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Full Length Research Paper

Body composition of freshwater *Wallago attu* in relation to body size, condition factor and sex from southern Punjab, Pakistan

Muhammad Yousaf*, Abdus Salam and Muhammad Naeem

Institute of Pure and Applied Biology, Bahauddin Zakariya University, Multan 60800, Pakistan.

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Wallago attu **is one of the large freshwater catfish found in Pakistan. The rapid growth and high nutritional quality encouraged investigation into the aquaculture potential of this excellent food fish. It was observed that body size had a positive influence on percent ash, percent fat and percent protein contents (wet weight) but there was no significant effect on percent water content. The condition factor had a positive correlation with fat, ash and protein contents (%wet weight) but no influence on percent water content. There was no significant influence of sex on body composition of *W. attu*. If it is impossible to find out the water content, then the body constituents can be estimated from the wet body weight, total length and condition factor of this species. As the variations in body composition are related to these variables, so the equations of each constituent were estimated. The predictive equations can be used to estimate the body composition with a fair level of accuracy.**

Key words: *Wallago attu,* body size, condition factor, body composition, sex.

INTRODUCTION

Wallago attu is one of the large freshwater catfish found in Pakistan, India, Sri Lanka, Nepal, Bangladesh, Burma, Thailand, Vietnam, Kampuchea, Malay Peninsula, Afghanistan, Sumatra and Java (Talwar and Jhingran, 1991; Giri et al., 2002). The rapid growth (Goswami and Devraj, 1992) and high nutritional quality of its flesh (Lilabati and Viswanath, 1996) encourage investigation into the aquaculture potential of this excellent food fish. Taking into consideration the various health risks, fish's mineral and body composition and their health status were assessed in order to establish the safety level of the table sized species prior consumption (Fawole et al., 2007). Body composition illustrates the nutritional quality of food because analysis of biochemical composition including protein, fat and ash is very important in assessing food value (Kamal et al., 2007). So, bio-chemical evaluation is necessary to ensure the nutritional value as well as eating quality fish (Azam et al., 2004). However, the value of these body constituents vary significantly from one species and one individual fish to another depending on age, sex, feeding season, sampling time, activity and environmental condition (Weatherley and Gill, 1987; Jobling, 1994; Tang et al., 2009). The aim of the present study is to examine changes in the proximate composition in relation to body weight, length, condition factor and sex. Predictive equations are developed to describe these relationships in wild *W. attu.*

*Corresponding author: E-mail: mahyousaf@hotmail.com.

MATERIALS AND METHODS

Seventy-eight, wild *W. attu* of different body sizes, ranging from 16.7-50.2 cm total length and 14.54-648.82 g body weight, were obtained from different localities of Indus River Southern Punjab using a cast net and were transported live to the Institute of Pure and Applied Biology in plastic containers. On arrival at the laboratory, fresh fish were washed with tap water several times to remove adhering blood and slime. They were anaesthetized with Tricaine Methanesulfonate (MS 222), weighed to nearest 0.01 g on an electronic digital balance (MP-3000 Chyo, Japan) and their length measured to the nearest 0.1 cm on wooden measuring tray. These fish were placed in a pre-weighed aluminum foil tray in an electric oven (Memmert ® 8540) at 70°C until a constant weight

Table 1. Wet body weight (g) versus body constituents of *Wallago attu*.

Body constituents (%)	r	a	b	S.E. (b)	t value when b = 0
Water contents	0.010	76.112	-0.0001	0.002	-0.05
Ash contents (wet weight)	0.120	3.224	0.001	0.0003	1.667
Fat contents (wet weight)	0.448***	3.570	0.003	0.001	4.143
Protein contents (wet weight)	0.265**	15.035	0.003	0.001	2.462

Statistical parameters of various relationships, correlation coefficient (r), intercept (a), regression coefficient (b), standard error of b (S.E.) and n = 78 in each case.
Significance level: **P<0.01, ***P <0.001.

Table 2. Total length (cm) versus body constituents of *Wallago attu*.

Body constituents (%)	r	a	b	S.E. (b)	t value when b = 0
Water contents	0.026	75.877	0.006	0.028	0.214
Ash contents (wet weight)	0.215*	2.999	0.010	0.005	2.00
Fat contents (wet weight)	0.506***	2.248	0.058	0.011	5.124
Protein contents (wet weight)	0.339**	13.280	0.073	0.023	3.147

Statistical parameters of various relationships, correlation coefficient (r), intercept (a), regression coefficient (b), standard error of b (S.E.) and n = 78 in each case.
Significance level: *P<0.05, **P<0.01, ***P<0.001.

was obtained. The total water content in the fish body was calculated by using the following formula:

Total water content = Wet body weight – Dry body weight.

Dry carcasses were powdered in an electric blender (Moulinex) and sub-samples taken for ash and fat determination. Ash content was determined in duplicate for each fish using 1 g sub samples in a muffle furnace (RJM-1.8-10A) for 12 h at 450-500°C.

The total lipid contents of 1 g dry tissue were determined by extraction in a 1:2 mixture of chloroform and methanol (Bligh and Dyer, 1959). For single fish, the difference between replicate samples was less than one percent. Protein contents were estimated by difference from the mass of other main constituents that is, ash, fat, water (Weatherley and Gill, 1987; Salam and Davies, 1994). Carbohydrates do not form a major component of fish and are usually present in negligible amounts (Elliott, 1976; Weatherley and Gill, 1987; Salam and Davies, 1994). Condition factor (K) for each fish was calculated using a formula $K = 100 \times W/L^3$ by the method of Weatherley and Gill (1987) and Wootton (1990; 1998). Statistical analysis including regression analysis, calculation of correlation coefficients, standard error of the estimates and plotting of data were carried out using Excel/Lotus 1-2-3 program on IBM computer following Zar (1996).

RESULTS AND DISCUSSION

As variations in the body constituents were found to be related to body weight or length, regression analysis was applied to assess the size dependence of percent water, ash, fat and protein content. The regression parameters of these relationships are given in Table 1. Student's *t*-test shows that the slopes (*b*) of the regression lines are statistically different from *b*=0 in all cases. Ash, fat and protein contents (as percentage) increase with increasing body weight or length, whereas percentage of water content remains constant (Tables 1 and 2). The values of each of these parameters of body composition (water, fat, protein and ash) are strongly correlated with wet body weight or total length. Values of K for *W. attu* ranges between 0.312-0.720. It was observed that percentages of ash, fat and protein contents increase with increasing condition factor, whereas percentage of water is inversely related to it. However, the regression between fat content and condition factor is statistically highly significant (P<0.001) (Table 3).

The percentages of various body constituents varied with the variation of sexes in the present study of *W. attu*. Mean values of percent water contents, percent ash contents (wet weight) were slightly greater in male as compared to female, while that of percent fat contents (wet weight) was some what greater in female as compared to male but these differences were not significant. Percent protein contents (wet weight) were not influenced by sexes (Table 4).

Many investigators have published analysis of body composition of fish (Love, 1980; Weatherley and Gill, 1987; Jobling, 2001; Dempson et al., 2004) but few have examined the changes in body composition in relation to body size, condition factor and sex (Elliott, 1976; Caulton and Bursell, 1977; Salam and Davies, 1994; Salam et al., 2001). Previously, no studies on *W. attu* have been observed to correlate the variables of body weight, length, condition factor and sex with whole body composition parameters in southern Punjab. In the present study, it was observed that total length and wet body weight of fish has positive influence on ash, fat and protein contents but no effect on water contents.

Table 3.Condition factor (K) versus body constituents of *Wallago attu.*

Body constituent (%)	r	a	b	S.E. (b)	t value when b = 0
Water contents	0.009	74.601	1.189	15.424	0.077
Ash contents (wet weight)	0.108	3.027	0.679	0.720	0.943
Fat contents (wet weight)	0.434***	1.146	6.743	1.605	4.203
Protein contents (wet weight)	0.117	14.166	3.410	3.324	1.026

Statistical parameters of various relationships, correlation coefficient (r), intercept (a), regression coefficient (b), standard error of b (S.E.) and n = 78 in each case.
Significance level: ***P<0.001.

Table 4. Mean values and ranges of various body constituents of ♂ and ♀ *Wallago attu.*

Body constituents (%)	Male		Female	
	Mean ±S.D.	Ranges	Mean ±S.D.	Ranges
Water contents	76.19 ± 1.95	71.58-82.43	76.00 ± 2.33	69.57-80.17
Ash contents (wet weight)	3.36 ± 0.38	2.56-3.99	3.31 ± 0.45	2.17-3.99
Fat contents (wet weight)	4.03 ± 0.91	2.80-6.69	4.27 ± 1.12	2.53-6.38
Protein contents (wet weight)	15.69 ± 1.91	12.22-20.80	15.69 ± 1.97	11.89-21.56

S.D. = Standard deviation.

This result is in general agreement with the findings reported for other fish species (McComish et al., 1974; Weatherley and Gill, 1987; Cui and Wootton, 1988; Salam and Davies, 1994). Condition factor is considered to be one of the important factors influencing body composition in fish (Groves, 1970; Caulton and Bursell, 1977; Salam and Davies, 1994). In the present study, highly significant positive correlation was found between condition factor and fat contents (wet and dry weight) but water contents decrease with the increase of condition factor. Caulton and Bursell (1977) reported that there is a linear decrease in water content, and exponential increase in fat content and a curvilinear increase in protein content in relation to increase of condition factor. The positive correlation between condition factor and percent fat content indicates that fat increases with increasing size of fish (Salam et al., 2001). But the use of the condition factor raises problems about the interpretation because the weight of a fish is not always proportional to the cube of its length (LeCren, 1951; Weatherley and Gill, 1987). When effect of sex on body composition of fish was determined, it was found that there was no significant difference between male and female body components. This result is in general agreement with the observation of Memid et al. (2006). It is therefore concluded that if it is impossible to determine proximate composition of *W. attu* directly, then body constituents can be estimated from weight or length of the fish using predictive regression model developed in this work with a reasonable amount of accuracy.

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