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EFFECT OF POND FERTILIZATION WITH BROILER DROPPINGS ON PROXIMATE BODY COMPOSITION OF MAJOR CARPS

Muhammad Hassan[1] & M. Javed[2]
[1]Department of Zoology, Government College, Faisalabad
[2]Fisheries Research Farms, Department of Zoology and Fisheries, University of Agriculture, Faisalabad

Three major carps viz. *Catla catla, Labeo rohita* and *Cirrhina mrigala* were reared under pond fertilization with broiler droppings on five nitrogen levels (0.10,0.13,0.16,0.19 and 0.22 g nitrogen per 100g wet fish weight daily) under polyculture condition. Proximate composition of fish was determined at the start and end of one year experiment. Fat and protein contents of fish increased and ash and carbohydrate decreased among the three fish species after pond fertilization trials. With the increase of nitrogen level, the body fat and protein contents of fish increased up to 0.16 g level of nitrogen. Both *Catla catla* and *Labeo rohita* had the highest fat and protein contents under the influence of 0.16 g nitrogen level, while *Cirrhina mrigala* accumulated ample fat and protein under 0.13 and 0.10 g nitrogen levels respectively. A significant increase in both fats and proteins in fish body under different fertilization levels was due to the better performance under these treatments towards planktonic productivity indices, especially zooplankton.

Key words: broiler droppings, major carps, pond fertilization, proximate composition

INTRODUCTION

The major objective of utilizing wastes in fish farming system is to recycle different nutrient elements present in such wastes. Due to energy crisis, prohibitive cost of chemical fertilizers and poor purchasing power of marginal and small farmers, it is necessary to use organic manures/wastes to their maximum potential with proper technology to meet the shortage of chemical fertilizer under sustainable fish pond ecosystem. However, proper pond management ensuring continued maintenance and building up fertility of an ecosystem is indispensable for greater productivity. This necessitates the importance of recycling organic wastes like poultry and livestock manures for enhancing the productivity of fish pond ecosystem without causing any adverse effect on the quality of fish meat. Therefore, integrated fish farming can be called a desirable model of recycling wastes, comprehensive utilization of various farm products, saving energy, full exploitation of the natural resources and finally maintaining the ecological balance.

Eckhardt et al. (1982) reported that at high protein content of feed, the addition of 5% fat resulted in small further growth increments in *Cyprinus carpio.* With the increase in crude protein and decrease in carbohydrate contents, the fish growth showed an increase up to 42 % of crude protein. In the fish body, fat deposition was positively correlated with the protein. There was a positive correlation between total fats and carbohydrates. Giri et al. (1983) reported that the fish *(Tilapia)* reared in sewage water had a slightly higher protein and significantly higher fat, energy, calcium, phosphorus and sodium contents than that of fish grown in freshwater. They also observed non-significant differences among the flavour, texture and colour of fish reared under different fertilization treatments but the scores of taste were higher for the fish grown in sewage water than that grown in freshwater. Javed et al. (1995) reported significant differences among the taste scores earned by *Catla catla, Labeo rohita* and *Cirrhina mrigala* when reared under inorganic fertilizer (N:P:K, 20:20:03), broiler and layer droppings, cow-dung, artificial feed and the control (without additives).

Javed et al. (1990) achieved a net fish yield of 3360.40 kg/ha/year by using. broiler droppings as pond fertilizer (at the rate of 0.10 g nitrogen/100 g fish daily) without any adverse effect on fish meat quality and limnology of ponds. During this study the level of nitrogen has been increased up to 0.22 g to find out an optimum level of nitrogen from broiler droppings and to determine their effect on the proximate body composition of fish.

MATERIALS AND METHODS

Factorial experiment, with two replications for each of the treatments, was conducted under ambient condition using earthen ponds. After preliminary preparations (Javed, 1988), all the ponds were initially fertilized, separately, with 40 kg broiler droppings (3333.33 kg/ha) as starter dose to stimulate primary productivity. Fingerling major carps, 6-7 months old (induced bred, procured from Fish Seed Hatchery, Faisalabad), average weight 21.32±1.99 g, were randomly stocked, from a selected population, in each of the ponds with stocking density of 25, 60 and 15 % for *Catla catla, Labeo rohita* and *Cirrhina mrigala* respectively (64 fish in each of the ponds). Fertilization of ponds with broiler droppings (4.37 % nitrogen) was started on the basis of nitrogen contents. Five nitrogen levels viz. 0.10, 0.13, 0.16, 0.19 and 0.22 g nitrogen per 100 g of wet fish weight daily were designated as T1, T2, T3, T4, and T5 respectively. Treatment 6 served as control without additives.

At the start of the experiment whole fish samples from the same population, other than the stocked fish, were analysed for their proximate composition following A.O.A.C. (1984). At the end of the experiment, five fish of each species were selected randomly from each of the ponds. The sampled fish were subjected to proximate (moisture, crude proteins, fats, carbohydrates and ash) analysis. The three meat samples (bone free fillet) of each specimen (from nape, center, and tail) were mixed to have a composite sample. The dry weights of planktonic biomass and planktonic productivities in terms of both phyto- and zooplankton were determined as described by Javed (1988). Data were subjected to analysis of variance and Duncan's multiple range test. Correlation and regression analyses were performed to find out relationships / trends among various parameters under study.

RESULTS

Table 1 shows the final weights of three fish species after one year growth trial. The proximate composition of fish at stocking and final harvest (bone free fillet) is presented in Table 2. At final harvest the moisture in fish under all the five fertilization levels showed significant ($P < 0.01$) differences. All the three fish species in control treatment had the highest moisture content which correlated inversely with the fish weight gains (Tables 1 and 2). However, the moisture contents were the lowest in both *Catla catla* and *Labeo rohita* in T3 while for *Cirrhina mrigala* in T4.

Table 1. Final wet weights (g) of three fish species at final harvest and responses of treatments towards planktonic productivity of ponds

	Final wet weights (g)					
Species	T1 (0.10gN)	T2 (0.13gN)	T3 (0.16gN)	T4 (0.19g)	T5 (0.22gN)	T6 (Control)
Catla catla	786.92±12.25 b	791.59±8.31 b	823.88±10.14 a	798.70±9.58 b	792.06±12.80 b	128.45±6.91 c
Labeo rohita	563.42±12.50 c	590.40±10.63 c	670.35±8.34 ab	686.92±12.12 a	650.02±8.53 b	142.02±3.72 d
Cirrhina mrigala	677.04±10.23 a	668.19±9.55 a	680.26±11.82 a	639.36±8.78 b	'517.24±12.11 c	157.36±6.15 e

Treatments	Planktonic productivity (No./5 ml of water) Phytoplankton	Zooplankton	Correlation coefficients (r) between planktonic productivity and increase in fish yield
T1	245.67 b	37.25 b	0.8930 **
T2	270.75 ab	44.58 b	0.9090 **
T3	318.75 ab	63.83 a	0.9480 **
T4	371.58 a	50.17 ab	0.9270 **
T5	337.42 ab	48.25 b	0.8940 **
T6	22.75 c	10.42 c	0.5980 *

Means with similar letters in a single column are statistically similar at $P<0.05$.
* = Significant at $P<0.05$; ** = Significant at $P< 0.01$.

The protein contents of both *Catla catla* and *Labeo rohita* were the highest in T3 (18.04 ±0.46 and 19.49 ± 0.54 % respectively). However, *Cirrhina mrigala* in T1 accumulated the highest protein content of 17.43 ± 0.61 %. The fish reared under control treatment had significantly lower protein content than with rest of the treatments. Control treatment caused significantly lower fat accumulation than other treatments in all the three fish species. However, the same was significantly high under T3 in both *Catla catla* and *Labeo rohita* with fat contents of 1.22 ± 0.17 and 2.04 ± 0.21 % respectively. *Cirrhina mrigala* reared under T2 had significantly higher fat content of 2.48 ± 0.27 % than with rest ofthe treatments. Ash contents of fish were significantly high in all the three fish species reared under T5. In control treatment the carbohydrate contents of all the three fish species increased significantly than with the five fertilization treatments (Table 2).

The differences were non-significant between replicate ponds for all the proximate composition variables. The interactions for the variables viz. proteins and carbohydrates were highly significant, however, the same for moisture, fats and total ash were statistically at par. The interactions between treatments and species for moisture, fats and ash contents were non-significant. However, the protein and carbohydrate contents of three fish species interacted significantly under six treatments.

Among the six treatments, T4 and T3 responded the maximum towards phytoplankton and zooplankton productivity respectively (Table 1). The correlation coefficients between planktonic productivity of ponds and increase in fish yields under all the fertilizing treatments were highly significant.

DISCUSSION

The fat and protein contents of fish meat increased and that of ash and carbohydrate contents decreased among the three fish species after pond fertilization trials. With the increase of nitrogen level, the body fat and protein contents were found to increase up to 0.16 g nitrogen level. However, both the fish species viz. *Catla catla* and *Labeo rohita* reared under T3 (0.16 g nitrogen level) contained the highest fat and protein contents of 1.22 ± 0.17, 2.04 ± 0.21 and 18.04 ± 0.46, 19.49 ± 0.54 % respectively, while *Cirrhina mrigala* accumulated maximum fats and proteins in its body under T2 and T1 respectively. As regards overall performance of the three fish species, under five fertilization treatments, *Labeo rohita* and *Cirrhina mrigala* came up as the best species containing maximum proteins and fats respectively. However, both the fat and protein contents of control fish were significantly lower than those with all the fertilization treatments because of slow fish growth under this treatment and a long period of restricted food supply to the fish (without any additives), causing a progressive reduction in fat reserves (Javed, 1988). This reached a critical low value before proteins began to be utilized and ultimately caused a reduction in protein contents (Parker and Vanstone, 1966). Love (1980) reported that the fish during starvation at first consume lipids from the liver and start to mobilize muscle proteins only when this source of energy has been nearly used up. After that, as protein is utilized, water moves in to take its place. Such a shift results in increased water content of the fish body as observed in present study (Table 2).

Zeitler et al. (1984) considered not only the protein contents but also the quantity of fats in fish meat as a parameter to evaluate fish meat quality. Sgnificantly high fat and protein contents of *Catla catla* and *Labeo rohita* in T3 and of *Cirrhina mrigala* under T2 andT1 was the result of comparatively higher growth rates of fish species under these treatments (Tables 1 and 2) as reported by Hassan et al. (1996). These high growth rates of fish were correlated positively and significantly with the' available planktonic biomass (Table 1), especially the zooplankton which showed significantly higher densities under T3 followed by T4, T5, T2, T1 and T6. However, the differences among T1, T2, T4 and T5 were non-significant. Thus, from the above findings it is concluded that high quantities of both fats and proteins in fish body under different fertilization treatments were due to the better performance under these treatments towards planktonic productivity indices especially the zooplankton, being an excellent source of fats and proteins (Seifken and Armitage, 1968; Javed, 1988). Zeitler et al. (1984) also reported that total fat and protein contents of *Cyprinus carpio* showed direct dependence on the quantity of food supplied. Since the productivity of T3 for both phyto- and zoopbnkton densities was significantly higher than rest of the treatments, therefore the fish under this treatment gave better growth performance along with fats and proteins in their muscles. However, better accumulation of proteins in *Labeo rohita* and fats in *Cirrhina mrigala* than *Catla catla* may also be due to feeding habits of these fish species (Jhingrán, 1982) under the response to different treatments towards planktonic biota (Javed et al., 1992 and 1993). Jirasek et al. (1984) reported that higher feeding frequency in fish increased significantly the total fat and protein contents of carps which may depend upon feeding habits ofthe fish species (Javed, 1988).

The ash contents of all the three fish species were significantly higher under 0.22 g nitrogen level (T5) than with rest of the treatments (Table 2) which may be due to higher droppings content. In the present study, the correlation coefficients between total fat

Table 2. Proximate composition of initially stocked and finally harvested fish

Proximate composition of initially stocked fish

Species	Moisture	Total proteins	Total fats	Total ash	Total carbohydrates
Catla catla	87.08±0.18	7.00±0.13	1.50±0.06	2.19±0.02	2.23±0.10
Labeo rohita	87.07±0.12	6.89±0.11	1.53±0.06	2.21±0.03	2.30±0.10
Cirrhina mrigala	87.00±0.14	6.94±0.09	1.48±0.01	2.17±0.04	2.41±0.03

Proximate composition of finally harvested fish

Species	T1 (0.10g N level)	T2 (0.13g N level)	T3 (0.16g N level)	T4 (0.19g N level)	T5 (0.22g N level)	T6 (Control)
Moisture (%)						
Catla catla	79.85±1.40 b	79.64±2.62 b	78.34±1.69 b	79.65±1.60 b	79.02±1.17 b	83.89±1.05 a
Labeo rohita	76.64±2.15 b	76.13±1.13 b	75.52±1.16 b	76.00±1.07 b	76.65±1.29 b	81.82±0.47 a
Cirrhina mrigala	77.82±1.80 b	77.94±1.45 b	77.26±1.11 b	77.22±0.49 b	77.49±0.99 b	81.30±0.39 a
Mean	78.10	77.90	77.04	77.62	77.72	82.34
Proteins (%)						
Catla catla	17.03±0.53 e	17.34±0.35 be	18.04±0.46 a	17.10±0.49 e	17.43±0.57 be	12.04±0.15 d
Labeo rohita	19.49±0.40 a	19.39±0.56 a	19.49±0.54 a	18.52±0.48 b	18.66±0.69 b	13.20±0.46 e
Cirrhina mrigala	17.43±0.61 ab	16.85±0.50 de	16.66±0.36 e	17.13±0.42 ede	17.25±0.58 bed	13.46±0.47 f
Mean	17.98	17.86	18.06	17.58	17.78	12.90
Fats (%)						
Catla catla	0.95±0.15 be	0.81±0.14 e	1.22±0.17 a	1.00±0.19 b	0.94±0.16 be	0.21±0.02 d
Labeo rohita	1.59±0.18 e	1.70±0.17 be	2.04±0.21 a	2.01±0.13 a	1.62±0.20 c	0.57±0.10 d
Cirrhina mrigala	1.83±0.15 c	2.48±0.27 a	2.19±0.19 b	2.11±0.15 b	1.87±0.10 c	0.73±0.02 d
Mean	1.46	1.66	1.82	1.71	1.48	0.50
Ash (%)						
Catla catla	0.99±0.07 d	1.05±0.14 d	1.38±0.12 c	1.59±0.21 b	1.77±0.17 a	1.63±0.11 b
Labeo rohita	1.30±0.19 c	1.27±0.05 c	1.88±0.29 b	1.95±0.16 ab	2.12±0.14 a	1.98±0.10 a
Cirrhina mrigala	1.53±0.12 d	1.68±0.15 cd	1.99±0.21 b	2.10±0.23 b	2.34±0.35 a	2.01±0.09 b
Mean	1.27	1.33	1.75	1.88	2.08	1.87
Carbohydrates (%)						
Catla catla	1.18±0.11 b	1.16±0.11 b	1.02±0.07 e	0.67±0.14 e	0.84±0.07 d	2.23±0.23 a
Labeo rohita	1.00±0.17 d	1.50±0.26 b	1.07±0.17 cd	1.50±0.09 b	0.95±0.05 d	2.43±0.10 a
Cirrhina mrigala	1.39±0.18 c	1.05±0.14 d	1.92±0.19 b	1.44±0.14 c	1.05±0.05 d	2.50±0.15 a
Mean	1.19	1.24	1.34	1.20	0.95	2.39

Means with similar letters in a row are statistically similar at $P<0.05$; NS = Non-significant; S.D. = Standard deviation; N = Nitrogen.

and carbohydrate contents of all the three fish species were negative but highly significant. Eckhardt et al. (1982) reported positive correlation between these two meat quality components in *Cyprinus carpio*. In general, the metabolic processes indicate a flow of lipids into carbohydrates (gluconeogenesis) and vice versa. Thus, the two energy producing nutrients remain in equilibrium. In case both of them increase/decrease in the same direction, then lipogenesis in the fish may be derived from the diet as for example increased consumption of zooplankton, whereas increase in carbohydrates might have been achieved through direct consumption of nitrogen free extract (NFE) from feed or phytoplankton (Javed, 1988).

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