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Proximate Analysis (Flesh and Bone) of Biofloc Farmed Pabda (*Ompok pabda*) in Fresh and Dry Conditions

Md. Rakin Ibna Alam[1], Mehedi Mahmudul Hasan[1], Md Robiul Hasan[1,2*]

[1]Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali, Bangladesh
[2]Centre for Sustainable Aquatic Ecosystems, Murdoch University, Murdoch, WA 6150, Australia
[*]Corresponding Author: robiul.rony@outlook.com

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ABSTRACT

The proximate composition of an endangered fish *Ompok pabda* from biofloc culture system was estimated in the current study. Major nutrient composition in raw and dry fish particles, such as crude protein, fat, ash, crude fiber, nitrogen-free extract and moisture content were assessed. The protein, lipid, ash, crude fiber and nitrogen-free extract (dry matter) contents (%) of *O. pabda*'s flesh in fresh and dried conditions were 26.08±2.13 and 99.23±0.21, respectively, while the rest was moisture content. On the other hand, in the case of bone, the protein, lipid, ash, crude fiber and nitrogen-free extract (dry matter) contents (%) in fresh and dried conditions were 27.98±1.84 and 97±0.28, respectively, and the rest was moisture content. This study supports the idea that biofloc cultured fish as a good source of nutrients might help to decrease the nutrient deficiency in people's diets, aligned with a possible increase in supply through biofloc cultured species to sustain its resources in poor countries.

INTRODUCTION

For the food security of the rising world population, aquaculture is a progressively vital farming system of concern **(Piedrahita, 2003; Sharifinia *et al.*, 2018, 2019)**. Currently, recirculating aquaculture systems have been evolved as a component of sustainable aquaculture development, incorporating a suitable way of regulating wastewater from an aquaculture system **(Gutierrez-Wing & Malone, 2006)**. However, in some instances, it is inconvenient for farmers in the developing countries to adopt the recirculating system due to the high cost of operation and maintenance such as the requirement of a daily 10% water exchange of the total capacity **(Twarowska *et al.*, 1997; Badiola *et al.*, 2012; Ahmad *et al.*, 2017)**. Consequently, an eco-friendly technology, which is relatively cost-effective for farmers; in addition it is suitable for large-scale use.

The biofloc system, also called biofloc (BFT) technology, appears to be profitable, sustainable and reverent to the environment as it necessitates a reduced percentage of artificial feed and about zero water exchange, which also helps in maintaining the quality of water and microbial production (i.e., source of protein) for fishes **(Sgnaulin *et al.*, 2018; Dinda *et al.*, 2019)**. Introduction of alternative protein sources to prepare low-cost diet leading to a decrease in production costs (in comparison to conventional high-cost feeds used in the intensive aquaculture) has recently received considerable attention **(Ballester *et al*., 2010; Ahmad *et al*., 2017)**. Nonetheless, major barriers to further expansion of cage-based and flow-through aquaculture systems are the paucity of space and scopes for expansion due to the competition among users and interests of other stakeholders, limited freshwater availability, and contamination **(Badiola *et al.*, 2012).**

Pabda (*Ompok pabda*) is deemed one of the culturable species using biofloc technology **(Debbarma *et al*., 2021)**. This species is a freshwater fish native to Bangladesh **(IUCN Bangladesh, 2015)**. Additionally, it is found in Afghanistan, India, Myanmar and Pakistan **(Hubbs & Jhinqran, 1977)**. The primary sources of pabda are ponds, backswamps, oxbow lakes, wetlands, lakes and rivers. However, in Banglaesh, this species is currently vulnerable to extinct, which could be due to a lack of public awareness of conservation and loss of fish habitat (**IUCN Bangladesh, 2015**). While, humans are in need of at least a third of total protein in their daily diet from animal sources, including fish and fishery products **(Nowsad, 2007)**. Fish muscle contains protein and fat representing the major nutrients, while fish proteins are richer in amino acids such as methionine and lysine, compared to mammalian proteins and have a lower tryptophan content **(Nowsad, 2007)**. There are also nitrogen free extracts, vitamins, and minerals as sub-components in the fish muscle. The proximate composition of any fish species is noteworthy to recognize its beneficial value, and superior processing and preservation **(Mridha *et al.*, 2005)**. The protein, fat and water contents in fish are the most important factors for consumers and producers for their value and for considering periodic variations and discretion regarding processing **(Murray & Burt, 1991)**. Nutrient composition differs notably within and between species, fish size, sexual situation, feeding, time of the year and activity **(Weatherley *et al.*, 1987)**. The variation has also been observed within the different segments of the body **(Ahmed *et al.*, 2012)**.

Pabda is very rich in essential macro and micro-nutrients and has gained strong demand in the market due to its excellent taste and aroma, pin-boneless muscles and traditional fish-based delicacies **(Hossain, 1996; Boran & Karaçam, 2011)**. However, the proximate composition of biofloc cultured *O. pabda* has been less studied. Therefore, this study was conducted to identify the nutritional composition of biofloc cultured *O. pabda* in fresh and dry conditions.

MATERIALS AND METHODS

Study area

Biofloc culture system was placed in the district of Feni, Bangladesh in which *Ompok pabda* was cultured (23.03431 latitude, 91.37131 longitude).

Preparation of samples for proximate analysis

The fish samples were collected from biofloc tank cultured in 6 months from fingerling to marketable, the weight of which ranged from 28 to 33 grams. After collection, the samples were put in the sterilized, clean airtight ice box and were transported to the laboratory **(Ahmed *et al*., 2012)**. The proximate composition of Pabda flesh and bones was analyzed in fresh and dry conditions individually. At first, the collected Pabda fish were divided into 2 groups, and each group contained 7 samples. Both groups of samples were carefully washed using tap water. Fins, gills and viscera were dissected and washed with tap water to remove blood, whereas slime and unnecessary flesh pieces were removed with a knife. Then, both groups of the sample were weighed and prepared for further processing. One group of fresh samples of experimental fish species were taken to the laboratory and washed with tap water, and another group of samples were prepared for drying. The latter group was oven dried at 60°C until a complete dry matter was released. Fig. (1) shows the details of the processing of samples for the proximate analysis.

1.1 Dressing

1.2 Separation of flesh and bone

1.3 Dry matter free blended sample

1.4 Dry bone

1.5 Dry flesh

1.6 Fresh flesh

1.7 Fresh flesh

Fig. 1. Sample preparation for proximate analysis

Proximate composition analysis

Micro- Kjeldahl method was used to estimate the crude protein of fish samples **(Pearson, 1999)**. The fat content was estimated using the Soxhlet method, invented in 1879 by Franz von Soxhlet. For dry matter estimation, about a 2-3g sample was taken in crucible and placed in a hot air oven for a day (24 hours) at a temperature of 105°C. Then, the crucible containing the sample was removed from the oven and placed in a desiccator for 15 minutes to cool. For estimation of ash, about 2-3gm of the sample was also taken in a crucible. The crucibles were then placed in a muffle furnace for around 6 hours at 550°C. After 6 hours, the muffle furnace was stopped and set for cooling overnight. A spatula was utilized to take out ash sample with crucibles. Then, the sample separately weighed and reported as ash. For the estimation of crude fiber, about 0.5gm sample was taken in filter crucible and subsequently placed in the hot extractor unit. A volume of 150ml preheated hydrochloric acid (HCl) solution (0.128M) was added to the sample and boiled for 30 minutes at 230°C. After that, the filter crucibles were removed from the hot extractor to the cold extractor. The sample was washed (usually done with 25-30ml acetone) and dried at 105°C in a hot air oven overnight to remove dry matter. This step was followed by weighing (W1) the dry matter free samples (Crude fiber + Ash). The dry matter free sample was then cooled using the muffle furnace at 500°C for 3 hours. The dried sample was weighed and reported as crude fiber. Finally, the nitrogen free extract content of the sample was calculated using the following formula: % of nitrogen free extract = 100 – % of (crude protein + fat + dry matter + ash + crude fibre).

RESULTS

In case of fish bone, the crude protein, fat, ash, fiber and nitrogen free extract contents were 58.26%, 20.45%, 17.09%, 0.47%, 0.73% under dry condition while the same components' values were 15.14%, 4.82%, 4.82%, 0.14%, 3.06% under fresh condition, respectively (Fig. 2). In case of fish flesh, the crude protein, fat, ash, fiber and nitrogen free extract contents were 61.56%, 30%, 4.21%, 0.42%, 3.04% under dry condition, while the same components' values were 15.25%, 8.92%, 1.23%, 0.11%, 0.56% under fresh condition, respectively (Fig. 3).

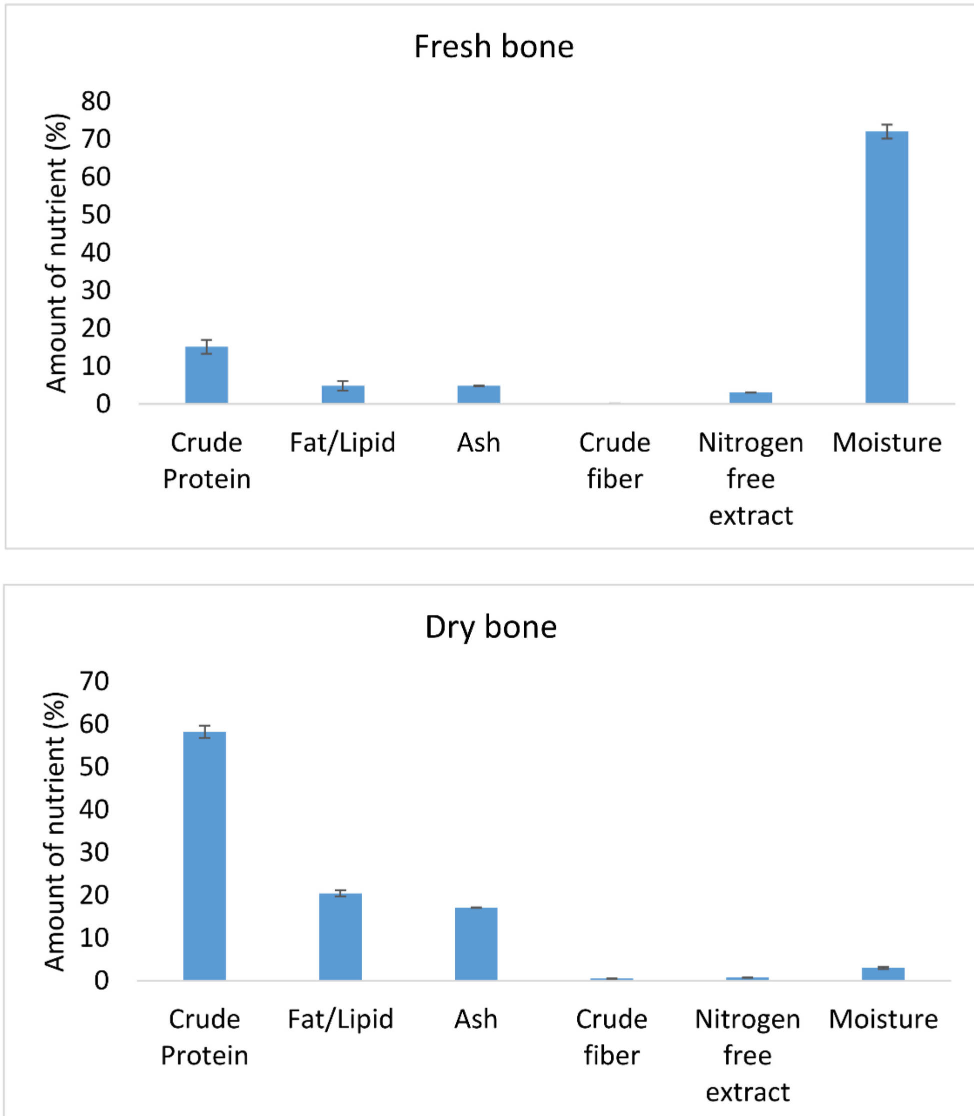

Fig. 2. Nutrient content in pabda bone under dry and fresh condition
Error bars represent standard deviation of nutrient contents in samples.

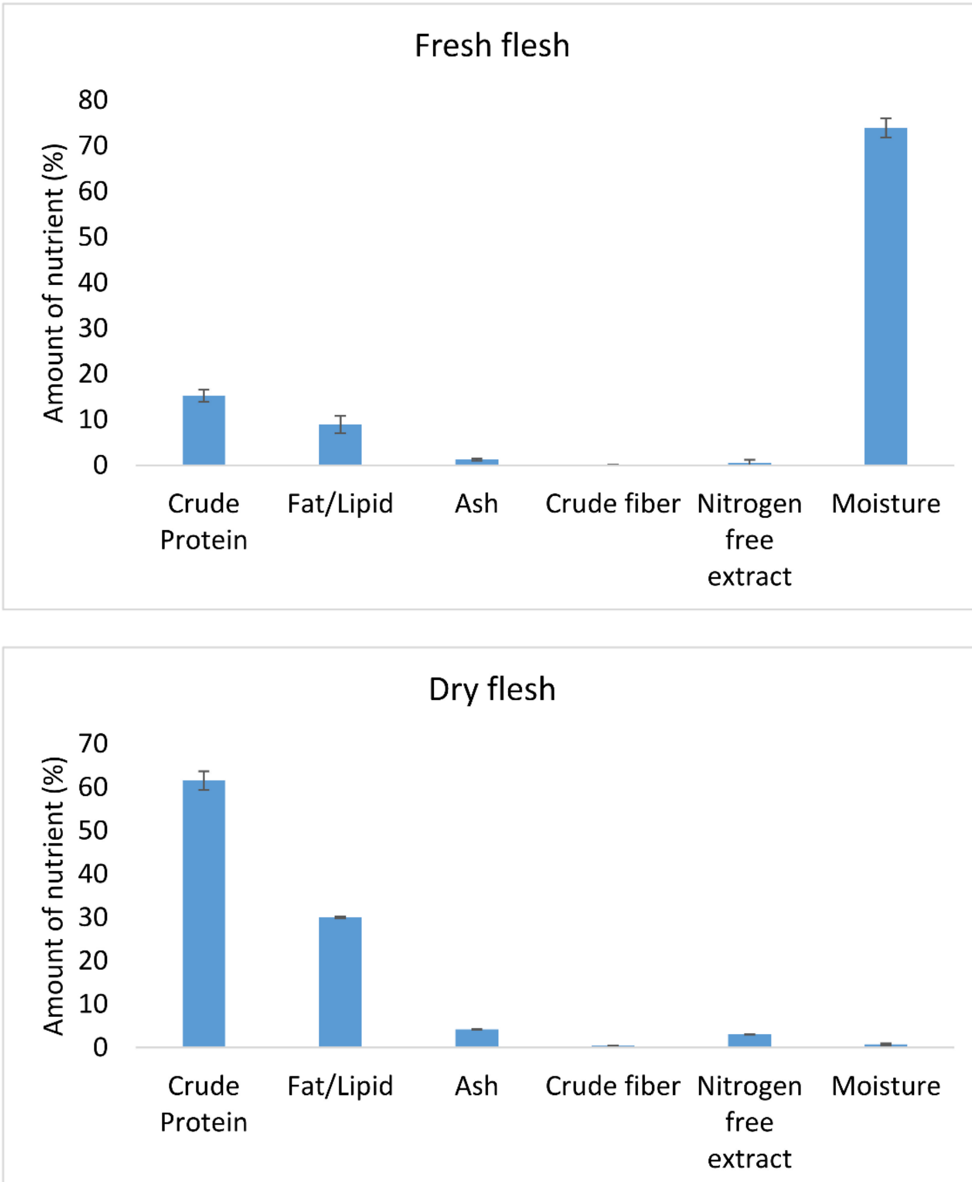

Fig. 3. Nutrient content in pabda flesh under dry and fresh condition
Error bars represent standard deviations of nutrient content in the samples.

DISCUSSION

The proximate composition of the studied fish provides the idea about whether the biofloc cultured fish species under study was nutritionally addressed in a sufficient way since it is part of people's diet and to observe the variation in nutrients between flesh and bone in fresh and dry conditions for human consumption. However, it is already reported that the biofloc system improved the protein utilization efficiency along with the growth performance of fish **(Zablon *et al.*, 2022)**. Bioflocs were also considered for proximate analysis of protein, lipid, ash and carbohydrate contents along with the total suspended solids of biofloc, as well as the organic matters **(Elias *et al.*, 2015; Zablon *et al.*, 2022)**. The current study considered proximate compositions of nutrients in the cultured fish (*O. pabda*) using biofloc. A study on the Asian stinging catfish (Heteropneustes fossilis) reported biofloc as the best alternative approach toward sustainable aquaculture and mentioned higher protein and lipid contents in biofloc culture, compared to the control **(Zafar *et al.*, 2021)**. Our results showed that the proximate composition of *O. pabda* is always higher in dry conditions compared to fresh conditions for both flesh and bone samples. Moreover, the protein content (%) varied from 15.14 to 61.56 among the different conditions. Such variation is not limited to the studied species; it also happens in other species such as shing (*Heteropneustes fossilis*), magur (*Clarias batrachus*), tengra (*Mystus tengara*) etc. and varies from one individual to another in different culture systems **(Ahmed, 2012; Paul *et al.*, 2015; Pal *et al.*, 2017; Jinia *et al.*, 2019; Sheikh *et al.*, 2022)**. In our study, the lipid content (%) varied from 4.82 in fresh to 30.00 in dry samples. Similar results are found in previous studies **(Hosen *et al.*, 2017; Haider *et al.*, 2021)**. Lipid content in fish may vary due to a number of factors, including size, sex, different parts of the body, fasting condition of the fish or oxidation of fat in separate culture systems such as recirculating aquaculture **(Fatema *et al.*, 2017; Hosen *et al.*, 2017; Rahman *et al.*, 2020; Haider *et al.*, 2021)**. Protein, lipid, ash, crude fiber and nitrogen free extract are the major nutrient components of fish muscle. This study's dry matter content varied from 26.07% to 99.23%. The highest value was found in dry bone, whereas the lowest was in pabda's fresh flesh. Similarly, in previous studies, the dry matter content (%) in the shing and magur was 78.21 and 80.44, respectively **(Ahmed, 2012; Paul *et al.*, 2015)**. In our study, the ash content (%) varied from 1.23 to 17.09 among the different conditions. Such value differs from another previous study **(Sheikh *et al.*, 2022)**, possibly due to differences in season, culture and methods. Nitrogen-free extracts are probably the most abundant and widespread organic substances in nature and are essential constituents of all living things. It is vital for human body to provide energy. In the present study, nitrogen-free extract content varied from 0.56 to 3.06 among the different conditions. This result coincide with the findings of other previous studies **(Ahmed, 2012; Banik & Bhattacharya, 2012; Binsi *et al.*, 2015; Paul *et al.*, 2015; Pal *et al.*, 2017; Jinia *et al.*, 2019; Islam *et al.*, 2020)**.

It was observed that the amount of nutrients viz. crude protein, fat, ash, fiber, nitrogen-free extracts and moisture contents are within the standard range **(DoF, 2002)** in terms of both flesh and bone in fresh and dry conditions. **Zahid *et al.* (2021)** reported results close to that of the current current study on *Ompok bimaculatus* cultured in recirculating and closed aquaculture systems, analyzing fresh flesh. They suggested that, recirculating aquaculture system is comparatively better than the closed aquaculture system in terms of fish growth performance and setting up cost. Researchers in Tripura assessed seasonal variation in growth performance and proximate composition of farmed and wild *O. bimaculatus* **(Pal *et al.,* 2017)**. They found no significant difference in proximate composition (protein, ash and moisture) between farmed and wild other than the lipid content. In that study, lipid content was comparatively higher in the farmed cultured *O. bimaculatus*. Similarly, higher levels of polyunsaturated fatty acids were reported in the closed aquaculture system **(Zahid *et al.,* 2021)**. In contrast, we found that the lipid content was relatively higher for the fresh flesh. This may be because our cultural system involved circular tanks, which could be defined as closed systems. However, biofloc cultured *O. pabda* for this current study resulted in producing fish which contained nutrients in a standard range **(DoF, 2002)**. This study supports the idea that such biofloc culture system could be good for culturing this endangered species as this system seems to retain the nutrient composition of *O. pabda*.

CONCLUSION

In conclusion, our study provides important information about the nutrient contents of crude protein, fat, ash, fibre and nitrogen-free bone and flesh extract, as well as moisture content. Such information would help people to plan a nutritional diet for good health. Consequently, biofloc farmed pabda fish culture may be used to sustain fish resources in an area where natural fish are rare and people cannot fulfil their nutrient requirements. However, this is merely an initial stage to finalize this conclusion since few other factors such as the impacts of microorganisms in such biofloc and the composition of biofloc particles in this system have not yet been considered. Our future work would focus on the proximate composition of pabda fish from the earthen ponds to compare with those cultured in biofloc in the Feni district and determine the microbial effects on the fish growth performance.

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