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Body weight characteristics and chemical composition of Nile tilapia *Oreochromis niloticus* collected from three different Sudanese dams

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Abstract
The fillet yield of tilapia *Oreochromis niloticus* collected from Jebel Aulia, Sennar and Marawi dams was significantly differed at (P<0.05) in upstream while there were no significant differences in all environmental conditions throughout the collection period. The samples of the studied fish collected from upstream from three localities showed significant variations in the total weight, head weight, viscera weight, fin and skeleton weight and fillet weight. Chemical composition was presented as percentage for moisture, fat, Ash, crude protein and nitrogen free extract were tested for fish freshness and quality in all sites. The chemical composition of the studied fish collected from the three different sites significantly differed at (p<0.05) i.e. moisture, Dry matter, protein, Ash content, Fat content and either extract for upstream and downstream in Jebel Aulia, Sennar, Marawi dams, respectively.

Keywords: Body weight, dams, chemical composition, oreochromis niloticus

1. Introduction
Sudan is endowed with diversified surface and underground water resources, and arable lands that are suitable to support a vigorous capture Fishery activities are centered around the River Nile and its tributaries, and the territorial water of Sudan on the Red Sea [4].
Sudanese fishes were distributed over an area of 100,000 km of fresh water and 760 km of marine environment revealing the total sustainable production accounted for 114,100 tons per year, and human consumption is estimated to be 1.4 kg/individual/year [10].
Recently, the demand for Tilapia (*Oreochromis niloticus*) consumption has increased continuously because *O. niloticus* is of low price with high nutritional value. The whole fish and fillet are admirable for consumers. As a result, it affects the trend of both domestic and export consumption. Moreover, *O.niloticus* has many outstanding advantages such as easy to culture, high growth rate, easy breeding, high fibrillate protein, good taste, white cotton meat, having more Omega-3 fatty acids than other wild freshwater fishes and wild estuarine fishes as well.
Fish fillet consists of several components, such as moisture, protein, lipids, vitamins and minerals, all of which contribute to the overall meat composition. Fish body composition is affected by both exogenous and endogenous factors [8]. Exogenous factors that affect fish body composition include the diet of the fish e.g. composition and frequency as well as the environment in which it is found e.g. salinity and temperature. The main exogenous factor affecting proximate composition is diet. Various studies have examined the effects of temperature, light, salinity, pH and oxygen concentration on the proximate composition of fish but these factors would seem to have very limited effects. On the other hand, endogenous factors are genetic and linked to the life stage, age, size, sex and anatomical position in the fish [8]. These endogenous factors govern the majority of principles that determines the composition of fish [8]. Proximate composition of body muscles of *Puntius stigma* (male and female) analyzed shows that the moisture content was found to be higher in female, while protein, fat, ash, carbohydrate and minerals contents were higher in male. Moreover, different sexes were observed to have varying chemical composition [3].
Nile Tilapia exhibits sexual dimorphic growth where males grow significantly faster, larger and more uniform in size than females [3]. There are, therefore, a number of variables that can

affect the overall chemical composition of fish meat. Nevertheless, there is little information on the effects of sex and size (age) on the individual chemical components of Nile Tilapia meat.

Fish received increasing attention as a potential source of animal protein and essential nutrients for human diets. Fish meat contains significantly low lipids and higher water contents than beef or chicken and favored over other white or red meats [13]. The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals. Minerals are essential nutrients, they are components of many enzymes and metabolism, and also contribute to the growth of the fish [6]. The human body usually contains small amount of these minerals and the deficiency in these principal nutritional elements induces a lot of malfunctioning; as it reduces productivity and causes diseases [11]. Besides being used as food, fish is also increasingly demanded for use as feed. However, information concerning the chemical composition of freshwater fishes in general is valuable to nutritionists concerned with readily available sources of low-fat, high-protein foods such as most freshwater fishes [12] and to the food scientists who are interested in developing them into high-protein foods, while ensuring the finest quality flavor, color, odor, texture, and safety obtainable with maximum nutritive value. It is also useful to ecologists and environmentalists who are interested in determining the effects of changing biological/environmental conditions on the composition, survival, and population changes within fish species. Therefore, the present study was designed to determine the body weight characteristics and chemical composition of *O. niloticus* from three different dams.

2. Materials and Methods

Monthly samples were collected from each station representing the three different locations; twelve fish from each water source were sacrificed for the proximate analysis. Standard Methods of Association of Official Analytical Chemists [1] were used for the analysis and determination of fish flesh and carcass for moisture, crude protein, fat and ash. The nitrogen free extract was calculated by subtracting N.F.E = 100 - (moisture + protein + lipid + fiber +ash); moreover, the gross energy (kcal/kg diet) were calculated using factor 5.64, 9.44 and 4.11 for crude protein, fat, and carbohydrates, respectively.

Moisture content, crude protein, fat and ash were determined for wet samples according to standard methods of Association of Official Analytical Chemists [1]. Statistical analysis were performed using the Analysis of variance one way (ANOVA) and Duncan's multiple Range Test, to determine differences between treatments means at significance rate of $P<0.05$. The standard deviation of treatment means was also estimated. All statistics were carried out using Statistical Analysis program (SPSS, 16).

3. Result and Discussion

Data in Table (1 and 2) showed fillet yield for *Oreochromis niloticus* upstream and downstream in different areas at summer, winter and autumn seasons. The samples of the studied fish collected from upstream from three localities showed variations in the total weight, head weight, viscera weight, fin and skeleton weight and fillet weight. In case of samples collected from downstream the results obtained showed that there were significant differences ($p<0.05$) in the head weight, viscera weight, fin, skeleton weight and fillet, respectively.

The chemical composition of *O. niloticus* collected from three different localities is presented in table (3, 4 and5). The results showed that there were significant differences ($P<0.05$) in the chemical composition of *O. niloticus* samples except in the crude protein, Ether extract and Ash of the studied fish in the three samples collected from upstream. Also in case of three samples collected from downstream the results showed that there was a significant difference ($P<0.05$) in the Moisture and Ether extract, and also there were significant differences in the crude protein and nitrogen free extract. The present study revealed that there is highly significant difference ($P<0.05$) in the Ash content.

Table 1: Mean yields percentages of *Oreochromis niloticus* collected in winter season from three different dams.

Habitats (Dam)		Body weight characteristics %			
		HW	VW	SF	F
Jebel Aulia	Upstream	30.25±0.48^{a}	10.61±3.59^{a}	19.16±1.60^{b}	40.71±2,66^{a}
	Downstream	30.36±2.20^{a}	6.22±1.48^{b}	19.83±1.50^{b}	39.53±1.63^{a}
Sennar	Upstream	30.81±3.03^{a}	4.77±0.68^{b}	24.99±5.12^{a}	37.02±1.69^{b}
	Downstream	30.11±1.67^{a}	5.20±1.14^{c}	22.72±1.24^{a}	36.51±0.14^{b}
Marawi	Upstream	25.68±12.91^{b}	9.60±0.51^{a}	19.29±2.11^{b}	41.84±7.59^{a}
	Downstream	29.35±12.13^{a}	9.36±3.27^{a}	18.70±1.35^{b}	39.80±6.75^{a}

^{a,b,c}: Mean in the same raw with superscript are significant different at ($p\leq0.05$),

Table 2: Mean yields percentages of *Oreochromis niloticus* collected in autumn season from three different dams.

Habitats (Dam)		Body weight characteristics %			
		HW	VW	SF	F
Jebel Aulia	Upstream	28.41±3.13^{a}	7.41±1.15a	23.10±2.62^{a}	35.68±2.27^{c}
	Downstream	30.04±3.10^{a}	9.60±2.62^{a}	21.58±1.50^{b}	31.78±3.05^{c}
Sennar	Upstream	27.88±5.19^{a}	8.28±3.91^{a}	21.25±2.56^{b}	39.20±0.93^{b}
	Downstream	29.99±2.73^{a}	8.57±0.69^{a}	23.05±3.73^{a}	36.65±3.97^{c}
Marawi	Upstream	28.90±3.02^{a}	6.86±2.00^{b}	19.53±1.15^{b}	42.79±1.92^{a}
	Downstream	28.82±0.68^{a}	6.42±1.55^{b}	19.53±1.35^{b}	42.55±6.69^{a}

^{a,b,c}: Mean in the same raw with superscript are significant different at ($p\leq0.05$)

Table 3: Mean Chemical Composition of *Oreochromis niloticus* During Summer Season.

Parameters	Jebel Aulia Dam		Sennar Dam		Marawi Dam	
	Upstream	Downstream	Upstream	Downstream	Upstream	downstream
Moisture	75.50±3.08[a]	77.00±0.89[a]	75.00±2.6[a]	76.50±1.51[a]	71.33±1.96[b]	76.50±1.04[a]
DM	24.50±3.08[b]	23.00±0.89[a]	25.50±1.5[b]	23.50±1.51[a]	28.66±1.96[a]	23.50±1.04[a]
CP	30.33±0.55[b]	31.05±0.57	32.00±0.7[a]	31.02±0.56	32.77±0.37[a]	31.25±0.38
Ash	1.28±0.14[a]	1.20±0.15[a]	1.48±0.3[a]	1.53±0.32[a]	1.06±0.08[a]	1.21±0.07[a]
EE	7.05±0.18[a]	7.00±0.23[a]	7.53±0.1[a]	7.21±0.23[a]	7.46±0.16[a]	7.05±0.12[a]
NFE	36.81±2.81[a]	37.75±1.43[a]	33.98±3.3[b]	36.88±2.07[a]	30.03±1.85[b]	36.40±1.63[a]

[a,b,c]: Mean in the same raw with superscript are significant different at ($p \leq 0.05$), DM = Dry matter, CP = Crude protein, EE = Esther extract, NFE = Nitrogen free extract.

Table 4: Mean Chemical Composition of *Oreochromis niloticus* During Winter Season.

Parameters	Jebel Aulia Dam		Sennar Dam		Marawi Dam	
	Upstream	Downstream	Upstream	Downstream	Upstream	downstream
Moisture	74.83±3.37[b]	76.00±1.41[b]	69.50±1.3[c]	69.70±1.70[c]	85.16±1.72[a]	85.66±2.06[a]
DM	25.00±3.16[b]	24.00±1.41[a]	30.56±1.3[a]	30.28±1.71[b]	14.83.±1.7[c]	14.33±2.06[c]
CP	27.96±0.63[c]	27.85±0.62[b]	30.03±0.7[b]	29.43±0.96[a]	31.53±0.97[a]	30.73±0.32[a]
Ash	3.33±0.81[a]	2.50±0.54[a]	2.16±0.1[b]	2.18±0.14[a]	2.91±0.73[a]	2.86±0.35[a]
EE	6.35±0.81[a]	6.36±0.54[a]	6.10±0.08[a]	5.88±0.14[a]	6.75±0.18[a]	6.88±0.14[a]
NFE	37.35±4.22[b]	39.28±1.09[b]	31.20±1.4[c]	32.21±1.42[c]	43.96±1.50[a]	44.35±2.18[a]

[a,b,c]: Mean in the same raw with superscript are significant different at ($p \leq 0.05$), DM = Dry matter, CP = Crude protein, EE = Esther extract, NFE = Nitrogen free extract.

Table 5: Mean chemical composition of *Oreochromis niloticus* in autumn season.

Parameters	Jebel Aulia Dam		Sennar Dam		Marawi Dam	
	Upstream	Downstream	Upstream	Downstream	Upstream	downstream
Moisture	74.44+1.46[a]	77.64+1.06[a]	71.46+3.36[b]	73.23+2.18[b]	73.00+2.19[a]	76.33+1.36[a]
DM	25.55+1.46[b]	23.69+2.60[b]	28.36+3.31[a]	30.10+4.61[a]	27.00+2.19[a]	23.66+1.36[b]
CP	31.62+0.54[b]	30.88+0.59[a]	31.49+0.53[b]	30.80+0.33[a]	32.95+0.30[a]	31.03+0.49[a]
Ash	1.11±0.11[a]	1.26±0.05[a]	1.13±0.12[a]	1.21±0.11[a]	1.15±0.10[a]	1.15±0.10[a]
EE	7.20±0.23a	7.35±0.18[a]	7.03±0.18[a]	7.26±0.18[a]	7.51±0.14[a]	7.15±0.18[a]
NFE	34.50±1.58[a]	38.21±1.20[a]	31.71±4.08[b]	30.61±4.58[b]	31.25±2.24[b]	37.13±1.62[a]

[a,b,c]: Mean in the same raw with superscript are significant different at ($p \leq 0.05$), DM = Dry matter, CP = Crude protein, EE = Esther extract, NFE = Nitrogen free extract.

he fish fillet of the studied fish collected from Jabel Aulia, Sennar and Marawi Dams upstream and downstream disagreed with the findings mentioned that the edible parts is ranged between 45–50% and percentage levels differ according to the shape and body size of fish [5] and yet [14] in the line with the results revealed from this study. [9 and 14] who carried out studies on meat yield and nutrition value determination of Nile Tilapia *Oreochromis niloticus* found that the physical characteristics of the species has a decreasing order of fillet, head, fins and skeleton, viscera and skin for Tilapia as well as weight of whole fish and weight of fillets were significantly differed from each other. These findings were matched the low fillet yield which might also be attributed to large head, lower viscera and method and techniques of filleting from this study. Further, the results showed a decreasing order of fillet, head, fins and skeleton, viscera for *O. niloticus* respectively.

The results of the fish body weight characteristics has clearly revealed that the percentage of fillet, head, fins and skeleton, viscera and skin between the studied species differ significantly this variability might to attributable to differences of food intake, diet, size, age, sex, season of capture and environmental conditions.

The finding of the present study regarding the chemical composition showed some stark fact on the manifesto of the most popular consumed fish of tilapia *Oreochromis niloticus* collected from three different water resources which serves as the principle basis in evaluating the nutritional value of the fish. The proximate chemical composition analysis clearly revealed that, a distinct variation on the chemical composition of the studied fish. The levels of moister content percentage of *Oreochromis niloticus* collected from upstream sites of Jebel Aulia, Sennar and Marawi Dams showed significant differences between the three localities and was found to be i.e. 74.44±1.46, 71.46±3.36 and 73.00±2.19, respectively.

Further, the results obtained showed significant differences in moister content and dry matter between *O. niloticus* meat collected from downstream at the three localities and was found to be as following consequences 77.64±1.06, 73.23±2.18 and 76.33±1.36; 23.7±0.2, 28.36±3.31 and 23.66±1.36, respectively. Moreover, results expressed significant effects in the Dry matter of the studied fish collected from upstream at the three localities and were found to be 25.55±1.46, 28.36±3.31 and 27.00±2.19, respectively.

The ether extract showed a slight variation between the flash of *O. niloticus* collected from upstream at three different localities and there was significantly differed in ether extract at downstream as well as the nitrogen and Ash. However, at the downstream ash content showed highly significant differences among collection sites. In respect to nitrogen free extract content, yet showed significant difference at upstream but at downstream no significant differences were observed. In all the treatments the moisture percentage level increases while the percentage of total fat level decreases and vice versa. The protein percentage also increases with the decrease in fat percentage, and ash percentage show a little variation than the rest of the constituents of the fish flesh.

In conclusion, the present study was concluded that there was

slightly variation in the chemical composition in the studied fish collected from the three localities in all parameters. Moreover, the samples of the studied fish collected from upstream from three localities showed significant variations in the total weight, head weight, viscera weight, fin and skeleton weight and fillet weight.

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