Proximate Composition of Viscera of Major, Common and Some Chinese Carps Under the Effect of Different Fertilization Schemes and Feed Supplementation in Composite Culture System

Shahid Mahboob[1] and A. N. Sheri
Department of Zoology, Govt College Faisalabad, University of Agriculture, Faisalabad, Pakistan

ABSTRACT : The proximate composition of viscera of six fish species viz., *Catla catla, Labeo rohita Cirrhina mrigala, Hypophthalmichthys molitrix, Ctenopharyngodon idella* and *Cyprinus carpio* under the influence of artificial feed (T_1), broiler manure (T_2), buffalo manure (T_3), N:P:K (25:25:0 T_4) and control pond (T_5) has been studied on final harvest after the end of experimental period of one year. The overall comparison of six fish species under five different treatments showed that *Cyprinus carpio* remained the best for viseral total protein contents. The maximum visceral protein content was recorded in fishes under T_2 except *Cirrhina mrigala,* while the minimum under T_5. The comparison of five treatments showed that maximum (6.69) percentage of fat in viscera of fish was recorded under T_2, closely followed by T_4 while minimum (4.89) under the effect of T_5. Among the six fish species under five treatments *Cyprinus carpio* showed maximum accumulation/deposition of total fats in viscera.
(**Key Words**: Organs, Moisture, Protein, Fat, Total Ash, Carbohydrates)

INTRODUCTION

Fish is today considered as the most promising inexpensive alternative sources of animal protein and is consumed by man. Fish offers relatively high amount of essential amino acids, mineals and fatty acids as compared to live stock (Huisman, 1989). The whole body composition is often used as an indicator of fish quality (Mahboob et al., 1996). However, our knowledge of chemical composition of the viscera (all organs combined) is one of the least advanced area of fish composition. Although viscera is not used as edible part of fish by man, yet it can be successfully utilized in the preparation of various feeds and pharmaceutical products due to its higher protein contents as low/no cost.

No comprehensive information could be available regarding the proximate composition of viscera (all organs combined) in the literature in Pakistan under available resources. A few quantitative studies about some of the organs were conducted. Creach and Cournede (1965) reported that due to restricted food supply or starvation during the first two months exploitation of the organs to lose their nutrients occurs. Boggio et al. (1985) reported no marked difference in the fatty acid composition of muscle and viscera of trout.

The present work was, therefore, planned to establish the bench marks for the proximate composition of different fish species as influenced by pond fertilization with isonitrogenous organic, inorganic fertilizers and supplementation of feed under composite culture system.

MATERIALS AND METHODS

The research reported here was carried out over a period of one year from December, 1992 through December, 1993 under ambient conditions typical of Faisalabad area. Area of Faisalabad recognized for somewhat salty ground-water and is growing almost all cash crops and fodders. Five newly dug earthen fish ponds of dimensions 15m × 8m × 2.5m (length × width × depth) located at Fisheries Research Farms, Department of Zoology and Fisheries, University of Agriculture, Faisalabad were used in the present investigation. Each experiment was replicated three times in a factorial experiment.

After preliminary preparation of ponds, approximately four months old fingerlings of *Catla catla, Labeo*

[1] Address reprint requests to S. Mahboob.
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rohita, *Cirrhina mrigala*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella* and *Cyprinus carpio* were stocked randomly in each of the ponds in the ratios of 10:30:12.5:25:10.5:12.5, respectively with the stocking density of 2.87m^3/fish (Javed, 1988). The interspecies ratios was adopted according to Lakshmanan et al. (1971) as showen in table 1.

The percentage N, P, and K of the, four treatments materials in this study were obtained by AOAC. (1984) methods as shown in table 2.

Table 1. Interspecies ratio, initial weight, fork length and total length of six fish species

Fish species	Individual	Ratio	Weight (gm)	Fork length (mm)	Total length (mm)
Catla catla	10	10	12.87 ± 0.08	53.23 ± 0.05	59.31 ± 0.09
Labeo rohita	32	30	11.93 ± 0.05	50.84 ± 0.08	57.62 ± 0.07
C. mrigala	13	12.5	16.80 ± 0.02	51.68 ± 0.06	61.22 ± 0.07
H. molitrix	26	25	22.14 ± 0.07	124.18 ± 0.09	143.74 ± 0.16
C. idella	10	10	19.57 ± 0.09	93.16 ± 0.07	97.82 ± 0.08
C. carpio	13	12.5	18.49 ± 0.10	83.32 ± 0.07	101.43 ± 0.23

Table 2. Percentage nitrogen and phosphorus contents of treatment materials

Treatment	Pond No.	Treatment Material	% Nitrogen	% Phosphorus
T_1	1	Artificial feed (vegetable sources)	5.60 ± 0.03	2.05 ± 0.06
T_2	2	Broiler manure	4.62 ± 0.12	1.66 ± 0.14
T_3	3	Buffalo manure	1.02 ± 0.05	0.96 ± 0.02
T_4	4	N:P:K(25:25:0)	25.00 ± 0.04	25.00 ± 0.04
T_5	5	Control	No additive	No additive

Feed supplementation of T_1 and fertilization of T_2, T_3 and T_4 was done with broiler manure, buffalo manure and N:P:K (25:25:0) based on their nitrogen contents at the rate of 0.15 gm nitrogen per 100 gm of wet fish weight daily for one year. However, control pond (T_5) remained without any additives.

Artificial feed composed of sesame oil cake (32%), maize gluten meal 30% (20%), cotton seed meal decardicated 30% (40%), wheat bran (3.5%), rice polish (3.5%) and vitamin mineral mix (1%).

At the end of experimental period, the moisture, total proteins, fats and ash contents of fish viscera (all organs combined) were analysed by following AOAC (1984) while total carbohydrates were calculated by difference as nitrogen free extract (NFE).

The data thus obtained were subjected to statistical analysis by using Micro-computer IBM-PC. The comparison of mean values and significance of interactions by using analysis of variance and Duncan's multiple range test through two-way classification (Factorial Experiment) with repeated sampling. MSTAT package of computer was used for the analysis.

RESULTS AND DISCUSSION

In the present investigation, the overall comparison of six fish species under five different treatments showed that *Cyprinus carpio* accumulated the highest visceral total protein contents, followed by *Cirrhina mrigala*, *Catla catla*, *C. idella*, *Labeo rohita* and *H. molitrix* (Table 1). The maximum protein content was recorded in fishes supplied broiler manure (T_2) except *Cirrhina mrigala* while the minimum under T_5. The comparison of means showed that the differences were significant due to treatments.

The fish *Cyprinus carpio* viscera came up with highest (7.13%) contents of total ether extract, followed by *H. molitrix*, *Cirrhina mrigala*, *Catla catla*, *Labeo rohita* and *C. idella* (table 3). The comparison of five treatments showed that maximum percentage of fats in viscera of fish was recorded under T_2, closely followed by T_4. However, the minimum visceral fat were recorded under the effect of T_5. This marked difference in the protein and fat contents in viscera of fish under control pond (T_5) was due to shortage of food which resulted in

Table 3. Comparison of means (± SE) for proximate composition of viscera

	T_1	T_2	T_3	T_4	T_5	Means
a) Water (%)						
Catla catla	75.57 ± 0.05[c]	73.44 ± 0.04[d]	78.15 ± 0.04[b]	75.69 ± 0.04[c]	79.91 ± 0.05[a]	76.55
Labeo rohita	77.68 ± 0.07[b]	75.51 ± 0.04[d]	76.57 ± 0.06[d]	77.16 ± 0.05[b]	81.17 ± 0.06[a]	74.02
Cirrhina mrigala	73.89 ± 0.06[bc]	72.72 ± 0.03[cd]	74.46 ± 0.05[b]	74.55 ± 0.03[b]	78.27 ± 0.07[a]	74.78
H. molitrix	76.06 ± 0.05[d]	77.31 ± 0.05[c]	78.85 ± 0.06[b]	77.38 ± 0.07[c]	80.90 ± 0.04[a]	78.10
Cyprinus carpio	69.62 ± 0.04[c]	65.24 ± 0.06[d]	72.29 ± 0.07[b]	68.46 ± 0.05[c]	75.87 ± 0.05[a]	70.30
C. idella	76.22 ± 0.05[c]	73.73 ± 0.05[d]	76.18 ± 0.05[c]	77.83 ± 0.06[b]	81.16 ± 0.06[a]	77.02
Means	74.84	72.99	76.08	75.18	76.55	
SE	Treatment = 0.867		Species = 0.950	Treatment × species = 2.12		
b) Total protein (%)						
Catla catla	12.47 ± 0.03[c]	13.06 ± 0.04[a]	12.19 ± 0.05[d]	12.62 ± 0.06[b]	9.94 ± 0.06[e]	12.06
Labeo rohita	11.21 ± 0.04[b]	11.88 ± 0.05[a]	11.08 ± 0.06[d]	11.15 ± 0.05[c]	8.20 ± 0.03[e]	10.70
Cirrhina mrigala	13.10 ± 0.03[c]	13.52 ± 0.04[b]	13.14 ± 0.04[c]	13.61 ± 0.04[a]	10.14 ± 0.05[d]	12.70
H. molitrix	9.70 ± 0.06[b]	9.93 ± 0.05[a]	8.92 ± 0.05[d]	9.02 ± 0.03[c]	7.21 ± 0.05[e]	8.96
Cyprinus carpio	14.28 ± 0.04[c]	15.02 ± 0.04[a]	13.91 ± 0.04[d]	14.50 ± 0.03[b]	10.62 ± 0.03[e]	13.68
C. idella	11.14 ± 0.05[b]	11.72 ± 0.03[a]	10.64 ± 0.04[d]	10.90 ± 0.05[c]	8.82 ± 0.05[e]	10.65
Means	11.98	12.53	11.65	11.97	9.15	
SE	Treatment = 0.008		Species = 0.009	Treatment × species = 0.021		
c) Total fats (%)						
Catla catla	5.08 ± 0.04[b]	6.12 ± 0.05[a]	4.66 ± 0.03[d]	4.96 ± 0.03[c]	3.86 ± 0.04[e]	4.94
Labeo rohita	4.90 ± 0.04[c]	5.50 ± 0.04[b]	4.31 ± 0.03[d]	5.65 ± 0.02[a]	3.23 ± 0.03[e]	4.72
Cirrhina mrigala	5.74 ± 0.02[d]	6.70 ± 0.03[a]	5.88 ± 0.02[c]	6.02 ± 0.03[b]	4.17 ± 0.02[e]	5.70
H. molitrix	5.94 ± 0.03[d]	7.06 ± 0.02[a]	6.12 ± 0.05[c]	6.50 ± 0.03[b]	4.96 ± 0.03[e]	6.11
Cyprinus carpio	6.54 ± 0.04[c]	9.15 ± 0.03[a]	6.13 ± 0.04[d]	8.66 ± 0.02[b]	5.15 ± 0.02[e]	7.13
C. idella	4.57 ± 0.03[d]	5.62 ± 0.02[a]	4.69 ± 0.05[c]	5.24 ± 0.04[b]	3.19 ± 0.04[e]	4.66
Means	5.46	6.69	5.30	6.17	4.89	
SE	Treatment = 0.006		Species = 0.007	Treatment × species = 0.012		
d) Carbohydrates (%)						
Catla catla	2.88 ± 0.04[a]	2.44 ± 0.06[b]	0.95 ± 0.04[d]	1.84 ± 0.05[c]	0.65 ± 0.05[e]	1.75
Labeo rohita	1.42 ± 0.05[d]	2.66 ± 0.07[b]	3.36 ± 0.03[a]	1.95 ± 0.04[c]	1.34 ± 0.05[e]	2.15
Cirrhina mrigala	4.02 ± 0.03[a]	2.92 ± 0.04[b]	2.09 ± 0.05[d]	1.23 ± 0.02[e]	2.29 ± 0.06[c]	2.51
H. molitrix	4.09 ± 0.04[a]	1.47 ± 0.05[d]	1.78 ± 0.04[c]	2.61 ± 0.03[b]	1.74 ± 0.04[c]	2.34
Cyprinus carpio	4.46 ± 0.04[a]	3.87 ± 0.05[b]	1.93 ± 0.06[c]	1.90 ± 0.05[c]	1.41 ± 0.06[d]	2.71
C. idella	3.34 ± 0.03[c]	3.97 ± 0.04[a]	3.86 ± 0.04[b]	1.80 ± 0.06[d]	1.52 ± 0.05[e]	2.90
Means	3.37	2.89	2.33	1.89	1.49	
SE	Treatment = 0.011		Species =0.012	Treatment × species = 0.027		
e) Ash (%)						
Catla catla	4.00 ± 0.03[e]	4.94 ± 0.04[b]	4.06 ± 0.03[d]	4.88 ± 0.05[c]	5.66 ± 0.05[a]	4.71
Labeo rohita	4.78 ± 0.04[b]	4.46 ± 0.05[d]	4.67 ± 0.04[c]	4.09 ± 0.03[e]	6.06 ± 0.03[a]	4.81
Cirrhina mrigala	3.96 ± 0.02[e]	4.14 ± 0.03[d]	4.43 ± 0.05[c]	4.59 ± 0.03[b]	5.13 ± 0.04[a]	4.45
H. molitrix	4.22 ± 0.02[d]	4.23 ± 0.06[d]	4.33 ± 0.04[c]	4.49 ± 0.04[b]	5.18 ± 0.03[a]	4.49
Cyprinus carpio	5.11 ± 0.03[e]	6.64 ± 0.04[b]	5.76 ± 0.04[d]	6.48 ± 0.03[c]	6.95 ± 0.02[a]	6.19
C. idella	4.73 ± 0.06[c]	4.96 ± 0.05[b]	4.62 ± 0.03[d]	4.23 ± 0.02[e]	5.32 ± 0.03[a]	4.78
Means	4.47	4.89	4.65	4.80	5.72	
SE	Treatment = 0.006		Species = 0.007	Treatment × species = 0.012		

Treatment means with the same letter in a row are statistically similar at $p < 0.05$.

the retarded development of visceral organs along with growth of fish and ultimately long period of restricted food supply of fish, causing a progressive reduction in fat contents, whereas, the viscera of fish placed on control pond (T_5) was rich in water contents (table 3). These findings were in line with the results of Creach and Cournede, (1965). They reported that due to restricted food supply or starvation during the first two months the exploitation of the organs to lose their nutrients occurs in the following order: intestine, liver, kidneys, spleen, muscle and heart. After eight month the liver and kidneys are most affected, spleen and intestine less and heart hardly at all.

The higher protein contents in the viscera of fish under the influence of T_2 could be due to better growth performance of six fish species under this treatment. Shul' man (1974) mentioned that the "plastic material" for the formation of genital products and other organs is derived from food and from reserves built up on the organism. The reserve proteins intensively utilized for the synthesis of generative tissue include serum albumin and α-globulin. In the present investigation the protein synthesis in viscera of fish related to linear and volumetric growth of fish and substantiated the findings of Shul'man (1974).

Carbohydrates are stored in the liver as glycogen, a polysaccharide built of glucose units. Of all the energy reserve, the carbohydrates are the most readily utilized and the first to be affected by depletion (Love, 1980). The viscera of six fish species showed different response of the treatments for total carbohydrates. The overall comparison of viscera of fish for the carbohydrates under all the five treatments, *C. idella* showed highest percentage, followed by *Cyprinus carpio*, *Cirrhina mrigala, H. molitrix, Labeo rohita* and *Catla catla* (table 3).

The significant interactions (treatment × species) for the different proximate constituent of viscera of fish for the six fish species in depositing these compounds in various organs under the five treatments was due to difference in nutritional status and response of fish to these treatments according to their weight gaining ability. Difference in accumulation of chemical compounds may also be due to difference in available food which was due to response of treatments. Overall results showed that the visceral chemical constituent of the six fish species under all the five treatments followed the same general trend of the muscle and there were no marked difference between muscle and viscera. It may be due to the fact that the various visceral organs are also part of the body of fish. These results are supported by the findings of Boggio et al. (1985). They reported no marked difference in the fatty acid composition of muscle and viscera of trout.

The proximate compostion of visceral organs showed similar relationshiop between increase in weight and protein contents as described by Mahboob et al. (1996) for the protein conents of meat and fish increments under different treatments. This means that the organs on the whole grow proportionate to the growth of fish body and the growth was protein dependent. The rest of the proximate constituents also went along with the relationship as between the weight gains and protein concentrations. The particular example of the other constituents is the carbohydrate part of viscera was negatively correlated with the increase in weight. Discrepancies were observed in the water and ash contents under some treatments could be due to deficiencies in the response of different treatments for planktonic biota or artificial starvation due to unwillingness of fish to feed for a long or short period. Under such circumstances the feed back mechanism start with the result that the changes in the nutrient composition may happen.

No comprehensive information could be available regarding the chemical composition of viscera (all organs combined) in the literature in Pakistan under available resources. These values may be presumed as new bench marks for various fishes viz., *Catla catla, Labeo rohita, Cirrhina mrigala, H, molitrix*, *Cyprinus carpio* and *C. idella* under local conditions. Although viscera is not used as edible part of fish by man yet it can be successfully utilized in the perparation of various feeds and pharmaceutical products due to its higher protein contents as low/ no cost.

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