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PERFORMANCES OF CATLA (*Catla catla*) FINGERLING REARED ON LOCALLY AVAILABLE FEED INGREDIENTS

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ABSTRACT: *A comprehensive trial was undertaken to assess the effect of various types of feed ingredients on the biomass conversion rate in a 12- week feeding trials to evaluate the use of agro - based products, as locally available feed ingredient materials for fish catla (Catla catla) fingerling (av. wt. 1.52±0.11 to 1.55±0.07 g) growth performances. In experiment, three (26.14 to 26.56 % crude protein) practical diets were formulated. The experimental diets were fed to five replicate groups of fingerlings at 8% of body weight and results were compared. After 12-week study the final weight gain recorded as 12.45±0.03 g, 15.23±0.15 g and 18.12±0.17 g in F1 to F3 fishes respectively. The percentage weight gain recorded as 719.1%, 895.4% and 1069.0% respectively from initial weight. The results suggest that the growth is better in feed F3 containing higher soybean meal, Potato starch and lower content of Mustard oil cake. The feed conversion ratio (FCR) ranged between 2.34±0.11 to 2.98±0.09. The survival was recorded in F1 to F3 as 60±4.1%, 70±2.3% and 80±3.3% respectively. Lipid and protein contents in carcass composition differ significantly (P<0.05) among the three feeding trials. The study suggests that the soybean diet which is more effective, than the mustard oil cake, in the deposition of nutrients in terms of flesh (at early growing stage of life), and led to be significantly higher (P<0.05) growth than the other two diets in, Catla catla.*

Key words: *Feed ingredients, Fingerling, Growth performances, Catla catla*

ORIGINAL ARTICLE

INTRODUCTION

The Indian major carp, *Catla catla,* is a promising species for aquaculture exploitation with its rapid growth and good market potential. In terms of value-added, processed fish products, this species should have potential as the present market price of this fish is ranging between Rs. 80 to 140 per kilogram in Indian markets. One key biological component is the availability of suitable diets that are efficiently digested and supplement the required nutrients for optimizing growth performances (Mokolensang et al., 2003).The suitability of using formulated feed sources will provide cost effective management practices for efficient fish growth with cheaper feed ingredient under culture system in this herbivore fish, Indian major carp (*Catla catla*) for aquaculture candidate species. Indian major carp, *Catla catla*, is a valuable herbivorous food fish in India. Polyculture of Indian major carps (IMC) viz: Rohu (*Labeo rohita*), Catla (*Catla catla*) and Mrigala (*Cirrhinus mrigala*) is mainly dependent on plant-based agro-by-products. All three species of IMC (Rohu, Catla and Mrigala) are known to be capable of utilizing dietary protein and carbohydrates well, with even cellulolytic activity in Rohu (*L.abeo rohita*) as described by Saha and Ray (1998) and Das and Tripathi (1991). Sabapathy and Teo (1993) have reported amylolytic activity in major carp. Rohu are able to utilize complex polysaccharides more efficiently than simple sugars (Erfanullah and Jafri, 1995, 1998). Protein sparing effect of carbohydrate in fry and fingerlings of rohu, mrigal and common carp was demonstrated by Rao (1987). There was no weight gain difference recorded on fry fed diets with 40:30 and 45:25 w/w protein: carbohydrate levels and protein sparing effects have been recorded (Sen et al., 1978). Supplementary feeding is known to increase the carrying capacity of culture systems and can enhance fish production by many folds (Devaraj et al., 1976). It also offers the best means of fish production within the shortest possible time in the ponds.

Attempts have been made to understand the gross level of nutrient requirements for proteins, lipids, carbohydrates, vitamins and minerals for Indian major carps (De-Silva and Gunasekera, 1991; Balogu et al., 1993; Saeed et al., 2005).The role of artificial feed in fish farming cannot be avoided as nutritional requirements of fish depend upon the feed supplied. The quantity and quality of feed consumed have a impactful effect on growth, feed conversion and proximate composition of fish (Hassan et al., 1996; Jena et al., 1998; Erfanullah and Jafri, 1998). The FCR values of various fish feeding ingredients for carps under controlled conditions have been studied by many researchers (Jhingran, 1991; Shabbir et al., 2003; Jabeen et al., 2004; Ali and Salim, 2004; Saeed et al., 2005; Inayat and Salim, 2005; Gull et al., 2005).Thus this study was planned to observe the growth of catla on feeding with specified agro-based by-product sources and this study will be much useful to determine the role of supplementary nutrition for weight gain and survival rate of the *Catla catla* fingerling.

MATERIALS AND METHODS

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The hatchery-bred spawn of catla, after acclimatization, were fed with laboratory made egg-custard feed (Table 1). The healthy fish were separated to conduct feeding experiment.

Nutritional Studies on fingerling: Feed preparation and feeding

During the acclimation the fish were fed *ad libitum* with the moist feed containing Mustard oil cake, Wheat flour, Soybean meal and vitamin and mineral mix mixed in a ratio of 30:20:48:2 w/w (Table 2) for further weaning and rearing on artificial feed. After seven days various economical feeds with gross protein as 26.14 – 26.56% (Table 3) were formulated and growth study was carried out for 12 week rearing period for the fingerling of C. *catla* with different feeds and the growth performances was recorded (Table 4).

Table 1 - Feed compositions used during rearing of *C. catla* spawn

Ingredients	Percentage
Hen egg white	28.0
Lactogen powder	60.0
Fishmeal powder	10.0
Vitamin & Mineral Mix*	2.0

*From 'Agrimin Forte' contains Vit. A 700000 IU, Vit. D_3 70000 IU, Vit. E 250mg, Nicotinamide 1000mg, Co 150mg, Cu 1200mg, I 325mg, Fe 1500mg, Mg 6000mg, Mn 1500mg, K 100mg, Se 10mg, Na 5.9mg, S 0.72%, Zn 9600mg, Ca 25.5%, P 12.75% Manufacturer Brindavan Phosphates Pvt. Ltd, 48N, doddaballpur Ind. Area, Doddaballapur – 561 203, India Batch No. BFA-61.

Table 2 - Feed compositions used during acclimatization of *C. catla* fry

Ingredients	Percentage
Mustard oil cake	30.0
Wheat Flour	20.0
Soybean meal	48.0
Vitamin and Mineral Mix*	2.0

*From 'Agrimin Forte' contains Vit. A 700000 IU, Vit. D_3 70000 IU, Vit. E 250mg, Nicotinamide 1000mg, Co 150mg, Cu 1200mg, I 325mg, Fe 1500mg, Mg 6000mg, Mn 1500mg, K 100mg, Se 10mg, Na 5.9mg, S 0.72%, Zn 9600mg, Ca 25.5%, P 12.75% Manufacturer Brindavan Phosphates Pvt. Ltd, 48N, doddaballpur Ind. Area, Doddaballapur – 561 203, India Batch No. BFA-61.

Table 3 - Feed compositions used during rearing of *Catla catla* fingerling

Feed	Mustard Oil Cake (%)	Potato Starch (%)	Rice Polish (%)	Soybean meal (%)	Vitamin Mineral* (%)	Gross protein (%)
F 1	43	8	31	17	1	26.14
F 2	32	5	40	22	1	26.14
F 3	19	9	40	31	1	26.56

*From 'Agrimin Forte' contains Vit. A 700000 IU, Vit. D_3 70000 IU, Vit. E 250mg, Nicotinamide 1000mg, Co 150mg, Cu 1200mg, I 325mg, Fe 1500mg, Mg 6000mg, Mn 1500mg, K 100mg, Se 10mg, Na 5.9mg, S 0.72%, Zn 9600mg, Ca 25.5%, P 12.75% Manufacturer Brindavan Phosphates Pvt. Ltd, 48N, doddaballpur Ind. Area, Doddaballapur – 561 203, India Batch No. BFA-61.

Protein contents in ingredients and feed:

Protein** contents in feed and ingredients are given below -

Protein in mustard cake (MOC) was = 32.0 %
Potato Starch = 2.0 %
Rice Polish = 12.0 %
Soybean meal = 50.0 %

Footnote: Average protein contents in prepared feed ranged between 26.14 – 26.56% from F1 to F3.(Feed 1 Crude Protein, 26.14 %; Feed 2 Crude Protein, 26.14 %; Feed 3 Crude Protein, 26.56%.
** Protein estimated using N x 6.25

Physico–chemical parameters of water

The water quality of rearing tanks was analysed following the standard methods (APHA 1998) and was found in normal range with temperature 26+1 0C, pH 6.5-7.1, total alkalinity 129-136 ppm and dissolved oxygen 6.8-7.3 ppm.

Analytical methods and analysis of data

Growth Performance Activities: The fingerling of catla were kept in separate tanks/pools with five replicates per feed totalling fifteen pools and were fed *ad libitum* with different feeds in these fifteen pools (300 l capacity) arranged in Random Block Designing. The performance of the feeds, in terms of the weight gain (%), specific growth rate (SGR), feed conversion ratio (FCR), Protein efficiency ratio (PER). The growth in length and weight and the survival data were analysed using one-way ANOVA. Duncan's multiple range test was used to determine which treatment means differed significantly ($P<0.05$) using SPSS version 16.0.

The weight gain, specific growth rate, survival and biomass were calculated using the following formulae.

Weight Gain (%) = {(Final body weight) – (Initial body weight)/ (Initial body weight)} x 100

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Specific Growth Rate (SGR; % day $^{-1}$) = {(Final body weight) - (Initial body weight) / (experimental days)}x 100
Survival (%) = 100 x (No. of total fish - No. of dead fish)/Number of total fish
Biomass = Final average weight x Total no. of fish

The results were recorded in terms of specific growth (SGR), protein efficiency ratio (PER), per day increment (PI) and feed conversion ratio/efficiency (FCR) (Table 4 & 6). The survival was recorded at the end of the 4th, 8th and 12th week (Table 4 and 7).

Biochemical Analysis

Proximate compositions of feeds and fish carcasses were analyzed in triplicate. Dry matter was estimated after drying in oven at 105°C for 24 hours; crude protein (N x 6.25) by the Kjeldahl method) after acid digestion; crude lipid by di-ethyl ether extraction method using Soxhlet apparatus. Proximate analysis study was carried out for the reared fingerling of *C. catla*, fed with different feeds was analysed for body composition (Table –8). The body tissue, feed of the experiments were analysed for dry matter (DM), crude protein (CP), lipid and total ash according to AOAC (1990). The organic matter (OM) was calculated by subtracting the total ash from dry matter (DM).

RESULTS

The growth performances, survival and proximate composition of *C. catla* are depicted in Table -4, 5, 6, 7 and 8. The final weight gain, after 12th week, ranged between 12.45±0.03 to 18.12±0.17 g in F1 to F3 feeding trials. Growth parameters of *Catla* fingerling with different feed clearly showed significant enhancement with Mustard oil cake, potato starch, rice polish and soybean meal when compared with other concentrations of these four feed ingredients.

Catla fingerling showed maximum increase in length (45 mm), weight gain (16.57 g) were observed in F3 and similar trends were observed with F2 and F1 feeds.

The biochemical parameters of *Catla catla* fingerling fed with different types of food showed most favorable enhancement in the levels of proteins, lipids, FCR and SGR in F3, F2 and F1 feeds. *Catla* fingerling fed with F3 feed, the FCR, SGR, PI and survival were 2.34±0.11, 19.73, 215.7 mg and 80±3.3% respectively. Similarly the results of F1and F2 were also encouraging.

Table 4 - The growth performance of the fingerling of *Catla catla*

Feed	Initial weight (g)	Final weight (g) 4th week	Final weight (g) 8th week	Final weight (g) 12th week	Specific growth rate (SGR) after 12 weeks	Survival (%)	FCR
F-1	1.52±0.11^{a}	3.23±0.2^{a}	6.34±0.23^{a}	12.45±0.03^{a}	13.01^{a}	60 ±4.1^{a}	2.98±0.09^{b}
F-2	1.53±0.09 ^{a}	3.61±0.3^{c*}	7.76±0.21^{b}	15.23±0.15^{b}	16.31^{b}	70±2.3$^{b.}$	2.55±0.10^{a}
F-3	1.55±0.07^{a}	3.84±0.1^{b}	8.87±0.12^{b}	18.12±0.17^{c}	19.73^{c}	80±3.3^{c,**}	2.34±0.11^{a,**}

Same alphabet in superscript in a column represents no significant difference in weight gain. * = p< 0.01 ; **= p< 0.05. The results are of five replicates of feeding trial.

Table 5 – Initial and final weights and lengths, weight gain and percent weight gain of the *Catla catla* fingerling of different treatments during 12 week experimental period

Feed	In length (mm)	Fn length (mm)	In weight (g)	Fn weight (g)	length gain (mm)	% Length gain	Weight gain (g)	% Weight gain
F1	50±1^{a}	92±2^{a}	1.52± 0.11^{a}	12.45±0.03^{a}	42.0^{a}	84.0^{a}	10.93^{a}	719.1^{a}
F2	52±1^{a}	94±1^{a}	1.53± 0.09 ^{a}	15.23±0.15^{b}	42.0^{a}	80.8^{b}	13.7^{b}	895.4^{b}
F3	51±2^{a}	96±2^{a}	1.55± 0.07^{a}	18.12±0.17^{c}	45.0^{b}	88.2^{c}	16.57^{c}	1069.0^{c}

Means in a given column having the same letter superscript are not significantly different at (p <0.05) by ANOVA and Duncan multiple range test.

Table 6 – Average initial and final weight, protein efficiency ratio (PER) and per day increment (PI) of *C.catla* fingerling fed various experimental diets for 12 weeks.

Feed	In weight (g)	Fn weight (g)	PER	PI (mg)
F1	1.52± 0.11^{a}	12.45±0.03^{a}	1.23± 0.01^{a}	148.2^{a}
F2	1.53± 0.09 ^{a}	15.23±0.15^{b}	1.34± 0.02^{b}	181.3^{b}
F3	1.55± 0.07^{a}	18.12±0.17^{c}	1.4± 0.03^{b}	215.7^{c}

Means in a given column having the same letter superscript are not significantly different at (p <0.05) by ANOVA and Duncan multiple range test.

Table 7 – Survival percentage of *Catla catla* fingerling on every 4th week

Feed	Stocking Nos. (N=50 X 5 replicates)	4th Week (%)	8th Week (%)	12th Week (%)
F1	250	88± 1.2 ^{a}	72± 1.8^{a}	60 ± 4.1^{a}

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F2	250	91± 4.1 [b]	80± 3.2[b,*]	70 ± 2.3[b.]
F3	250	87± 3.4 [a]	84± 6.2[c,*]	80 ±3.3[c,**]

Same alphabet in superscript in a column represents no significant difference in survival. * = p< 0.01 ; **= p< 0.05. The results are of five replicates of feeding trial.

Table 8 – Whole body composition of *Catla catla* fingerling

Feed	Dry Matter (%)	Crude Protein (%)*	Lipid (%)*	Ash (%)*	Organic Matter (%)*
F1	20.6± 0.45[a]	48.4± 3.3[b]	5.5± 0.2[a]	12.1± 0.3[a]	87.1± 1.3[a]
F2	21.3± 0.27[a]	45.1± 1.2[a]	5.8± 0.4[b]	11.4± 0.4[a]	86.3± 1.5[a]
F3	21.1± 0.33[a]	46.2± 1.4[a]	5.6± 0.1[a]	11.3± 0.2[a]	88.4± 1.0[a]

Different alphabet in superscript in a column differ significantly(p< 0.05). The results are of five replicates of feeding trial. *= Dry matter basis

DISCUSSION

In the present study, the experimental feeds were formulations with different protein are based on previous reports (Kikuchi, 1999 and Cho et al., 2006). In the study, the experimental feeds F1, F2 and F3 with mustard oil cake, soybean and starch levels were formulated and the differences observed in the performance of the different feeds. Dietary proteins play a dominant role in fish growth (Cowey et al. 1972; Satia, 1974 and Cho et al., 1976). On the basis of average specific growth rate and % live weight gain, an improvement in growth response was noticed with increase in soyprotein (Das and Ray, 1991).

Results of this study substantiate the fact that various feed ingredients have direct growth promoting effects on Catla which is accordance with the report of Chaudhary and Qazi (2007). The overall growth pattern of fingerlings also remained highest for sunflower meal. The findings of Shabbir et al. (2003) are in agreement with the present study. They reported higher growth of Cirrhinus mrigala on sunflower meal, followed by maize gluten and wheat bran. Ali and Salim (2004) noted that *Labeo rohita* gained body weight on sunflower meal, which is less than the weight gained by Catla in the present study. The difference in weight gain may be due to variations in experimental fish and feed used. Ali and Salim (2004) used balanced feed, whereas in the present study four ingredients were used in the experiment. The present study showed that different protein types of even plant origin significantly affected the growth and feed utilization of Indian major Carp, Catla (*Catla catla*). As far as the value of FCR is concerned, the better (lower) feed conversion ratio was observed for sunflower meal, followed by cottonseed meal and bone meal. Ali and Salim (2004) noted higher FCR value for rice polish (5.27), followed by fish meal (3.026) and sunflower meal (3.021). The FCR values on rice polish meal were not comparable with present study. However, in the present study, FCR value on all the three rice polished mixed feeds were comparatively lower than the value observed by Ali and Salim (2004). Similar findings were also observed by Shabbir et al. (2003). The FCR value on cotton seed meal (1.55) reported by Jabeen et al. (2004) was somewhat lesser value of FCR observed in the present study. The negative effects of weight gain, FCR, PER in response to dietary plant protein from Mustard oil cake suggesting that dietary plant protein type from this origin is is poorly suitable than soybean protein. Similar reports are recorded in Japanese Flounder (Ye et al., 2011) by using soybean meal more than 16% and, who found that 43% of fishmeal protein could be replaced by soybean meal (25%) in combination with blood meal (10%) or corn gluten meal (10%) in blue murrels meat @5% (Kikuchi, 1999).

The data in present study on *Catla catla* indicated that response to soybean meal protein substitution by mustard oil cake protein was somewhat better. According to, experiment conducted (Rao and Kumar, 2006) to know the effect of plant protein incorporated formulated feeds on the growth and nutritive value of Rohu fingerlings, the test feeds containing 35% dietary protein level, showed better performance in growth and fertilization than the control feed having only plant protein and also the test feeds having higher protein levels. This infers that the plant protein (MOC) can be replaced by Soybean meal (SBM), which is more efficient for growth promotion. Soybean meal has superior nutritive values over other plant proteins (Eyo, 1991), because of its well-balanced amino acid compositions and their bioavailability as reported on the influence of the performance of animal (Gaylord and Gatlin, 1996). The results of their findings are similar to our findings. Further, the foregoing results agree and extend the findings (Chakrabarthy et al., 1973) by showing that groundnut and wheat bran was better utilized by fingerling *Labeo rohita* and *Cirrhinus mrigala* than that of mustard oilcake and rice bran. Prawn shell waste protein is rich in essential amino acids (Forster, 1975).

In the present experiment conducted to know the effect of different feed, containing plant proteins and also may be having anti-nutritional factors, and may lead to cumulative effects on growth performance in longer days feeding trials. Based on the results of the present study, it was concluded that mustard oil cake, potato starch, rice polish and soybean meal can be included in combination in the feed formulation for catla fingerling.

CONCLUSION

Results indicate that soybean incorporated feed was much acceptable than alternative plant protein source for the catla (*Catla catla*) however, the potential for including mustard oil cake protein in the feeds of fish need more evaluation.

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