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Article

Effect of nutrients enriched feed premix on the growth performance of major carps Rohu, Catla and Mrigal in a polyculture system

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Abstract: To evaluate the effect of nutrients enriched feed premix on the growth performance of major carps Rohu (*Labeo rohita*), Catla (*Catla catla*) and Mrigal (*Cirrhinus mrigala*) in a polyculture system, the present experiment was carried out in six earthen ponds located at Khulna University of Bangladesh for a period of 90 days. Two treatments each with three replications were stocked with 40% Rohu, 30% Catla and 30% Mrigal with a total stocking density of 10000/ha. T-2 was treated with feed premix at the rate of 4g/1 kg feed while T-1 was not treated with any feed premix. Both treatments were applied normal feed twice a day at the rate of 2% to 4% of the body weight of the fingerlings. The net fish production was found to be 2238.06 kg/ha and 3607.33 kg/ha in T-1 and T-2 respectively. The results showed that fish production was significantly higher in T-2 than T-1 ($P<0.05$). T-2 showed 0.60 times greater fish production than that of T-1.

Keywords: feed premix; growth; polyculture; production; carp

1. Introduction

Aquaculture is the fastest-growing food-producing sector in the world with an annual rising rate of 8.9–9.1% since the 1970s. According to FAO (2016), global aquaculture has grown dramatically over the past 50 years to around 52.5 million tons and accounting for around 50 percent of the world's fish food supply. Out of all, Asia dominates aquaculture production of the world and contributes around 87% to the global cultured fin-fish production of 25.7 million tons in 2005 (De Silva *et al*., 2006). Bangladesh has achieved 5th position in aquaculture production (FAO 2017). Bangladesh is a small dense populated country where day by day protein requirement is rising due to population inflation. As a developing country fishes are the major sources of animal protein to most rural Bangladeshi's (DoF, 2012; Hossain *et al*., 2002 and Amin *et al*., 2009). In our country aquaculture is mostly represented by pond culture. Carp polyculture is an age-old popular method in southasia, specifically in Bangladesh and India, where it is the major aquaculture production system (Miah *et al*., 1997; FAO, 1997; Reddy *et al*., 2002). In south Asian, a wide variety of fish species are cultured. Among various species *Labeo rohita* (Hamilton), *Catla catla* (Hamilton) and *Cirrhinus mrigala* (Hamilton) are very popular (Uddin *et al*., 1994; FAO, 1997; Miah *et al*., 1997; Kanak *et al*., 1999) in polyculture system. In Bangladesh, aquaculture habitually has been drowned polyculture of three Indian major carps including *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* (Azim and Wahab, 2003). The widespread use of polyculture farming practices is increasing dietary nutrition, productivity and profitability of farming households in rural Bangladesh. In polyculture system one species enhance the food accessibility for other species and as a result promote the entire fish yield. The growth performance of Indian major carps viz; *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* can be developed by providing available enough amount of innate food and balanced artificial diet. As we know

that vitamins, minerals, prebiotics and so on are a prerequisite for normal cell function, various biochemical and physiological processes, development and boost up immunity of farmed fish (Panush and Delafuente, 1985; National Research Council, 1993; Hamre, 2011; National Research Council, 2011; Halver, 2002; Dhur, Galan and Hercberg 1991; West *et al*., 1991; Jurin and Tannock 1972; West *et al*., 1991; BASF, 2000 and Chakraborty *et al*., 1976). Considering above facts, attempts were taken to investigate the effect of nutrients enriched feed premix on the growth promotion of Rohu, Catla and Mrigal in a polyculture system.

2. Materials and Methods

2.1. Study area and period

The study was conducted in the experimental pond complex II of Fisheries and Marine Resource Technology discipline, Khulna University, Khulna, Bangladesh during February to May, 2018. All experimental ponds were same sizes and rectangular in shape with a maximum depth of 1.5 m. Additionally, all the ponds were fully exposed to prevailing sunlight.

2.2. Experimental Design

The trial was conducted into two different treatments with three replications each (Table 1).

2.3. Prestocking management

Ponds were renovated and cleaned of aquatic vegetation in January. All unwanted fishes and other aquatic organisms were eradicated by applying rotenone and repeated netting. Pond dikes were repaired using the excavated bottom soils. The weeds of embankment were also cleaned manually. Agricultural lime ($CaCO_3$) was applied to the pond bottom at the rate of at a rate of 1kg/decimal. The ponds were filled with water after seven days of liming from adjacent deep tube well by using pump. After three days, all ponds were fertilized with inorganic fertilizer like, Urea, TSP, and Molasses-yeast mixture at the same rate. After the first fertilization and before fish stocking, the ponds were left 10 days to allow plankton development.

2.4. Stocking

Rohu, Catla and Mrigal were collected from a local nursery named Sowakat Ali at Dumuria Upazilla of Khulna District. The ponds were stocked with fish after ten days of fertilization. All fish were released in the ponds in early morning after acclimatization.

2.5. Post stocking management

All ponds were subject to the same regime of feed application. In case of treatment, firstly, fish feed was mixed with feed premix (Table 2) by using soybean oil. After that, fish were fed with that additives mixed feed in treatment (T2). Fish were fed at the rate of 2% of total body weight of stocking fingerlings twice daily at 8:30 am and 4:30 pm. Additionally, feeding rate was increased gradually from 2% to 4% of total body weight of the fish. However, no feed premix was applied in control (T-1) (Table 1). Furthermore, all ponds were fertilized with inorganic fertilizer like, Urea, TSP, and Molasses-yeast mixture at the same rate fortnightly.

2.6. Water sampling and analysis

Water quality parameters such as temperature, pH, dissolved oxygen level (DO), salinity, alkalinity and hardness were monitored in every 30 days' interval to ensure suitable culture condition. Samples were brought to the Water Quality Research Laboratory, FMRT Discipline, Khulna University, Khulna for chemical analysis.

2.7. Growth parameters

Fish sampling were conducted at monthly intervals to assess their growth and health status. The following equation were used to evaluate the growth and survival rate of fishes:

Weight gain (cm) = Average final weight (g) – average initial weight (g)

Survival rate (%) = (No. of fish harvested/ Initial no. of fishes) x 100

2.8. Harvesting of Fish

After 90 days of rearing, the fish were harvested from all the ponds. Final harvesting was done by dewatering the ponds with a submerged low fit pump. During harvest, all fishes were counted and weighted from each pond to assess the survival rate and production.

2.9. Statistical Analysis

The data collected during experiment were recorded. Data were analyzed using MS excel and the statistical package SPSS (16). One-way ANOVA was performed to observe the degree of difference between the treatments at the 5% level of significance.

3. Results

3.1. Water quality parameter

All the water quality parameters were present within acceptable range. The overall mean values of each water quality parameter in different treatments are presented in Table 3.

Temperature, salinity, pH, dissolved oxygen, alkalinity and hardness were varied from 22 to 27 ºC, 3 to 4 ppt, 7.3 to 7.8, 5 to 6 mg/L, 200 to 250 mg/L, 550-750 mg/L with mean values of 24.75±1.75 and 24.75±1.98 ºC, 3.62±0.51 and 3.62±0.51 ppt, 7.58±0.21 and 7.61±0.18, 5.75±0.46 and 5.75±0.46 mg/l, 228.12±24.77 and 231.25±25.87 mg/l, 675±103.50 and 668.75±99.77 mg/l in T-1 and T-2 respectively (Figure 1-6). No parameters were found to be varied ($p>0.5$) between two treatments.

Table 1. Layout of the experiment.

Parameter/Stocking Density	Treatment (T-1)	Treatment (T-2)
Area of each pond (m^2)	120	120
Water depth (m)	1-1.5	1-1.5
Rohu (ind. /m^2)	0.4	0.4
Catla (ind. /m^2)	0.3	0.3
Mrigal (ind. /m^2)	0.3	0.3
Feed premix	Not Applied	Applied at rate of 4g/1 kg feed
Composition of feed premix	Not Applied	Vitamins, Minerals, Amino acids, Prebiotic
Replication	3	3

Table 2. Composition of feed premix.

Type	Name	Content
Vitamins	Vitamin A	14,000,000 I.U.
	Vitamin D_3	3,000,00 I.U.
	Vitamin E	3,500 mg
	Vitamin C	5,000 mg
	Vitamin B_1	1,000 mg
	Vitamin B_2	700 mg
	Vitamin B_6	500 mg
	Vitamin B_{12}	1,800 mcg
Minerals	Iron (Fe)	700 mg
	Copper (Cu)	70 mg
	Manganese (Mn)	1,400 mg
	Cobalt (Co)	12 mg
	Zinc (Zn)	2,000 mg
	Calcium (Ca)	2,50,000 mg
	Magnesium (Mg)	5,000 mg
	Phosphorous (P)	1,000 mg
Amino Acids	Lysine	15,000 mg
	Methionine	20,000 mg
	Threonine	1,606 mg
	Glycine	2,500 mg
	Tryptophan	200 mg
Prebiotic	Fructo-oligosacharides	10,000 mg

Table 3. Mean (±SD) values and ranges of water quality parameters.

Parameters	T-1		T-2	
	Mean (±SD)	**Range**	**Mean (±SD)**	**Range**
Temperature (ºC)	24.75±1.75 [a]	22-27	24.75±1.98 [a]	22-27
DO (mg/l)	5.75±0.46 [b]	5-6	5.75±0.46 [b]	5-6
pH	7.58±0.21 [c]	7.3-7.8	7.61±0.18 [c]	7.4-7.8
Alkalinity (mg/l)	228.12±24.77 [d]	200-250	231.25±25.87 [d]	200-250
Hardness (mg/l)	675±103.50 [e]	550-750	668.75±99.77 [e]	550-750
Salinity (ppt)	3.62±0.51 [f]	3-4	3.62±0.51 [f]	3-4

*Different superscript letters indicate the significant difference among the treatment (P<0.05)

Table 4. Survival and Production of rohu, catla and mrigal under two treatments.

Treatment		At stocking			At harvest			Survival Rate (%)	Production (kg/ha)
	Fish species	Av. Initial wt (g)	No. of fish stocked	Total wt(g)	Av. Final wt (g)	No of fish recovered	Total wt (g)	Species wise	Total
T-1	Rohu	89.16±5.78	44	3923.04	150.12±9.84[a]	39	5854.67	89	2238.06
	Catla	86.86±8.12	32	2779.52	138.77±7.99[c]	28	3885.56	88	
	Mrigal	74.09±9.028	34	2519.05	131.72±7.05[e]	28	3688.16	84	
T-2	Rohu	89.45±8.29	44	3935.79	237.41±19.02[b]	40	9496.40	90	3607.33
	Catla	85.31±8.41	32	2729.91	226.13±19.65[d]	28	6331.64	88	
	Mrigal	75.68±5.97	34	2573.12	200.59±17.70[f]	29	5817.10	86	

* Different superscript letters indicate the significant difference among the treatment (P<0.05)

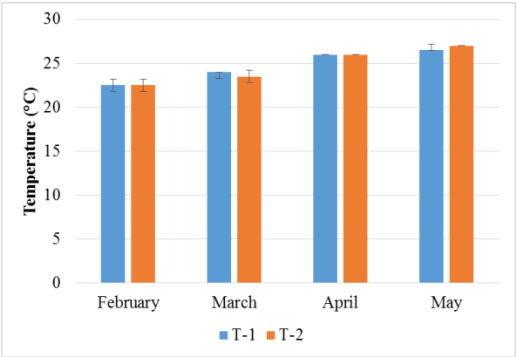

Figure 1. Changing pattern of temperature at two groups in different times.

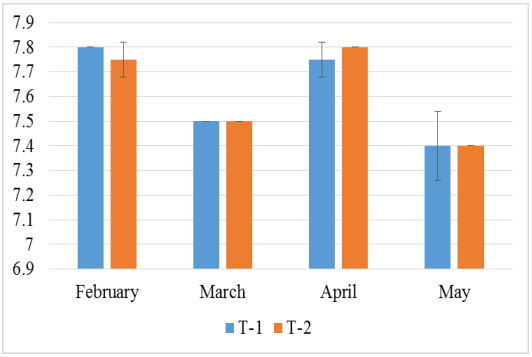

Figure 2. Changing pattern of pH at two groups in different times.

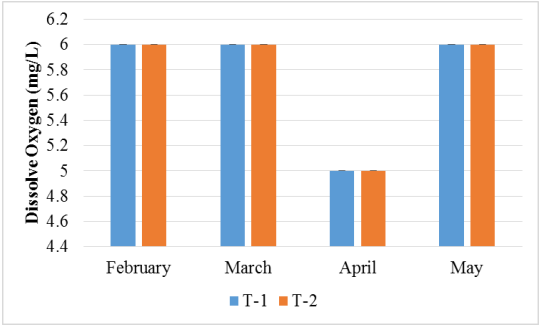

Figure 3. Changing pattern of DO at two groups in different times.

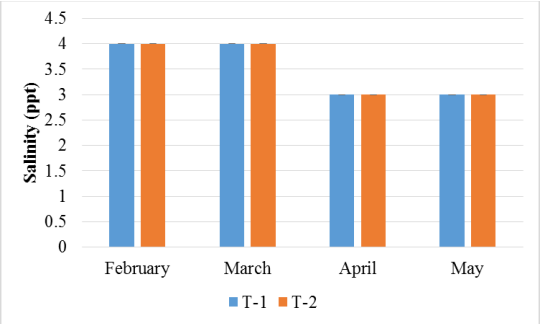

Figure 4. Changing pattern of salinity at two groups in different times.

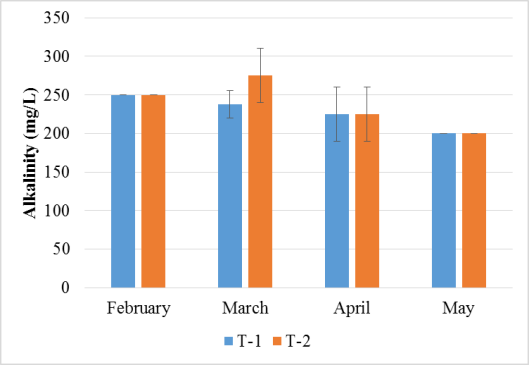

Figure 5. Changing pattern of alkalinity at two groups in different times.

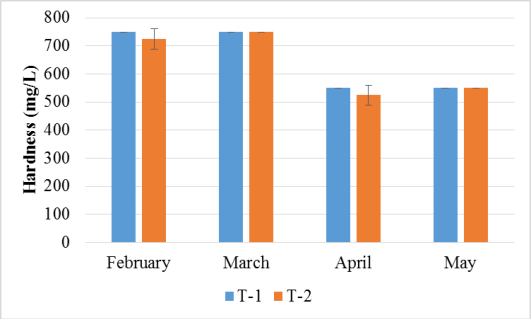

Figure 6. Changing pattern of hardness at two groups in different times.

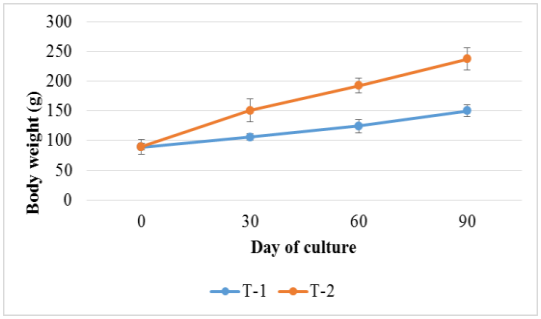

Figure 7. Growth curve of *L. rohita* in two treatments.

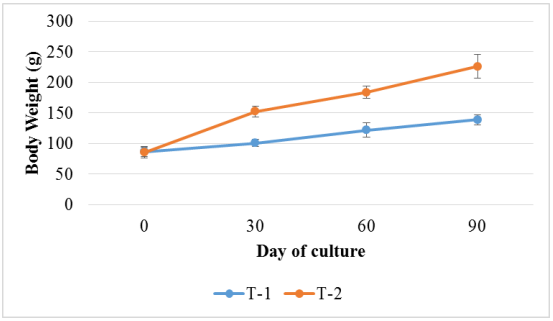

Figure 8. Growth curve of *C. catla* in two treatments.

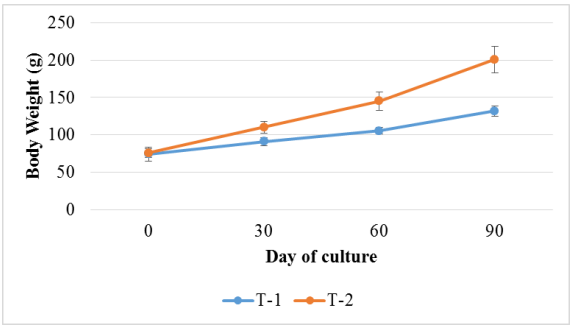

Figure 9. Growth curve of *C. mrigala* in two treatments.

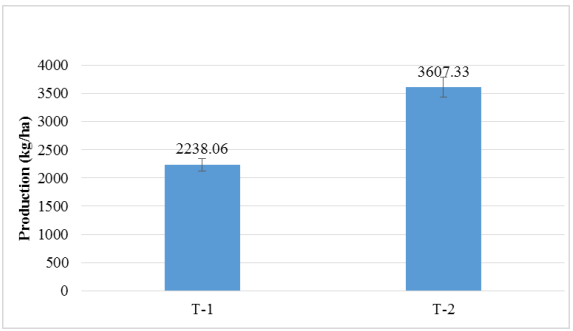

Figure 10. Total production in two treatments.

3.2. Growth and production

Details of growth performance and production of fish are presented in Table 4. Among three species, rohu attained the maximum weight at harvest. The weight gain by rohu, catla and mrigal was better in T2, where feed premixes was added. The average final mean individual weights of rohu, catla and mrigal in T1 and T2 were 150.13±9.85g, 138.77±8.00g, 131.73±7.05g and 237.42±19.02g, 226.14±19.65g, 200.59±17.70g respectively. The average final mean individual weights of rohu, catla and mrigal in T1 and T2 were significantly different at

5% level of significance. The survival rates of rohu, catla, mrigal in T-1 and T-2 were 89, 88, 84 % and 90, 88, 86 % respectively. Between two treatments, there was no significant difference in the survival rates of rohu, catla and mrigal.

The final production of fish after three months of culture was 2238.06 and 3607.33 kg/ha in treatments 1 and 2 respectively. Maximum fish production was obtained in T-2, where growth promoter chemicals was mixed. It was evident from the result that growth of rohu, catla and mrigal in ponds that were treated by feed premix varies (Figure 7-9). Statistical analysis showed that there was significant differences in the production between these treatments. The highest production rate was observed in T-2 having 3607.33 kg/ha and the lowest production was found in T-1 having 2238.06 kg/ha (Figure 10). Indeed, there was 0.60 times greater net fish production in T-2 than that in T-1.

4. Discussion

Water quality is very necessary for the growth of fish. It involves all physical and chemical parameters that may affect the primary production (Zhang, 1987). In the present study, the water quality parameters surveyed in all treatments were found within the acceptable range of fish culture and there was no significant difference among the treatments.

During the experiment the water temperature of treatments was found to vary from 22°C to 27°C, the pH values of treatments was found to vary from 7.3 to 7.8, the Dissolved Oxygen (DO) of treatments was found to vary from 5 to 6, the salinity of treatments was found to vary from 3 to 4 ppt, the alkalinity of treatments was found to vary from 200 to 250 mg/L, the hardness of treatments was found to vary from 550 to 750 mg/L in T-1 and T-2 respectively which are more or less similar to the finding of Rahman *et al*. (2006), Huq *et al*. (2004), Ahamed (2004) and Asaduzzaman (2005) who recorded uniform range during their experiment. There was no significant difference ($p>0.05$) among the treatments.

The present study provides experimental evidence on the effect of nutrients enriched feed premix on rohu, catla and mrigal after feeding. Feed premix contains vitamins, minerals, amino acids and prebiotics. Feed introducing feed premix as mentioned earlier showed a clear change of result on growth performance. During the experimental period fish growth rate of rohu, catla and mrigal were measured in every 30 days interval. The growth rate of 2 treatments was showed in (Figure 7, Figure 8, Figure 9) that persuades the growth increment of rohu, catla and mrigal. The yield of this polyculture system is similar to several production levels obtained in other polycultures in the South Asian region, e.g. Shahabuddin *et al*. (1994) obtained yields of 2000-3400 kg/ha and Mazid *et al*. (1997) recorded a gross production of 3600 kg/ha. Again, Sumitra *et al*., (1981) who reported a significant increase in fish growth due to the effect of nutrients on the planktonic productivity of a commercial pond. Munir *et al.* (2016) reported dietary prebiotics and probiotics influence the growth performance of snakehead (*Channa striata*) fingerlings.

Azim *et al*. (2002) and Islam *et al*. (2008) also concluded that artificial diet comprising of rice bran, soybean meal, fish meal, vegetable oil, vitamin and mineral mixture (40:20:10:3:2) influenced the growth and survival of carp fingerlings on the basis of specific growth rate and harvested fish biomass. Agarwal *et al*. (1980) Studied on survival, growth and morphological changes of *Cirrhina mrigala* are reported under ascorbic acid. Similar results as present study were previously suggested by of Mehrim (2001) and Diab *et al*. (2002) for tilapia. Later, Khattab *et al*. (2004) and Mohamed *et al*. (2007) who also indicated that the Nile tilapia (Oreochromis niloticus) fingerlings fed on diets supplemented by prebiotics exhibited better growth than those fed with the control diet. Additionally, Misra *et al*. (2007) conducted to evaluate the efficacy of dietary L-ascorbic acid (AA) dosages on immunity, growth of the fingerlings of *L. rohita*. They indicated that elevated levels of dietary AA could be recommended for optimum immunity, growth of fingerlings of *L. rohita*. Furthermore, Hussein *et al*. (2016) studied was carried out to compare the effect of some commercial growth promoters on growth performance, feed utilization, body composition and blood pictures of juveniles common carp reared in earthen ponds. These results suggested that supplementing diets with commercial feed additives promotes growth performance, feed utilization and net financial return comparing with the control. Though, no work had been found to see combine effect of vitamins, minerals, amino acids and prebiotics on fish species, above researchers' findings supported the recent findings.

It is possible to conclude that the nutrients enriched feed premix significantly ($P<0.05$) improved growth and total production with improved feed efficiency. In this study, treatment with nutrients enriched feed premix showed highest weight gain compare with others this might be attribute to the fact that, feed premix contains different vitamins, minerals, amino acids and prebiotics that promotes growth. The results of the present study also showed that average gain in body weight of all the fish species together was less in the treatment without feed premix than that in the treatment with feed premix. The net fish production in T-2 was found to be 3607.33

kg/ha; while in T-1 it was 2238.06 kg/ha. Indeed, there was 0.60 times greater net fish production in T-2 than that in T-1.

In the present study, the enhanced production in T-2 can be justified by the fact that the nutrients enriched feed premix not only contributed to fish growth but also helpful for the pond environment. This research would be useful for the aquaculture production enhancement in Bangladesh as well as other Asian countries.

5. Conclusions

Rohu (*L. rohita*), catla (*C. catla*) and mrigal (*C. mrigala*) species which have a high market value and a simple culture technique. Yet, a very few research has been commenced to enhance the growth and production performance of these species. Nutrients enriched feed premix could be very effective for the cultivation of these species as they enhance the growth and production. This study clearly showed that feed premix effect on fish growth. These feed premix are very much beneficial for fish production. Suitable production was found in T-2 than T-1 which had no premix. So, this investigation revealed that application of nutrients enriched feed premix contributes to higher production for all three species and generate better economic returns.

Conflict of interest

None to declare.

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