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Protein Digestibility of Different Animal and Plant Protein Sources for *Labeo rohita* Fingerlings

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Abstract: A laboratory trial was conducted on the protein digestibility of rohu (*Labeo rohita*) fingerlings in a static indoor fish rearing water system of glass made aquaria (90 cm x 30 cm x 30 cm) for a period of 75 days. Each treatment had two replicates containing 12 fingerlings. Five experimental diets A, B, C, D and E were prepared from different combination of five major sources of protein *viz.*, fish meal, protein concentrate, meat & bone meal, mix of animal protein sources and mix of plant protein sources each containing 33% dietary protein level. The apparent protein digestibility (APD) values of the above mentioned diets were 81.70, 78.66, 75.53, 72.53 and 69.96%.

Keywords: *L. rohita*, protein, fish meal, digestibility

Introduction

Protein based diet is one of the most important prerequisite for the growth performance of fish but in feed formulation and manufacture, it is essential to have a knowledge of nutrient digestibility of various feed staffs used in formulating fish feed so that effective substitution of one ingredient for another may be achieved. Actually digestibility of protein of each of the ingredient is necessary. Along with chemical analysis, digestibility determination will allow a more thorough evaluation of the performance of a particular protein source in a complete diet for fish. It appears that the ingredients in question could be treated as a diet and usual digestibility determination method could be used to determine its digestibility. This is not always possible for instance, the ingredient by itself might not behave in the same way as it would as a component of a compound diet. The main objective of the present study was to determine the protein digestibility of fishmeal, protein concentrate, meat & bone meal, mix of fish meal-protein concentrate-meat & bone meal, and mixed plant based protein for *Labeo rohita*.

Materials and methods

The experiment was conducted in a static indoor water system consisted of 10 glass aquaria of size 90 cm x 30 cm x 30 cm having a capacity of 81 L. All the aquaria were kept on 1 m high cemented platform to facilitate better observation and management. An adequate level of dissolved oxygen in each aquarium was maintained through artificial aeration by using equarium air-pump (Davio pump NS6200).

Induced breed fingerlings of Indian major carp, rohu (*Labeo rohita*) were collected from a local fish farm named 'Sree Anil Matshya Khamar' Kewatkhali, Mymensingh. They were than transferred in a round plastic pool of 250 L capacity as stocking tank. The fish in the stocking tank were given a prophylactic treatment with 0.5% Nacl dip for 20 minutes and methylene blue bath of 0.5 ppm for 3 days. Before starting the experiment, fish fry were acclimated to the experimental system for 15 days. During acclimatization the fish were fed on formulated pelleted diet containing 33% crude protein at a rate of 1% body wt. as maintenance ration. There were five treatments each with two replicates.

Uniform size of 12 fingerlings of rohu (1.00 ± 0.1 g size) were randomly distributed per aquarium with a mean initial weight of 12.00 ± 0.2g. Siphoning method was followed to remove any uneaten food or faeces everyday in the morning.

The experimental diets, fish meal was collected from poultry service centre, Purohitpara, Mymensingh. Protein concentrate of commercial grade was collected from mymensingh local market. Meat & bone was obtained from local supplier of mymensingh market. Mustard oil cake was procured from mymensingh market. Sesame cake, soybean meal, rice bran and wheat flower were purchased from the local market of Mymensingh town. ∝ cellulose, carboxymethyl cellulose and chromic oxide were obtained from local agent, Dhaka Bangladesh. Mineral and vitamin premixes were collected from Rhone Poulenc, Bangladesh.

Prior to formulation of diets all the ingredients were subjected to proximate analysis and the results are presented in Table 1. Five iso-nitrogenous diets were formulated to contain 33% crude protein. Diets A contained fish meal as the sole source of protein, whereas diet B,C, D and E contained protein concentrate, meat & bone meal, mix of fish meal - protein concentrate - meat & bone meal and mixed plant based protein respectively. All the diets were formulated (Table 2) in such a way to contain about 33% protein 10-12% lipid and 30-35% carbohydrate. Diets were formulated to be as iso-caloric as possible and the gross energy content (K cal/g) was estimated alternate smith (1971), Pike and Brown (1967), formulated diets contained 0.5% chromic oxide to study protein digestibility, Diets were subjected to analysis for proximate composition and results are furnished in Table 3.

Table 1: Proximate composition of dietary ingredients (% Moisture free basis)

Ingredients	Dry matter	Crude Protein	Crude Lipid	Ash	NFE*
Fish meal	92.13	66.13	10.12	14.93	8.82
Meat & bone meal	92.91	62.85	9.23	23.05	4.87
Protein concentrate	95.24	54.59	10.85	27.97	6.59
Mustard Oil cake	88.13	32.89	12.62	13.05	41.44
Soybean meal	88.97	42.80	2.32	13.17	41.71
Sesame cake	88.48	26.25	10.89	15.04	47.82
Rice bran	96.31	17.40	14.30	9.18	59.12
Wheat flour	89.97	12.59	8.89	9.14	69.38

* Nitrogen free extract calculated as 100-% (Moisture + Crude protein + crude lipid + Ash).

The fishes were fed with the formulated diets up to satiation level twice daily at 6 hour interval between 09.00 and 15.00 hours. Faeces were collected during last two weeks of the experimental period for studying the protein digestibility of feeds. Any uneaten food or faeces from each aquarium was removed carefully by siphoning about 30 minutes after last feeding. Faeces were

Table 2: Formulation of different experimental diets (33% crude protein level dry weight basis).

Ingredients (g) dry diet	Diet				
	A	B	C	D	E
Fish meal	43.00	-	-	13.60	-
Protein concentrate	-	52.00	-	17.20	-
Meat & bone meal	-	-	45.20	15.90	-
Mustard Oil cake	-	-	-	-	13.00
Soybean meal	-	-	-	-	49.50
Sesame cake	-	-	-	-	10.50
Rice bran	-	-	-	-	15.00
Wheat flour	30.00	30.00	30.00	30.00	10.00
Carboxy methyl cellulose	2.00	2.00	2.00	2.00	-
Tasting salt (Monosodium glutamate)	0.50	0.50	0.50	0.05	0.50
Vit. premix	1.00	1.00	1.00	1.00	1.00
Chromic oxide	0.50	0.50	0.50	0.50	0.50
∝- cellulose	19.00	10.40	16.8	16.45	-
soybean oil	4.00	3.60	4.00	3.30	-
	100	100	100	100	100

Table 3: Proximate composition of different diets (% dry matter basis)

Parameters	Diet				
	A	B	C	D	E
Dry matter	92.92	93.30	92.55	93.13	92.28
Crude protein	33.34	33.38	33.32	33.13	33.36
Crude Lipid	11.53	10.57	10.96	11.23	12.60
Ash	9.65	15.83	15.89	12.60	13.53
NFE*	45.48	40.22	39.83	43.04	40.51
Gross energy** (Kcal/g)	4.35	4.06	4.07	4.22	4.25

* Nitrogen free extract-calculated as 100-% (Moisture + Crude protein +Lipid + Ash)

** Gross energy calculated as Protein = 4.50 kcal/g (smith,1971), Carbohydrate = 4.00 kcal/g (Pike and Brown, 1967) and Lipid = 9.00 kcal/g (Pike and Brown,1967)

Table 4: Protein and chromic oxide percentage of feed and faeces

	Diet				
	A	B	C	D	E
% protein in feed	33.34	33.38	33.32	33.80	33.36
% protein in faces	6.10	7.10	9.80	9.10	8.00
% Cr_2O_3 in feed	0.4583	0.5086	0.48	0.4785	0.4785
% Cr_2O_3 in faces	0.4583	0.507	0.47	0.4690	0.3990

collected separately from each replicate once in the morning. Collected faeces were then pooled from each replicate and dried in oven at 60°C and then kept in air-tight contains for subsequent chemical analysis.

The water quality parameters such as temperature, pH and dissolved oxygen were monitored weekly and the ranges were temperature 27-29°C; pH 6.8-7.3 and dissolved oxygen 5-6.5 mg/l.

The proximate composition of the dietary ingredients, diets, faeces and the fish samples were analyzed in triplicate according to standard procedures given in Association of Official Analytical Chemist (AOAC, 1980).Chromic oxide in the diets and faeces was determined by using wet-digestion techniques of Furukawa and Tuskahara (1966) Apparent protein digestibility (APD) of experimental diets were then calculated using the formula of Maynard and Loosli (1969).

$$APD\% = 100 - \left(100 \times \frac{\%Cr_2O_3 \text{ in feed}}{\% Cr_2O_3 \text{ in faeces}} \times \frac{\% \text{ nutrient in faeces}}{\% \text{ nutrient in feed}}\right)$$

Amount of chromic oxide in feed and faeces of fish fed the test diet was estimated by the following equation:

Weight of the sample = A (mg)

Optical density = Y

$$\text{weight of } Cr_2O_3 \text{ in sample (mg)} \quad \frac{Y - 0.0032}{0.2089} = X$$

$$\% \text{ Chromic oxide in sample} = \frac{100}{Y} \times 100$$

Results and Discussion

The Proximate composition of the various experimental diets is presented in Table 3. After analysis, it was found protein, lipid, ash and the nitrogen free extract in different diets ranged between 33.13 to 33.38%, 10.57 to 12.60%, 9.65 to 15.89% and 39.83 and 45.48% respectively. The gross energy contents as was expressed as K cal/g were more or less similar in all five diets and ranged between 4.06 (diets B) and 4.35 (diets A). The protein & chromic oxide content in both feed and faeces are furnished in Table 4.

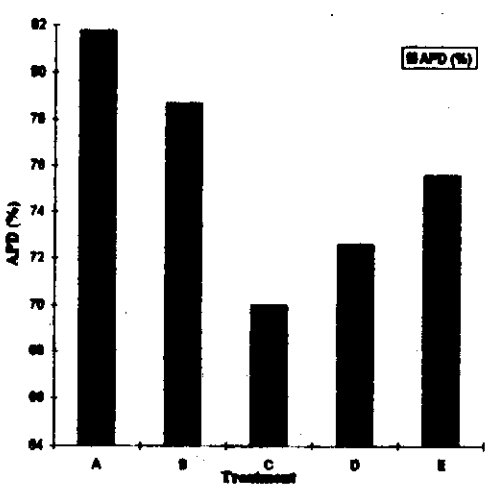

Fig. 1: Apparent protein degestibility (APD) of different diet fo *Labeo rohita*

The apparent protein digestibility (APD%) values for differe experimental diets ranged between 69.96 to 81.70% (Fig.1). Th apparent protein digestibility (APD%) was highest (81.70%) i Treatment A and followed by B (78.66%), E (75.53%), D (72.5 and C (69.96).

The ranges of water quality parameters monitored during the stu period were well within the limit for fish life and could not ha hampered the growth of fish. (Jhingran, 1983). The result of t present study indicated that the dietary protein in each treatme were well digested.

The apparent protein digestibility value (APD) were fairly hi which ranged between 69.96 to 81.70%. The fish meal based d

'A' in the present study produced the highest APD value (81.70). This APD value is slightly lower then the APD value of fish meal (90.81%) reported by law (1986) for jelawat (*L. lovenii*) but higher than the value reported by khan (1994) for cat *fish (M. nenurus)*. According to NRC (1977) carp can digest up to 90% of fish meal protein. However, this value may be decreased depending on the orginal and processing of fishmeal involved (Ogino and Chen,1973). Nandeesha *et al.* (1991) reported higher APD value of 90.40% for fish meal in *Catla catla* using fish meal as 30% of the reference diet on the other land, Hasan *et al.* (1990) reported a some what lower APD value 79% for fish meal in *Labeo rohita*. Hossain *et al.* (1997) determined 88.05% APD value for (*Puntius gonionotus Bleeker*) . It was seen that the mixed diet containing animal protein source (Diet,D) did not show much increased APD value than the mixed plant protein source (Diet,E). The reason behind it could not be understood properly. May be the combination of plant protein increased the APD values.

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