Sind Univ. Res. Jour. (Sci. Ser.) Vol: 37(2) 17-24 (2005)

Studies on comparison of body composition parameters of different fish species cultured in a brackish water pond in Muzaffar Garh

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Abstract

30 specimens of seven species (*Labeo rohita* 3, *Cirrhinus mrigala* 6, *Catla* catla 3, *Hypophthalmicthys molitrix* 3, *Cyprinus carpio* 6, *Thaila-Rohu hybrid* 3 and Mori-Rohu hybrid 6) were collected for the comparison of body composition parameters from a brackish water pond in Muzaffar Garh. The mean values of body constituents, except for % protein (dry and wet body weight), varied significantly among various fish species. Minimum values of % water and maximum vaues of % lipid, % organic contents (dry and wet body weight) and condition factor were observed in *Cyprinus carpio* indicating *that C. carpio* shows overall better growth in brackish water as compared to other species.

Keywords: Body composition, brackish water, carps.

Introduction

Growth is an appropriate property for system analysis. Fish growth is influenced by food, space, temperature, salinity and other factors. Furthermore, since fish are poikilothermic and live permanently immersed in water, they are directly affected by changes in their ambient medium (Weatherly and Gill. 1972). The term growth signifies change in magnitude. The variable undergoing change may be the length or other physical dimension, including volume, weight, or mass either of an organism's whole body or its various tissues or it may relate to the contents of protein, lipids and other chemical consitituent of the body. Growth may also relate to the change in the number of animals in population (Weatherly and Gill, 1987).

Body composition parameters are good indicators of the physiological condition of a fish but it is relatively time consuming to measure. Proximate body composition is the analysis of water, fat, protein and ash contents of fish (Love, 1970). Carbohydrates and non-protein compounds are also important constituents but are present in negligible quantity and are usually ignored for routine analysis (Cui and Wootton, 1988). The percentage of water is good indicator of its relative contents of energy, proteins and lipids. The lower the percentage of water, greater the lipids and protein contents and higher the energy density of the fish (Dempson *et al.*, 2004). However, these values vary considerably within and between species, size, sexual condition, feeding, season and activity. Protein content, which is an important component, tends to vary little in healthy fish (Weatherly and Gill, 1987).

The present study was designed to make comparison between the body compositions of fish of different species cultured in brackish water ponds. In southern Punjab, there is an increasing problem of fresh water shortage and those areas, which have more saline soil and brackish water can be used for fish culture. By doing this a very vast area, which is still untapped can be exploited for fish culture, which will generate a lot of employment and boost the economy of the area. If some fish species are performing better in brackish water then farmers can be encouraged to culture those species in brackish water ponds.

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Materials and methods

The present study was carried out on brackish water pond situated at 18km away from Muzaffargarh at Shahgarh. The area of this pond was 2 acres, its depth was 5feet and average salinity was 3.489 gm/lit. The study was carried out for a growth period of seven months from May to December 2002. 30 specimens of seven species were collected for laboratory studies from brackish water pond with the help of cast nets. These fishes were killed by using heavy anesthetic MS222, blotted dry and weighed using an electronic digital balance to nearest 0.1 g. Total body length was measured to the nearest of 0.01cm using a Perspex measuring tray fitted with a sheet of millimeter ruler. All measurements were made from the tip of the maxilla to the longest caudal fin ray. To estimate the water contents, each fish was placed as a whole in pre - weighed aluminum foil tray for drying till constant weight in an electric oven (Gallen Kamp, England) at 65-80°C. To calculate ash content of each individual fish, 50 mg of sample was taken in a pre-weighed, heat resistant China clay crucible and ashed in a Muffle furnace (Sybron Thermolyne, 1300) for 7 hours at 500°C and reweighed after cooling.

The fat contents were estimated using dry tissue by dry extraction method in which a mixture of chloroform and methanol in a ratio of 1:2, following the method of Bligh and Dyer (1959), Cui and Wootton (1988) and Salam and Davies (1994), was taken and 3 mg sample of powdered dry tissue was mixed with 10ml of this mixture and stirred with a glass rod. The resultant mixture was left over night and then centrifuged. After centrifugation, the clear supernatant was removed carefully into washed, dried and pre-weighed small bottles. These bottles were then put in an oven at 40 to 50°C to evaporate the solvent to dryness leaving the lipid fraction. Lipids were then weighed on an electronic balance to nearest 0.0001 grams.

Total protein present in dry mass can be calculated by the difference method from the mass of other main constituents i.e. Ash, Fat and Water (Caulton and Bursell, 1977; Dawson and Grimm, 1980; Salam and Janjua, 1992, Salam and Davies 1994 and Dempson *et al* 2004) carbohydrates do not form a major component of fish and thus are generally neglected due to their negligible amounts (Elliott,1976; Caulton and Bursell,1977; Salam, 1983 and Salam and Davies, 1994). Excel and Minitab were used for statistical analysis. The comparison of body composition parameters of different fish species cultured in brackish water pond was carried out by using ANOVA and Least Significant Difference (L. S. D.) was calculated in those parameters which were significantly different among various species following Zar (1996).

Results

Comparison of Body Composition Parameters

Water content

% Water content was significantly ($P<0.01$) different between species (Table 2). The maximum value of % water content was observed in *Labeo rohita* (72.810) while minimum value was observed in *Cyprinus carpio* (65.605). interspecfic comparison (L.S.D. calculations) showed that all fish species significantly differ from each other with respect to % water content. Some species (*Labeo rohita* and *Hypophthalmicthys molitrix*) showed similar response with respect to % water content while *Cirrhinus mrigala*, *Catla catla*, Rohu-Mori hybrid and Thaila-Rohu hybrid showed similar trend of water content. While water content of *Cyprinus carpio* was significantly different from all other species (Table 1).

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Ash Content

There was a highly significant (P<0.001) difference between species in relation to % ash (dry and wet body weight) (Table 2). *Catla catla* showed the maximum value (19.667) as (dry body weight) while minimum values (9.667) was observed in *Cyprinus carpio*. L. S. D. values for % ash (dry body weight) indicates that *Cyprinus carpio* and *Catla catla* had significantly different values with one another as well as with the remaining five fish species which had no significant difference in % ash content (dry body weight) values with respect to each other

Studies of % ash content (wet body weight) showed the maximum value in *Catla catla* (6.330) while minimum value (3.316) was in *Cyprinus carpio*. Interspecfic comparison (L.S.D. calculations) showed that except from Thaila-Rohu hybrid and *Cirrhinus mrigala*, all fish species significantly differ from each other with respect to % ash contents (wet body weight) (Table 1).

Lipid content

A least significant difference (P<0.05) in relation to % lipid (dry body weight) was observed between species (Table 2). *Cyprinus carpio* showed the maximum (22.667) while *Labeo rohita* and Mori-Rohu hybrid showed the minimum values (17.333) for % lipid (dry body weight) L. S. D. values for % lipid content (dry body weight) indicates that *Cyprinus carpio* and *Hypophthalmicthys molitrix*, Thaila-Rohu hybrid and *Cirrhinus mrigala* showed similar response while Mori-Rohu hybrid. *Labeo rohita* and *Catla catla* had similar trend of % lipid content (dry body weight) (Table 1).

% Lipid (wet body weight) showed significant difference (P < 0.01) between species (Table 2). Maximum values of % lipids (wet body weight) were observed in *Cyprinus carpio* (7.573) while minimum value (4.714) was observed in *Labeo rohita*. Interspecfic comparison (L .S. D. calculations) showed that *Hypophthalmicthys molitrix*, *Cirrhinus mrigala* and Thaila- Rohu hybrid showed similar response while all fish species significantly differ from each other with respect to % lipid content (wet body weight) (Table 1).

Organic Content

There was highly significant (P<0.001) difference between species in relation to % organic contents (dry and wet body weight) (Table 2). The % organic contents were highest in *Cyprinus carpio* {both dry (90.333) and wet body weight (31.065) } while minimum values of % organic contents were observed in *Catla* catla for dry body weight (79.667) and in *Labeo rohita* for wet body weight (23.200).

For %organic content (dry body weight), Interspecfic comparison (L. S. D. calculations) showed that Mori-Rahu hybrid and *Labeo rohita* showed similar response, all other fish species except *Cyprinus carpio* behaved like a group while % organic content (dry body weight) of *Cyprinus carpio* was significantly different from all other species.

L.S. D. values for % organic content (wet body weight) indicated that Mori-Rohu hybrid and *Cyprinus carpio* showed similar response while all other species showed similar trend with respect to % organic contents (wet body weight) (Table 1).

Protein content

There was non-significant (P>0.05) difference between species in relation to %protein contents (dry and wet body

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weight) (Table,2). The maximum value of % protein { dry (68.332) and wet body weight (21.007)} was observed in Mori-Rohu hybrid while minimum values were observed in *Cirrhinus mrigala* { dry body weight (62.333), wet body weight (18.975)} (Table 1).

Condition Factor

There was highly significant (P<0.001) difference between species in relation to condition factor (Table 2). The condition factor had highest values in *Cyprinus carpio* (1.915) and lowest in *Cirrhinus mrigala* (1.080). Interspecfic comparison (L.S.D. calculations) showed that all fish species significantly differ from each other with respect to condition factor (Table 1).

Table 1: Mean Values of various body constituents in different fish species cultured in brackish water pond. Standard deviation is given in parenthesis.

Body constituent	Mori-Rohu Hybrid	*Labeo rohita*	*Cyprinus carpio*	Thaila-Rohu hybrid	*Cirrhinus mrigala*	*H. molitrix*	*Catla catla*
% Water	69.265$^{(b)}$ (3.182)	72.810$^{(a)}$ (2.030)	65.605$^{(c)}$ (2.051)	69.250$^{(b)}$ (1.020)	69.500$^{(b)}$ (2.044)	72.680$^{(a)}$ (2.010)	68.840$^{(b)}$ (1.040)
% Ash (dry wt.)	14.333 $^{(b)}$ (1.966)	14.667$^{(b)}$ (1.528)	9.667$^{(c)}$ (1.033)	16.33$^{(b)}$ (1.155)	17.667$^{(b)}$ (1.966)	14.333$^{(b)}$ (1.528)	19.667$^{(b)}$ (0.577)
% Ash (wet wt.)	4.355$^{(c)}$ (0.284)	3.9867$^{(d)}$ (0.418)	3.3167$^{(e)}$ (0.334)	5.0233$^{(b)}$ (0.358)	5.3917$^{(b)}$ (0.748)	3.9133$^{(d)}$ (0.4179)	6.330$^{(a)}$ (0.478)
% Lipid (dry wt.)	17.333$^{(c)}$ (2.066)	17.333$^{(c)}$ (2.309)	22.667$^{(a)}$ (2.191)	20.00$^{(b)}$ (4.00)	20.00$^{(b)}$ (3.578)	22.00$^{(a)}$ (2.309)	18.667$^{(c)}$ (2.309)
% lipid (wet wt.)	5.325$^{(d)}$ (0.776)	4.7140$^{(e)}$ (0.629)	7.5733$^{(a)}$ (0.856)	6.1433$^{(b)}$ (1.240)	6.118$^{(b)}$ (1.266)	6.193$^{(b)}$ (0.635)	5.183$^{(c)}$ (0.722)
% Organic contents (dry wt.)	85.667$^{(b)}$ (1.966)	85.667$^{(b)}$ (1.155)	90.333$^{(a)}$ (1.033)	83.667$^{(c)}$ (1.155)	82.333$^{(c)}$ (1.966)	85.667$^{(b)}$ (1.528)	79.667$^{(c)}$ (1.528)
% Organic contents (wet wt.)	26.363$^{(a)}$ (2.765)	23.200$^{(b)}$ (0.412)	31.065$^{(a)}$ (1.111)	25.723$^{(b)}$ (0.352)	25.048$^{(b)}$ (0.593)	23.403$^{(b)}$ (0.417)	24.813$^{(b)}$ (0.472)
% Protein (dry wt.)	68.332 (3.202)	68.00 (1.000)	66.250 (8.069)	63.667 (3.055)	62.333 (5.279)	62.997 (3.610)	60.000 (1.000)
condition Factor	1.4290$^{(c)}$ (0.253)	1.8200$^{(a)}$ (0.040)	1.9150$^{(a)}$ (0.258)	1.6500$^{(b)}$ (0.156)	1.080$^{(e)}$ (0.187)	1.1700$^{(d)}$ (0.020)	1.320$^{(c)}$ (0.030)

Note: Letters indicate results of multiple range tests (LSD. Mean with same letters are not significantly different from each other at 0.05 level.

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Table 2: Anova table showing the comparison between different fish species.

Body constituent	DF	SS	MS	F	P
%water	6,23	153.90	25.65	5.21	0.002**
%Ash (dry wt.)	6,23	287.50	47.92	19.45	<0.001***
%Ash (wet wt.)	6,23	25.946	4.324	19.22	<0.001***
%Lipid (dry wt.)	6,23	112.53	18.76	2.49	0.05*
% Lipid (wet wt.)	6,23	22.668	3.778	4.26	0.005**
% Organic	6,23	308.80	51.47	20.18	<0.001***
Content (dry wt.)					
% Organic	6,23	207.04	34.51	16.69	<0.0001***
content (wet wt.)					
% Protein (dry Wt.)	6,23	210.9	35.2	1.43	0.246 n.s
% Protein (wet wt.)	6,23	141.7	23.6	1.84	0.136 n.s.
condition Factor	6,23	2.909	0.4849	12.61	<0.001***

DF = Degree of freedom, SS= Sum of square, MS=Error mean square, F = F Calculated and P= Probability.

n.s	=	P>0.05=	non signigicant	
*	=	P< 0.05	=	least significant
**	=	P< 0.01	=	significant
***	=	P<0.001	=	highly significant

Discussion

Pakistan, at present faces two major problems (a) water logging and (b) salinity and a number of saline water bodies are in the form of lakes and ponds (Javaid and Khan, 1972). The successful economic use of these resources depends upon adopting the fish rather than adopting the environment (Jackson, 1977).

A lot of work has been accumulated on the body composition since the comprehensive survey on 65 species of American food fishes by Atwater (1888). Much of the analytical data accumulated since then has been reviewed by Love, 1970,1980; Jobling, 1980; Weatherley and Gill, 1987; Dawson and Grimm, 1980; Salam and Davies, 1994; Grayton and Beamish, 1997; Jonsson and Jonsson, 1998; Berg *et al.*, 2000 and Dempson *et al.*, 2004. A perusal of literature revealed that little is known about the effect of salinity on growth of fish in Pakistan. The present investigation was therefore the pioneer study of body composition of fish species in brackish water. brackish water.

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The main aim of present study was to test the growth of various fish species using the body composition parameters as an index of growth in brackish water pond.

Results from the current study indicated that body composition varied significantly among the various fish species in brackish water pond. The observed differences suggested that variable rearing conditions within the brackish water system are sufficient to influence body composition (Shackley *et al.*, 1994; Shearer, 1984 and Wootton, 1990). This could be related to physiological adaptations of various species to acclimatize in brackish water.

When interspecfic comparisons were made (L. S. D. calculations) in pond under observation, no consistent results were obtained. For same body composition parameter, some species respond in similar fashion while others showed significantly different results (Table, 1). This may be because of several factors, however percentages obtained do not indicate the adverse effect of salinity and the species are found to be relatively adapted to the existing environment. However, significant differences are observed in body composition parameters among various species.

The present study shows indirect evidence using body composition parameters as an indicator of fish growth. It is concluded that *Cyprinus carpio* shows better growth in brackish water and farmers should be encouraged to culture this species in such waters.

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