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Optimization of blood meal in rice and wheat bran based pelleted feeds for stinging catfish (*Heteropneustes fossilis*)

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ABSTRACT

A ten-week experiment was carried out to evaluate the effect of blood meal in rice and wheat bran based pelleted feeds on growth and survival rate of *Heteropneustes fossilis* in the Wet Laboratory of the Faculty of Fisheries of Bangladesh Agricultural University, Mymensingh. For the experiment, 9 aquaria of 60L capacity were used and fish fry of 0.437g of initial average weight were released at the same stocking density (20 fry per aquarium). Three different treatments (T_1, T_2 and T_3) with three replications were used having different percentage of protein containing diets (Diet I -10% blood meal, Diet II -15% blood meal and Diet III -20% blood meal). All three diets having a constant inclusion level of the following ingredients: rice bran 20%, wheat bran 20%, fish meal 20%, molasses 5%, vitamin and mineral premix 1% and chromic oxide 0.5%. Feeds were supplied at 10% body weight twice daily in the morning at 9.00 am and in the afternoon at 5.00 pm throughout the study period. Sampling was done at 7 days interval throughout the experimental period. Water quality parameters were within the acceptable range during the experimental period. The significant highest mean final weight (g), weight gain (g), percent weight gain, specific growth rate (%/day) and the best feed utilization in terms of food conversion ratio were found at 20% blood meal containing diet (Diet -III). The results suggested that 20% blood meal containing feed could be recommended for the intensive culture of *H. fossilis.*

INTRODUCTION

Land resources are not adequate enough to satisfy the growing demand for food; therefore, universal requirement for aquatic food products is rising, the population from capture fisheries have exceeded the limits and most of the fishing areas have met its maximum potential (Siddiqui et al., 2013). Aquaculture has emerged as a dominant component of Bangladesh fisheries. Over last ten years, yield from closed water aquaculture has been increasing steadily. But with the increasing demand for food fish and decline in capture fisheries production, aquaculture in Bangladesh is heading towards intensification. The per capita annual fish consumption in Bangladesh stands at about 62.58 g/day as against a recommended minimum requirement of 60 g/day (DoF, 2020). Hence there is still shortage of fish to meet the demand of the country people. The stinging catfish, *Heteropneustes fossilis* (shing) is a promising species for aquaculture by virtue of its air-breathing characteristics and widely distributed throughout Indian sub-continent. Among the air-breathing catfishes, stinging catfish is very popular and high-priced fish in Bangladesh. It is considered as highly palatable and tasty and well preferred because of its less spine, less fat. Presently, intensive culture of *H. fossilis* is getting momentum. However, high feed cost is the major constraint for the culture of catfishes and other cultivable species. To minimize the feed cost we should go for non-conventional feed ingredients to formulate low-cost fish feed. Therefore, in order to attain more economically sustainable, environmentally friendly and viable production,

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research interest has been directed towards the evaluation and use of non-conventional protein sources. Hence special attention is demanded to formulate low-cost fish feed using blood meal. Blood meal has long been recognized as a valuable feed, and a rich source of essential amino acids for pigs, poultry (Crawshaw, 1994), and fish (Crockford, 1998; Hardy, 2006; Otubusin, 2009).In general, compared with most marine feed ingredient sources, blood meal and blood products contain low levels of environmental contaminants, including persistent organic pollutants and heavy metals (Otubusin, 1987).

The aim of the research was to evaluate the growth performances of *H. fossilis* by feeding the feed formulated by blood meal, which would be helpful for reduction of feed-cost and ensure better growth performance and production. The specific objectives were to evaluate the effect of blood meal in pelleted feeds on the growth and survival rate of *H. fossilis* and to determine proper inclusion level of blood meal in formulated feed.

MATERIALS AND METHODS

Experimental design

The experiment was carried out in the Wet Laboratory of the Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. For this work, 9 glass aquaria (each contains 60L) were set at the wet laboratory during June –August and were operated under the same conditions. An adequate level of dissolved oxygen, in each aquarium was maintained through artificial aeration during the experimental period. The water temperature in the experimental tanks ranging 27.4-31.2^{0}C was maintained. The entire aquariums were kept on 1m high wooden table to facilitate better observation and accessibility. For convenience the tanks were numbered as 1, 2, 3 up to 9.

Sample collection:

Fingerlings of *H. fossilis* were collected from the fish seed production hatchery (Othentic hatchery of Sadar upazila, Mymensingh). Transportation of fry was done in oxygen bag to avoid stress and injury. During the period of acclimation, adequate oxygen supply was maintained through artificial aeration and fish were fed formulated pelleted feed.

Feed formulation

The selected ingredients for this experiment were collected from Mymensingh local market. Blood was collected from local slaughter house and was sundried and oven dried. Proximate compositions of three different formulated diets are showed in table 1. All three diets had a constant inclusion level of the following ingredients: rice bran (RB) 20%, wheat bran (WB) 20%, fish meal (FM) 20%, molasses 5%, vitamin and mineral premix 1%, and chromic oxide 0.5%. Crude fiber percentage in Diet I, Diet II and Diet III was 8.5%, 13.5% and 18.5%, respectively. The feed ingredients (finely ground and sieved) were weighed accordingly, moistened with water to form dough and pelletized using an electric meat mincer. The feeds were stored in airtight polythene bags at room temperature until fed.

Experimental procedure

The experiment was conducted for 70 days. Each treatment had three replications. The initial average weight of stinging catfish fry was 0.437g. The fry was randomly distributed at a rate of 20 fish per aquarium. Feeding was done twice daily at 9.00am and 5.00pm. Partial change of water from each aquarium was done daily during the removal of uneaten feed and faeces.

Sampling procedure

Initial and final weight of fish in each aquarium was recorded. To record the weighing data, fish were bulk weighed at every 7 days interval. Fish were netted by using a fine mesh scoopnet and excess water was then removed from fish body gently by using a blotting paper before weighing to the digital balance (Model:GL-300, GULF, Dubai, U.A.E.). After recording the weight, the fingerlings were released in the aquarium. pH, temperature and dissolved oxygen (DO) were measured weekly.

Feeding rates

Fingerlings were fed with experimental diets twice daily in the morning at 9.00 am and in the afternoon at 5.00 pm throughout the study period. Fingerlings in each aquarium were fed daily at the rate of 10% of their body weight which was fixed after observing that they were not interested to have more than this percent of feed.

Analytical methods

Proximate composition of prepared feeds and individual ingredients were analyzed in the Nutrition Laboratory of the Department of Aquaculture, Bangladesh Agricultural University following Association of Official Analytical Chemists (AOAC, 2000) methods.

Data analysis

The collected data were analyzed by one way ANOVA SPSS (Statistical Package for the Social Sciences) software. The means of different treatment were compared by Duncan's New Multiple Range Test (Duncan, 1955) to test the significance of variation between the treatment means. Standard error (SE) of the treatment means was calculated from the residual mean square in the analysis of variance.

RESULTS AND DISCUSSION

Growth performance of *H. fossilis*

In the study, the effect of different protein source of fish feed on the production of catfish (*H. fossilis*) reared in aquarium was evaluated. At the end of experiment the highest mean final weight (g), weight gain (g) and percent weight gain (%) was observed at 20% blood meal containing diet (Diet III) (Table 3). The SGR of *H. fossilis* under different treatments varied from 0.90 to 1.27(%/day). The significantly (P>0.05) highest SGR was found at 20% blood meal containing diet having a crude protein percentage of 30.41% and nearly highest growth performance was found at 15% blood meal containing diet (26.60% crude protein). Ahmad et al. (2004) found that dietary protein level was 45% for Nile tilapia fry and 35% for growing adult without natural food. However, many authors obtained conflicting results from their studies on tilapia nutrition (Bahnasawy, 2009). The dietary protein requirements of several species of tilapia have been estimated to range between 20% and 56%. The protein efficiency ratio (PER) under different treatments in this study ranged from 0.35 to 0.38. The result showed no significant variation in PER value. The survival rate of *H. fossilis* under different treatments ranged from 83.33% to 86.67%. There was no significant difference in survival rate (%).

Table 1: Proximate composition analysis of formulated feed (dry basis)

Diet	Moisture (%)	Crude Lipid (%)	Crude Protein (%)	Ash (%)	Crude Fiber (%)	NFE (%)
Diet I	12.56	8.61	22.79	15.86	16	24.17
Diet II	13.28	7.45	26.60	15.19	13	24.47
Diet III	13.4	6.98	30.41	15.29	11	22.92

Table 2: Summary of water quality parameters observed during the experimental period

Parameters	Value range
Temperature (^{0}C)	27.4-31.2
pH	7.50-8.40
Dissolved Oxygen (DO)	6.5-9.60

Table 3: The effect of different treatments on growth performance, feed utilization and survival of stinging catfish (*H. fossilis*) reared in aquaria (Mean ± SE) during the study period

Variables Parameters	Treatments (Mean ± SE)				
	Treatment 1	Treatment 2	Treatment 3	LSD	Level of significance
Initial weight (g)	0.437±0.000	0.437±0.000	0.437±0.000	0.000	**
Final weight (g)	0.82±0.020c	0.91±0.026b	1.06±0.020a	0.012	**
Weight gain (g)	0.383±0.020c	0.473±0.026b	0.623±0.020a	0.036	**
Percent weight gain	87.643±4.577c	108.238±6.05b	142.56±4.57a	5.902	**
SGR-Specific growth rate (%/day)	0.90±0.035c	1.05±0.042b	1.27±0.027a	0.036	**
Average weight gain	0.005±0.000	0.007±0.00	0.009±0.000	0.020	**
Food conversion ratio (FCR)	6.82±0.356c	5.83±0.304b	4.88±0.255a	0.96	**
Protein efficiency ratio (PER)	0.35±0.024	0.36±0.020	0.38±0.027	0.176	NS
Survival rate (%)	85±1.876	83.33±0.433	86.67±0.621	1.348	NS

******Means with the different letter in the same row are significantly different (P≥0.05)
NS= Non-Significant

In the study the food conversion ratio (FCR) under different treatments ranged from 4.88 to 6.83 considering 30% feed loss. The improved performance of FCR was observed at 20% BM containing diet. Similarly, Bahnasawy (2009) reported that the best FCR was obtained from 35% protein diet. Abdel (2004) recorded FCR of four Egyptian Nile tilapia strains as followed: 2.21, 1.8, 2.7 and 2.03 for Abbassa, Aswan, Manzalah and Mariut, respectively. The important contribution of blood meal in feeds (diet) in this study was further highlighted by the intermediate performance of the diets 2 and 3 fed to fish under treatments 2 and 3, respectively. Clearly, fish fed with diet 3 (containing 20% blood meal) had overall better growth performances.

Water quality parameter

The water quality parameters play an important role for maintaining healthy environment for aquatic organisms. The water temperature monitored during the study period in the experimental tanks varied from 27.4^{0}C to 31.2^{0}C (Table 2).

Boyd (1982) reported that the range of water temperature from 26.06 to 3l.97^{0}C is suitable for fish culture. Alam (2009) measured the water temperature in ponds of Agro-3 Farm, Trishal, Mymensingh ranged from 26.9 to 32.5^{0}C. From the above statement, water temperature in aquarium was similar of pond temperature. The dissolved oxygen content from present experiment ranged from 6.5 to 9.60 mg/l. Alam (2009) also obtained dissolved oxygen level 5.l to 8.7 mg/l in ponds behind the Faculty of Fisheries, Bangladesh Agricultural University campus. The oxygen content found in the present experiment lied within productive range. During the study period the pH value was found within the range of 7.5 to 8.4. Alam (2009) measured the pH value in ponds of Agro-3 Farm, Trishal, Mymensingh ranged from 7.54 to 8.3 and 7.72 to 8.03, respectively.

CONCLUSION

In this experiment it was revealed that the best growth performances, feed utilization, survival rate and production of *H. fossilis* were obtained at 20% blood meal containing feed. Finally, it may be concluded that 20% inclusion level of blood meal could be a good source of alternative protein other than fish meal to make feed more cost-effective which may play a great role in minimizing production cost.

Blood meal which is a non-conventional feed item can certainly play a supporting role of fish meal and improve fish production scenario in Bangladesh. Blood meal contributes to produce

quality fish by reducing production cost and it may be a better alternative protein source for fish feed. Pond treatment may be conducted to evaluate the efficiency of blood meal along with fish meal or partial replacement of fish meal with blood meal. However, much more can be achieved by intensifying research on blood meal inclusion in fish feed for better balanced diets in the fish farming industry, as desired by fish farmers worldwide. This undoubtedly will aid in superior fish growth and healthier fish production.

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