

Breeding Performance of Catla, *Catla catla* (Ham.) Fed with Different Formulated Diets

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Breeding performance of catla, (*Catla catla*) was assessed through feeding trial for three months. Test diets with 30% protein (diet B) and 35% protein (diet C) were developed using a combination of rice bran, groundnut cake and fish meal. The proportion of these ingredients was reduced in diet D and replaced with horse gram, black gram, broken cake, rice and maize. Control diet (diet A) having 25% protein was formulated with 1:1 mixture of rice bran and groundnut oil. The breeding weight loss in females was lower ($P < 0.05$) in treatments A (7.43%) and D (6.37%) and higher in treatments B (8.36%) and C (9.00%) and the difference was significant ($P < 0.05$). Fecundity, fertilization, hatching and length and weight of hatchlings were the lowest ($P < 0.05$) in fish fed diet A and did not vary ($P > 0.05$) between treatments B and C. Diet D performed superior to diet A in terms of fecundity, percentage of fertilization and hatching and length and weight of hatchlings. Among the different treatments, the highest weight of hatchlings was recorded in treatment D.

Key words: Breeding, protein, broodstock diets, catla

Available literature on the effect of broodstock nutrition on reproductive performance and egg quality in cultured fish species suggests that egg production and viability are greatly affected by the nutritional quality of the diets (Watanabe *et al.*, 1984; Mokoginata *et al.*, 1998). Detailed studies on protein requirement for reproduction in fish are few (Pathmasothy, 1985; Dahlgren, 1980 and Shim *et al.*, 1989). Catla is one of the most popular species in the Indian sub-continent and seed farms are confronted with poor spawning response and poor quality spawn. In the present study catla broodstock was fed diets with different levels of protein to assess its effect on reproductive performance. A formulated diet with non-conventional ingredients (25% protein) was also tested for its efficacy in improving breeding response.

Materials and Methods

Catla, (*Catla catla*), two years old, of 2.33 kg average weight, were stocked in four earthen ponds of 600 m² area at the rate of 0.17 kg/m², almost 3 months before the onset of their natural breeding season. All the ponds were fertilized initially with cow-dung

at the rate of 5000 kg/ha 15 days prior to stocking and were refertilized at the rate of 4,000 kg/ha at monthly intervals in April, May and June. Four diets (diets A, B, C and D) were formulated; the ingredients used and their proportion are given in Table 1. The proximate composition of different diets was analysed following AOAC procedure (1995). Fishes in each pond were fed with one of the diets at the rate of 2% of their body weight.

The ingredients were mixed thoroughly to form a dough and was cooked in a pressure cooker for 30 min. Vimeral, a commercial vitamin supplement was added to the dough after cooling. The dough was placed in trays suspended in ponds. Sampling for fish growth was done at fortnightly intervals. Water was analyzed for dissolved oxygen, free carbon dioxide, total alkalinity, pH and temperature following standard methods (APHA, 1992). The breeding trials were conducted in the month of July.

On every breeding trial, ready to spawn females and males were collected in the morning hours (8.30 to 10.30 hrs) and kept separately in hapas. At about 16.30 to 17.30 hrs, the females were injected with Ovaprim,

a spawning inducer and Epidosine, a muscle relaxant at the rate of 0.5 and 0.2 ml/kg body weight respectively. The males were injected with pituitary extract at 5 mg/kg body weight. The females and males in the ratio of 1:2 were then released for spawning (1:1.5 by weight). Breeding performance was assessed based on parameters explained earlier (Manissery *et al.*, 2001). The percentage weight loss was calculated based on the average weights of females before and after breeding. Fecundity was calculated based on the number of eggs obtained per kg body weight of fish. The fertilization rate was estimated by examining 100 eggs collected at random from each treatment. Hatching rate was calculated based on the number of eggs hatched out by keeping 100 fertilized eggs from each treatment separately. Hatchling weight was determined by weighing 100 hatchlings from each treatment in an electronic balance. The average length of hatchling was calculated by measuring 100 hatchlings at random. The data were analyzed by one-way ($y_{ij} = \mu + t_i + e_{ij}$) ANOVA (Snedecor and Cochran, 1968) followed by Duncan's (1955) multiple range test.

Results and Discussion

The water temperature ranged from 27-29°C over the experimental period. Dissolved oxygen ranged from 5.6 to 10.0 ppm and free carbon dioxide from 0 to 6.0 ppm. pH was in the alkaline range (7.0-8.4), while the total alkalinity ranged from 38-112 mg/100 L. Generally, water quality parameters did not vary between the treatments and were found to be optimum for the survival and growth of carps (Jhingran, 1991). The diets A, B and C had 25.04, 30.03 and 34.86% crude protein respectively. The fat and NFE contents progressively decreased with increase in dietary protein levels. The formulated diet with non-conventional ingredients had the lowest crude protein (24.95%) and fat (3.44%) and highest NFE (51.44%) and gross energy (15.82 kJ/g).

Spawning was 100% as there was marked weight reduction in all the females.

Breeding response of fishes reared on three levels of dietary protein (diets A, B and C) in terms of percentage weight loss after breeding, fecundity, fertilization, hatching rate and length and weight of hatchlings are presented in Table 2. The breeding weight loss was lower ($P < 0.05$) in treatments A and D and higher in treatments B and C and the difference was significant ($P < 0.05$). The formulated diet with non-conventional ingredient sources (diet D) performed superior to diet A in terms of fecundity, percentage of fertilization and hatching and length and weight of hatchlings. Among the different treatments, the highest weight of hatchlings was recorded in treatment D.

Table 1. Proportion of ingredients and proximate composition ($\pm$ S.D.) of experimental diets (dry weight basis)

	Diet			
	A	B	C	D
Ingredients (%)				
Rice bran	50	44	38	18
Groundnut cake	50	44	38	18
Fishmeal	-	12	24	10
Horse gram	-	-	-	13.5
Black gram	-	-	-	13.5
Broken rice	-	-	-	13.5
Maize	-	-	-	13.5
Vimeral	0.01	0.01	0.01	0.01
Proximate composition (%)				
Moisture	4.61 $\pm$ 0.25	4.58 $\pm$ 0.23	4.96 $\pm$ 0.03	4.41 $\pm$ 0.06
Crude protein	25.04 $\pm$ 0.95	30.03 $\pm$ 1.86	34.86 $\pm$ 0.37	4.95 $\pm$ 0.32
Lipid	5.52 $\pm$ 0.17	4.85 $\pm$ 0.01	4.71 $\pm$ 0.03	3.44 $\pm$ 0.04
Ash	12.08 $\pm$ 0.18	11.50 $\pm$ 0.08	12.79 $\pm$ 0.09	8.04 $\pm$ 0.13
Crude fibre	15.15 $\pm$ 0.42	13.80 $\pm$ 0.32	11.51 $\pm$ 0.47	7.72 $\pm$ 0.22
NFE	37.60	35.24	31.17	51.44
Gross energy (kJ/g)	14.27	14.73	15.07	15.82

In the present study the spawning weight loss and fecundity were the highest ($P < 0.05$) in fish fed diets B and C with 30 and 35% protein respectively. Pathmosothy (1985) recorded larger ovaries and higher gonadosomatic index value of *Leptobarbus hoevenii* fed diets containing 32 and 40% protein than diet with 24% protein. Female dwarf gourami (Shim *et al.*, 1989) and Nile tilapia (Santiago *et al.*, 1985) fed on 35% protein diets recorded the greatest ovary weight and gonadosomatic index. Many factors influence the potential fecundity of an individual fish namely, age size, reproductive

Table 2. Effect of feeding different diets on the breeding performance of catla.

Treatment	Number of trials conducted	Av. wt. of female before breeding (kg)	Average weight loss of female (%)	Average fecundity (lakh)	Fertilization (%)	Hatching (%)	Hatchling Av. length (mm)	Av. wt. (mg)
A	12	2.96	7.43 ^a (0.48)	1.12 ^a (0.09)	80.00 ^a (3.60)	62.75 ^a (1.32)	4.43 ^a (0.21)	2.28 ^a (0.02)
B	15	2.87	8.36 ^b (0.40)	1.43 ^{bc} (0.07)	92.34 ^b (2.45)	83.86 ^c (0.75)	4.86 ^{ab} (0.23)	2.37 ^b (0.01)
C	8	3.56	9.00 ^b (0.72)	1.60 ^c (0.13)	90.00 ^b (1.74)	85.28 ^c (2.30)	5.03 ^b (0.15)	2.24 ^a (0.06)
D	13	2.67	6.37 ^a (0.63)	1.37 ^b (0.03)	90.00 ^b (4.06)	77.59 ^b (1.58)	5.00 ^b (0.15)	2.55 ^c (0.04)

Figures in the same column with same superscript are not significantly different ($P>0.05$).

Figures in parentheses indicate standard deviation.

history, physical condition and in particular its nutritional status. However, the results from investigations on the effects of experimental alterations in diet formulation, in terms of basic nutrient composition, are conflicting (De Silva and Anderson, 1995). De Silva and Radampola (1990) stated that tilapia (*Oreochromis niloticus*) receiving lower dietary protein had a higher relative fecundity and spawned greater number of times. This was in agreement with the phenomenon observed by Mironova (1978), who showed that reduced food of uniform quality induced reproduction in female *Tilapia mossambica*. On the other hand, in guppy and *Oreochromis niloticus*, fecundity remained almost unaffected by a reduced amount of protein (Dahlgren, 1980; Gunasekera *et al.*, 1996). A low protein diet produced eggs lower in hatchability in red sea bream, *Pagrus major* (Watanabe *et al.*, 1984) and dwarf gourami (Shim *et al.*, 1989). Pathmasothy (1985) and Manisserry *et al.* (2001) also recorded an increase in fecundity with increasing dietary protein from 24 to 32% in *Leptobarbus hoevenii* and 24 to 25% in *Cyprinus carpio* respectively. A further increase of the latter to 40% resulted in decrease in fecundity in these studies. The equal ($P>0.05$) performance of catla fed diets with 30 and 35% protein diets indicates the adequacy of a fishmeal based 30% protein diet for catla broodstock.

Catla, fed the formulated diet with non-conventional ingredients recorded higher

fecundity, percentage fertilization and hatching and weight of spawn than the rice bran and groundnut oil-cake mixture (diet A). Further, the performance of catla fed diet D was comparable with that of treatments B and C. This indicates that not only the quantity of protein is important but also the composition of ingredients in the breeding performance of catla. Cumaranatunga and Thabrew (1989) substituted legume meal for fish meal in diets of tilapia, *Oreochromis niloticus* and found that fish fed fishmeal based diet had better ovarian growth and significantly larger oocytes indicating that legume meal is an inadequate source of nutrients for egg production. They attributed this difference to higher levels of vitellogenic proteins and/or lipids in fishmeal. Manisserry *et al.* (1995) recorded significantly higher egg weight and percentage hatching in common carp fed diet containing legumes horse gram and black gram (substituting rice bran and groundnut cake) as compared to those fed a diet formulated with rice bran and groundnut oil cake. However, the percentage weight loss of female, fertilization, fecundity, egg diameter and weight of hatchling recorded by them were not significantly different between the treatments. Thus, the better breeding performance of catla with the non-conventional diet compared to the rice bran and groundnut oil-cake mixture indicates that a species-specific difference exists in the nutritional effects of broodstock diets. A growth trial conducted in manured tanks revealed the adequacy of a diet containing

10% fish meal having 24% protein and 46% NFE for catla (Manjappa, 1999). In the present study the diet D had 51.44% NFE. Catla is known to utilize carbohydrate efficiently in manured systems resulting in protein sparing. The highest hatchling weight recorded in treatment D is a clear indication of the nutritional adequacy of the new formulated diet D for catla breeders.

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