Study of Reproductive Behaviour of Fish Catla Catla

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Abstract

The present study is to investigate the effect of selective Synthetic feed like Agrimin and Fishmin having some additive components for enhancing on certain metabolic profiles and yield parameters of the cultivable fish species like Catla catla, Labeo rohita, Cirrhinus mrigala. The fishes selected for the study are considered into two groups viz. control group and experimental group. The control group of fishes are fed with control feed i.e. Groundnut cake, rice bran. The experimental group of fishes shall further be divided into two groups, Agrimin and Fishmin which are commercially available, have been selected for the study. The first group of experimental fish was fed with control feed mixed with Agrimin. These differences among the two types of synthetic feeds, which are found to be highly significant ($P<0.001$) may be attributed to be may be attributed to the nature of the growth and food habits of major carp as suggested by AliKunhi (1957). Analysis of gut contents of C. mrigala samples collected from managed ponds of district Hisar indicated the presence of members of Bacillariophyceae (31.17%) along with some unidentified matter and debris (40.48%).

Keyword*: Reproductive, Catla Catla, Fish Feeding.*

1. INTRODUCTION

Fish reproduction is characterized by a puzzling diversity of strategies (in sharp contrast to the reproductive scheme of mammals, birds, most reptiles and amphibians) regarding how different species determine their sex, produce male & female fertile gametes and mate; however the ovary in most teleosts is a paired organ that is attached to the body cavity. Lal Mohan came across several abnormalities in gonads of Pennahia aneus, a sciaenid fish, such as (i) ovary with a constriction on right lobe, (ii) ovary with partially atrophied left lobe, (iii) ovary with completely atrophied left lobe, (iv) testis with atrophied left lobe, (v) testis with completely atrophied right lobe and malformed left lobe and (vi) asexual gonad.Therefore, it is evident that occurrence of abnormal ovaries and testes was mostly reported in marine fishes, and not in freshwater fishes. The minimum tolerance temperature limit is ~14 °C. The use of catla as a component in pond culture was a traditional practice in the eastern Indian states, spreading to all other Indian states only during the second half of the 20th century. Its higher growth rate and compatibility with other major carps, specific surface feeding habit, and consumer preference have increased its popularity in carp polyculture systems among the fish farmers in India, Bangladesh, Myanmar, Laos, Pakistan and Thailand. The collection of riverine seed was the only source for culture until the 1950s.

2. LITERATURE REVIEW

Pandi Mariappan et.al (2021) The present experiment was conducted to breed a vulnerable cyprinid fish, *Dawkinsia rohani* (Rohan's barb), in captivity through hormonal inducement using one of the reproductive synthetic hormones WOVA-FH, since these fish did not breed spontaneously in captivity. The experiment was conducted in 500-L capacity fibre-reinforced plastic tanks with breeding hapa. The male (length 8.5 ± 1.5 cm and weight of 12 ± 2 g) and female (length 9.5 ± 2 cm and weight of 15 ± 1.5 g) brooders were injected intramuscularly with variable dose of WOVA-FH and released into the breeding hapa at 2:1 (male:female) ratio. Varied doses of WOVA-FH used for fish in the present study refer to 0.3 ml/kg (T1), 0.5 ml/kg (T2), 0.7 ml/kg (T3), 1.0 ml/kg (T4) and 0.0 ml/kg T0 (control). General courtship behaviour was observed in hormone-induced fish after 6–9 h after injection. Breeding was observed in all the treatment group fish except T0 (control groups). Success of spawning, fertilization and hatching rate varied depending on the dose of hormone. Significantly higher fecundity (1142.3 ± 40.20 eggs/female), fertilization rate (90.2 ± 0.67%) and hatching rate (88.92 ± 0.25%) were achieved in fish injected with 0.7 ml/kg for female and 0.3 ml/kg for male per kg body weight compared to other hormone treatment groups.

Assefa Tessema et.al (2020) This study was conducted in Lake Hayq between January and December 2018. The objectives of this study were to determine the growth, condition, sex ratio, fecundity, length at first sexual maturity

(L50), and spawning seasons of common carp (Cyprinus carpio). Monthly fish samples of C. carpio were collected using gillnets of stretched mesh sizes of 4, 6, 7, 8, 10, and 13 cm and beach seines of mesh size of 6 cm. Immediately after the fish were captured, total length (TL) and total weight (TW) for each individual were measured in centimeters and grams, respectively, and their relationship was determined using power function. Length at first maturity (L50) was determined for both males and females using the logistic regression model. The spawning season was determined from the frequency of mature gonads and variation of gonadosomatic index (GSI) values of both males and females. Fecundity was analyzed from 67 mature female specimens. The length and weight relationship of C. carpio was TW = 0.015TL2.93 for females and TW = 0.018TL2.87 for males that indicate negative allometric growth in both cases. The mean Fulton condition factor (CF) was 1.23 ± 0.013 for females and 1.21 ± 0.011 for males. The value of CF in both cases was > 1 that shows both sexes are in good condition. Among the total 1055 C. carpio collected from Lake Hayq, 459 (43.5%) were females and 596 (56.5%) were males. The chi-square test showed that there was a significant deviation between male and female numbers from 1:1 ratio ($\chi 2$= 22, df = 11, P > 0.05) within sampling months. The length at first sexual maturity (L50) for females and males were 21.5 and 17.5 cm, respectively. Males mature at smaller sizes than females. The spawning season of C. carpio was extended from February to April, and the peak spawning season for both sexes was in April. The average absolute fecundity was 28,100 ± 17,462. C. carpio is currently the commercially important fish while Nile tilapia fishery has declined in Lake Hayq. Therefore, this baseline data on growth, condition, and reproductive biology of common carp will be essential to understand the status of the population of carp and design appropriate management systems for the fish stock of Lake Hayq, Ethiopia, and adjacent countries.

Arvind Kumar Dwivedi (2019) Interspecific natural hybridization is an indicator of altered ecosystem. Habitat destruction increases competition with fish species in close proximity for spawning habitat with overlapping reproductive activities, thereby causing natural hybridization. This study is first investigation on detecting hybrids among Indian major carps (Labeo rohita, Cirrhinus mrigala and Gibelion catla) from the Ganga River by applying a cost-effective method, "Geometric Morphometrics". The relative warps (RW), principal component analysis (PCA) and canonical variate analysis (CVA) were employed on superimposed images to determine morphometric variations. Deformation grid of RW showed that G. catla and hybrid specimens have a deeper whereas L. rohita and C. mrigala specimens have slender body profile. The PCA showed separation among specimens of four groups (three species and one hybrid) with slight overlap between G. catla and hybrid. CVA extracted Mahalanobis and Procrustes distances among four non-overlapping groups found to be highly significant (P < 0.0001) with hybrid specimens lying between position of L. rohita and G. catla specimens in close proximity to G. catla, suggesting that hybrids are product of crossing between L. rohita and G. catla. The CVA separated four groups with 100.00% classification, indicating that all the three species and hybrid were clearly distinct from each other. In this study, all the four specimens of hybrid were caught from upstream of four barrages (Bijnor, Narora, Kanpur and Farakka) commissioned along the middle and lower stretch of the Ganga River. This suggests that, barrages obstruct upward movement of fish population and impact on reproductive activities, thereby increases possibilities of natural hybridization among these species.

Farah Bano et .al (2018) The influence of different photoperiods was studied on the growth and behaviour of the giant gourami, Trichogaster fasciata. Fish (weight=1.1g; length=4.36cm) were subjected to photoperiod regimes of 0L:24 D, 8L:16 D, 12L:12 D and 16L:8 D for 90 days in triplicates. The growth rate was highest (weight=4g) and lowest (weight=2.36g) in the groups subjected to 16L: 8D and 0L: 24D photoperiods respectively. The mean body weight and mean total length were significantly higher (P0.05) were not significant in the 16 hours light. Mean values of food conversion ratio and condition factor were lowest while various growth parameters were found to be maximum in the 16 hours light. 16L:8D photoperiod regime produced pronounced effects on the welfare of giant gourami as shown by the nonintrusive welfare indicators. The photoperiodic signals were found to be capable of modifying the behavioural activities where male aggression related to territory or defence and female selection were reduced in control group. The optimum photoperiod (16 L: 8 D) was an environmental cue for the better growth, welfare and behaviour.

Rajib Majumder et.al (2017) Bioassays were conducted with technical grade and commercial formulation of cypermethrin using freshwater fish Oreochromis niloticus as the test fish. The technical grade cypermethrin contained 92% active ingredient (a.i.) and the commercial formulation was an emulsified concentrate (EC) containing 10% a.i. (10% EC). Based on the actual concentration in water (2 h), the commercial formulation was found to be more acutely toxic to O. niloticus (96-h LC50 = 4.85 μg/L) than the technical grade cypermethrin (96-h LC50 = 9.74 μg/L). Exposure to sub-lethal concentrations (1.25, 2.5 μg/L) of commercial cypermethrin for 96 h produced stress on the fish, which was evident from the reduction of hepatic glycogen, reduction in the activities of alkaline phosphatase, acetylcholinesterase and catalase in liver and elevation of plasma glucose level and activities of hepatic acid phosphatase, aspartate aminotransferase and alanine aminotransferase. Exposure to these concentrations of cypermethrin for 14–28 days produced anaemia in fish. Long-term exposure (90 days) of the fish to these concentrations reduced the growth and deposition of protein and lipid in the body of fish as compared to control. It is

concluded from this study that even minute concentration (1.25 µg/L) of cypermethrin (10% EC) in water can produce stress on fish. Long term exposure to such concentration of cypermethrin may also affect growth of the fish.

3. METHODOLOGY

Study area

The fishes selected for the study shall be divided into two groups viz. control group and experimental group: age, two years .The control group of fishes shall be fed with control feed i.e. Groundnut cake, rice bran. The experimental group of fishes shall further be divided into two groups, Agrimin and Fishmin which are commercially available, have been selected for the study. The two groups of experimental fish shall be fed twice a day at 10 a.m. and at 5 p.m. The exposure period selected for the study is 30 days,after 30 days the fishes were killed and isolated the tissues like muscle and liver at 40C .Two of the ponds were unmanaged pond but with cattle and domestic effluent intakes. The other two ponds were managed type pond with control of household effluent intake and cattle movement. The four ponds are geographically evenly located with similar soil characteristics and exposed to sunlight. The physicochemical and biological characteristics of the unmanaged and managed ponds are shown in Table 1.

Analysis of Gut Contents

Specimens of live and mature freshwater fishes of the species Labeo rohita, Catla catla and Cirrhinus mrigala from each of the selected ponds were sampled using cast net on fortnightly.120 mature fish of each species (360 fish) were taken for analysis from each pond (total 1440 fish) with a weight range of 248.00g to 298.00g. Fish were dissected in ice surface and the digestive tracts were removed together with the contents and preserved in 5% formalin. The gut contents were then analysed both quantitatively and qualitatively following the procedure outlined in Garg.

Chemicals and synthetic feed

Agrimin and Fishmin which are commercially available have been selected for the study. All other chemicals used are of technical grade from sigma, St. louis, USA, SDH, CDH (India).

Agrimin

Agrimin is a product from Glaxo, Mumbai, India. A product with high quality supplement of minerals with essential amino acids for cattleand fish feeding. Regular supplement of Agrimin helps in maintaining healthy growth and higher productivity.

Direction for use

Can be mixed in Cattle and fish feed at the rate of 1-2% of feed (or) Large animals - 20 to 30 gms daily Small animals - 5 to 10 gms daily.

Fishmin

Fishmin is a product from Arias Agro-vet industries Pvt. Ltd., Mumbai, India. A product with high quality supplement of minerals, mainly for aquatic animals. However, the author mixed fishmin with control feed at the rate of 1-2% for his study.

Determination of Rate of Fecundity

Fecundity which represents the number of eggs released from a breeder is calculated in the following way. Before carrying out the breeding experiment the weight of the female is recorded with the help of a single pan balance. After the eggs are released, the weight is recorded again. The difference in the Weight indicates the mass of eggs released. This is converted into rate and % fecundity.

$$\text{Rate of fecundity} = W1 - W2$$

Where

W1 = Weight of the female before releasing eggs.

W2 = Weight of the female after releasing eggs.

From the mass of eggs released, the number of eggs is counted by transferring them into a 10 ml measuring cylinder without water. The rate of fecundity is calculated by dividing the number of eggs released with the weight of the fish.

The % of fecundity is calculated by using the following formula.

$$\%\, of\ Fecundity = \frac{No.of\ eggs\ released}{Weight\ of\ the\ fish} x\,100$$

4. ANALYSIS

Fecundity represents the number eggs laid by the female. This directly gives an indication of the rate of fertility in any organisms including fishes. The results of present investigation on the rate of fecundity in selected fish species shows maximum in Agrimin over Fishmin.

These differences among the two types of synthetic feeds , which are found to be highly significant (P<0.001) may be attributed to be may be attributed to the nature of the growth and food habits of major carp as suggested by AliKunhi (1957).

Fertilization that is union of male and female gamates is external in Indian Major Carps as in the case of any other fish. Therefore, it is found to be influenced by environmental factors of aquatic media and nutrients. The results on fertilization indicate that the selected fish species registered a higher rate of fertilization in Agrimin than Fishmin. This might be due to nutritional status. It is also reported that in most species the eggs are more stenothermal than Juvenile or older fishes and are the most vulnerable stages in the life cycle to the effects of thermal stress. These effects will influence not only the survival of individual fish but also the ultimate survival of the population. Further courtship behaviour between male and female which forms a pre-requisite for fertilization will only be highly successful in undisturbed waters and provided micro nutrients as reported by Elliot (1981). L.rohita as a column feeder might have experienced least thermal changes and disturbances in the middle portion of the water because of generally calm and quite aquatic conditions. That's why the column feeder L.rohita has shown a significantly higher rate of fertilization in highly nutrient Agrimin over Fishmin. It is followed by C.mrigala and C.catla (Table-1&Fig. 1).

The higher rate of fecundity in Agrimin is due to the increased presence of micro nutrients and amino acids. These observations are supported by the fact that the water on acid soil is generally less productive than on alkaline soils as suggested by Alikunhi (1960). Further the Agrimin and Fishmin particles might have absorbed considerable amount of nutrient elements like phosphates, potassium and nitrogen to enhance the nutritional status to produce more planktons, the micro food for fishes. This is also supported by Salaskar and Yeragi (2003) as the plankton population on which the total aquatic life depends directly or indirectly. Salaskar and Yeragi (2003) found abundant growth of phytoplankton's and zoo planktons having high concentration of pH.

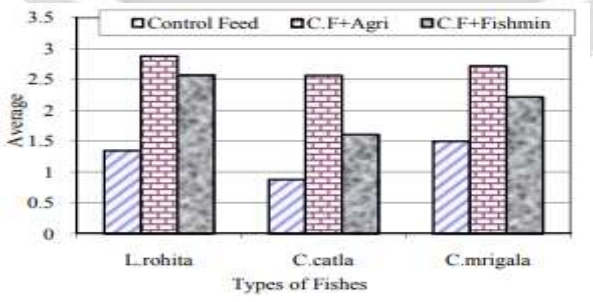

Figure 1 Impact of Agrimin and Fishmin on the Rate of Fertilization of Selected Fish species C.catla, L.rohita, C.mrigala

Gut content analysis and Managed ponds of district Hisar

Cirrhinus mrigala: Analysis of gut contents of C. mrigala samples collected from managed ponds of district Hisar indicated the presence of members of Bacillariophyceae (31.17%) along with some unidentified matter and debris (40.48%) (Table 1). Forage ratio indicating the preferred food items were calculated and results showed significantly

($p<0.05$) high value of forage ratio for cyclotella (2.45), Navicula (1.83) and Synedra (1.63) for C. mrigala. The value for zooplankton was much lower indicating that C. mrigala is a phytoplanktivorous and Cyclotella, Navicula and Synedra are its preferred food items.

Labeo rohita: Analysis of gut contents of L. rohita collected from managed ponds of district Hisar indicated the presence of member of Bacillariophyceae (14.20%), Chlorophyceae (13.20%), Cladocera (12.84%) and Copepoda (9.47%) along with some unidentified matter and debris (43.18%) (Table 2). The preferred food items that were foraged appear in Table 3. The results showed significant ($p<0.05$) value of Microspora (3.21), Moina (3.20) and Diaptomous (2.56) indicating that L. rohita is omnivorous and Microspora, Moina and Diaptomous are preferred food items.

Catla catla: Analysis of gut contents of C. catla collected from managed ponds of district Hisar indicated the presence of member of Copepoda (15.20%) and Cladocera (11.40%) along with some unidentified matter and debris (46.80%) (Table 1).

Table 1: Physicochemical and biological characteristics of the unmanaged ponds (H1 and H2) and managed ponds (H3 - H4) of Hisar district

j	H1	H2	H3	H4
Water Temp. (°C)	22.12 ± 1.40	22.24 ± 1.36	23.57 ± 1.06	23.92 ±. 90
pH	9.08 ± 0.09	8.19 ± 0.02	8.17 ± 0.08	8.12 ± 0.13
Conductivity (µS cm-1)	201.94 ± 56.60	1618.33 ± 10.45	1023.44 ± 84.40	427.66 ± 15.97
Salinity ppt	2.0 ± 0.02	0.0	0.0	0.0
Free CO2 (mg L)-1	Absent	22.55 ± 1.42	11.50 ±. 95	13.10 ± 1.55
Dissolved oxygen (mg L-1)	3.93 ± 0.08	6.26 ± 0.03	7.21 ± 0.05	7.51 ± 0.06
BOD (mg L-1)	2.70 ± 0.13	3.04 ± 0.10	2.45 ± 0.05	2.38 ± 0.10
Carbonate Alkalinity (mg L-1)	57.21 ± 4.25	Nil	Nil	Nil
Biocarbonate Alkalinity (mg L-1)	29.77 ± 25.64	382.83 ± 14.67	240.55 ± 9.16	168.16 ± 2.34
Total alkalinity mg L-1)	86.98 ± 22.82	382.83 ± 14.67	240.55 ± 9.16	168.16 ± 2.34
Chloride (mg L-1)	21.26 ± 11.16	193.18 ± 13.04	115.65 ± 22.55	9.42 ± .38
Total Hardness (mg L-1)	43.72 ± 14.60	206.33 ± 6.6	234.83 ± 28.21	172.11 ± 3.24
Calcium (mg L-1)	73.26 ± 10.65	41.57 ± 1.69	43.54 ± 11.76	26.45 ± 4.06
Magnesium (mg L-1)	87.96 ± 8.88	25.04 ± 2.40	30.75 ± 1.05	25.87 ± 2.79
O-phosphate (mg L-1)	2.3 ± 0.06	1.93 ± 0.04	0.74 ± 0.02	0.46 ± 0.02
Total phosphate (mg L-1)	2.87 ± 0.10	2.54 ± 0.03	1.15 ± 0.05	0.63 ± 0.05
Total ammonia (mg L-1)	2.05 ± 0.56	1.36 ± 0.35	0.52 ± 0.04	0.59 ± 0.11
Plankton Population (L-1)	80.00 ± 193.21	893.33 ± 238.62	3520 ± 208.65	333.33 ± 156.86
Phytoplankton (L-1)	53.33 ± 143.35	076.66 ± 172.74	206.66 ± 157.73	083.33 ± 113.02
Zooplankton (L-1)	26.66 ± 83.94	816.66 ± 151.17	1313.33 ± 98.55	037.33 ± 183.00
All values are mean ± S.E. of mean				

Table 2: Gut content analysis of Labeo rohita, Cirrhinus mrigala and Catla catla from the managed and unmanaged ponds of the Hisar district. All values are in percentage of total contents

Managed ponds			
Variables	*Catla catla*	*Labeo rohita*	*Cirrhinus mrigala*
Phytoplankton			
Debris	40.48	43.18	46.80
Bacillriophyceae	31.17	14.20	9.5

Chlorophyceae	5.66	13.20	9.5
Zooplankton			
Hisar Rotifera	11.33	7.10	7.6
Cladocera	5.66	12.84	11.4
Copepoda	5.66	9.47	15.2
Hisar unmanaged ponds			
Variables	*Catla catla*	*Labeo rohita*	*Cirrhinus mrigala*
Phytoplanton			
Debris	42.39	45.66	47.72
Bacillriophyceae	24.69	19.55	6.83
Chlorophyceae	12.32	6.52	4.54
Zooplankton			
Rotifera	6.16	4.34	11.36
Cladocera	8.22	8.69	13.62
Copepoda	6.16	15.21	15.90

5. CONCLUSION

The results of feeding experiment of Catla fry suggest that Cyclopoid diet can be used as live feed for effective production of fry. The present study suggests that Cyclopoid and Cladoceran can be used as ideal live-feed and its use in the hatchery seed production will lead to sustainable as well as economically viable aquaculture activity

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