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Body Composition and Fatty Acid Profile of Carps under the Influence of Rice Polish and Pond Fertilization

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ABSTRACT

The experiment was conducted in two earthen ponds to investigate the body composition, and fatty acid profile of carps along with growth performance by using rice polish as fish feed with urea and ammonium nitrate fertilization of pond. Silver carp (*Hypophthalmichthys molitrix*), Rohu (*Labeo rohita*) and Mori (*Cirrhinus mrigala*) were stocked in the ratio of 1:2:1 respectively with total number of 40 fishes in each pond. Pond 1 was treated with urea and rice polish while pond 2 was treated with ammonium nitrate and rice polish at the rate of 0.3g Nitrogen/100g of wet body weight of fish daily. There was found highly significant difference between species and ponds in terms of growth. Highest growth in terms of gain in body weight was shown by *H. molitrix* in both ponds *i.e.* 399.0g in pond 1 and 299.9g in pond 2. Net fish production of pond 1 remained as 1311.3 kg/ha/year and pond 2 was 1104.2 kg/ha/year. Pond 1 showed 1.5 times greater fish production than pond 2. Proximate analysis of the fish meat showed that there was no significant difference in body composition of three species in both the ponds. Highest protein contents (18.04 %) were found in the meat of *C. mrigala* in P_1 and lowest protein contents (17.16 %) were in the meat of *H. molitrix* in P_2. There was also non-significant difference between three species in terms of fatty acid profile. The overall contents of fatty acids were highest in *L. rohita* as compared to other two species. Saturated fatty acids were highest in *L. rohita* whereas monounsaturated fatty acids were highest in *C. mrigala*.

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AM executed the experimental work. AG performed chemical analysis. SF performed fatty acid analysis. GA and LG wrote the article.

Key words
Carps body composition, fatty acid profile, rice polish, pond fertilization

INTRODUCTION

Current days, health awareness has increased among the people. Food of good and desired quality is required for health and growth. In this effort, the best method is to integrate the essential fatty acids (EFAs) along with protein in the routine diet for growth and development. Fish is an important source of animal protein in food for human consumption. Nutrition experts consider fish as a great alternative of protein for red meat. Flesh of fish contains all the essential amino acids and minerals namely, iodine, phosphorus, potassium, iron, copper, vitamin A and D inappropriate concentrations (Sandu, 2005). To include fish in our diet can provide a valuable contribution to any diet pills that contain mostly starchy roots and sugar for growth (Rizvi, 2006; Salim, 2006; Yildrim, 2008). Fish flesh is not only good in taste but it is highly nutritious and easily digested. In many developing countries, it is not less than a blessing to obtain energy in the form of protein. About 60% of the people in developing countries obtain 30% of animal protein from fish while in developed countries, this value is 20%. Fish flesh is quite different from other animal meat in this manner that it is not only source of low energy but also provides high levels proteins, a significant amount of polyunsaturated fatty acids and long muscle fiber (Kandemir and Polat, 2007).

Fish body composition appeared to be largely influenced by feed composition and fertilization of pond. Increase or decreases in feed composition, use of organic or inorganic fertilizer and fish size resulted in enhanced adipose deposition and decreased in water contents in the fish body (Rasmussen, 2001; Abbas *et al*., 2010; Rao *et al*., 2010). Mahboob *et al*. (2004) reported the proximate body composition of six fish species under different fertilization schemes. They found that flesh of all fish species depicted overall highest protein contents (60.72%) in fish from broiler manure fertilization. *Labeo rohita* showed the best performance (60.75%) in terms of accumulating protein in body. The maximum fat and ash contents were recorded in *Cyprinus carpio* and correlation coefficient between total fat and total protein was highly significant and positive.

We can increase the production of fish with the application of fertilizers and supplements in the polyculture system of carp. The main purpose of fertilizing ponds is to increase production of plankton that is a natural food for fish, as both autotrophic and heterotrophic levels grow up by fertilization and fish

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production increases (Grag and Bhatnagar, 2000). Food and fertilization increases the fish production up to 5000 kg/ha (Azim, 2002). The concept of polyculture carp based on the idea that when the crop species consistent with the dietary habits reside in the same basin, the maximum food consumption of all pond columns occur. Fertilization of the ponds is essential to improve fish production and farmers use fertilizers at different doses, which can sometimes be three or four times the standard dose for achieving more benefits. However, the current crisis of chemical fertilizers in the country is a serious problem. Moreover, farmers are facing financial losses for the purchase of fertilizer in excess (Sayeed *et al*., 2007).

Because of its importance in the formation of strategies to improve the fatty acid content, **Ω-**3 improve the quality of animal products. Fish are an excellent source of the protein and fatty acids, but EFA varies between freshwater and marine species. The first is rich in **Ω-**6 fatty acids, while the second contains more fatty acids as, **Ω-**3. In fact, in fish, liver is the main body of the synthesis of long chain fatty acids and plays a crucial role in various aspects of lipid metabolism (Kumar *et al*., 2011).

Keeping in view the importance of growth and fatty acid profile of fish, this research work has been designed to evaluate the body composition and fatty acid profile of carps under the influence of rice polish and fertilizer supplementation.

MATERIALS AND METHODS

To study the body composition and fatty acid profile of carps under the influence of rice polish and fertilizer supplementation, the choice of two ponds was made, each with dimensions of 25m × 8.5m × 1.5m (length × width × depth) located at Fisheries Research Farms, University of Agriculture, Faisalabad. Both ponds were dried up before stocking the fish. CaO was applied in the ponds to maintain the pH and for disinfection. Water inlets were screened to prevent extruders to enter or leave of fish from ponds. After a week of taking these initial steps, each pond was filled with water up to 1.5 meters and this water level was maintained throughout the experiment. Forty fishes were stocked in each pond as 10 silver carps (*Hypophthalamichthys molitrix*), 20 rohu (*Labeo rohita*) and 10 mori (*Cirrhinus mrigala*). Urea and rice polish was applied in pond 1 while ammonium nitrate and rice polish in pond 2 @ 0.3 gN/100gm of body weight per day. Feed was given daily, while fertilizers were added on a weekly basis. Growth parameters of fish like body weight and total length was measured weekly for a period of 15 weeks.

At harvest, five meat samples of each species from each pond were collected and stored in freezer for proximate analysis in terms of moisture, total fat, crude protein, total ash and carbohydrates following AOAC (2000). Fatty acids profile of each fish was analyzed for three fatty acids *i.e.* unsaturarted, monounsaturated and polysaturated fatty acids. The data on growth parameters, body composition and fatty acid profile was subjected to statistical analysis through microcomputer using MSTATC and MICROSTAT packages.

RESULTS

Results on growth performance of carps are given in Table I. The survival rate of these fishes was found 100% throughout the experimental period. Fishes produced significantly higher values for weight increment. *H. molitrix* gained highest weight 399.0g that is highly significant than *L. rohita* and *C. mrigala* at the end of experiment. *H. molitrix* gained maximum length in both the ponds *i.e.* 37.9cm in pond 1 and 36.7cm in pond 2 (Table I). There was non significant difference in increase of total length of fish in each week. ANOVA on fork length showed highly significant difference in increase in body weight of fish. Highest fork length was also gained by *H. molitrix* (Table I). For one year, gross production of *H. molitrix* was 21.7 kg, *L. rohita* 14.6 kg and *C. mrigala* 8.0 kg in P1, and in P2 15.6 kg *H. molitrix*, 13.9 kg *L. rohita* and 7.6 kg *C. mrigala*.

Results on body composition of three species in both ponds are given in Table II. There was non significant difference (P>.05) in body composition of three species. Greater protein contents were found in *C. mrigala* 18.04% relative to *L. rohita* and *H. molitrix* in pond 1 while the lowest protein contents were found in meat of *H. molitrix* 17.16% in P 2(Table II). The highest moisture contents were observed in the flesh of *H. molitrix* (78.11 %) in P_2 and lowest moisture contents were also in the flesh of *H. molitrix* (76.90 %) in P_1. The highest fat contents were observed in the flesh of *L. rohita* (1.64 %) in P_2 while the flesh of *H. molitrix* (1.15 %) in P_2 showed the lowest fat contents. The highest ash contents were observed in the flesh of *H. molitrix* (1.93 %) in P_1 and lowest ash contents were in the flesh of *L. rohita* (1.22 %) in P_2. The highest carbohydrate contents were observed in the flesh of *L. rohita* (1.76 %) in P_1 and lowest carbohydrate contents were in the flesh of *H. molitrix* (1.41 %) in P_2. Mean fatty acid values of three species are given in Table III. Total saturated fatty acids accounts for 29 % in all the samples. The predominant saturated fatty acid was 16: 0 followed by 18: 0 and 14:0. The monounsaturated fatty acids were found to be 37 % in all fish samples and the major fatty acid of this group

Table I.- **Fish Production of *Hypophthalamichthys molitrix, Labeo rohita* and *Cirrhinus mrigala* in two experimental ponds.**

	P1 Urea +Rice polish			P2 Ammonium nitrate + Rice Polish		
	H. molitrix	*L. rohita*	*C. mrigala*	*H. molitrix*	*L. rohita*	*C. mrigala*
No. of fish	10.0	20.0	10	10	20	10
Survival rate (%)	100	100	100	100	100	100
Total gain in weight (g)	399.0	160.4	147.1	289.9	139.7	140.1
Total gain in length (cm)	37.9	29.3	18.3	36.7	22.3	18.0
Net fish production/pond/year (Kg)	20.8	13.7	7.3	15.2	12.5	7.2
Net fish production/hectare/year (Kg)	652.5	429.8	229.0	476.9	392.2	235.2
Gross fish production/hectare/year (Kg)	680.8	458.0	250.9	489.4	436.1	238.4

Table II.- **Body Composition of *Hypophthalamichthys molitrix, Labeo rohita* and *Cirrhinus mrigala* in two experimental ponds.**

		Moisture (%)	Protein (%)	Lipids (%)	Ash (%)	Carbohydrates (%)
H. moltrix	P 1	76.90 ± 0.78	17.41 ± 0.30	1.37 ± 0.16	1.93 ± 0.04	1.48 ± 0.12
	P 2	78.11 ± 0.20	17.16 ± 0.50	1.15 ± 0.05	1.65 ± 0.04	1.41 ± 0.22
L. rohita	P 1	77.46 ± 0.69	17.33 ± 0.53	1.36 ± 0.21	1.55 ± 0.21	1.76 ± 0.16
	P2	77.53 ± 0.32	17.19 ± 0.60	1.64 ± 0.08	1.22 ± 0.12	1.54 ± 0.19
C. mrigala	P1	77.96 ± 0.51	18.40 ± 0.39	1.59 ± 0.14	1.50 ± 0.16	1.72 ± 0.13
	P2	78.08 ± 0.51	17.32 ± 0.34	1.56 ± 0.18	1.36 ± 0.07	1.61 ± 0.28

was 18:1 n-9 followed by 16:1 n-7 and 18:1 n-7. Polyunsaturated fatty acids accounted 33 % of the total fatty acids in all samples and the leading fatty acid of this group was 18:2 followed by 22:6 and 20:5. The overall contents of fatty acids were higher in *L. rohita* compared to other two species.

DISCUSSION

Rearing of *L. rohita, C. mrigala* and *H. molitirix* in ponds fertilized with urea and ammonium nitrate and giving rice polish as feed resulted in improved growth of these fishes. As for as the individual growth of three cultured carp species is concerned there is found significant difference was found among these in both pond 1 and 2 with respect to gain in body weight of three said fish species. Silver carp (*H. molitirix*) showed the maximum gain in weight, 399 g and 289.9 g in pond 1 and 2 respectively which showed greater adaptability of silver carp to low temperature as compared to *L. rohita*, 160.4 g in pond 1 and 139.7 g in pond 2 and *C. mrigala*, 147.1 g and 140.1 in pond 1 and 2, respectively. These results were similar to the findings of Ezra and Nwankwo (2001) who reported the highest growth of fish in the presence of suitable environmental conditions such as high dissolved oxygen, low temperature and low ammonia. These results were also confirmed by Afzal *et al*. (2007) who reported that *H. molitirix* gained higher body weight (849.1 g) than *Ctenopharyngodon idella* (809.20 g) and *L. rohita* (777.8 g) in the pond which is treated with inorganic fertilizers. *L. rohita* ranked 2nd in gaining body weight (160.4g in pond 1 and 139.7g in pond 2) while *C. mrigala* gained lowest weight (147.1g in pond 1 and 140.1g in pond 2).

Meat excellence is an important feature. Fertilization, diet composition and feeding rates affect pond ecosystem directly and indirectly and also fish meat quality. The body composition of fish meat showed that *C. mirgala* showed maximum moisture contents (78.811%) observed in pond 1 and minimum (76.93%) were noted in pond 2 in *L. rohita*. Maximum crude protein (17.93%) was recorded in *L. rohita* in pond 2 whereas minimum crude protein (16.81%) was observed in pond 1 in *L. rohita*. The results are in accordance with Hassan and Javed (1999) who reported higher moisture and protein contents in *L. rohita* under pond culture.

The predominant fatty acids among total values were 16:0 (SFA) and 18:1 n-9 (MUFA) in all fish

Table III.- Fatty acid profile (%) of *Hypophthalamichthys molitrix*, *Labeo rohita* and *Cirrhinus mrigala* in two experimental ponds.

Type	Isomers	Silver carp		Rohu		Mori	
		P1	P2	P1	P2	P1	P2
Saturated fatty acids	14:0	1.31	1.28	1.56	1.47	1.54	1.74
	15:0	0.26	0.27	0.14	0.23	0.09	0.10
	16:0	22.28	21.99	23.84	21.66	20.99	21.21
	17:0	0.92	0.86	0.47	0.43	0.65	0.64
	18:0	4.35	4.96	4.12	4.12	4.98	5.31
	20:0	0.65	0.52	0.45	0.45	0.70	0.64
	24:0	0.88	0.87	0.68	0.58	0.63	0.64
Mono-unsaturated fatty acids	14:1	0.26	0.25	0.25	0.29	0.34	0.32
	15:1	0.75	0.74	0.76	0.44	0.65	0.56
	16:1(n-9)	1.83	1.71	1.18	1.17	1.28	1.14
	16:1(n-7)	4.81	4.96	4.11	4.07	3.47	3.55
	17:1	0.34	0.25	0.27	0.29	0.43	0.41
	18:1(n-9)	23.39	23.16	21.94	22.45	26.06	25.86
	18:1(n-7)	3.98	3.70	3.66	3.31	3.78	3.48
	20:1	1.57	1.34	1.83	1.83	1.75	1.53
	22:1	1.27	1.24	0.20	0.28	0.08	0.06
Poly-unsaturated fatty acids	18:2	11.81	11.95	12.50	12.65	13.07	12.78
	20:2	0.46	0.52	0.29	0.49	0.58	0.42
	20:4	1.43	1.46	0.73	0.76	0.87	0.90
	18:3	1.29	1.42	1.16	1.06	1.37	1.43
	20:3	0.65	0.59	0.71	0.68	0.97	0.95
	20:5	3.92	4.33	3.62	3.25	2.20	2.13
	20:5	1.31	1.33	1.33	1.41	2.83	2.75
	22:6	10.18	9.94	14.05	15.44	10.53	10.96

samples. These results were similar to those of Kaneniwa *et al*., 2000 and Jabeen and Chaudhry, 2011. Among saturated fatty acids, the major fatty acid was 16:0 followed by 18:0 and 14:0. These results were confirmed by the work of Luczynska *et al*. (2008). In addition, 18:1 n-9 was the dominant fatty acid of monounsaturated fatty acids followed by 16:1 n-7 and 18:1 n-7 (Rao *et al*., 2010). Among polyunsaturated fatty acids, the abundant fatty acids were 18:2 22:6 and 20:5. The results were similar with Hedayatifard and Jamali (2008) and Ugoala *et al*. (2008).

Statement of conflict of interest

Authors have declared no conflict of interest.

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