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Comparative account on nutritional analysis of fresh and sun-dried fish species, *Amblypharyngodon mola*, *Cabdio morar* and *Chanda nama*

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ABSTRACT

Fishes are good sources of varied macro and micronutrients. However, being highly perishable, different post-harvest methods such as sun-drying are employed to preserve fish for a longer time. The present study has been conducted to determine the proximate composition and mineral content of fish species namely, *Amblypharyngodon mola*, *Cabdio morar* and *Chanda nama* in fresh and sun-dried conditions. The moisture, crude protein, crude fat, ash and carbohydrate content of the fresh and sun-dried *A. mola, C. morar,* and *C. nama* revealed significantly higher ($p<0.05$) moisture content in the fresh fish samples than in sun-dried samples. While, significantly higher ($p<0.05$) crude protein, crude fat, ash and carbohydrate contents were obtained in the sun-dried samples in comparison to the samples in fresh condition. The microbiological load of the selected sun-dried fish samples ranged from $56.33\pm6.51 \times 10^3$ cfu/g to $75.67\pm4.04 \times 10^3$ cfu/g. The present study aims to highlight the nutritional advantages of consuming sun-dried fish thereafter safeguarding nutritional security across a greater population.

Figure : 00 References : 34 Tables : 04
KEY WORDS : Fish, Microbial analysis, Nutrition, Proximate composition, Sun-dried fish

Introduction

Fish is considered as an essential food source for humans. They are key sources of animal protein in addition to micronutrients and polyunsaturated fatty acids, particularly EPA and DHA[28]. Furthermore, fish is less expensive and more widely available in tropical countries than other sources thus making them a staple source of animal protein worldwide. Fish is consumed by more than half of Indians, and in some regions. Assam, Arunachal Pradesh, Goa, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Sikkim, Tripura, and West Bengal, more than 90% of people consume fish as a part of their routine diet[6,31]. An important category of freshwater fish is the small Indigenous fish species which attain a length of about of 25 cm or 6 inches at maturity or adult stages of their life cycle[9]. They are regarded as important source of nutrition since they are generally eaten as whole including head, bone and eyes, thus utilizing all available micronutrients[19]. However despite being nutritionally significant, they are known as weed fish in aquaculture management practices[30]. As such : consumption rates are mostly seen in favour of big carps, at the expense of the valuable native fish species[34]. These small fishes collected in bulk are not sold altogether and the surplus is preserved by various methods so that they can be stored for a longer duration. One such method is sun-drying which is considered the least expensive method of fish preservation and is one of the most primitive and oldest methods for preserving fish, traditionally practiced in many developing countries [4,32]. Sun-dried fishes are nutritionally rich in vital elements like iodine, zinc, copper, selenium, and calcium, as well as high-quality proteins and beneficial fatty acids like omega-3s (EPA and DHA)[27]. Due to their reduced moisture content and subsequent increase in shelf life, sun-dried fish make

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TABLE-1: Proximate composition of fresh and sun-dried *A. mola.* Values (in g/100g or %) are expressed as Mean ±SD, n=3. t-test was performed and there was a significant difference ($p<0.05$) between the means of individual proximate parameters in fresh and sun-dried conditions.

Proximate composition	*A. mola* (Fresh)(g/100g)	*A. mola* (Sun-dried)(g/100g)
Moisture	75.55±0.17	9.01±0.33
Crude protein	15.54±0.25	52.19±0.19
Crude fat	3.30±0.40	7.85±0.26
Ash	3.18±0.22	10.31±0.20

an invaluable food source, particularly during challenging times when fresh fish may be scarce or inaccessible. Although being rich in different macro and micronutrients sun-dried fishes are not nutritionally recognized across the greater spectrum and hence its economy encounters sustainability issues. The present study was thus carried out to enunciate the health benefits associated with the consumption of sun-dried fish so as to fill the void of information prevalent among people owing to their nutritional profile. By making people aware of the nutritional advantages of consuming sun-dried fish, the study also seeks to improve the socio-economic standing of those involved in the preparation and sale of these dried fish.

Materials and Method

Sample collection: Fresh fish samples of *Amblypharyngodon mola, Cabdio morar*, *Chanda nama* were collected from different markets of Guwahati city. The samples collected were transported to the laboratory for further analysis.

Sample preparation: The fresh fish samples collected were washed with clean tap water, eviscerated, and scales, fins were removed. They were then again washed thoroughly under running tap water. The prepared samples were divided into two equal batches. In one batch all the analyses were carried out in fresh condition. While in the corresponding batch all the tests were carried out in sun-dried condition as per traditional procedures[18].

Proximate Analysis: Proximate analysis was evaluated by using standard methods [2]. All types of analyses were completed in triplicate. Electronic balance was used in weighing purpose.

Microbial analysis: The microbiological characteristics were assessed following the standard method recommended by APHA[33].

Statistical analysis: Results are represented as Mean±SD. All the experiments were done in triplicates. t-test was performed to find out significant differences between the results obtained. The statistical analysis was performed in Past 4.13 software.

Results and Discussion

Moisture content: In the fresh fish samples the moisture content was found to be 74.99±0.10%, 75.03±0.16%, and 75.55±0.17% respectively in *C. nama, C. morar,* and *A. mola* (Tables 1-3). Findings[24] revealed the moisture content of *A. mola* and *C. nama* as 76.38± 2.52% and 65.88±3.00% which is higher than the values recorded for the present study. Similar study in moisture content was conducted[15] where the moisture content of *A. mola and C. nama* was recorded to be 74.68±0.09% and 74.19±0.27% respectively. However values of moisture content recorded[7,29] were 77.42±0.36% and 78.21% respectively for *C. morar.* The moisture content of the sun-dried samples in the present study was found to be highest in *C. morar* (11.28±0.21%) followed by *C. nama* (10.05±0.23%) and *A. mola* (9.01±0.33%) (Table1-3). Normally sun dried fish contain an average of 10-20% moisture[11]. A study[23] recorded the moisture content of traditionally sun-dried *A. mola* (5.98%) and *C. morar* (7.42%) which is lower than the values recorded for the present study. Similar study[22] recorded the moisture content of sun-dried *A. mola* (12.73±0.05%) and *C. nama* (10.85±0.12%). The reduction in moisture content in the sun-dried fish samples in comparison to the fresh fish samples was basically due to the evaporation of moisture while being dried under the sun. Although relative humidity is high in Northeast India, the moisture content in the sun-dried samples was found to be low due to good storage facility.

Crude protein content: In the fresh fish samples the crude protein content was found to be 15.54±0.25%,

TABLE-2: Proximate composition of fresh and sun-dried *C. morar.* Values (in g/100g or %) are expressed as Mean ±SD, n=3. t-test was performed and there was a significant difference (p<0.05) between the means of individual proximate parameters in fresh and sun-dried conditions.

Proximatecomposition	*C. morar* (Fresh) (g/100g)	*C. morar* (Sun-dried) (g/100g)
Moisture	75.03±0.16	11.28±0.21
Crude protein	15.09±0.37	52.03±0.31
Crude fat	3.39±0.22	8.51±0.28
Ash	3.10±0.30	10.05±0.26

15.09±0.37%, and 14.85±0.26%, respectively in *A. mola, C. morar, C. nama* (Tables 1-3). A study on the nutrient properties of small fishes in Bangladesh reported a higher protein percentage in *A. mola* as compared to other species[24] which is matched with the findings of the present study. More or less similar values in crude protein content was recorded[16] where the protein content of *A. mola* and *C. nama* was revealed as 16.75±0.12% and 13.23±0.23% respectively. Another study recorded the protein content of *C. morar* as 16.71±0.70%[29]. The quantity of crude protein generally remains higher than all other nutrient compositions in the fish which is supported by previous researches and as such fish is often considered as cheap source of rich protein. The crude protein content in the sun-dried samples was found to be 52.19±0.19%, 52.03±0.31% and 51.20±0.13% respectively in *A. mola, C. morar,* and *C. nama* respectively (Table1-3). The protein content varied between 40.69 to 66.52% in fourteen selected dried fish species[3]. The sun-dried fishes normally contain 60 to 80% protein[11]. The protein content of 10 dried fish species was recorded in the range of 28.63% to 54.39%[12]. Findings[23] revealed the protein content to be higher in *C. morar* (60.79%) in comparison to *A. mola* (56.44%) which is a contrast to the present findings. However the crude protein content was found to be significantly higher in the sun-dried fishes which indicated that the protein nitrogen content did not degrade during the sun-drying process. This interpretation is in agreement with the results noted earlier[35].

Crude fat content: In the fresh fish species the crude fat content was found to be 3.30±0.40%, 3.39±0.22%, and 3.11±0.31% respectively in *A. mola, C. morar,* and *C. nama* (Tables 1-3). Fat content was found to be 4.10±0.98% and 1.53±0.25% respectively for *A. mola* and *C. nama*[24]. The lipid content of 10 indigenous small fish species in Bangladesh was found to be ranging from 1.55% to 3.1%[13]. Findings revealed the crude fat content of *A. mola* (4.3%), *C. nama* (2.87±0.09%), and *C. morar* (4.96±0.39%)[16,25,29]. In the selected sun-dried fish species crude fat content was found to be 7.85±0.26%, 8.51±0.28%, and 7.51±0.22% in *A. mola, C. morar,* and *C. nama* respectively (Table1-3). Results of lipid content of *A. mola* revealed[26] showed values higher than the present study. The fat content of *A. mola* (29.39%), *C. morar* (24.53%) recorded[23] is very high than the values recorded for the present study. The high values might result from the fat content being expressed in dry-weight basis. However[20] recorded lipid content in the range of 1.34 ±0.10% to 4.24±0.14% were during first 3 days of drying. Increase in crude fat content in the sun-dried samples might be due to dehydration in the fish samples from drying under the sun as loss of moisture content results in increased concentration of fat per unit weight. The increase of crude fat content in the sun-dried samples as a result of drying under the sun also confirms with the previous findings[35].

Ash content: In the fresh fish samples ash content was found to be 3.18±0.22%, 3.10±0.30%, and 2.94±0.19% respectively in *A. mola, C. morar,* and *C. nama* (Tables 1-3). The ash content of six small indigenous fish species ranged from 1.19±0.29% to 3.92±0.54% with the highest value in *C. nama*[24]. Ash content of *C. morar* recorded earlier[7] was found to be 1.75% which is lower than the present study. The ash content of sun-dried fish species was found to be 10.31±0.20%, 10.05±0.26, and 9.55±0.24% in *A. mola, C. morar,* and *C. nama* respectively (Tables1-3). The values of ash content in six dried fish species reported[17] were found in the range of 8.1±0.43% to 15.2±0.91%. However ash content values recorded[8,14] were lower than the values of the present study. The ash content of *A. mola* (12.53±0.16%) and *C. nama* (17.68±0.04%) recorded[22] is higher than the findings of the present study. Increase in ash content

TABLE-3: Proximate composition of fresh and sun-dried *C. nama.* Values (in g/100g or %) are expressed as Mean ±SD, n=3. t-test was performed and there was a significant difference ($p<0.05$) between the means of individual proximate parameters in fresh and sun-dried conditions.

Proximatecomposition	*C. nama* (Fresh)(g/100g)	*C. nama* (Sun-dried)(g/100g)
Moisture	74.99±0.10	10.05±0.23
Crude protein	14.85±0.26	51.20±0.13
Crude fat	3.11±0.31	7.51±0.22
Ash	2.94±0.19	9.55±0.24

in the sun-dried fishes may result due to different drying conditions. Fishes dried under the sun are exposed to dust being carried by wind, insects which results in increase in organic matter[10]. Also increase in ash content can be explained due to the reduction of moisture content in the sun-dried samples which is in accordance to the explanations[1,35].

Microbial analysis: In the present study total plate count (TPC) and *E. coli* was evaluated for the selected sun-dried fish species. The TPC for *A. mola, C. morar,* and *C. nama* were found to be $61.00\pm5.0\times10^3$ cfu/g, $75.67\pm4.04\times10^3$ cfu/g, $56.33\pm6.51\times10^3$ cfu/g respectively. However, presence of *E. coli* was not detected in the selected sun-dried samples. The TPC or APC of six traditionally dried market samples were found to be ranging from 1.45×10^5 cfu/g to 2.52×10^6 cfu/g[26]. Another study recorded the APC of three sun-dried fish species in the range of 2.17×10^6 cfu/g to 2.52×10^6 cfu/g[21]. Study on microbial load of sun-dried *A. mola* revealed a bacterial load of 5.54×10^4 cfu/g, 3.17×10^4 cfu/g, 2.65×10^4 cfu/g respectively in the 1st, 2nd, and 3rd days of drying[20]. The study clearly reveals a reduction in bacterial load with increasing days of drying. Quantitative microbiological analysis of dried Bombay duck from selected fish drying centres in Bangladesh also recorded no detection of *E. coli*[5]. The findings of TPC in the above researches were found to be comparatively higher than the present study. One probable explanation is that a significant amount of moisture was added to the sun-dried fish samples because the samples were kept open for exhibition in the market places, where the majority of the fish samples were obtained in the studies cited above. But in the present study fish samples were dried in the sun under net covers and kept in closed containers thereafter leading to low TPC values and also loss of *E. coli.*

Conclusion

In a country like India, with a global hunger index score of 28.7, researchers continuously quest for alternative sources of animal protein that can prove to be effective in mitigating problems like malnutrition. Even though rich in different essential proximate parameters such as protein, fat, ash; consumption of sun-dried fish is mostly restricted to the ethnic communities of Assam which constitute only 12.47% of the total populations. The consumption efficacy is however very limited and a broad spectrum of people disregard the consumption of sun-dried fish species due to different myths associated with its processing and nutritional profile. The present study focuses on highlighting the nutritional significance of sun-dried fish by evaluating its macronutrient profile

TABLE-4: Microbial analysis (TPC and *E. coli*) of sun-dried *A. mola, C. morar,* and *C. nama.*

Sun-dried fish species	TPC (cfu/g)	Log cfu/g	*E. coli*
A. mola	$61.00\pm5.0\times10^3$	4.79	Absent
C. morar	$75.67\pm4.04\times10^3$	4.88	Absent
C. nama	$56.33\pm6.51\times10^3$	4.75	Absent

and attempts to encourage their consumption on a wider scale particularly among the vulnerable populations (children and pregnant and lactating women) for overall health and development.

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