Analysis of Proximate Composition of Shingi fish (*Heteropneustesfossilis)* Fed with Poultry Offal Protein-Rich Formulated Feed under Captive Conditions

Abstract

The experiment aimed to evaluate the effects of poultry offal protein-rich formulated feed on the proximate composition of shingi fish (*Heteropneustesfossilis*) using four treatments and three replications over 60 days. By using the method of AOAC, dry matter (DM), moisture, crude protein (CP), crude fat (CF), and total ash were measured to observe the composition of shingi fish after feeding formulated feed. According to the study, shingi fish fed four distinct poultry offal-formulated feeds—Diet-1 (30% FM + 0% POM), Diet-2 (20% FM + 10% POM), Diet-3 (10% FM + 20% POM), and Diet-4 (0% FM + 30% POM)—had their proximate compositions changed. During the first phase, shingi fingerlings' proximate composition was ascertained to be 80.15% moisture, 19.85% dry matter, 58.51% crude protein, 13.02% ash, and 10.21% crude fat. After culturing with different formulated diets, the mean values of moisture, dry matter, crude protein, total ash, and crude fat were found 78.54%, 21.48%, 60.47%, 13.14%, and 12.04%, respectively. The study found significant variations ($p<0.05$) in proximate composition between fingerling Shingi and those cultured with poultry offal-formulated diets. Among the formulated feds, diets-4 displayed the highest amount of crude protein (62.12%) and the lowest ash contents (12.14%) while Diet 3 contained the highest amount of dry matter (22.89%), ash (12.41%), and lipid contents (13.98%). The study suggests that poultry offal prepared-fed could be a low-cost, locally accessible protein substitute for fish meals that would also help sustainably farmed fisheries to boost fish yield.

Keywords: Poultry offal, fish meal, proximate composition, shing fish, protein-rich formulated feed

1. INTRODUCTION

Fish are considered a highly nutritious food, providing high-quality animal proteins at a relatively low cost and often more accessible and affordable than other sources of animal protein [1]. Fish provide about 60% of total national daily animal protein consumption (With a per capita consumption of 62.58 grams per day, surpassing the targeted demand of 60 grams per day)[2]. Among the fishes, shingi fish (*Heteropneustesfossilis*) is one of the most highly demandable freshwater air-breathing fish species in the Indian subcontinent and Southeast Asian region. It is considered highly nourishing, palatable, tasty, and well-preferred because it has less spine, less fat, and a high digestibility [3]. It has enormous aquaculture potential and it could be easily grown in ponds and small ditches.

In recent years, global fish demand has risen significantly, so the aquaculture industry has increased gradually. The main goals of the aquaculture industry include optimizing growth and ensuring the availability of high-quality fish [4] while increasing global awareness of fish as a valuable protein source. It also led to growing prospects of aqua feeds with diets specifically designed to meet the nutritional requirements of different species, their life cycles, and their health conditions [5]. Aqua feed production has traditionally relied on fish meal (FM) for many years due to its high protein content, balanced essential amino acids (EAA), acceptability among cultured fish, and high digestibility and palatability. These qualities are beneficial for improving nutrient uptake, digestion, and absorption in fish [6, 7]. The steady decline in wild fish catches due to over-dependence and increased demand for aquaculture feeds has resulted in a rapid decrease in the availability of fish meal [8].Moreover, numerous studies, including those on market and environmental factors suggest that fish meal is financially and environmentally unsustainable as a protein source for aqua feeds [9, 10]. Therefore, there has been significant attention given to the possibility of replacing fish meal in aquaculture feeds with protein-rich animal or plant ingredients [11, 12].Poultry offal is an interesting economic alternative to fishmeal having digestibility and high nutrient composition. Poultry offal meal has a high protein content that ranges from 60% to 80% and is a rich source of essential amino acids, minerals, and vitamins [13, 14].

The proximate composition generally comprises the estimation of moisture, protein, fat, and ash components of fresh fish bodies that vary widely from species to species due to food quality, habitat, water quality, and other parameters. Assessment of the proximate composition of fish is not only important to know its nutritive value, but also for its better processing and preservation [15]. To establish *H. fossilis* as a strong contender in the fish market in comparison to other fishes, knowing of proximate composition is of great importance. There is no notable research regarding the proximate composition of *H. fossilis* from the viewpoint of different poultry offal formulated feed. So, it is a great opportunity to open up a new window for the improvement of proximate composition in stinging catfish *(H. fossilis)* in Bangladesh throughout poultry offal as aquafeed. Regarding this contest, the research was conducted to determine the effect of different poultry offal formulated fed on the proximate composition of stinging catfish, Shingi (*H. fossilis*).

2. MATERIALS AND METHODS

2.1 Study area and duration

The study was conducted from January 2023 to March 2023 at the Department of Fisheries and Marine Science laboratory at Noakhali Science and Technology University.

2.2 Experimental Fish

Fingerlings of Shingi (*Heteropneustesfossilis*), weighing between 2g and 3g on average, were obtained from Daulat Fish Hatchery and Nursery in Mymensingh. Before the start of the feeding trial, they were fasted for 24 hours. Subsequently, 20 fingerlings were placed in each of twelve 35-liter rectangular glass aquariums.

2.3 Experimental Diets Formulation

Various ingredients were gathered from the Noakhali local market, including fishmeal, wheat bran, de-oiled rice bran, soybean meal, and rapeseed meal. Then the raw poultry offal was processed into poultry offal meal (POM). Following that, the Animal Nutrition and Feed Section, DLS, Dhaka. Conducted a chemical composition analysis of fish meal, poultry offal meal, and the remaining feed ingredients (wheat bran, de-oiled rice bran, rapeseed meal, and soybean meal). The experimental diet was finally developed.The diet contained 35 % protein that was formulated to include varying amounts of poultry offal meal (POM) to partially or completely replace the diet's fishmeal component. The first diet (D_1) contained fish meal 30%

and without the (POM), the second diet (D_2) contained 20% fish meal and 10% (POM), the third diet (D_3) contained 10% fish meal and 20% (POM), while the fourth diet (D_4) containing 30% (POM) only. The percentage composition of the experimental diets with different inclusion levels of poultry offal meal in replacement of fishmeal is shown in Table 1.

Table 1. Inclusion levels of different feed ingredients

Ingredients	**Inclusion level (%)**			
	Diet-1	Diet-2	Diet-3	Diet-4
Fish meal	30.00	20.00	10.00	0.00
Poultry offal Meal	0.00	10.00	20.00	30.00
Wheat bran	11.45	11.45	11.45	11.45
De-oil rice bran	10.30	10.30	10.30	10.30
Rapeseed meal	21.05	21.05	21.05	21.05
Soybean meal	22.20	22.20	22.20	22.20
V & M	2.00	2.00	2.00	2.00
Binder	3.00	3.00	3.00	3.00
Total	100	100	100	100

2.4 Experimental Design with Different Feed

The experiment was carried out by using an aquarium of (43 cm × 35 cm × 30 cm) installed in the lab for semi circulatory aquarium system for 60 days with four treatments and three replications. The aquarium was aerated by the aquarium air pump with a 25% level of water exchange daily and a thermo-state water heater was applied to fix the water temperature. All the treatments were subjected to the same stocking density & feed quantity. The fingerlings of Shingi fish had an initial weight (gm). The first treatment (D1) contained only 30% fish meal, the second treatment (D2) contained 20% fish meal and 10% POM, the third treatment (D3) contained 10% fish meal and 20% POM, while the last treatment (D4) fed with only 30% POM.

2.5 Feeding

The fish were fed at the daily rate of 12 % biomass for 1st month and 10 % biomass for 2nd month. The diet was administered thrice daily at 06.00 am, 6.00 pm, and 11.00 pm in equal portions, and the daily rations were adjusted accordingly after each monthly weighing.

2.6 Proximate composition analysis

According to the [16] method, the proximate composition levels (moisture, ash, crude protein, crude fat, carbohydrate, crude fiber,) were analyzed based on ground powder samples by weight. Each parameter was assessed as follows: Samples were initially dried in an oven at 105°C until a constant weight was achieved to determine moisture content. Protein content was determined using the micro-Kjeldahl method, employing a DKL 42/26 automatic digestion unit and a UDK 129 distillation unit (VelpScientifica, Italy). The crude protein was calculated by multiplying the total nitrogen measurement using 6.25 as a conversion factor. Crude fat was assessed using the Soxhlet extraction method with petroleum ether as the solvent. Ash content was determined by incinerating samples at 600°C for 6 hours in a muffle furnace (JSMF-45HT, South Korea). Carbohydrate content was calculated using the difference method. The moisture, protein, fat, ash, and carbohydrate levels in the analyzed samples were expressed as percentages.

2.7 Data analysis

Data were analyzed by using ANOVA followed by Tukey's HDS post hoc for multiple comparisons. The data were presented as mean ± SD and analyzed using the statistical program IBM SPSS statistics version 20.0 with a significance level of 5% ($p<0.05$).

3. RESULTS

Experimental diets were performed on the culture of *H. fossilis* for 60 days in the laboratory condition. To compare the proximate composition of fish, three different types of chicken offal-formulated feed were fed in addition to the 30% fishmeal formulated feed, which served as the control. During the rearing and feeding trial, the investigation was carried out on the proximate composition of *H. fossilis*two times (Initial stage and after 60 days of culture). After using the formulated feed with different poultry offal levels, the protein, fat, ash, and moisture content of the shingi fish (*H. fossilis*) showed differences. The following section presents the findings of the investigation into the approximate composition of the experimental diet and fish (*H. fossilis*) raised in twelve aquariums and fed on four prepared diets: Diet-1(30%FM+0%POM); Diet-2(20%FM+10% POM); Diet-3(10%FM+20%POM); Diet-4(0%FM+30%POM).

3.1 Proximate composition of experimental diets (% Dry matter basis)

Diet-1, Diet-2, Diet-3, and Diet-4 were found to have the following nutrient contents (% Dry matter basis): dry matter 92.44%, moisture7.56%, protein 34.69%, lipid 15.62 %, ash 11.86 %; dry matter 88.97%, moisture11.03%, protein 35.63%, lipid 15.2 %, ash 11.3 %; dry matter 89.35%, moisture10.13%, protein 34.82%, lipid 14.06%, ash12.37%; dry matter 89.35%, moisture10.65%, protein 35.81%, lipid 19.71 %, ash 12.64 %, respectively are shown in (Table 2).

Table 2. Proximate composition of experimental diets (% Dry matter basis)

Sample	Moisture (%)	Dry matter (%)	Crude Protein (%)	Total Ash (%)	Crude Fat (%)	Crude Fiber (%)
S1	79.98	20.02	57.93	13.05	10.06	Nil
S2	79.92	20.08	58.71	12.99	10.23	Nil
S3	80.54	19.46	58.89	13.03	10.33	Nil
Average	80.15	19.85	58.51	13.02	10.21	Nil

3.2 Initial proximate value of fingerling shingi (*H. fossilis*) (%Dry matter basis)

The study revealed that the average nutrient contents (on a dry matter basis) of fingerling shingi (*H. fossilis*)viz., 80.15% moisture, 19.85% dry matter, 58.51% crude protein, 13.02%

ash, and 10.21% crude fat (Table 3). The highest values for moisture, dry matter, crude protein, ash, and crude fat were observed in samples S3 (80.54%), S2 (20.08%), S3 (58.89%), S1 (13.05%), and S3 (10.33%), respectively, while the lowest values were recorded in samples S2 (79.92%), S3 (19.46%), S1 (57.93%), S2 (12.99%), and S1 (10.06%), respectively (Table 3). Notably, no crude fiber was detected in any of the samples (Table 3).

Components	Diet-1 Control (0%)	Diet-2 (33.33%)	Diet-3 (66.66%)	Diet-4 (100%)
Dry matter	92.44	88.97	89.87	89.35
Moisture	07.56	11.03	10.13	10.65
Protein	34.69	35.63	34.82	35.81
Lipid	15.62	15.24	14.06	19.71
Ash	11.86	11.30	12.37	12.64

Table 3. Initial proximate value of fingerling shingi (*H. fossilis*) (%Dry matter basis)

3.3 Proximate composition of Shingi (*H. fossilis*) after culturing with different diets

The proximate composition of shingi fish showed differences with the treatments of different diets displayed in Table 4 and Figure 1. The results of the experiment revealed that the highest amount of moisture content was found in diet-1 (79.94%) whereas the lowest was in diet-3 (77.11%) which was significantly ($p<0.05$) different as compared to others. Additionally, the dry matter content was maximum in Diet-3 at 22.89%, while the minimum was in Diet-1 at 20.08%. Moreover, Diet-4 had the highest crude protein percentages at 62.12%, while Diet-2 had the lowest values at 58.65% which are significantly different ($p<0.05$). The total ash content and crude fat were the highest in Diet-3 at 13.98% and 12.41%, respectively while the lowest amount was in Diet-4 at 12.10% and crude fat was in Diet-2 at 11.45%. Both values significantly differed ($p < 0.05$) from the other diets (Table 4). No crude fiber was detected.

Table 4. The proximate composition of Shingi fish (*H. fossilis*)after culturing with different diet

Diet	Moisture (%)	Dry matter (%)	Crude Protein (%)	Ash (%)	Crude Fat (%)	Crude Fiber (%)
Diet-1	79.94±0.05	20.08±0.08	61.55±0.02	13.88±0.06	12.17±0.04	Nil
Diet-2	78.40±0.07	21.60±0.07	58.65±0.10	12.59±0.35	11.45±0.27	Nil
Diet-3	77.11±0.17	22.89±0.17	59.54±0.51	13.98±0.90	12.41±0.42	Nil
Diet-4	78.72±0.76	21.28±0.76	62.12±0.74	12.10±0.81	12.14±0.56	Nil
Mean	78.54	21.48	60.47	13.14	12.04	Nil

3.3 Percent changes of proximate composition from initial to culture with different diets

The percentage changes in protein was significantly higher in Diet-4 (3.61%) and the lowest in Diet-1 (1.24%) from the initial to cultured Shingifish (*H. fossilis*)with different poultry offal formulated feeds. Besides, the percent changes of fat were found maximum (0.92%) in Diet-2 and the minimum in Diet-3 (0.05%). On the other hand, the ash percentage was comparatively higher in Diet-1 (2.13%) and less in both Diet-2 and Diet-4 (1.93%) after using formulated fish feed (Table 5).

Table 5. Changes of proximate composition percent (%) from initial to culture with different diets

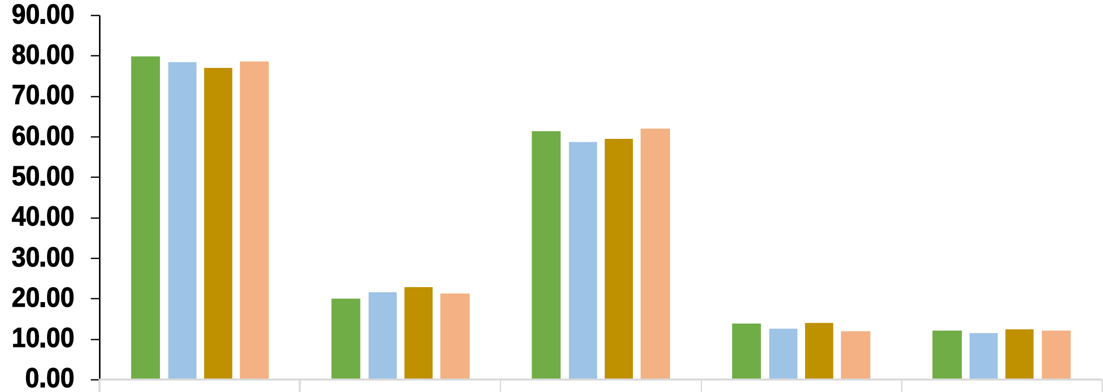
Contents	Protein	Fat	Ash
Initial	58.51	13.02	10.21
% Changes in proximate composition			
Contents	Protein	Fat	Ash
Diet-1	1.24	0.82	2.13
Diet-2	2.65	0.92	1.93
Diet-3	1.94	0.05	2.03
Diet-4	3.61	0.92	1.93

4. DISCUSSION

This study focuses on analyzing the proximate composition profile of frequently consumed fish the Stinging Catfish species to determine the level of the important constituents viz. moisture, protein, fat, and ash. The proximate composition of fish varied from species to species and even within the same species from one individual to another [17].

Moisture is a major component of fish muscle. In the study, moisture content varied between fingerling of Stinging Catfish shingi (*H. fossilis*) and cultured shingi with different poultry offal formulated feed. As demonstrated in Table 4 and Fig.1, the moisture content varied from 77.11% to 80.15%. In the present study, the percentage of moisture was found higher in the fingerling condition. On the other hand, among the four diets, the highest moisture content was found in Diet-1 and the lowest moisture value was found in Diet-3. These results are in good agreement with the findings of [18]. [19] were recorded that moisture content in gulsha fish muscle varied from 75.3% to 77.37% in different diets of poultry fish offal. In another study, [20] investigated the moisture content for twenty-seven species of freshwater fish, where moisture content was found in the range of 72.18-83.65%, which is almost similar to our study.

Fish is a rich source of high-quality protein, containing all the essential amino acids that are crucial for the growth, development, and repair of the body.In the present study, the protein content varied among the four formulated feeds as well as the fingerling condition. Crude protein content varied from 58.51% to 62.12% (Table 4 and Fig. 1). The percentage of protein was found in higher after culture with Diet-4 and lower in the fingerling condition. [19] showed that protein content (%) varied from 63.27% to 71.18% in Gulsha with different diets of poultry offal. [1] also determined the crude protein (62.66%) in *H. fossilis* which was almost consistent with the study fish. The present study also approximately agreed with the subsequent result of [21, 22] on crude protein in Shingi (*H. fossilis*).



	Moisture	Dry matter	Crude Protein	Total Ash	Crude Fat
Diet1	79.94	20.08	61.55	13.88	12.17
Diet 2	78.40	21.60	58.65	12.59	11.45
Diet 3	77.11	22.89	59.54	13.98	12.41
Diet 4	78.72	21.28	62.12	12.10	12.14

Fig. 1. Comparison of proximate value of shingi (*H. fossilis*) cultured with four different feeds.

Lipids (Crude fat) are water-insoluble macro-biomolecules that are soluble in organic solvents and have a variety of biological roles ranging from fuel molecules, and energy stores to components of membranes [23]. Lipids are the best source of energy producers in the body through metabolism. In the study, lipid content varied between fingerling Shingi (*H. fossilis*) and cultured shingi with different poultry offal formulated feed.In the present study, lipid content was found to be in the range of 10.21-12.41% (Table 4 and Fig. 1). No significant difference was found in fat content using various levels of poultry offal formulated feed, but a significant difference was shown between fingerling conditions and cultured shingi with a different diet. Besides, the percentage of lipids was found to be higher in Diet-3 and the lowest was in the fingerling condition of Shingi (*H. fossilis*). [18] observed the lipid content of 11.88%, 11.40-11.88%, 11.68-12.60% (dry matter basis) of stinging catfish *(H. fossilis*) during the rearing and feeding trial with different Vitamin C level. Where [1] recorded8.05% fat contents in *H. fossilis*. [19]reported 11.18% to 12.38% of fat contents in Tulsa by feeding different diets of poultry offal.

In the study, ash content varied between fingerling Shingi (*H. fossilis*) and cultured shingi with different poultry offal formulated feed. The results showed that the ash percentage was found to be higher in Diet-3 and the lowest was in Diet-4 ranging from 12.10% to 13.98% (Table 4 and Fig. 1). The ash content of our experiment is almost nearer to the result of [22, 24, 25] in Shingi (*H. fossilis)*. [1] reported14.38% ash contents in *H. fossils*.

5. CONCLUSION

The study discovered that feeding native catfish with poultry offal-based formulated feed resulted in increased protein and lipid content compared to their fingerling state. This indicates that protein-rich poultry offal meals can be an effective and cost-efficient source of protein and lipids for fish diets, enhancing growth performance, feed utilization, and the healthshing fish. This approach could contribute to reducing reliance on fishmeal, a more expensive and environmentally impactful protein source. Further research is recommended to explore the long-term effects of this diet on the overall growth, health, and particularly the flesh quality of shingi fish for human consumption. Additionally, studies comparing the digestibility and utilization of nutrients from poultry offal protein compared to other protein sources would provide valuable insights into optimizing feed formulations for shingi aquaculture. (enhancing growth performance - where is the data? It is hypothetical.)

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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