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Analyses of Growth Performance and Whole Body Composition of *Labeo rohita* Fed with Bone Meal Diet

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ABSTRACT

The present study was conducted to check the growth performance and body composition of *Labeo rohita* fed with two different levels of fish meal replacement with bone meal. The trial was carried out in glass aquaria for a period of 8 weeks. Ten (n=10) fingerlings of *L. rohita* were reared per aquaria having capacity of 80-L water. Feed having 100% fish meal was considered as T1 and diets having 30% and 60% replacement of fish meal by bone meal as main protein source was considered as T2 and T3, respectively. Results showed that replacement of 30% and 60% fish meal with bone meal has better effect on growth of *L. rohita* analysed whole body composition revealed that lower values of total fat there was observed no significant differences in carbohydrates and moisture content of fish was observed. Bone meal could replace fish meal as an acceptable protein source to promote growth of *L. rohita* without any negative effects on growth and body composition.

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NI conducted the research. AM conceived idea. LS wrote original draft. HN and SR performed statistical analysis. NN wrote the methodology and QL revised the manuscript. All authors read and approved the final manuscript.

Key words
***L. rohita*, Growth, Fish meal, Bone meal, Body composition**

INTRODUCTION

Population in the world is increasing day by day, the population estimated today is 6.5 billion and may reach nine billion till 2050 (United Nations, 2006). To meet their food requirements, man learned to culture plants and animals. In developing countries, many people face malnourishment and shortage of food because of rapid increase in population. It is the most important issue now a days to get all available natural sources to attain food with effective quality and quantity and peculiarly beneficial to our institution. Including needs of life, food is one of the entire basic ingredient and way of living properly explained by the idea of suitable development; reinforcement and maintenance of body organs and tissues (Anonymous, 2005). To obtain maximum production and for the betterment of fisheries, it is essential to give substituted feed, so the fish can gain maximum length and weight in short time interval (Bhosale *et al*., 2010; Ishtiaq *et al*., 2023). In aqua feeds, fish meal is considered as sole protein source (Xue and Cui, 2001).

Protein is most valuable nutrient which present in fish meal, as a highly protein source their price become so high. So, replacement of fish meal with animal and plant protein sources decreased feed cost (Hossain and Paul, 2007). The by-product accomplishing meat and bone meal which contains 43 to 58% raw protein and also contains essential amino acids. Meat and bone meal are somewhat cheaper source of protein than fish meal (Habib *et al*., 2001). Bone meal is identified as an outstanding source of protein and well balanced amino acid profile in most of fish species e.g., rainbow trout (Sugiura *et al*., 2000). In feed formulation, bone meal, blood meal, feather meal and PBM have been effectively utilized fora diversity of fish species e.g. rainbow trout (Bureau *et al*., 2000), Cuneate drum (Wang *et al*., 2006), red drum (Kureshy *et al*., 2000). Bone meal is considered as one of the inexpensively source from animal protein source. It has comparatively high protein rate, and as compared to other alternative plant protein sources enhance growth of fish species (Ai

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et al., 2006).

The main object of my study was to check whole body composition of *L. rohita* bythe replacement of fish meal with bone meal.

MATERIALS AND METHODS

The present study was conducted in the Saline Fisheries Laboratory, Department of Zoology, Wildlife and Fisheries, University of Agriculture Faisalabad. Thirty to forty live fish Rohu (*Labeo rohita)* with average weight 12 ± 1.5 g and length 11 ± 1.5 cm was procured from Fisheries Research Farm and acclimatized for 24 hours in laboratory condition in the glass aquaria. Three glass aquaria of capacity 300-400 litter of water was used having n=10 fish in each. The experiment would carried out in triplicates under each treatment group and exchange of water was ensured to maintain the water quality. The test and control diets was prepared using locally available ingredients like sunflower oil, wheat flour, vitamin and mineral premix which was mixed at definite proportions to form a basal feed that contained around 40% crude protein (Table I). The required quantities of ingredients were weighed accurately, ground, mixed and hand kneaded to required consistency with just sufficient quantity of oil. All the diets were packed separately in high density polythene bags and labelled. Fish was fed at the rate of 6% of their body weight till the end of the experiment. The feed was given to fish twice daily in the morning and evening.

Table I. Diet formulation for experimental treatments.

Ingredient	T1 (g)	T2 (g)	T3 (g)
Fishmeal	62.00	43.40	24.80
Bone meal	0.00	18.60	37.20
Wheat flour	30.00	30.00	30.00
Oil	3.00	3.00	3.00
Vitamin	5.00	5.00	5.00
Total	100	100	100

After each sampling and assessment for growth, the given quantity of feed given were re-adjusted. The fishes were sampled every week to assess the progressive growth performance. A minimum of 50% of the stocked fish were collected during each sampling and was measured individually for length and weights. After a rearing period of 8 weeks, all the survived fish were collected and their weight, lengths was measured and % survival was recorded. Water samples were collected from different depths of aquaria, three water samples from each aquarium were taken and the average value of physico-chemical parameters were determined. Water temperature was recorded by using Microprocessor Dissolved Oxygen meter (HANNA-HI, 9146) fixing the temperature factor at "℃". For pH determination, Microprocessor pH meter (HANNA-HI, 9023) was used after setting its range at "pH" point.

Growth parameters

After the experiment, weight gain (% of final weight - % and initial weight of fish), feed conversion ratio (gram dry food fed/wet weight gain), specific growth rate ln {Final weight(g) – Initial weight(g)}/experimental periods in days × 100 were calculated.

Proximate analysis

The samples of fish body along the muscles were homogenized using pestle and mortar and analyzed by standard methods (AOAC, 1995). Moisture was determined by oven-drying at105^{0}C for 24 hours, crude protein by micro Kjeldahl apparatus and crude fat by petroleum ether extraction method through soxtec HT2 1045 system.

Statistical analysis

Finally, the data was analyzed using one way Analysis of Variance (ANOVA). The difference among means was compared by Tukey's Honesty Significant Difference Test (Snedecor and Conhran, 1991).

RESULTS AND DISCUSSION

Growth performance

Live fish of Rohu (*Labeo rohita*) (120) with average length of 11 ± 1.5 cm and average weight of 12 ± 1.5 g were acquired from the Fisheries Research Farm. The fish was kept in cement tanks for two days at Fisheries Research Farms University of Agriculture, Faisalabad. So, that they can accommodate the intensive controlled condition. Length of every fish used in experiment was examined with care by using measuring tape that was mounted on wooden table. Initial data of both length and weight was registered. The difference in growth both weight and length was described in the form of tubular form of each week and other parameters were examined like SGR, FCR, survival rate %, body fats and proteins (Table II).

Table II. Growth performance of fish fed with bone meal.

Parameters	Control	30%	60%
Average weight	34.48±0.74a	24.06±0.54c	26.00±0.84b
Average length gain	14.14±0.26a	13.30±0.30b	13.09±0.18b
Specific growth rate	0.61±0.03c	0.68±0.34b	0.81±0.22a
Feed conversion ratio	4.43±0.34a	1.51±0.09c	2.23±0.39b

Means sharing similar letter in a row are statistically non-significant ($p>0.05$).

Table III. proximate analyses of fish fed with bone meal.

Group	Crude protein	Total fat	Moisture	Ash	Carbohydrates
Control	34.01±0.11a	2.10±0.05a	60.01±0.58a	1.68±0.04b	2.20±0.07a
30%	33.26±0.23b	2.01±0.01a	61.03±0.57a	1.78±0.02ab	2.16±0.01a
60%	32.91±0.23b	1.68±0.11b	61.43±0.01a	1.89±0.05ab	2.09±0.02a

Means sharing similar letter in a in a column are statistically non-significant (p>0.05).

Result showed that total weight gain of *L. rohita* was 10.4g in T1, 7.3g in T2 and 10.2g in T3 respectively. Total length gain of *L. rohita* was measured in meters as 3.6m, 4.1m and 2.22 in was observed in T1, T2, T3 correspondingly. Maximum values of specific growth rate SGR (%) were recorded in T2 and T3 as0.68±0.34 and 0.81±0.22%, respectively. At high bone meal concentration FCR increased, highly significant results ($p<0.05$) were seen in T3 (60%) as compared to other treatments, mean values of FCR (Feed conversion ratio) for T1, T2 and T3 were calculated as 4.43±0.34, 1.51±0.09 and2.23±0.39.

Proximate analysis

Results observed that crude protein level in T2 and T3 treatment showed no significant differences calculated as 33.26±0.230 and 32.91±0.231%. Total fat (%) content decreased as bone meal increased while T2 showed highest values as 2.01±0.015%. Moisture (%) content and carbohydrates (%) had no significant difference between treatments while T3 showed highest value for moisture content as 61.43±0.015%. Ash (%) content was significantly higher ($p<0.05$) in T3 calculated as 1.89±0.050%. Results showed that replacement of 30%and 60% fish meal with bone meal has better effect on growth of *L. rohita* whereas whole body composition revealed lower values of total fat and no significant differences in carbohydrates and moisture content. Bone meal could replace fish meal as an acceptable protein source to promote growth of *L. rohita* without any negative effects on growth and body composition (Table III).

DISCUSSION

Growth performance

In present research work growth performance of *L. rohita* were observed by partially replaced bone meal with fish meal in diet. Similar findings also observed by (Gomaa and El Moghazy, 2014) reported that bone meal could safely replace up to 50% of fish meal in Nile tilapia diets without any adverse effect. So, 25% fish meal replacement is economical. According to Davies *et al.* (1989) an optimum ratio of MBM121 could effectively replace fish meal in practical diet for tilapia At high bone meal concentration FCR ratio increased, 60% showed higher significant results ($p<0.05$) as compared to other treatments, mean values of FCR for TI, T2 and T3 were calculated as4.43±0.34, 1.51±0.09 and 2.23±0.39 as reported by Wang *et al.* (2006) that cuneate drum fed the feed in which the bone meal was incorporated at 17.5% (to replace 50% of the fish meal)in feed formulation, however, exhibited significantly lower SGR. Comparatively, lower SGR (2.1–2.5) and higher FCR (1.7–2.2) for sutchi catfish were reported by Rahman *et al.* (2006) and Islam *et al.* (2008) in net cages and earthen ponds. Bharadwaj *et al.* (2002) also FCR of fish fed 30% BM was significantly higher than in fish fed 20% BM, but other values were not significantly different. Traylor *et al.* (2005) found that growth rate and feed efficiency improved linearly by adding P from MBM.

Proximate analysis

Body composition analysis of *Labeo rohita* revealed that by substituting bone meal up to 30%showed deposition of protein and fats up to certain level as bone meal substitution increased its value declines. Whole-body crude protein % decreased with the increase of dietary BM relates to Habib *et al.* (2001) that product rendered such as meat and bone meal which generally contain 43 to 58% crude protein and good sources of indispensable amino acids. When MBM protein replaced 600 g per kg or more of the FM protein, the whole-body protein was significantly lower compared to fish fed the control diet. Wang *et al.* (2006) reported that decrease in whole-body protein was decreased with higher inclusion of MBM-based diets. Inclusion of MBM alone or in combination with other proteinsources may spare 30–50% of the dietary fish meal requirement (Bureau *et al.*, 2000; Webster *et al.*, 2000; Millamena, 2002; Wang *et al.*, 2006; Guo *et al.*, 2007). Bharadwaj *et al.* (2002) reported that apparent crude protein digestibility and amino acid availability values were lower in fish fed 35 and 45% MBM than in fish fed other concentrations, but similar in146 fish fed 40% and concentrations below 35%. The ash content increased with high concentration of BM. It was observed that 60% bone meal showed highly significant results by (Yamamoto *et al.*, 2002). The replacement of bone meal

with fish meal up to 50% creates depression because the high ash contents may produce a faster gut transit rate, thus providing an increased feed intake with poor reflection on growth and thus, poor feed efficiency. Yu *et al*. (2015) reported that whole-body lipid decreased with the increase of dietary BM. Although the experimental diets used were formulated to be Iso-energetic and the lipid contents were more or less the same as each other, the fatty acid decreased with the increase of dietary BM, which might have had a negative effect on growth performance and lipid utilization. Carbohydrates contents had no significant differences between treatments.

In conclusion, replacement of fish meal by bone meal was proved economical as it showed satisfactory proximate body composition and growth results. So, bone meal being cheaper than fish meal could be used to replace fish meal.

Statement of conflict of interest

The authors declare there is no conflict of interest.

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