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Study of Body Composition of Female Population of Farmed Oreochromis mossambicus in relation to Body Size and Condition Factor from Pakistan

Muhammad Naeem, Abdus Salam, Rahat Baby, Abir Ishtiaq and Saeed Akhtar Rasool
Institute of Pure and Applied Biology, Zoology Division,
Bahauddin Zakariya University,
Multan, 60800, Pakistan.
dr_naeembzu@yahoo.com

***Abstract*— Fifty two farmed female *Oreochromis mossambicus* of different body sizes ranging 13.1 – 21.1 cm total length and 40.70 – 149.50 g body weight were studied for the analysis of body composition parameters (Water content, ash content, fat content, protein content) in relation to body size and condition factor. Mean percentage for water found 74.52 %, ash 5.13 %, fat 2.73 % and protein content 17.61 in whole wet body weight.**

Highly significant positive correlations were observed between body size and total body constituents. While condition factor has no influence on %water (wet weight), %ash (wet weight), %fat (wet weight) and % protein (wet weight). % water has Inverse correlations with % ash, % fat and % protein in wet weight.

Keywords- Oreochromis mossambicus, Body Composition, Body Size, Condition Factor.

I. INTRODUCTION

Oreochromis mossambicus (Peters, 1852) is an African tilapiini Cichlid fish which was introduced to Pakistan from Egypt, Indonesia and Thailand in 1951 [1]. It is widely used for food [2]. Easy growth and mild white flesh attract consumers and make it economically important fish [3].

Fish is safer and healthier to be consumed compare with goat, mutton, buffalo meat and chicken meat. Fish are good sources of protein, fat, vitamin, and mineral. Compared to other sources of protein, fish are well known to be excellent sources of protein which can be seen from amino acid composition and protein digestibility [4]. Fish is also one of the main sources of protein in the developing countries [5]. The live weight of majority of fishes usually consists of about 70 – 80 percent of water, 20 – 30 percent protein and 2 – 12 percent of lipid [6]. However these values may vary considerably within and between species and also with size, sexual condition, feeding, time of the year and physical activity. The distribution of these substances among the various organs and tissues of the body may also show considerable differences [7]. The term growth signifies changes in magnitude. The variable undergoing change may be the length or other physical values, including volume, weight, or mass either of an organisms whole body. Or its various tissues or it may relate to protein, lipid or other constituents of the body. Growth may also relate to the change in the number of animals in population [8].

The information obtained on fats, protein and mineral component and how they vary in relation to size and condition factor are important for the fish used as food by the consumers. It also facilitates the selection of most appropriate species having higher protein contents and optimum size and condition for human consummation [9]. The percentage of water in a fish is a 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 [10].

During ecological studies when fluctuations in body size and condition are monitored, the lipid content of an animal is often estimated from the percentage of water and fat. The use of such estimates is made simply because the measurement of water is very easy and rapid. Such relationships have been shown to exist in various fish species and have been extensively used for predictive estimates [7,10,11,12, 13,14]. There are numerous factors affecting body composition that include morphological, physiological, environmental and genetic variable. The effect of condition factor on body compositionwas studied by Caulton and Bursell [15] and Salam [16]. The effect of body size on body composition has been demonstrated by Tarr and Hill [16] and Salam [17].

The current study was conducted to know the parameters of body composition and the influence of body size and condition on different body constituents of *Oreochromis mossambicus*.

II. MATERIALS AND METHODS

Fifty two specimens of female *Oreochromis mossambicus* were sampled from Nursery unit Dera Ghazi Khan, Pakistan and brought to the Applied Fisheries Research laboratory, Institute of Pure and Applied Biology (Zoology Division) Bahauddin Zakariya University, Multan, Pakistan. They were weighed to nearest 0.01g 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, the dead, pre-weighed and measured fish placed as a whole in pre-weighed aluminium foil tray for drying till constant weight in an electric oven at 60-65^{o}C. For further analysis, each dry carsses were crushed and powdered in an electric blender (Moulinex) and preserved in plastic bottles with proper labeling. Ash content was determined in duplicate for each fish using 1g sub samples in heat resistant China clay

crucibles and ashed in a muffle furnace (Bamford) for 8 – 10 hours at 500-600°C and reweighed after cooling. The total lipid contents of dry tissue were dertermined by extraction in a 2:1 mixture of methanol and chloroform [18]. Protein contents of ♀ *O. mossambicus* was estimated by difference from the mass of other main constituents i.e., ash, fat, water [14].

Condition factor was calculated by using a formula $K = 100 \times W/L^3$ following the method of Wootton [19].

Statistical analysis, including regression analysis and calculations of correlation were carried out by using a computer package Lotus 1-2-3.

III. Results

Mean percentages for water, ash, fat and protein contents in whole wet body weight of ♀ *Oreochromis mossambicus* are presented in Figure 1.

A. The Relationship between Percent Water and Percent Body Constituents

It was found that % water has inverse correlations with % ash, % fat and % protein in wet weight (Table I). All these relationships were highly significant ($P < 0.001$).

B. The Relationship between Condition Factor and Other Body Constituents

The index of fish condition factor used in this study is "K". Values of K range from 1.65 to 2.31 for this female *Oreochromis mossambicus*. Insignificance relationship was found between condition factor and body constituents of *O. mossambicus* (Table II).

C. The Relationship between Body Constituent and Body Size

Body weight of fish showed insignificant relationships with % water, % ash, % fat and % protein in both dry and wet weights. Total length also showed insignificant relationships with % water, % ash, % fat and % protein in both dry and wet weights.

All the equations developed for wet weight and total length against total values of body constituents were found to be highly correlated ($P < 0.001$). Body weight and total length have positive influence on all contents. Highly significant positive correlations found in log transformed total wet body weight (Table III) and total length (Table IV) with total body constituents in wet body weight of *O. mossambicus*.

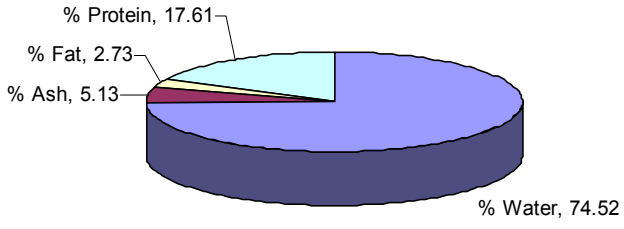

Figure 1. Mean percentages for water, ash, fat and protein contents in whole wet body weight of ♀ *Oreochromis mossambicus*.

IV. Discussion

A. The Influence of Percent Water on Percent Body Constituents

In this study, it was found that percentage fat, protein and organic contents showed highly significant ($P<0.001$) inverse relationship with water percentage in wet body weight. These results were in general agreement with other studies by Craig et al. [20], Salam et al., [12], Salam and Khaliq [21], Salam and Janjua [13], Salam and Davies [14], Salam et al., [22], Naeem et al., [23].

B. The Influence of Condition Factor on Body Constituents

Condition factor is considered to be one of the factors influencing body composition in fish [14]. The index of fish condition factor used in this study in this species is "K". Values of K for this female *Oreochromis mossambicus* ranges between 1.65 to 2.31. No influence of condition factor was found on different body constituents of *O. mossambicus* (Table I).

Caulton and Bursell [15] found that there is linear decrease in water content, an exponential increase in fat content and a curvilinear increase in protein content in relation to increase in condition factor, while ash remain fairly constant when expressed as a percent of body weight. Costopoulos and Fonds [24] demonstrated that % water content of young plaice, Pleuronectes plates decreases with increasing condition factor. Their result are generally different to those of the present study (Table I) for ♀ *O. mossambicus*.

However Naeem et al., in different studies have also found insignificant relationships between condition factor and percent water and fat in hatchery reared *Tor putitora* [23]; with percent water, protein and fat in ♀ *Oreochromis niloticus* [25]; and with percent water, fat and protein in wild *Colisa lalia* [26].

It has been found that in areas, where seasonal fluctuations in ecological condition are more pronounced, changes in condition factor are often related with feeding and seasonal cycles [27]. The natural variation in body shape also affects the condition factor, brood fish have a higher condition factor than selender individuals [24].

C. The Influence of Body Size on Body Constituents

In the present study, body weight and total length influences on total water, ash, fat and protein contents which increases with the increases of body weight and total length. When total values of each body constituents i.e., water, fat, ash, and protein of both species were transformed into log and plotted against log wet weight and log total length, a linear relationship of the form: $\text{Log } Y = a + b \log X$ was obtained showing a high degree of correlation in *O. mossambicus*. Different studies show that when fish grows in size, puts on relatively more fat and protein; and comparatively less water and skeleton. In the present study, fat and protein contents were similar to reported for other fish species [11,14,22,28,29,30].

TABLE I. PERCENT WATER VERSUS PERCENT BODY CONSTITUENT OF ♀ *OREOCHROMIS MOSSAMBICUS*

Relationships	r	a	b	S. E. (b)	t value when b=0
% Water (x) % Ash wet weight, g (y)	0.483***	15.912	-0.144	0.036	-4.000***
% Water (x) % Fat wet weight, g (y)	0.5553***	14.584	-0.159	0.033	-4.818***
% Water (x) % Protein wet weight, g (y)	0.911***	59.502	-0.696	0.044	-15.818***

correlation coefficient (r), intercept (a), regression coefficient (b), standard error (S.E.) and probabilities (p), n = 52 in each case, *** $p < 0.001$

TABLE II. CONDITION FACTOR VERSUS BODY CONSTITUENT OF ♀ *OREOCHROMIS MOSSAMBICUS*

Relationships	r	a	b	S. E. (b)	t value when b=0
Condition factor (x) % Water (y)	0.109 $^{n.s}$	81.015	-3.350	4.175	-0.802 $^{n.s}$
Condition factor (x) % Ash wet weight, g (y)	0.134 $^{n.s}$	7.447	-1.210	1.242	-0.974 $^{n.s}$
Condition factor (x) % Fat wet weight, g (y)	0.242 $^{n.s}$	-1.316	2.087	1.171	1.782 $^{n.s}$
Condition factor (x) % Protein wet weight, g (y)	0.104 $^{n.s}$	12.822	2.473	3.191	0.774 $^{n.s}$

correlation coefficient (r), intercept (a), regression coefficient (b), standard error (S.E.) and probabilities (p), n = 52 in each case, , $^{n.s}$ $p > 0.05$

TABLE III. STATISTICAL PARAMETERS OF LOG TOTAL WEIGHT VERSUS LOG TOTAL BODY CONSTITUENTS OF ♀ *OREOCHROMIS MOSSAMBICUS*

Relationships	r	a	b	S. E. (b)	t value when b=1
Log body weight, g (x) Log water content, g (y)	0.985***	-0.150	1.011	0.024	0.458 $^{n.s}$
Log body weight, g (x) Log ash content, g (y)	0.706***	-1.034	0.858	0.121	-1.173 $^{n.s}$
Log body weight, g (x) Log fat content, g (y)	0.585***	-1.841	1.125	0.220	0.568 $^{n.s}$
Log body weight, g (x) Log protein content, g (y)	0.815***	-0.605	0.917	0.092	-0.902 $^{n.s}$

correlation coefficient (r), intercept (a), regression coefficient (b), standard error (S.E.) and probabilities (p), n = 52 in each case, *** $p < 0.001$, $^{n.s}$ $p > 0.05$

TABLE IV. STATISTICAL PARAMETERS OF LOG TOTAL LENGTH VERSUS LOG TOTAL BODY CONSTITUENTS OF ♀ *OREOCHROMIS MOSSAMBICUS*

Relationships	r	a	b	S. E. (b)	t value when b=3
Log total length, cm (x) Log water content, g (y)	0.967 ***	-2.209	3.305	0.120	2.541*
Log total length, cm (x) Log ash content, g (y)	0.697***	-2.800	2.820	0.409	-0.440$^{n.s}$
Log total length, cm (x) Log fat content, g (y)	0.536***	-3.837	3.432	0.762	0.566 $^{n.s}$
Log total length, cm (x) Log protein content, g (y)	0.768***	-2.325	2.876	0.338	-0.366 $^{n.s}$

correlation coefficient (r), intercept (a), regression coefficient (b), standard error (S.E.) and probabilities (p), n = 52 in each case, *** $p < 0.001$, * $p < 0.01$, $^{n.s}$ $p > 0.05$

It is concluded that total length and body weight significantly affect body constituents. Water contents also provide satisfactory estimates of different body constituents within the size range analyzed.

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