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Formulation of quality fish feeds from indigenous raw materials and their effects on growth and maturity of *Mystus gulio*

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Abstract

An experiment was conducted for 140 days in earthen ponds to evaluate the effect of three dietary protein levels on the growth and maturity of bagrid catfish *Mystus gulio*. Three different iso-caloric feeds containing 30%, 35% and 40% dietary protein levels were prepared from indigenous fish feed ingredients and were fed to *Mystus gulio* at the rate of 5% of total body weight of the fish. The overall growth of *Mystus gulio* fed with feeds of different levels of dietary protein was found to increase with the increase of dietary protein levels in the feed. The gonadosomatic index (GSI) values of both male and female were higher in Feed-C (40% protein) compared to the Feed-A (30%) and Feed-B (35%). There was significant differences ($P<0.05$) between the gonadosomatic index values of *Mystus gulio* fed on different dietary protein levels. Statistical analysis showed that the feed at a level of 40% protein was significantly different from other feeds and most effective in changing the growth and maturity of *M. gulio*.

Keywords: Formulated feed, Maturity, *Mystus gulio*

Introduction

Mystus gulio, locally known as nona tengra, is a euryhaline estuarine catfish commonly occurring in coastal waters of Bangladesh. The species feed and thrive well in low salinity, and the salinity exceeds 10‰, they migrate into waters of low salinity (Pandian, 1966). This species is supporting the coastal fisheries to a great extent, both in point of commercial and local consumption views. *M. gulio* has already been trapped and grown as a significant additional harvest in most of traditional coastal shrimp *ghers*. Due to increasing demand in export market and high price, the increased fishing pressure on this species has been resulting in progressively reduced catch. Therefore, to protect and conserve the natural stock, the potential for seed production and culture of this important brackishwater fin fish in captivity has to be developed. We have many kinds of by-products, natural (of plant and animal origin) as well as from domestic and industrial activities. These locally available indigenous raw materials may serve as important ingredients for the formulation and development of cheaper and quality fish feed. In order to do this, it is necessary to develop the technology for proper formulation and manufacturing of the feeds, assuring the optimum contents of indispensable proteins, lipids, minerals, vitamins, growth promoting substances and energy. Though a lot of works have been done on the biology, the fecundity, induced spawning, spawning behavior and larvae rearing of *M. gulio* (David, 1963; Pandian, 1966; Jhingran and Natarajan, 1969; Kaliyamurthy, 1981; Sarker *et* al 2002; Alam *et al* 2006a and 2006b; Islam *et al* 2007), but no scientific study has been conducted for formulation of the quality feed for *M. gulio* brood rearing. So, the present experiment was designed to formulate quality fish feeds from indigenous raw materials and to investigate their effects on growth and maturity (GSI) of *M. gulio.*

Material and Methods

'A' grade fishmeal, mustard (*Brassica* sp) oil cake and fine rice bran were collected from local market of Paikgacha, Khulna.Vitamin premix was collected from sales agent of Bangladesh Pharmaceutical Industries Ltd. All the feed ingredients were analyzed to determine its proximate composition i.e. Protein, Lipid, moisture, ash, crude fiber and nitrogen free extract by the AOAC procedure (1980) as shown in Table 1.

Table 1. Proximate composition of feed ingredients (Dry basis)

Name of ingredient	Moisture (%)	Crude protein (%)	Fat (%)	Ash (%)	Crude Fibre (%)	Nitrogen free extract (%) (100-protein % + ash% + fibre %)
Fish meal	10.02	61.20	22.62	4.32	0.65	1.19
Mustard oil cake	11.50	27.00	29.15	16.60	11.48	24.87
Rice bran	10.90	10.80	20.60	5.35	15.00	37.35

Three different iso-caloric feeds denoted by A, B and C were prepared by mixing the ingredients in various combinations so as to give three different protein levels, viz, 30%, 35% and 40%. The protein level of 30%, 35% and 40% were maintained by various combinations of the ingredients in such a manner that the total metabolizable energy per 100 gm of feeds was about 300 Kcal (Table 2). The energy content of the feeds was calculated on the basis of 4.0 Kcal/g carbohydrates, 4.0 Kcal/g proteins and 9.0 Kcal/g lipids (Pike and Brown, 1967). The feeds were made into pellets by adding the starch liquid and dried in oven at 45ºC for two days.

Table 2. Composition of fish feed at different protein level

Name of ingredients	Feed A at 30% Protein level		Feed B at 35% protein level		Feed C at 40% protein level	
	Weight in gm of feeds	Total protein in feed (gm)	Weight in gm of feeds	Total protein in feed (gm)	Weight in gm of feeds	Total protein in feed (gm)
Fish meal	34.00	20.80	43.80	26.80	54.00	33.04
Mustard oil cake	14.50	3.91	15.00	4.05	14.00	3.78
Rice bran	49.00	5.29	38.70	4.16	24.50	3.18
Starch	2.00	-	2.00	-	2.00	-
Vitamin premix	0.50	-	0.50	-	0.50	-

For rearing of the *M. gulio* brood the ponds were prepared by draining out of water and application of lime to the pond bottom at the rate of 250 kg/ha. After seven days of liming the pond was filled up (about one meter) with tidal water of the nearby the Shibsha river and after seven days cow dung was applied @ 750kg/ha. After four days, inorganic fertilizer (TSP 25kg/ha and urea 20kg/ha) were applied.

M. gulio fishes having initial body wt. of 40.3±1.15 gm were collected from natural sources of brackishwater environment and stocked (male: female 1:1) in the earthen ponds @ 80 individual/ decimal. The experiment was conducted for 140 days in six earthen ponds of 3.5 decimal each. The experimental specimens were divided randomly into three treatments groups A, B, and C, each having 280 *M. gulio* equally divided into three replications. The fishes were fed twice a day @ 5-6% body weight using the prepared feeds, as per the experimental design.

Gain in length and weight and development of maturity were monitored and recorded periodically. To identify GSI value and maturity of *M. gulio*, fishes of different feeding trials were collected and data on different parameters of male and female (n=30) were recorded and analyzed. GSI values were estimated as the ratio of the wet gonad weight to somatic weight expressed in percentage by using the following formula:

$$GSI = \frac{\text{Weight of gonad}}{\text{Weight of fish}} \times 100$$

One way analysis of variance (ANOVA) was performed on the yield data to determine treatment effects. Duncan's New Multiple Range Test (Gomez and Gomez, 1984) was used to compare the differences of means.

Results and Discussion

The overall water quality parameters of ponds in different months are presented in Table 3. The values of water quality parameters in different months were: temperature 24.66±0.45 to 31.33 ±0.74^{0}C, dissolved oxygen (DO) 5.32±0.98 to 7.95±0.52 mg/l, alkalinity 160.0±11.20 to 182.50±12.30 mg/l and salinity 8.30±1.22 ppt to 8.60±0.50 ppt.

Table 3. Mean value (±SD) of water quality parameters in different months

Month	Water temperature (^{0}C)	pH	Dissolve oxygen (mg/L)	Total Alkalinity (mg/L)	Salinity (ppt)
February	24.66±0.45	7.55±0.58	5.64±0.86	160.0±11.20	8.30±1.22
March	25.57±0.12	7.43±0.31	7.95±0.52	182.50±12.30	8.65±1.10
April	28.40±0.69	7.59±0.56	7.05±0.43	176.20±15.30	8.50±1.38
May	30.60±0.57	7.94±0.51	5.38±1.12	179.30±9.86	8.70±0.32
June	31.33±0.74	7.63±0.21	5.32±0.98	176.78±10.98	8.60±0.50

Water temperature influences the physico-chemical and biological factors of a water body. The ranges of mean value of water temperature in different months in the present study were 24.66-31.33^{0}C. These values are more or less similar to that reported by Paul (1998), Rahman (1999), Kohinoor (2000) and Kohinoor *et al* (2004). The pH in all ponds water was alkaline throughout the experimental period. Different authors have reported a wide variation in pH from 6.7 to 8.3 (Hossain *et al*. 1997), 7.18 to 7.24 (Kohinoor *et al*. 1998), and 7.37 to 8.65 (Kohinoor *et al*. 2004) in fertilized fish ponds and found the ranges productive. The ranges and mean values of pH in the present study were alkaline indicating the productive nature of the fertilized ponds.

The ranges of mean value of dissolved oxygen concentrations were found from 5.32±0.98 to 7.95±0.52 mg/L which is similar to findings reported by several researchers (Ali *et al*. 1982; Martyshew, 1983; Rahman, 2000; Kohinoor, 2000 and Kohinoor *et al*. 2004). Total alkalinity more than 100 mg/L should be present in high productive water bodies (Alikunhi, 1957). Paul (1998), Kohinoor (2000), Grag and Bhatnagar (2000) and Kohinoor *et al* (2004) found the average total alkalinity values above 100 mg/L in their experiments. The total alkalinity values found in the present study were within the suitable range.

The overall growth performance of *M. gulio* brood fed with feeds of different levels of dietary protein is presented in Table 4. Final growth attained under Feed-A (30% protein), Feed-B (35% protein) and Feed-C (40% protein) were 78.47±2.43, 86.58±3.26 and 105.37±8.16g, respectively. The highest growth was obtained in Feed-C (40% protein) and lowest in Feed-A (30% protein). The final weight showed significant difference ($p<0.05$) in Feed-C (40% protein) followed by Feed-B (35% protein) and Feed-A (30% protein) when ANOVA was performed. Absolute growth and absolute growth rate were higher in Feed-C compared to both the feeds A and B. Specific growth rate was also higher in Feed-C (0.69±0.05) followed

by feed-B and Feed-A. From the results of growth it is clear that the Feed-C is better than the Feed-B followed by the Feed-A i.e. increase in weight in fish is directly related with the increase in protein levels in feed which is similar to the experimental results reported for chinok salmon (De Long *et al*. 1958), common carp (Ogino and Saito, 1970), rainbow trout (Saitia, 1974), *Clarias batrachus* (Sanaullah *et al.* 1986 and Rahman *et al*. 1987).

Table 4. Growth performance of *M. gulio* brood fed with feeds of different levels of dietary protein

Treatments	Mean initial weight (g)	Mean final weight (g)	Absolute growth (g)	Absolute growth rate (g)	Specific growth rate (%)
Feed-A (30% protein)	40.3±1.15	78.47±2.43 ^{c}	38.17±2.42	0.27±0.02	0.48 ± 0.02 ^{c}
Feed-B (35% protein)	40.3±1.15	86.58±3.26 ^{b}	46.28±3.26	0.33±0.02	0.55±0.02 ^{b}
Feed-C (40% protein)	40.3±1.15	105.37±8.16 ^{a}	65.07±8.16	0.46±0.06	0.69±0.05 ^{a}

Figures in the same column having the different superscripts are significantly different (P<0.05)

Gonado-somatic index is a very important parameter for understanding gonad development of fish. The gonadosomatic index values (GSI) of *M. gulio* of different feeds are shown in Fig. 1. From the Fig. 1 it is observed that the gonadosomatic index values of both male and female were higher in Feed-C (40% protein).The average values of gonadosomatic index values for male in Feed-A, in Feed-B and in Feed-C were 2.75, 3.0 and 3.13 respectively. The gonadosomatic index values for female were also higher in Feed-C compared to the other two feeds. There was significant differences (P<0.05) between the gonadosomatic index values of *M. gulio* fed on different dietary protein levels. This is an agreement with the results obtained by Mollah *et al.* (2003) where 40% protein level in the feed gave the better gonadosomatic index values in case of *H. fossilis*. Female dwarf gourami and Nile tilapia fed on 35% protein diets recorded highest ovary weight and gonadosomatic index (Shim *et al.* 1989; Santiago *et al.* 1985). Pathmasothy (1985) recorded larger ovaries and higher gonadosomatic index values of *L. hoevenii* fed diets containing 32 and 40% protein than diet with 24% protein which is similar to the present study.

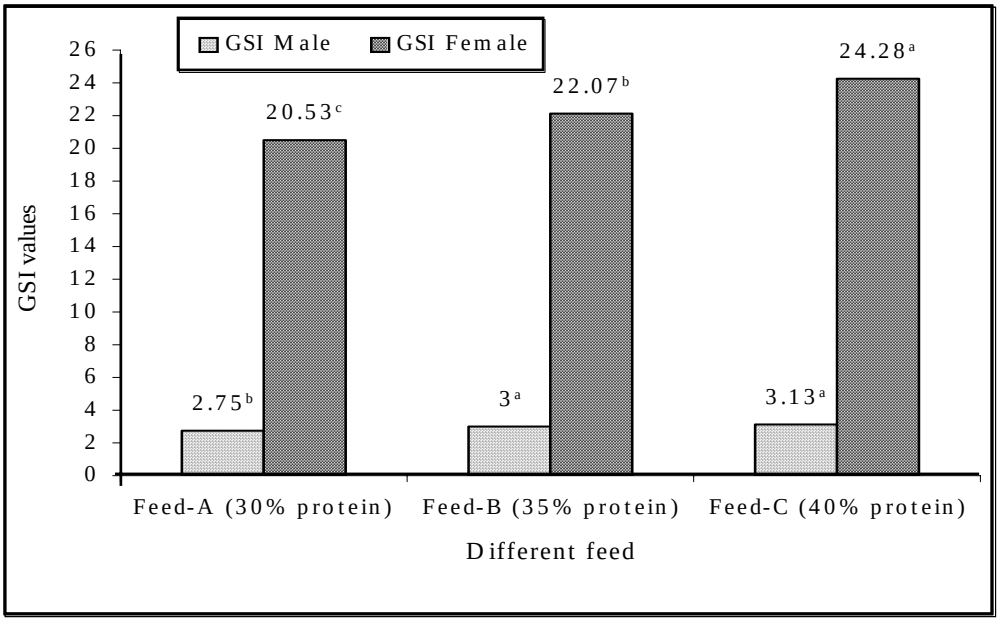

Fig.1. Effect of different dietary protein levels on the maturation of *M. gulio*. Bars with same color having different letters are significantly different (P<0.05)

In the present research work, growth performance and maturation of *M. gulio* were studied. Somatic growth and gonado-somatic index were highest in the fish provided with 40% dietary protein in the feed. Though protein has a positive impact on the growth performance and gonad development of *M. gulio* and other fish species, the present research is probably the first ever work of its nature in Bangladesh. Therefore, the preliminary success obtained through this work can serve as an important base for future research on this point.

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