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Apparent Digestibility of Selected Plant Based Ingredients and Their Impacts on Body Composition of Mori, *Cirrhinus mrigala* (Hamilton, 1882)

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Abstract: Feeding trial was conducted to assess the apparent digestibility of some selected plants based ingredients (Guar meal, rice polish and sunflower meal) and their impacts on body composition of Mori, *Cirrhinus mrigala* fingerlings. The fish were fed twice a day at 4% body weight. Feed percentage was adjusted after every week, according to an increase in body weight of fingerlings. The diets used for fish feed were analysed for dry matter (DM), crude protein (CP), crude fibre (CF), ash, fat and Phosphorus (P). Apparent nutrient digestibility was evaluated by proximate analysis of fish faecal matters and percent digestibility of nutrients while body composition was evaluated through fish proximate analysis. The results showed that plant based feed, more economical, can be used as an alternate to fish meal.

Key words: Guar Meal · Rice Polish · Sunflower Meal · Digestibility · Mori · Body Composition

INTRODUCTION

Nutrition is one of the key requirements for survival and growth of an individual. The world has greatly relied for fish as a basic nutrient provider, especially protein on account of its cost [1]. Swift increase in world's population is elevating humans' need of food for survival and growth. Food scarcity specifically in the form of protein is a serious problem of the day. Human beings are in search of finding remedial steps to this major problem.

Fish is a major and a good source of protein. It is also having essential amino acids and minerals such as zinc, magnesium, sodium, potassium and iron, etc. [2]. To cope with the shortage of food, particularly protein, intensive and semi-intensive fish culture systems have been employed for producing low cost fish [3]. In this type of farming, fish has to utilize all provided resources in the form of supplemented feed. In return, it causes greater output in the form of growth and high quality fish [4]. Thus, this technique makes more ideal use of supplementary feed. This enables the fish to attain maximum growth and to be of marketable size in less time. The intensive culture is wholly feed dependent and is expected to maximize fish production in coming years [5]. In Asia aquaculture practices are dominated by semi-intensive culture, both earthen and freshwater culture systems [6]. In these types of systems, natural fish productivity is improved by using different types of fertilizers and supplemental feeds [7].

Using a supplementary feed predicts success of fish culture all around the world. Supplementary feed is the most desirable measure for increasing fish production [8-10]. Its importance varies according to the required intensity of cultivations and food preferences of different fish species [11]. As the whole nutritional requirements of fish are dependent upon feed, so its crucial role in fish farming cannot be ignored. It is known to elevate the carrying capacity of culture system and boost fish yield by many folds [12]. Secondly, it is also handy for increasing fish production in a shorter time span. Various attempts have been made to follow the overall nutrient requirements, including protein, carbohydrates, lipids, minerals and vitamins for different fish species. The key supplements need for feed formulation should have enough nutrients specially abundance of protein in them for a significant and better growth [13].

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Fish meal contains the highest amount of protein served in diets. It ranges from 32-44%, but it is uneconomical from a commercial point of view on account of its cost. The agro-based feedstuffs are rich in macro nutrients. These are locally available on a commercial basis and these can be used for fish diet ingredients on account of cost effectiveness [14]. For formulating a fish's diet, knowledge regarding digestibility of feed ingredients is a basic requirement and it is considered as an important parameter in evaluating the nutrient efficiency of foodstuffs [15]. The information related to nutrient digestibility of foodstuffs limits for warm water fish species specifically in carps [16]. There have been few studies on nutrient digestibility of *Cirrhinus mrigala* as well, but these are not complete.

Cirrhinus mrigala (Hamilton, 1882) is a kind of fish commonly known as mori, is commercially raised in semi-intensive poly culture system, but its growth is slow due to non- availability of a balanced diet. It is a bottom feeder herbivorous fish so mostly fed upon natural vegetation, while in the absence of natural feed artificial feed is used as a supplement. Presently, mixture of few conventional feedstuffs is fed as supplementary feed. There is increasing emphasis on the development of a balanced diet for achieving maximum growth of fish. It is imperative to develop a nutritionally balanced diet using locally available agro-based by-products.

In the presence of incomplete information on digestibility of various foodstuffs for Mori, it was needed to determine the nutrient digestibility and protein availability of locally available plant based feedstuff. Therefore, the present study was conducted to provide information on digestibility of feedstuffs, their availability required for the formulation of diet for mori. Protein requirement can be supplemented by replacing or minimizing fish meal with plant base feed, as fish meal is expensive and hence un-economical from a commercial point of view. We carried out trials by using different types of available feeds in different quantity and ratios. Our study aimed to assess the digestibility of these feeds and their impact on body composition of mori.

MATERIALS AND METHODS

The study was conducted at the Research and Training Facilities, Department of Fisheries and Aquaculture, University of Veterinary and Animal Sciences, Lahore, Ravi Campus, Pattoki- Pakistan.

Test Species: Mori, *Cirrhinus mrigala*-a bottom feeder fish species were experimental fish for this study.

Experimental Design: The trial was conducted in 4 raceways rectangular tanks having a dimension of 320cm x 100cm. The tanks were divided into halved for replica of each treatment.

Tanks Preparation: The system was operated under water flow system. All the tanks were thoroughly washed with tap water and a nylon mesh barrier was placed between 3 treatment tanks and the 4th treatment control was without a barrier. A PVC pipe was placed in the hole at the end to prevent water loss. The water was filled with water up to 0.8 m and it was maintained during the whole study.

Stocking Density: Fish were collected from the local fish hatchery and farm and were randomly stocked at the rate of 22 fingerlings/halved of a tank and 22 in control tank. All the fish were weighed and measured individually before initiation of each feeding trial. Later on, each species was taken every week from all the tanks, weighed and measured and then released into the respective tank.

Procurement of Ingredients, Feed Formulation and Preparation: The feed was purchased from local markets. Feed formulation and percentage composition of ingredients used is given in Table 1. All the ingredients were taken according to their concentration, mixed with sunflower oil and passed through extruder machine for pellet formation. After that pellets were set under the sun for drying.

Nutritional Composition Determination: The diets used for fish feed were analysed for dry matter (DM), crude protein (CP), crude fibre (CF), Ash, fat and P. All these tests were performed in NIR Analyzer. Standard protocol was followed for carrying out the analysis, as followed by Ullah *et al.* [17]. Their values are given in Table 2.

Feeding Protocol: The fish were fed twice a day at 4% body weight at 9:00 am and 2:00 pm. Feed percentage was adjusted after every week, according to increase in body weight of fingerlings. Pelleted feed were crumbled to size adjusted to fingerling size for smooth feeding.

Table 1: Percentage of different diets on dry matter basis

Feed ingredient	T1 (Reference)	T2 (Rice Polish)	T3 (Sunflower)	T4 (Guar)
Fish Meal	20	14	14	14
Maize Gluten (60%)	30	20	20	20
Wheat Bran	44	30	30	30
Rice Polish	0	30	0	0
Sunflower Meal	0	0	30	0
Guar Meal	0	0	0	30
Vitamin Premix	1	1	1	1
Chromic Oxide	1	1	1	1
Sunflower Oil	4	4	4	4
Total	100%	100%	100%	100%

Table 2: Proximate Analysis of Feed Ingredients %

Ingredients	CP	Fat	Moisture	Fiber	Ash	P
Sunflower meal	32.06	6.33	8.42	19.04	8.41	0.61
Rice polish	6.06	3.01	4.53	24.10	5.98	0.23
Fish meal	56.72	7.99	5.90	1.5	24.56	0.55
Wheat bran	13.21	11.34	8.09	7.89	11.73	0.67
Maize gluten	25.77	0.41	11.72	9.13	9.34	0.45
Guar meal	33.11	2.42	5.51	8.11	10.61	0.57

Table 3: Proximate analysis of fish fecal matter

S. No.	Fat	Moisture	Protein	Fiber	P	Ash
T_1	15.5	2.01	22.73	3.47	14.5	0.43
T_2	4.15	0.97	16.7	6.28	14.51	0.59
T_3	4.52	0.04	19.7	4.64	14.05	0.52
T_4	11.46	4.45	26.19	4.35	8.76	0.6

Table 4: Percentage digestibility of nutrients

Parameters	Guar meal diet	Rice polish	Sunflower	Control
CP %	57.1985	41.856	60.135	49.6755
Fat %	56.335	70.256	87.649	53.5545
Fiber %	78.1085	55.554	60.372	66.8525

Table 5: Proximate analysis of Mori, *Cirrhinus mrigala*

S. No.	Fat	Moisture	Protein	Fiber	P	Ash
T_1 (Ref)	27.93	13.88	51.57	15.89	0.26	12.23
T_2(Rice)	27.93	10.08	36.05	4.83	0.48	14.08
T_3(Sun)	27.93	13.28	48.83	12.35	0.84	12.28
T_4(Guar)	27.72	13.54	40.89	12.04	0.72	17.03

RESULTS

Apparent Nutrient Digestibility (%): The results for proximate analysis of fish faecal matters are given in Table 3. The maximum fat contents were found in the *C. mrigala* fed with the reference diet in T_1 while the minimum fat contents were found in the samples collected from the tank (T_2) which was fed with the diet in which fish meal was replaced with rice polish meal.

Nutrients' Percent Digestibility: The percent digestibility of nutrients in the four treatments is given in Table 4. Maximum protein digestibility was found in the *C. mrigala* fed with the sunflower meal in T_3 while the minimum protein digestibility was found in the samples collected from a tank (T_2) which was fed with rice polish meal.

Body Composition: Table 5 shows the body composition of the fish. The maximum fat contents were found in the *C. mrigala* fed with the reference diet in T_1 while the minimum fat contents were found in the samples collected from the tank (T_4) which was fed with the diet in which fish meal was replaced with guar meal.

DISCUSSION

The maximum moisture contents were found in the *C. mrigala* fed with the guar meal in T_4 while the minimum moisture contents were found in the samples collected from a tank (T_3) which was fed with the diet in which fish meal was replaced with sun flower meals. Maximum protein contents were found in the *C. mrigala* fed with the reference diet in T_4 while the minimum protein contents were found in the samples collected from a tank (T_2) which was fed with the diet in which fish meal was replaced with rice polish meal. Maximum fibre contents were found in the *C. mrigala* fed with the rice polish meal in T_2 while the minimum fibre contents were found in the samples collected from a tank (T_1) which was fed with the diet in which fish meal was replaced with reference diet.

Maximum phosphorus contents were found in the *C. mrigala* fed with the rice polish meal in T_2 while the minimum fibre contents were found in the samples collected from a tank (T_4) which was fed with the diet in which fish meal was replaced with guar meal. Maximum ash contents were found in the *C. mrigala* fed with guar meal in T_4 while the minimum fibre contents were found in the samples collected from a tank (T_1) which was fed with the diet in which fish meal was replaced with reference diet.

Our results are similar to the findings of Nekoubin *et al*. [19]. They investigated the effect of different types of plants (*Lemna* Sp., *Azolla filiculoides* and Alfalfa) and artificial diet (with two protein levels) on grass carp (*Ctenopharyngodon idella*).

The maximum fat digestibility was found in the *C. mrigala* fed with sunflower meal in T_3 while the minimum fat digestibility was found in the samples collected from the tank (T_4) which was fed with guar meal. Maximum fibre

digestibility was found in the *C. mrigala* fed with reference diet in T_1 while the minimum fibre digestibility was found in the samples collected from a tank (T_2) which was fed with rice polish meal.

Our results are similar to that of Shahzadi *et al*. [18]. Their study indicated that rohu efficiently utilize corn and wheat meals (plant ingredients) as compare to feather meal (animal ingredient).

The maximum moisture contents were found in the *C. mrigala* fed with the reference diet in T_1 while the minimum moisture contents were found in the samples collected from a tank (T_2) which was fed with the diet in which fish meal was replaced with rice polish meal. Maximum protein contents were found in the *C. mrigala* fed with the reference diet in T_1 while the minimum protein contents were found in the samples collected from a tank (T_2) which was fed with the diet in which fish meal was replaced with rice polish meal.

Maximum fibre contents were found in the *C. mrigala* fed with the reference diet in T_1 while the minimum fibre contents were found in the samples collected from a tank (T_2) which was fed with the diet in which fish meal was replaced with rice polish meal. Maximum phosphorus contents were found in the *C. mrigala* fed with the sunflower diet in T_3 while the minimum fibre contents were found in the samples collected from a tank (T_1) which was fed with the diet in which fish meal was replaced with reference diet. Maximum ash contents were found in the *C. mrigala* fed with guar meal in T_4 while the minimum fibre contents were found in the samples collected from a tank (T_1) which was fed with the diet in which fish meal was replaced with reference diet.

The chemical analysis of the faecal matter collected from experimental tanks showed that maximum fat contents were found from the faecal material collected from T_1 where the reference diet was served. The minimum fat contents were found in the samples collected from T_2, which was fed with the diet in which fish meal was replaced with rice polish meal. In case of moisture contents maximum moisture was found in the samples collected from T_4 which was fed with the guar meal. Minimum moisture contents were found in the samples collected from T_3, which was fed with the diet in which fish meal was replaced with sun flower meal.

In terms of protein contents, maximum protein contents were found in the samples collected from T_4 where the reference diet was served while minimum protein contents were found in the samples collected from T_2, which was fed with the diet in which fish meal was replaced with rice polish meal. The fibre contents were maximum in samples collected from T_2 while minimum fibre contents were found in the samples collected from T_1 which was fed with the diet in which fish meal was replaced with reference diet.

The phosphorus was higher in faecal matter from T_2 where the rice polish meal was served while minimum phosphorus contents were found in the samples collected from T_4, fed with the diet in which fish meal was replaced with guar meal. Ash was maximum in T_4 while minimum ash was found in the samples collected from T_1 fed with the diet in which fish meal was replaced with reference diet.

CONCLUSION

Fish showed better growth fed with guar meal (T_4), followed by sunflower (T_3) and rice polish (T_1). Our study concludes that mori performed well by replacing fish meal with guar meal. Plant based feeds are an economical and important source of protein, thus the results obtained from the trial conclude that plant based feed can be used as an alternative to fish meal.

Disclosure: None of the authors has any conflict of interest.

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