Assessment of Physicochemical, Nutritional and Biochemical Properties of “Shidal” Processed from Two Different Species of SIS Available in Bangladesh


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Abstract: The present investigation was carried out to determine the proximate composition of shidal and to learn more about the traditional fermenting process. Shidal is a fermented fisheries product made from small indigenous species. Darkina (Esomus danricus) and punti (Puntius sophore) were used for shidal preparation. Fresh fish samples were collected, washed thoroughly and sun dried for 5 days. The dried fish was then combined with Giant taro (Alocasia macrorrhizos) to make shidal, with Giant taro accounting for the majority of the shidal. Shidal was made by crushing dried fish, thoroughly mixing it with Giant taro paste and finally adding a small amount of turmeric powder and mustard oil before drying it in the sun for 7 days. The proximate composition was then determined using the dried fishes and shidal. The percent mean value of moisture, protein, lipid and ash of dried darkina fish were 28.11±0.68, 51.06±0.74, 16.45±0.28 and 4.05±0.28, respectively. The percent mean value of moisture, protein, lipid and ash of darkina shidal were 25.84±0.46, 48.94±0.68, 9.79±0.44 and 14.66±0.55, respectively. The percent mean value of moisture, protein, lipid and ash of dried Punti were 30.02±0.35, 50.92±0.72, 14.70±0.57 and 3.84±0.33, respectively and the percent mean value of moisture, protein, lipid and ash of Punti shidal were 25.93±0.78, 49.23±0.60, 8.62±0.46 and 14.67±0.69, respectively. The percent mean value of TVB-N of dried darkina, darkina shidal, dried punti and punti shidal were 10.03±0.69, 0.1124±0.00127, 11.29±0.58 and 0.0513±0.00136, respectively. In both shidals, protein and lipid contents were found comparatively lower whereas ash level was noted higher when compared to their dry products. Shidal's acceptability was shown by the TVB-N value. As shidal contains a significant number of nutrients, it has the ability to meet our country's protein demand as well as contribute to our national economy. In North Bengal, shidal is a well-known product. It's crucial to understand the proximate composition of shidal as so many people ingest it. During the production of shidal, it is highly necessary to ensure the hygiene and sanitation of the product.

Key words: Shidal - Fermentation - SIS - Nutritional - Quality Attributes - Hygiene

INTRODUCTION

In Bangladesh, fish is an irreplaceable animal food in the diet. Fish is considered as one of the most important sources of animal protein and other essential nutrients such as minerals, lipids etc. for maintaining healthy body [2]. They play an important role in providing nutrition, income generation and foreign exchange earnings of the country. In 2019-20 fiscal years, total fish production of our country was reported as 45.03 lakh Metric Ton [3].
In Bangladesh more than 17 million people together with 1.4 million women depend on fisheries and aquaculture related activities including fishing, fish handling, farming and processing [4, 5]. Fish contributes about 60% of total animal protein in daily diet [5]. Small indigenous fishes act as contributor to fulfill the demand of protein. Small indigenous species (SIS) like mola, punti, darkina, chapila etc., are also contributes as valuable sources of macro and micro nutrients and provide essential nutrients for the people of Bangladesh. They have high nutritional value particularly proteins and vitamins that are commonly unavailable in other foods [7, 8]. For the proper utilization of this nutritional quality of fish, they need to be properly preserved as they are more perishable in nature. When the cold chain function is not working then quality deterioration and spoilage of fresh fish takes place which ultimately ended up in resulting huge loss. Drying is a well-known method of fish preservation that hinders microorganism growth through the removal of water from fish. From ancient times, food preservation has been practiced using the action of sun and wind however, Saiithi [9] suggested that simple drying is a lengthy process due to frequent rainfall results presence of high humidity in the atmosphere during peak fishing season, i.e., monsoon and post-monsoon from May to September. So that people had found out a method through which they could preserve of small indigenous fish species like Amblypharyngodon sp., Botia spp., chanda spp., etc., for consumption and sale when scarcity will occur in the fish market. As a result, they invent a preparation process of fermented fishery product [10]. In Bangladesh, shidal is produced in winter season because of raw material availability, less humidity and homogenous moisture evaporation rate. The dried fish remain suitable for fermentation due to presence of fog [11].

Traditional fishery products are native to a country or culture. Dried, semi-fermented (chepa shutki, shidal shutki), fermented, salted and some smoked products are major traditional products in Bangladesh [12]. Fermentation is one of the popular and most economical methods of preserving fish in the Northern region of Bangladesh. Fermented foods are introduced worldwide as they have a prolonged shelf-life, reduced volume, high nutritive value and shorter cooking time compared to other non-fermented fish products [13].

Shidal is a salt-free fermented fish product indigenous to the Northern region of Bangladesh. It is popular due to its distinctive flavor and taste. It has antioxidant properties that inhibit lipid peroxidation and protect biomolecules from being damaged by free radicals [14]. Fermented food products contain peptides and amino acids. Peptides that are released from food proteins exhibit biological activities like anti-microbial properties, blood pressure-lowering effect, the activity of reducing cholesterol and also shows antioxidative and anti-thrombin activity [15]. The fermented fish and fish products have provided not only bio-nutrients and minerals but also increases digestibility and exert health-promoting benefits [16, 17].

Shidal, a fermented fisheries product that has more nutritional potential and will be considered a superior food in the near future [18]. Shidal is never eaten fermented; instead, it is eaten as a chutney or sauce-like delicacy known as shidal bhorta, which is served as a side dish with rice or bread. Fermentation does not contain pathogen-killing processes like heating or pasteurization and the products are often stored at room temperature [19]. In comparison to other indigenous fermented foods, fermented fishing items are commonly consumed [20]. As a result, we must need to work on its manufacturing process in a scientific way in order to ensure its quality. Traditional fermented food has a great nutritional value and is flavored, aromas and texture-based [21]. It is a low-cost protein source that is suitable for anyone. It's crucial to understand the proximate composition, quality and safety of fermented fish. Fermentation is an ancient and traditional technology that responds to the perishability of fish and shellfish, according to a number of studies. Protein and necessary amino acids are abundant in shidal products. As protein deficiency is common among Bangladeshis, the current study aiming to determine proximate composition of two different shidals made from Darkina (Esomus danricus) and Punti (Puntius sophore) would be highly effective in addressing the low-cost protein shortage through creating its wide availability. Alongside, job opportunities can be created at the same time by developing industrial production of shidal.

MATERIALS AND METHODS

Site Selection: This study was carried out in Thakurgaon district within the time period of April 2018 to September 2018.
Collection of Sample: Darkina (Esomus danricus) and Punti (Puntius sophore) were collected from a local market of Thakurgaon district of Bangladesh. Simultaneously, giant taro (Alocasia macrorrhizos) was harvested as a major element in the preparation of shidal.

Preparation of Sample: After dressing, the fish were dried in the sun for 5 days. The fish were dried using bamboo kula. The moisture level of fish samples was lowered after they were sun-dried. The dried fish samples were taken for proximate composition analysis after drying was completed. The proximate composition including moisture, protein, lipid and ash content of dried Darkina (Esomus danricus) and Punti (Puntius sophore) were analyzed in the Biochemistry and Molecular Biology laboratory of Hajee Mohammad Danesh Science and Technology University, Dinajpur.

Preparation of Shidal: Shidal was prepared according to the traditional method used in the North Bengal region of Bangladesh. For the manufacture of shidal, dried samples of Darkina (Esomus danricus) and Punti (Puntius sophore) were used. Using a grinder, the dried fishes were properly ground into powder. It panned of employing net once the grinding was finished. Using a grinder, the stem of the edible root (Giant taro) was ground into a paste. The dry fish powder and large taro (Alocasia macrorrhizos) mixture are thoroughly combined, covered with a giant taro leaf and fermented overnight.
On the next day, after completion of fermentation, the paste of fermented fish and Giant taro was again mixed properly and a definite patty-like shape was given. At this stage, a little amount of turmeric powder and mustard oil was added to shidal and was dried in the sun for 7 days.

**Proximate Composition Analysis**

**Determination of Moisture Content:** A 5g sample was placed in a previously dried crucible and dried for 24 hours or more in an oven at 100-105°C until it reached a consistent weight. The crucible was taken out of the desiccator and weighed as soon as it reached room temperature and the moisture content was calculated using the formula below [1].

\[
\text{% Moisture} = \frac{\text{Loss of weight}}{\text{Weight of sample}} \times 100
\]

**Determination of Ash Content:** In the pre-weighed crucible, about 5 g of sample was precisely weighed (w). The crucible was heated in a furnace for a maximum of 4 hours at 650°C, then cooled in a desiccator and weighed (w'). The following equation was used to compute the ash content [1].

\[
\% \text{Ash} = \frac{W_1}{W_1 - W_2} \times 100
\]

**Determination of Protein Content:** In a digestion flask, around 1g of previously oven-dried material was taken. It was then boiled with 10g potassium sulfate (K₂SO₄), 0.1g copper sulfate (CuSO₄), 1g selenium powder and 25ml conc. H₂SO₄ until the solution turned clear. After digestion, 300 mL distilled water and 125 mL NaOH solution (40%) were added to the mixture. Meanwhile, a 250 mL conical flask was placed at the condenser, holding 25 mL of 4% boric acid and 4-5 drops of mixed indicator. A total of 150 milliliters of distillate were collected and titrated with a 0.2 N H₂SO₄ solution [1].

\[
\% \text{Nitrogen} = \frac{\text{Titrated value} \times N \times 0.014}{\text{Weight of sample}} \times 100
\]

\[
\% \text{Protein} = \% \text{Nitrogen} \times 6.25
\]

**Determination of Lipid Content:** The Soxhlet device was used to determine lipid content using acetone as the solvent. Samples (5g) were accurately weighed in thimbles and dipped in acetone in pre-weighed thimbles. 2 hours were spent boiling and extracting. The thimbles were removed from the chamber after extraction and acetone was placed in a pre-weighed beaker in an oven set to 1000°C. The beaker was heated until all of the acetone had evaporated. The lipid beaker was weighed again after cooling in desiccators. As a % sample, the computed value for lipid content was obtained [1].

\[
\text{Lipid content (\%)} = \frac{\text{Weight of lipid}}{\text{Weight of sample}} \times 100
\]

**Determination of Total Volatile Base Nitrogen (TVB-N) by Modified Kjeldahl Method:** The ground sample was weighed exactly 5 grams and mixed with 6% perchloric acid. Then, using Perchloric acid, it was transferred to a 100ml volumetric flask and the volume was increased to 100ml. 100ml of extract, 4-6 drops of phenolphthalein and 10ml of 20% NaOH solution were put to a Kjeldahl flask and placed in the distillation chamber. Distillation should be kept going for around 15 minutes. In a conical flask containing 50ml of 3 percent H₂BO₃ and 2-3 drops of the combined indicator, the distillate was collected. The color of the mixed indicator was changed to ensure distillation. The color will be changed from reddish to green. The collected distillate was titrated with 0.1N HCl after distillation. A crimson color will occur towards the end [1].

\[
\text{Amount of TVB-N (mg/100g)} = \frac{\text{Titrated value} \times \text{N(HCl)} \times 0.014}{\text{Wt. of sample}} \times 100
\]

**Statistical Analysis:** Statistical analysis was done by using SPSS version 16.0 software (SPSS for Windows. Release 11.5. Chicago: IL: SPSS Inc, 2005).

**RESULTS AND DISCUSSION**

The proximate composition of traditionally prepared shidal was determined according to the methods described in materials and method section. Observed findings were recorded and discussed below:

**Proximate Composition:** The proximate composition of dried Darkina, Darkina shidal, dried Punti and Punti shidal were shown in Table 1.

**Comparison of Proximate Composition Between Dried Fish and Shidal**

**Moisture Content:** The moisture content can be used as one of indicators to the rate at which deterioration occurred in the products resulting in the early decomposition [22]. The moisture content of dried Darkina, Darkina shidal, dried Punti and Punti shidal were shown in figure 2.

From the above-mentioned graph, the percent mean moisture content of dried Darkina and Darkina shidal were found as 28.11±0.68 and 25.84±0.46, respectively.
Table 1: Proximate composition of dried fish (Darkina and Punti) and prepared Shidal

<table>
<thead>
<tr>
<th>Dried fish/ Shidal</th>
<th>Moisture (%) (mean±SD)</th>
<th>Protein (%) (mean±SD)</th>
<th>Lipid (%) (mean±SD)</th>
<th>Ash (%) (mean±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried Darkina</td>
<td>28.11±0.68</td>
<td>51.06±0.74</td>
<td>16.45±0.28</td>
<td>4.05±0.28</td>
</tr>
<tr>
<td>Darkina Shidal</td>
<td>25.84±0.46</td>
<td>48.94±0.68</td>
<td>9.79±0.44</td>
<td>14.66±0.55</td>
</tr>
<tr>
<td>Dried Punti</td>
<td>30.02±0.35</td>
<td>50.92±0.72</td>
<td>14.70±0.57</td>
<td>3.84±0.33</td>
</tr>
<tr>
<td>Punti Shidal</td>
<td>25.93±0.78</td>
<td>49.23±0.60</td>
<td>8.62±0.46</td>
<td>14.67±0.69</td>
</tr>
</tbody>
</table>

In the table, SD = Standard Deviation

Fig. 2: Moisture content of dried fish and shidal

The percent moisture content of dried Punti and Punti shidal were noted as 30.02±0.35 and 25.93±0.78, respectively. The current finding is quite similar to those reported by Islam et al. [23], Rana et al. [24], Hasan et al. [25] and Azam et al. [26] where the authors recorded moisture as 31.35% in dried SIS, 15.66% to 35.50% in different dried fish species, 13.71% to 26.42% in dried fish and 18.23-23.61% in fourteen selected dried fish, respectively. Conversely, this finding is slightly higher than those reported by Flowra and Tumpa [27] and Hossain et al. [28], where they noted the moisture content as 12.13% to 18.18% and 10.30% in different dried fish species and sun-dried Rohu fish, respectively. The variation in moisture content of dried fish depends on seasonal variation, fish species and methods of drying [24]. Present study also revealed comparatively lower moisture content in Darkina shidal and Punti shidal. Loss of water holding capacity of raw fishes used for shidal preparation due to long-term drying under direct sunlight might be the possible cause of this reduction. On the contrary, Kakati et al. [29] reported the percent moisture content as 33.44±0.88 in shidal prepared from Puntius sophore, which might be resulted due to the absorption of moisture from the environment during storage. FAO [30] reported that, dried products with high moisture content (above 35%) are susceptible to attack by insects whereas low moisture content (below 15%) can make them brittle and prone to fragmentation. The present study revealed that the moisture content of shidal was within the range of 10-35% which was prescribed as BIS standard for smaller fishes [31]. The mean value of moisture content showed shidal as a stable product.

Protein Content: Fish protein is of high quality and contains sufficient amounts of all the essential amino acids required by the body for growth, maintenance of lean muscle tissue and active metabolism [32]. The protein content of dried Darkina, Darkina shidal, dried Punti and Punti shidal were shown in Figure 3.

In the present experiment, percent mean protein content in dried Darkina and dried Punti was recorded as 51.06±0.74, 50.92±0.72 which is almost similar to those reported by Rana et al. [24], Hasan et al. [25], Azam et al. [26] and Nath and Majumder [33], where the authors noted percent mean protein content as 52.73% in dried Puntius sophore, 44.72% to 60.33% indifferent small dried fish species, 40.69% to 66.52% in fourteen selected dried fish and 42.06% to 65.78% in indigenous dried fishes, respectively. On the contrary, Rasul et al. [34] reported 68.41% protein in solar dried silver carp which is far higher than our current observation. The variation in protein content is due to mainly for species variation [35]. Percent mean protein content of Darkina shidal and Punti shidal were observed relatively lower than those of dried product. This outcome is found in agreement to that observed by Kakati et al. [29] where the authors reported lower percent protein content 38.35±1.67 in Punti shidal prepared from Puntius sophore. This gradual degradation
of protein might occur due to the hydrolysis of protein by intrinsic and microbial enzymatic actions. The present finding showed a higher protein content compared to Kakati et al. [29] which is possibly because of the lower fermentation period which prevents it from further degradation and also the use of Alocasia macrorrhizos (Giant taro) which contain considerable amount of protein [36].

**Lipid Content:** Lipid is an important constituent, which determines both functional and sensory properties. Lipids including their fatty acids provide several quality attributes on the basis of their composition, content and properties. The lipid content of dried Darkina, Darkina shidal, dried Punti and Punti shidal were shown in Figure 4.

Lipid content of the present investigation is demonstrated on the graph. The percent mean lipid content of dried Darkina, Darkina shidal, dried Punti and Punti shidal were recorded as 16.45±0.28, 9.79±0.44, 14.70±0.57 and 8.62±0.46. This outcome is found in agreement to those reported by Islam et al. [22], Hasan et al. [24], Azam et al. [25] Flowra and Tumpa [26] and Nurullah et al. [36] where the percent mean lipid contents were reported as 16.34% in dried SIS, 8.91% to 18.07% in dried fish species, 5.38% to 15.86% in different selected dried fish, 7.1% to 26.13% in fourteen selected dried fish and 14.10 to 16.26% in solar dried SIS, respectively. Conversely, Flowra et al. [37] reported 3% lipid content in batashi fish which is quite lower than what is found in the current experiment. Lipid content significantly varies with species and extraction method might have involvement in the variation. Relatively lower lipid content is noticed in shidals compared to dried fish products. According to Majumder et al. [38] percent lipid content is recorded as 14.30±2.24, which is far higher than the finding of current investigation. This might happen due to the use of oil in vat during shidal preparation. The present study reported a lower lipid content because of the oxidation of lipid and due to the use of Alocasia macrorrhizos (Giant taro) as a major element of shidal, as Alocasia macrorrhizos contains very minute amount of lipid in its Singh et al. [35].

**Ash Content:** Ash can be fairly useful as it indicates the presence of high content of a variety of minerals. The ash content of dried Darkina, Darkina shidal, dried Punti and Punti shidal were shown in Figure 5.
Fig. 5: Ash content of dried fish and shidal

Table 2: TVB-N content in dried fish and shidal

<table>
<thead>
<tr>
<th>Dried fish/Shidal</th>
<th>TVB-N (mg/100g) (mean±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried Darkina</td>
<td>10.03±0.69</td>
</tr>
<tr>
<td>Darkina shidal</td>
<td>0.1124±0.00127</td>
</tr>
<tr>
<td>Dried Punti</td>
<td>11.29±0.58</td>
</tr>
<tr>
<td>Punti shidal</td>
<td>0.0513±0.00136</td>
</tr>
</tbody>
</table>

In the table, SD = Standard Deviation

The percent mean ash content in dried Darkina and dried Punti was recorded as 4.05±0.28 and 3.84±0.33. Findings of the current investigation is quite close to those reported by Rana et al. [23], Azam et al. [25] Nath and Majumder [32] where the authors reported percent mean ash content as 4.39% in dried Puntius sophore, 5.28% to 18.60% in different dried fish species and 5.08% to 12.14% in fourteen selected dried fish, respectively. In case of shidals, increasing trend in ash content is noticed when compared to dried fish which supports the work of Mahanta et al. [39] where the author prepared shidal using Puntius spp. and noted the percent mean ash content as 13.80±0.32. The use of Alocasia macrhorrhizos (Giant taro) might be responsible for this increase in ash amount as it is rich in calcium, magnesium, phosphorous and other minerals [35].

Quality Evaluation of Dried Fish and Shidal Through Estimating TVB-N: Quality of dried fish and shidal were assessed by determining the TVB-N (mg/100g) to know the acceptability of the products. The percent mean value of TVB-N of dried Darkina, Darkina shidal, dried Punti and Punti shidal were recorded as 10.03±0.69, 0.1124±0.00127, 11.29±0.58 and 0.0513±0.00136, respectively. The TVB-N value of both shidal indicated that there was very low level of TVB-N compared to dried product and the quality of shidal was acceptable.

The result of TVB-N content of our present study was supported by the work of Rana et al. [23], Nath and Majumder [32] and Islam et al. [40] where the authors reported the percent mean TVB-N content as 11.73 mg/100g in dried fish, 11.15 mg/100 g to 18.33 mg/100 g in different dried fish species and 10.64 to 20.36 mg/100 g in dried Mola species prepared using solar or rotary dryer, respectively. The research work revealed that the TVB-N value in Darkina shidal and Punti shidal were far lower. The production of nitrogenous compound such as ammonia and aliphatic amines was lower in shidal due to a lower fermentation period [9]. Nayeem et al. [41] conducted an investigation on chepa shutki a semi-fermented product and found the mean percentage of TVB-N as 1.12 mg/100g which indicates the degradation of tissue protein that may be responsible for the generation of typical flavor and aroma. The high value of TVB-N in their study might be attributed to the subsequent biochemical changes in the fish muscle during drying and fermentation. The present study showed that the TVB-N value in Darkina shidal and Punti shidal were lower due to the low fermentation period and use of different ingredients that increase the acceptability of the product.
CONCLUSION

Small indigenous species can be conserved by making shidal, a traditional fermented fishing product from Bangladesh's North Bengal region. The purpose of this study was to determine the proximate composition of dried fish and shidal made from Darkina (Esomus danricus) and Punti (Puntius sophore), as well as to preserve the fish by fermentation. Bangladesh, as a densely populated country, necessitates a large number of nutrients to meet demand. In this situation, the fermented product shidal has the ability to provide protein and other dietary demands. According to the findings, high-quality shidal can be made from Darkina (Esomus danricus) and Punti (Puntius sophore). Further analysis regarding its microbiological load, impact of turmeric powder and mustard oil on it and supply chain development through assessing consumer demand will increase its acceptance among mass people way higher than ever before.

REFERENCES