of sample with crucible

W_2 = weight of dried sample with crucible

W = weight of sample

Determination of Protein Content

AOAC [10] method was used with some modification to determine the protein content (N_2) of the dried fish powder by Kjeldahl apparatus (Model: Kjeldahl ESEL 300 MI). Usually three stages are used to determine protein content. These stages are given below:

 Digestion

Dried fish powder (1 g), Selenium powder (1 g), $CuSO_4$ (0.1 g), K_2SO_4 (10 g) were taken into a volumetric flask. Then 25ml of H_2SO_4 (conc.) was added. After that the volumetric flask was heated at 100 °C for 3 hr. and cooled for 20 minute at room temperature.

Distillation

After digestion 300 mL of distilled water and 125 mL of 40% NaOH were added to the volumetric flask. 25 mL of 4% boric acid solution and 2-3 drops mixed indicator were taken in a conical flask. The volumetric flask was connected with one end of the condenser and the conical flask was connected with other end. The volumetric flask was heated continuously until the conical flask was filled to 150 mL.

Titration

The conical flask was disconnected and was taken for titration. Titrated against 0.2 N of H_2SO_4 solution. The end point was indicated by orange color.

i) Calculation for N_2 content:

$$\% \text{ of } N_2 = \text{Burette reading} \times \text{Normality of } H_2SO_4 \times \text{ml equivalent of } N_2$$

Here;

Normality of H_2SO_4 = 0.2 mL equivalent of N_2 = 1.4

i)   Calculation for protein content:

$$\% \text{ Protein } = \% \text{ of } N_2 \times \text{Protein factor}$$

Here;

Protein factor = 6.25

Determination of lipid content

AOAC [10] method was used with slight modification to determine the lipid content. Dried fish powder (5 g) was taken into the thimble. Then the thimble was attached to the Soxhlet apparatus (Model: SZF-06A/SZF-06C) which was attached with a round bottom flask containing 200 mL ether. The lipid was extracted for 16 hours. After that ether was evaporated at 80 °C until the flask completely

dried. Lipid content was calculated by following formula:

$$\% \text{ Fat } = \frac{W_1 - W_2}{W} \times 100$$

Here,

W_1=weight of evaporated flask with sample

W_2=weight of empty flask

W=weight of sample

Determination of ash content

AOAC [10] method was used to determine the total ash content. Dried fish powder (5 g) was weighed and transferred into a clean, dry and pre-weighted crucible. Then the crucible was kept into muffle furnace (Model: ACMAS ATI-118-A) at 550 °C for 6 hours. It was cooled at desiccator and weighed. The ash content was calculated by the following equation:

$$\% \text{ Ash } = \frac{W_1 - W_2}{W} \times 100$$

Here,

W_1 = weight of ash with crucible

W_2 = weight of empty crucible

W = weight of sample

Determination of total volatile base nitrogen (TVB-N)

Total volatile base nitrogen (TVB-N) was determined according to the standard method described by Pravakar et al. [11] with some modifications. 10 g of dried fish powder mixed with 90 mL of 6% perchloric acid and homogenized for two minutes in cooled condition. After that, 100 ml of extract with 4-6 drops phenolphthalein was taken in a Kjeldahl flask and then some glass beads was added. Then 10 mL of 40% NaOH

was also added to the flask. After that the flask placed in the distillation chamber and distillation was continued for 15 minutes. Then the distillate was collected in the conical flask containing 50ml of 3% H_3BO_3. One drop of mixed indicator was added to it. Distillation confirmed through changing the color of mixed indicator from violet to greenish. After distillation, the collected distillate was titrated with 0.01 N standard HCl and regarding the violet color of mixed indicator confirms the end point. The TVB-N was calculated using the following equation:

$$\text{TVB} - \text{N} \left(\frac{\text{mg}}{100\text{g}} \right)$$
$$= \frac{\text{ml of titrant used} \times 0.014 \times \text{Normality of titrant}}{\text{Weight of sample (g)}}$$
$$\times 100$$

Microbial analysis

Total bacterial count of the samples was done by Standard Plate Count (SPC) method shown in Figure 1, ISO [12].

No. of bacteria per gram of the dried fish sample (CFU/g) was calculated by using the following formula:

$$\text{Total plate count} \left(\frac{\text{CFU}}{\text{g}} \right)$$
$$= (\text{No. of colonies on petridish}$$
$$\times 10 \times \text{dilution factor}$$
$$\times \text{weight of sample solution})$$
$$/(\text{Weight of sample (g)})$$

Organoleptic Properties Analysis

Fifteen trained members were selected from the University community. Randomly, the samples were presented. Grounded dried fishes were evaluated organoleptically for color, flavor and appearance according to the hedonic scale of nine points (9= like extremely to1= dislike extremely), as reported by Roy et al. [13].
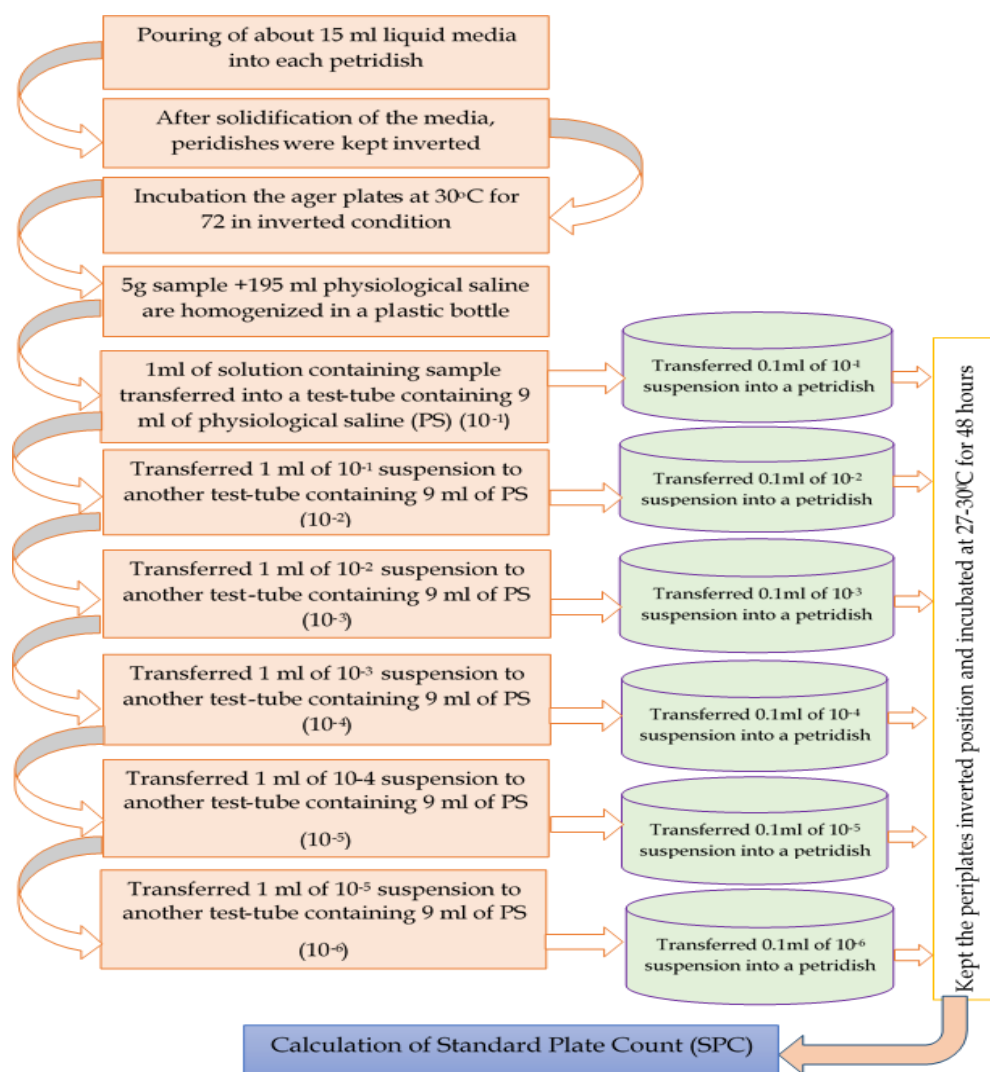
Figure 1. Schematically showing the standard plate count method using plate count agar medium

Statistical analysis

Data were analyzed statistically using the statistical software R (windows version 3.5.1).The mean values (±SD) were compared by following the DMRT (Duncan Multiple Range Test) at 5% level of significance. All measurements were carried out in triplicate for each of the sample.

Results and Discussion

The proximate compositions of different dried fish species are shown in Table 1. The moisture content of different dried fish species varied between 15.66% to 35.50%.

The highest moisture content in Taki species was 35.50% whereas lowest in chanda was 15.66%. Our result is closely related to some previous studies was carried out by Hasan *et al.* [14] who found that the moisture content of dried fish was 13.71% to 27.33%. These values are higher than the work of Flowra and Tumpa [3] who found the moisture content of five different dried fish species varies from 12.13% to 18.18%. Faturoti [15] showed that the gutted dried fish samples of African catfish (*Clarias nigrodigitus*) had a chemical composition of 6.27 to 10.92% moisture. According to Hossain *et al.,* [4] who reported that sundried Rohu fish contained 10.30% moisture.

Table 1. Proximate composition of different dried fish species

| Dried fish | Proximate composition | | | |
Species	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
Mola	24.85±0.97[c]	48.94±0.26[c]	10.06±0.20[b]	16.12±0.27[a b]
Puti	25.13±0.45[c]	48.82±0.87[c]	09.84±0.89[b c]	16.11±0.90[a b]
Batashi	27.05±1.90[b c]	45.80±2.96[d]	11.80±0.60[a]	15.00±0.88[b c]
Tengra	27.52±0.82[b c]	43.20±0.26[e]	12.84±0.28[a]	15.22±1.95[bc]
Chapila	27.32±1.12[b c]	49.60±0.51[c]	08.76±1.92[b c]	14.31±1.83[bc]
Katchki	28.20±2.11[b]	49.84±2.64[c]	09.15±1.13[b c]	12.63±1.62[c]
Churi	19.92±2.12[d]	65.78±1.20[a]	09.02±0.89[b c]	05.28±1.18[e]
Taki	35.50±1.30[a]	42.06±1.46[e]	04.20±0.48[d]	18.24±2.14[a]
Loita	28.96±1.10[b]	55.56±0.62[b]	08.06±0.78[c]	07.96±1.92[d]
Chanda	15.66±1.33[e]	50.53±1.55[c]	13.03±1.03[a]	18.60±0.98[a]

Mean ± SD (Three determinations)

[a-e] Mean followed by different superscript in each column are significantly different (P≤0.05)

According to Hasan *et al.,* [17] who observed 13.71% to 26.42% of moisture in three small dried fishes which are known as small indigenous species (SIS). The findings of Hussain et al. [18] the moisture content varied over a large range from 12.3%-54%. Azam *et al.* [19] studied biochemical assessment of fourteen selected dried fish and observed that moisture content ranging from 18.23-23.61%. Flowra and Tumpa [3] conducted an investigation on seasonal variation of biochemical composition in batashi fish (*Clupisoma atherinoides*) found moisture content around 3%.The variation in moisture content of dried fish depends on seasonal variation, fish species and methods of drying. Moisture content varied in the dried fish might be the effect of the different drying methods [8]. It has been shown that the moisture content significantly different among the fish species.

However, the protein content of different dried fish ranged from 42.06% to 65.78% (Table 1). The highest values of protein found in Churi and lowest in Taki species. This values were supported to the work of Hasan *et al.* [14] who found that the protein content of dried fish species varied from 44.72% to 60.33%. 44.72% to 60.33% of protein found by Hasan *et al.,* [17] in different small dried

fish species. Azam *et al.* [19] reported the biochemical assessment of fourteen selected dried fish and found the protein content varied between 40.69- 66.52%. Faturoti [15] showed that the gutted dried fish samples of African catfish (*Clarias nigrodigitus*) had a range of crude protein was 55.02 to 63.05%. Rasul *et al.* [8] reported that the protein content in solar dried silver carp was 68.41% this value is higher than that our values. Sultana *et al.,* [16] reported that sun dried fish species contained 60% to 80% protein. The variation in protein content is due mainly in species variation [1].

On the other hand, the lipid content of different dried fish species varies from 4.20% to 13.03% with highest in Chanda and lowest in Taki (Table 1). This values were supported according to the findings of Hasan *et al.* [14] who found that the lipid content of dried fish species from 8.91% to 18.07%. These values within the range according to the work of Flowra and Tumpa [3] they obtained lipid content ranges of 5.38% to 15.86% from different selected dried fish. The more or less close result found by Azam *et al.* [19] observed that fat content was in fourteen selected dried fish range of 7.1% to 26.13%. The lipid content in batashi fish was 3% reported Flowra *et al.* [20] this value was lower than

that we did. According to the report of Nurullah *et al.*, [21] the lipid content of solar dried SIS (A. mola, O. cotio cotio, P. atherinoides, M. vitatus and G. chapra) varied from 14.10 to 16.26%. The lipid content significantly different from fish species. Thelipid content may vary species to species and methods of extraction might be the causes of this variation.

The ash content of different dried fish species ranged from 5.28% to 18.60% with lowest value in Churi and and highest value in Taki (Table 1). This values almost similar with the work of Azam *et al.* [19] who found ash content in dried fish ranged between 5.08-12.14%. Our result also support the findings of Nurullah *et al.,* [21] who found the ash content of different dried fish species varies from 9% to 19.32%. Furthermore, the obtained ash content is lower as compared to the work of Islam *et al.* [22] who found the ash content ranged of 20.14 -24.40% in dried Mola and Taki respectively. Those values more or less similar than that of 11.00% to 14.63% [14]. The ash content of different dried fish species was significantly different (P≤0.05).

The total volatile base nitrogen (TVB-N) values of the different dried fish species are shown in Figure 2. The results of TVB-N in different fish species ranged from 11.15 mg/100 g to 18.33 mg/100 g with higher in Puti whereas lower in Chanda species. Our result of TVB-N were supported by the work ofIslam *et al.* [23] who found the TVB-N in the dried Mola species prepared using solar or rotary dryer ranged from 10.64 to 20.36 mg/100 g. Furthermore, obtained values of TVB-N lower than the traditionally dried marine fish samples ranged between 28.46 to 42.88 mg/100 g [9]. However, TVB-N values of all the samples were found lower than the recommended value of 100-200 mg/100 g for variety of salted and dried products [23]. It has been reported that the TVB-N value of dried tilapia fillets ranged between 44.27 and 64.39 mg/100 g of muscle [24]. It is likely to expect low TVB-N values of dried products because if the limit exceed the dried fish product can be considered to be spoiled [9].

The total plate count expressed in colony forming unit (CFU/gm) and the values of different dried fish species has presented in the Table 2. The bacterial load of dried fish species ranged from $3.13×10^7$ to $3.67×10^8$ (CFU/gm) with highest in Katchki and lowest in Puti. Our result is closely related the work of Hasan *et al.* [14] who found he bacterial load of traditional dried SIS products ranged from $1.43×10^8$ CFU/g to $2.89×10^8$ CFU/g.

Figure 2. Total volatile base nitrogen (TVB-N) content of different dried fish species
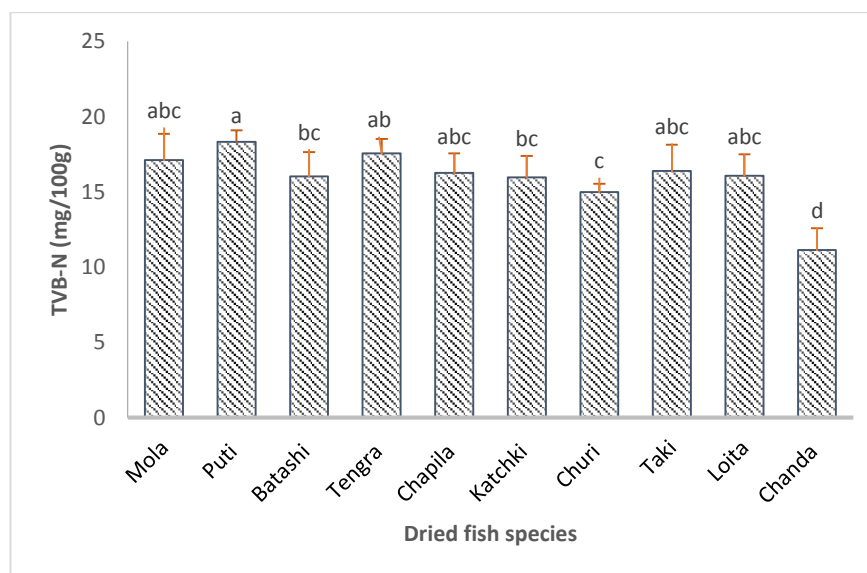
Table 2. Total plate count for the different dried fish species

Dried fish species	Total plate count (CFU/gm)	Log (CFU/gm)
Mola	1.87×10^8	8.26
Puti	3.13×10^7	7.50
Batasi	3.10×10^8	8.49
Tengra	1.73×10^8	8.24
Chapila	3.60×10^8	8.56
Katchki	3.67×10^8	8.56
Churi	4.07×10^7	7.61
Taki	1.97×10^8	8.29
Loita	2.43×10^8	8.39
Chanda	3.33×10^7	7.52

Table 3. Sensory evaluation of different dried fish species

Dried fish Species	Sensory evaluation		
	Color	Flavor	Appearance
Mola	3.20±1.01[abc]	3.80±1.21[abc]	3.87±1.41[bc]
Puti	3.93±1.62[a]	3.33±0.98[bc]	4.00±1.31b[c]
Batashi	3.20±0.94[abc]	4.20±1.26[a]	4.47±0.83[ab]
Tengra	2.93±0.96[bc]	3.07±0.88[c]	3.33±1.05[c]
Chapila	4.00±1.41[a]	3.80±1.21[abc]	4.27±0.88[ab]
Katchki	3.67±0.98[abc]	3.20±0.86[c]	3.87±0.88[bc]
Churi	3.87±1.55[ab]	4.07±1.22[ab]	5.13±0.92[a]
Taki	2.80±1.21[c]	3.40±0.91[abc]	3.33±1.11[c]
Loita	3.60±1.12[abc]	3.73±0.88[abc]	3.60±1.59[bc]
Chanda	3.93±1.09[a]	3.07±0.70[c]	3.93±1.16[bc]

Mean ± Standard Deviation (SD)

[a-c] Mean followed by different superscript in each column are significantly different (P≤0.05)

Our obtained result much more higher as compare to the findings of Hossain *et al.* [4] who obtained result from some dried fish varied between 7.06×10^3 CFU/g to 5.58×10^4 CFU/g. Furthermore, Ito *et al.* [25] observed that the viable bacterial count of dried Sardine was 4.9×10^4 CFU/g and dried Jel fish was 1.0×10^7 CFU/g respectively. According to Cho *et al.* [26] who reported the viable bacterial counts ranged from 10^3 to 10^7 CFU/g in dried fish. Although, a close relationship possess between the moisture content and the bacterial load in fish products. Mansur *et al.* [27] reported that, when the water content of fish fell below 25% of wet weight, bacterial

action stopped and when the water content further reduced to 15%, mold ceased to grow. But similar trend always not found. Dried fish products even with low moisture content stored under no protection against high humidity might be vehicle for bacteria responsible for food spoilage [4].

The organoleptic properties of different dried fish species were shown in the Table 3. The sensory profile evaluated in terms of color, flavor and appearance. The sensory score for color Chapila and Chanda was ahead from other species but for flavor Batashi and Churi got higher score follower by the others. On the other hand for appearance Churi had

higher score followed by Batasi, Chapila and so. However sensory evaluation score for color, flavor and appreance significantly different among the dried fish species.

Conclusion

Dried fish is one of the most important sources of animal protein and other essential nutrients for the maintenance of a healthy body. Moreover, Bangladeshi people from northeastern, central, and coastal areas highly prefer this dried fish due to its characteristic taste and flavor. However, proximate composition, microbial analysis and organoleptic properties were investigated from different dried fish species. Overall, Chanda was the better quality regarding all parameters among other dried fish species except protein content highest in Churi which was significantly different (P≤0.05) from Chanda species. Finally, this study might be helpful for consumer to buy better quality dried fish available in the local market in Bangladesh.

Acknowledgement

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Abu Saeid : 0000-0003-3905-0833

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How to cite this manuscript: Masud Rana, Subhash Chandra Chakraborty, Abu Saeid, Comparative Studies of Nutritional, Microbial and Organoleptic Properties of Different Indigenous Dried Fish from Local Market in Bangladesh*, Adv. J. Chem. A*, **2020**, *3*(3), 318–327.