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Effect of Body Size and Condition Factor on Whole Body Composition of Hybrid (*Catla catla* ♂x *Labeo rohita* ♀) from Pakistan

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***Abstract*—**In the present study, 49 Hybrid (*Catla catla* ♂ x *Labeo rohita* ♀) were sampled from Al-Raheem Fish Hatchery, Village Ali Pure Shamali, Jhang Road, 18 Km from Muzaffar Garh using a cast net and Live fishes were transported to research laboratory. Mean percentage for water found 79.13 %, ash 6.58 %, fat 2.22 % and protein content 12.06 % in whole wet body weight. It was observed that body constituents were found increasing in the same proportion with an increase in body weight while significant proportional increase was observed with total length. However, condition factor remained insignificant (P>0.05) with body constituents.

***Keywords*—**Hybrid fish, Body composition, Condition factor, Predictive equations

I. Introduction

FOOD is the most important basic need for the survival of the living beings on the face of the earth. Whenever it is not available in sufficient quantities, there arises the problem of competition. It is a well-known fact that the population of the world is increasing in geometrical proportion whereas the food production in arithmetic proportion. This leads to the shortage of the food materials, which could be overcome either by controlling the population explosion or by Fishes are valuable source of high-quality proteins and other organic products. The present scarcity of food has caused widespread culturing of fish. Aquaculture is getting worldwide attention due to this reason. Aquaculture occupies an important position in the socio-economic fields of a country in various respects for example by giving the people not only the nutritive food but also income and employment opportunities [1]. Of all the species of fish used for aquaculture, carps have the oldest history [2].

One of the major aspects in fisheries sciences is body composition and this is the parameter by which physiology of fish can be indicated but this is time consuming. Proximate body composition includes fat, protein, water and ash contents of fish whereas carbohydrates and other non protein parts are neglected. Relative lipid, protein and energy contents are inversely proportional to water contents in the fish [3]. But these factors except protein contents depend upon species, size, sexual condition, condition factor, physiology and feeding habits of that fish [4].

Successful fish husbandry practice and culturing needs consideration oriented to body composition especially the dietary protein component responsible for the production of optimal fish growth. Addition of suitable levels of non-protein energy sources in the diet is valuable that determines the efficiency of protein consumption [5], [6].

In body composition analysis it is estimated that compared to lipids, carbohydrates are comparatively inexpensive and a voluntarily available source of energy. In hot water fish, dietary carbohydrate consumption is significantly high, and this may add beneficial outcomes to the pelleting quality of the food and to fish growth [7],[8]. High levels of dietary lipid may cause problems in fish processing and may harmfully influence the fish carcass body composition [9].

There is no well defined information about body compsition of hybrids in published form. A number of interspecific and intergeneric hybrids of Indian major carps: *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala* and *Labeo calbasu* and those of Indian major carps with exotic carp viz. common carp [10],[11] have been artificially produced by hypophysation. Among these only a few hybrids have been studied in detail for their qualities, adaptability to various environments and nutritional point of view.

It is estimated that no variance body characters is present in Catla rahu hybrids and there is slight growth rate as catla catla but hybrids have different body characters and rapid growth rate as compared to *Labeo rohita* and rahu gives less production in reservior as compared to catla-rahu hybrids [12].

Furthermore it was also observed that the hybrids united advantageous qualities such as the small head of one and the

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deep body of other fish. Hybrids showed variations in terms of meat production with more flesh content than either of the parents. Hence the hybrids are considered a best choice for fish culture [13].

A catla-rohu hybrid produced by hypophysation is judged to be transitional in general morphology to the catla and rahu species and is generally phytophagous in its nutrition. It attains maturity within about 3 years and can also be artificially produced by hypophysation [14].

Catla-rahu hybrids are in-between the taxonomic characters. The ratio of total length/predorsal in catla x rohu shows greater value than both the parents individually, whereas it seems similar to catla in rohu x catla hybrids. Caudal peduncle is broader than both parents viz; catla and rahu. Gill rakers more or less long and the most distinctive feature of both hybrids is that, in catla x rohu hybrids, pectorals almost reach ventral base, whereas in rohu x catla pectorals do not reach the ventral base, creating a wide gap. Scales and fins color in the hybrids is the same as of the male parent [15].

In the present study an account of economically important hybrids of Indian major carps with respect to body composition have been given and their role in the development of reservoir fisheries and in increasing fish production in aquaculture has been discussed.

II. Materials And Methods

Fourty nine farmed hybrid (*Catla catla* ♂x *Labeo rohita* ♀) of different body sizes ranging from 4.4 - 27.00 cm total length and 0.52 - 58.35 g body weight, were sampled from Al-Raheem Fish Hatchery, Village Ali Pure Shamali, Jhang Road 18 Km from Muzaffar Garh using a cast net and Live fishes were transported to research laboratory. These were weighted to nearest 0.01 g on an electronic digital balance (Chyo-MP-3000) and their length measured to nearest 0.1 cm on wooden measuring tray.

To estimate the water content in each individual fish was dried till constant weight in an electric oven at 60-65 °C. For further analysis, each dry carcasses were crushed and powdered in a pestle and mortar, and further processed in an electric blender (Moulinex) and preserved in plastic bottles with proper labeling.

Ash content was determined for each sample using 500-1000 mg sub-samples in heat resistant China clay crucibles and ashed in a muffle furnace (RJM 1.8-10, China) for 24 hours at 450-500°C and reweighed after cooling. The total lipid contents of dry tissue were determined by extraction in a 1:2 mixture of chloroform and methanol [16]. Protein contents of farmed hybrid (*Catla catla* ♂x *Labeo rohita* ♀) was estimated by difference from the mass of other main constituents i.e., ash, fat, water [17].

Condition factor was calculated by using a formula $K = 100 \times W/L^3$ following the method of Wootton [18].

Statistical analysis, including regression analysis and calculation of correlation was carried out.

TABLE I
MEAN VALUES AND RANGES OF VARIOUS CONSTITUENTS OF HYBRID (CATLA CATLA ♂X LABEO ROHITA ♀)

Body Constituents	Mean ± S.D	Range
Water content (%)	79.13 ± 3.49	58.83-85.27
Ash content (%Wet weight)	6.58 ± 2.15	02.94-13.11
Ash content (%dry weight)	31.55 ± 9.26	18.00-62.00
Fat content (%wet weight)	2.22 ± 1.99	0.44-7.93
Fat content (% dry weight)	10.80± 10.09	2.00-40.00
Protein contents (%wet weight)	12.06 ± 3.31	05.21-25.52
Protein contents (%dry weight)	57.64 ± 11.77	29.00-77.00

S.D = Standard Deviation

III. Results

Mean values and ranges of various body constiruents of hybrid (*Catla catla* ♂ x *Labeo rohita* ♀) in whole body weight are given in Table I.

Relationship between percent water and various body constituents revealed that protein and ash contents (% wet body weight) significantly decrease with increasing percent water contents. While ash and protein (% dry body weight), and fat content (% wet and dry body weight) remained non-significant ($P>0.05$) with percent water content (Table II).

Highly significant ($P<0.001$) positive correlation was found in log-transformed wet total wet body weight (Table III) and total length (Table IV). Isometry was observed with increase in wet body weight, while, increasing trend was found with increase in total length in all studied body constituents of hybrid (*Catla catla* ♂x *Labeo rohita* ♀).

The index of fish condition used in this study in this species is "K". Values of K for Hybrid (*Catla catla* ♂x *Labeo rohita* ♀*)* ranges between 0.601 - 1.312. The condition factor remains fairly constant with percent water, percent ash percent fat and percent protein for Hybrid (*Catla catla* ♂x *Labeo rohita* ♀) (Table-V).

IV. Discussion

All the studied body constituents (i.e., water, fat, ash and protein) were found in greater proportion when compared with the study of Salam et al., [19] on *Catla catla*. Many investigators have developed equations relating water content with fat content and water content with protein content and concluded that body composition can be predicted from water content using regression equations [17],[20]-[25].

In the present study, equations were developed between percent water and percent of each body constituents which showed insignificant relations except percent ash and protein (wet body weight). These results were found in general agreement with the results of Naeem et al. [26], who have

TABLE II
STATISTICAL PARAMETERS OF WATER CONTENT VERSUS VARIOUS BODY CONSTITUENTS OF HYBRID (*CATLA CATLA* ♂X *LABEO ROHITA* ♀)

Relationships	r	a	b	S. E. (b)	t value when b=0
%Water (x)					
%Ash wet wt. (y)	0.429**	27.5539	-0.2650	0.0814	2.0339 ^{ns}
% Water (x)					
%Ash dry wt. (y)	0.010 ^{ns}	29.9179	0.0206	0.3869	1.3920 ^{ns}
% Water (x)					
%Fat wet wt. (y)	0.104 ^{ns}	6.9438	-0.0597	0.0828	1.0278 ^{ns}
% Water (x)					
%Fat dry wt. (y)	0.095 ^{ns}	-11.1504	0.2774	0.4194	0.6294 ^{ns}
% Water (x)					
%Protein wet wt. (y)	0.711***	65.5022	-0.6753	0.0973	6.1553***
% Water (x)					
%Protein dry wt. (y)	0.088 ^{ns}	81.2325	-0.2980	0.4895	1.0194***

Wt. = weight, r = correlation coefficient, a = intercept, b = regression coefficient, S.E. = standard error, P = probabilities, ***P < 0.001, **P < 0.01, ^{ns} P>0.05

TABLE III
STATISTICAL PARAMETERS OF BODY WEIGHT (G) VERSUS BODY CONSTITUENTS (G) OF HYBRID (*CATLA CATLA* ♂X *LABEO ROHITA* ♀)

Relationships	r	a	b	S. E. (b)	t value when b=1
Log body wt. (x)					
Log water content (y)	0.999***	-0.1010	0.9992	0.0044	-8.500***
Log body wt. (x)					
Log ash content (y)	0.981***	-1.1849	0.9868	0.0280	-0.320**
Log body wt. (x)					
Log fat content (y)	0.909***	-1.7842	0.9995	0.0667	-0.318n s
Log body wt. (x)					
Log protein content (y)	0.985***	-0.9617	1.0196	0.0252	4.222***

TABLE IV
STATISTICAL PARAMETERS OF TOTAL LENGTH (CM) VERSUS TOTAL BODY CONSTITUENTS (G) OF HYBRID (*CATLA CATLA* ♂X *LABEO ROHITA* ♀)

Relationships	r	a	b	S. E. (b)	t value when b=3
Log TL (x)					
Log water content (y)	0.994***	-2.3083	3.1674	0.0473	3.882***
Log TL (x)					
Log ash content (y)	0.977***	-3.3674	3.1304	0.0980	1.655 ^{ns}
Log TL (x)					
Log fat content (y)	0.914***	-4.0273	3.1995	0.2071	0.508 ^{ns}
Log TL (x)					
Log protein content (y)	0.981***	-3.2137	3.2318	0.0929	5.902***

TL = Total Length

TABLE V
STATISTICAL PARAMETERS OF CONDITION FACTOR VERSUS BODY CONSTITUENT OF HYBRID (*CATLA CATLA* ♂X *LABEO ROHITA* ♀)

Relationships	r	a	b	S. E. (b)	t value when b=0
Condition factor (x)					
% Water (y)	0.090 ^{ns}	77.1999	1.9881	3.2155	4.493***
Condition factor (x)					
% Ash wet wt. (y)	0.020 ^{ns}	6.8494	-0.2764	1.9934	0.3841^{ns}
Condition factor (x)					
% Fat wet wt. (y)	0.214 ^{ns}	4.8612	-2.7108	1.7999	5.631***
Condition factor (x)					
% Protein wet wt. (y)	0.047 ^{ns}	11.0895	0.9991	0.0614	1.0003 ^{ns}

reported significant relationships only in ash (dry weight) and protein (wet body weight). However, in fish with a good condition, water content decreases and the fat content increases [27].

Several studies have been carried out reporting the body composition of fish [27]-[30], however, a few investigators have examined the influence of the influence of size on body composition [17],[21],[26],[31]-[36]. When total values of each body constituents were transformed into log in the

present study, influence of size was also observed. Body constituents were found increasing in the same proportion with an increase in body weight while significant proportional increase was observed with total length.

Body composition in fish is also influenced by condition factor [17],[26],[31]-[37]. But this is not true for the present study where it remained insignificant with body constituents. Naeem et al. [36] have also reported the same results with condition factor. These variations in studies may be due to change in habitat, feeding, breeding or sampling season.

REFERENCES

[1] P.K. Talwar and A.G. Jhingran, "Inland Fishes of India and Adjacent countries," Bombay: Oxford and IBH Publishing Co., Vol, I and II, 1991.

[2] T.V.R. Pillay and W.E. Ricker, "Aquaculture principle and practices," Fishing News Books. Blackwell Scientific publication, Ltd. 1990.

[3] K. Gupakumar, "Utilization of by catches and low value Fish in India," In: D.G. James, (Ed.). Proceeding of The APFIC Sym.on Fish Utilization in Asia and The Pacific. Beijing People' Republic of China. 24-25 Sep. 1998. RAP Publication 24, 1998, pp. 29-47.

[4] Y. H. Hui, Meat Science and Application. CRC Press, 2001, pp:704.

[5] W. Steffens, "Protein utilization by rainbow trout *Salmo gairdneri*. and carp *Cyprinus carpio*.: a brief review," Aquaculture, vol. 23, 1981, pp. 337–345.

[6] R.P. Wilson and R.P. Halver, "Protein and amino acid requirements of fishes," Annu. Rev. Nutr. Vol. 6, 1986, pp. 225–244.

[7] NRC, National Research Council., "Nutrient Requirement of Fish," National Academy Press, Washington, DC, 1993, pp. 128.

[8] R.P. Wilson, "Utilization of dietary carbohydrate by fish," Aquaculture, vol. 124, 1994, pp. 67–80.

[9] K. Jauncey, "Carp *Cyprinus carpio*. nutrition—a review," In: J.F. Muir, R.J. Roberts, (Eds). Recent Advances in Aquaculture. Croom Helm, London, 1982, pp. 215–263.

[10] H. Chaudhuri, "Experiments on hybridization of Indian carps," Proc. Indian Sci. Congr.,vol. 45, No. 4, 1959 , pp. 20.

[11] H.A. Khan, S.D. Gupta, P.V.G. Reddy, S.K. Sahoo, "Use of milk, urea, sodium sulphite and human urine for degumming fertilized eggs of common carp, *Cyprinuc carpio* L.," Aquac. Hung. (Szarvas), vol. 5, 1986., pp. 47–54.

[12] A. V. Natarajan, V. R. Desai and D. N. Mishra, "On the account of inter-generic Catla-Rohu Hybrid in Rihand (Uttar Pradesh) with an account of its potential role in reservoir fisheries development in India," J. Inland Fish Soc. India, Vol. 8, 1976., pp. 83-90.

[13] Y. Basavaraju, K.V. Devaraj and S. P. Ayyar, "Comparative growth of reciprocal carp hybrids between *Catla catla* and *Labeo* in contrast to intraspecific data collected on D. melano- fimbriatus," Aquaculture, Vol. 129, Issues 1-4, 1995, pp. 187-191.

[14] R.M. Bhowmick and R.K. Janaa, Gupta, S.D., Kowtala, G.V. and Rout, M., "Studies on some aspects of biology and morphometery of the intergeneric hybrid, *Catla catla* (Hamilton) x *Labeo rohita* (Hamilton) produced by hypophysation," 1981. Aquaculture. Vol. 23, Issue 1-4, p: 367-371.

[15] P. Reddy, Konda and T.J. Varghese, "On the taxonomic characters of two major carp hybrids, catla - rohu and rohu - catla," Proc. Indian Acad. Sci. (Anim. Sci.), vol. 89, 1980 , 419–429.

[16] E.G. Bligh and W.J. Dyer, "A rapid method of total lipid extraction and purification," Canadian Journal of Biochemistry and Physiology, vol. 37, 1959, pp. 911-917.

[17] A. Salam, and P.M.C. Davies, "Body composition of northern pike, *Esox lucius* L. in relation to body size and condition factor," Fish. Res., vol. 19, 1994, pp. 193-204.

[18] R.J. Wootton, Ecology of Teleost Fishes. Chapman and Hall, London, 1990.

[19] A. Salam, M. Ali and S. Masud, "Effect of various food deprivation regimes on body composition dynamics of thaila, *Catla catla,*" Journal of Research (Science) Bahauddin Zakariya University, Multan, Pakistan, 2000, Vol. 11, No. 1, pp.26-32.

[20] J. R. Brett, J. E. Shelbourne and C. T. Shoop, "Growth rate and body composition of fingerling socheye salmon, Oncorhynchus nerka in relation to temperature and ration size," J. Fish Res. Bd. Can., vol. 26, 1969, pp. 2364-2394.

[21] M. Elliott, "Body composition of brown trout, *Salmo trutta* L. in relation to temperature and size," J. Comp. Physiol., vol. 114, 1976, pp. 191-202.

[22] M. Jobling, "Effect of starvation on proximate chemical composition and energy utilization on plaice, *Pliuronectes platessa* L," J. Fish. Biol., vol. 17, 1980, pp. 325-334.

[23] J. L. Tabachek, "Influence of dietary protein and lipid levels on growth, body composition and utilization efficiencies of Arctic Charr, *Salvelinus alpinus* L," J. Fish Boil., vol. 29, 1986, pp. 139-151.

[24] A. Salam, M. N. Khan and M., Naeem, "Effect of body size and condition factor on body composition of an exotic fish, *Tilapia nilotica,* Proc. Pakistan Cong. Zool., vol. 11, 1991, pp. 191-200.

[25] M.L. Brown and B.R. Murphy, "Relationship of relative weight (Wr) to proximate composition of juvenile Striped bass and hybrid Striped bass," Trans. Amer. Fish Soc., vol. 120, 1991, pp. 509-518.

[26] M. Naeem, A. Rasul, A. Salam, S. Iqbal, A. Ishtiaq and M. Athar, "Proximate Analysis Of Female Population Of Wild Featherback Fish (*Notopterus notopterus*) In Relation To Body Size And Condition Factor." Afr. J. Biotechnol., vol. 10(19), 2011, pp. 3867-3871.

[27] R. M. Love, "The chemical biology of fishes," Academic Press, Vol. 1. London, 1970.

[28] R.M. Love, "The chemical biology of fishes," Academic Press, II, London, UK, 1980.

[29] A.H. Weatherly, and H.S. Gill, "The biology offish growth," Academic Press, London, UK, 1987.

[30] Y. Bakhtiyar, S. Langer, S.K. Karlopia and I. Ahmed, "Growth, survival and proximate body composition of *Labeo rohita* larvae fed artificial food and natural food organisms under laboratory condition," Int. J. Fish. Aquac., vol. 3 (6), 2011, pp. 114-117.

[31] M.S. Caulton and E. Bursell, "The relationship between condition and body composition in young Tilapia rendalli (Boulenger)," J. Fish. Biol., vol. 11, 1977, pp. 143 – 50.

[32] A. Salam, M. Ali and M. Anas, "Body composition of *Oreochromis nilotica* in relation to body size and condition factor," Pakistan J. R. Sci., vol. 12, 2001, pp. 19-23.

[33] M. Naeem and A. Salam, "Proximate composition of fresh water bighead carp, *Aristichthys nobilis*, in relation to body size and condition factor from Islamabad, Pakistan," Afr. J. Biotechnol., vol. 9, 2010, pp. 8687-8692.

[34] M. Naeem, A. Salam, M. Khalid and M. Ashraf, "Effect of body size and condition factor on whole body composition of immature population hatchery reared mahseer, *Tor putitora* from Pakistan," Proc. 2nd International Conference on Chemical, Biological and Environmental Engineering (ICBEE 2010). 2010, pp. 286-289.

[35] M, Naeem, A. Salam, SA. Rasool and Shazia, "Study of proximate composition of wild *Colisa lalia* in relation to body size and condition factor," Proc. 2nd International Conference on Chemical, Biological and Environmental Engineering (ICBEE 2010). 2010, pp. 282- 285.

[36] M. Naeem, A. Salam, R. Baby, A. Ishtiaq and S.A. Rasool, "Study of Body Composition of Female Population of Farmed *Oreochromis mossambicus* in relation to Body Size and Condition Factor from Pakistan," Proc. 2011 International Conference on Bioscience, Biochemistry and Bioinformatics (ICBBB 2011), 2011, pp. 360-363

[37] T.D.D. Groves, "Body composition changes during growth in young sockeye (*Oncorhynchus nerka*) in fresh water," J. Fish. Res. Bd. Can., vol. 27, 1970, pp. 929 – 42.