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Variability in organic content of *Oreochromis niloticus* and *Sarethron galilaeus* from different locations in the Nile and its tributaries in Sudan

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Abstract

Analysis of variance showed extremely highly significant differences ($p=0.0000$) between location, species and their interaction in crude protein. Other parameters showed insignificant correlations ($p>0.05$). The response of different species to the change of site was different. The mean protein content was slightly higher in Wad Madani, Gitaina, Jebel and Shendi in *Sarethron galilaeus* compared with *Oreochromis niloticus*. The crude fat was found to be slightly higher in *S. galilaeus* in all locations except Shendi, The mean digestibility (0.067:1.0) was slightly higher in *S. galilaeus*, while the mean calorific value (80.452) was slightly higher in *O. niloticus*.

Keywords: Protein, fat, Nile, locations, variability

Introduction

Fish as a good is a major source of high quality protein, essential fatty acids, rich in vitamins and micronutrients (Lunven, ^[1]; Weichselbaum *et al.* ^[2]). Ye ^[3] discussed historical consumption and future demand for fish and fishery products for the years 2015/2030. According to FAO ^[4] it is important to contribute to food security and nutrition for all through fisheries and aquaculture. This essentially requires adequate knowledge of the biology and nutritive value (chemical composition) of the candidate fish, species and locality wise. The chemical composition of fish varies greatly between and within species (Alkobaby *et al.* ^[5]; Bombata-Fashina *et al.* ^[6]). Evaluation of the gross chemical composition is of pronounced importance in utilizing this resource in aquaculture and food security. It provides information on its calorific content and digestibility (Babiker ^[7] and Ahmed *et al.* ^[8]), which are both appreciated for their nutritional and health promoting benefits (Tidwell and Allan ^[9]). This knowledge is needed in animal feeds and formulations (Shafi ^[10]). In addition to its significance in post-harvest treatment, processing, preservation of fish and fishery products improves shelf-life keeping (Mahmoud ^[11], Luven ^[1], Ahmed *et al.* ^[8], Clement and Lovell ^[12]). The aim of this study was to determine and compare the crude protein and crude fat of 15 populations of *Oreochromis niloticus* and *Sarethron galilaeus* from different locations in the Nile and its Tributaries in Sudan.

Materials and Methods

Source of fish

Fifteen populations of *O. niloticus* and *S. galilaeus* were collected from different site (no samples of *S. galilaeus* were collected from Al Mawrada) Table 1. Collection was made by purchasing highly fresh from fishers operating in the area using different gill nets.

Table 1: Sample sites *O. niloticus* and *S. galilaeus* populations.

Site	Locations	Coordinate	
Blue Nile	Ad Damazin	11°47'N	34°21'E
	Sennar	13°33'N	33°35'E
	Wad Madani	14°23'N	33°30'E
White Nile	Gitaina	14°51'N	32°22'E
	Jebel Aulia	15°22'N	32°52'E
	Al kalakla	15°46'N	32°48'E
Rive Nile	AL Mawrada	15°64'N	32°48'E
	Shendi	16°41'N	33°26'E

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Proximate Chemical Composition

From each of the 15 populations of *O. niloticus* and *S. galilaeus*, three fishes were chosen randomly for measurement of crude protein and crude fat content following the standard methods of the Association of Official Analytical Chemists (AOAC^[13]). Digestibility and calorific value were determined following Babiker^[7]:

$$\text{Digestibility} = \text{Fat \%} \div \text{Protein \%}$$

$$\text{Calorific value} = \text{Protein\%} \times 4.1 + \text{Fat\%} \times 9.5$$

Results

The proximate organic composition (crude protein and crude fat) of *O. niloticus* and *S. galilaeus* were analyzed separately and averaged to obtain a reference value. Analysis of variance (Table 2) showed extremely highly significant differences ($p=0.0000$) among locations, between species and location x site interaction in crude protein. It showed insignificant correlation ($p<.05$) in crude protein with location or species as source of variations. With respect to crude fat, location, species and their interaction as a source of variation showed insignificant correlations ($p>0.05$).

Table 2: ANOVA for chemical composition (crude protein and crude fat) of *Oreochromis niloticus* and *Sarethronon galilaeus*.

Source of variation	Sum of Squares	DF	Mean Sum of Square	F-ratio	F-tabulated	Significance
Crude protein						
Location	10.772340	7	1.538906	2.2291	236.7684	$p>0.05$
Sp.	0.690367	1	0.690367	1.3977	4.2067	$p>0.05$
Locations.	6.606083	6	1.101014	769.45	2.3343	0.0000
Residual	0.060930	30	0.002			
Total	18.129720	44				
Crude fat						
Location	0.086813	7	0.012402	0.502	236.7684	$p>0.05$
Sp.	0.024703	1	0.024703	3.561	4.2067	$p>0.05$
Locations.	0.020897	6	0.003483	0.054	2.3343	$p>0.05$
Residual	0.067867	30	0.226223			
Total	0.200280	44				

According to locations, the highest mean protein value in *O. niloticus* (17.88±0.15%) was in Al Kalakla, while the lowest value (15.94±0.01%) was in Gitaina (Table 2). With respect to interaction *S. galilaeus* showed the highest mean protein

value (17.96±0.01) from Wad Madani and the lowest was (15.91±0.15) from Al Kalakla Table 3. Regarding the species the highest mean protein value (17.11%) was obtained for *O. niloticus*, while *S. galilaeus* showed (16.86%) Table 3.

Table 3: Mean protein content (%) of *Oreochromis niloticus* and *Sarethronon galilaeus* from the different sites along the BN, WN and RN.

Locations	Number of Samples	<i>O. niloticus</i>	<i>S. galilaeus</i>
Ad Damazin	3	17.41±0.01	17.12±0.01
Sennar	3	17.32±0.01	16.99±0.01
Wad Madni	3	17.15±0.01	17.96±0.01
Getina	3	15.94±0.01	16.23±0.02
Jebel Aulia	3	16.43±0.01	16.49±0.01
Al Kalakla	3	17.88±0.15	15.91±0.15
Al Mawrada	3	17.62±0.01	-
Shendi	3	17.12±0.09	17.33±0.01
Species mean		17.12±0.61	16.86±0.67

%LSD Location=0.053, 5%LSD Species = 0.027 and 5%LSD L×S = 0.075.

Crude fat statistical analysis (Table 4) showed that in *S. galilaeus* the highest mean value of (1.14%) was in Jebel Aulia, while and the lowest value of (1.01%) was in Al Mawrada. For *S. galilaeus* according to the interaction Gitaina

is highest fat content (1.19%). the lowest value (1.03%) was obtained from Shendi (Table 4). The crude fat was slightly higher in *S. galilaeus* in all locations except Shendi,

Table 4: Mean % fat content of *Oreochromis niloticus* and *Sarethronon Galilaeus* from the different sites along the BN, WN and RN.

Locations	Number of Samples	<i>O. niloticus</i>	<i>S. galilaeus</i>
Ad Damazin	3	1.11±0.01	1.11±0.02
Sennar	3	1.03±0.06	1.07±0.06
Wad Madni	3	1.07±0.06	1.14±0.05
Getina	3	1.12±0.01	1.19±0.05
Jebel Aulia	3	1.14±0.07	1.17±0.06
Al Kalakla	3	1.07±0.06	1.18±0.05
Al Mawrada	3	1.01±0.01	-
Shendi	3	1.11±0.01	1.03±0.06
Species mean		1.08±0.06	1.13±0.07

5%LSD Location=0.056, 5%LSD Species=0.028 and 5%LSD L×S=0.079.

Digestibility and Calorific values of *O. niloticus* and *S. galilaeus* (Table 5) showed that:

The highest digestibility was recorded in for *O. niloticus* from Gebel Aulia (0.069:1.0) and the lowest from Al Mawrada (0.057:1.0). In *S. galilaeus* the highest calorific value was

recorded from Al Kalakla (0.074:1.0) and the lowest from Shendi (0.059:1.0). The highest calorific value was recorded in for *O. niloticus* from Sennar (90.7978) and the lowest from Jebel Aulia (78.193). In *S. galilaeus* the highest calorific value was recorded from Wad Madni (84.466) and the lowest

from Al Kalakla (76.441).

Table 5: Digestibility and Calorific values of *Oreochromis niloticus* and *Sarethronodon galilaeus* from the different sites along the BN, WN and RN.

<i>O. niloticus</i>		<i>S. galilaeus</i>	
Digestibility	Calorific value	Digestibility	Calorific value
0.064:1.0	81.926	0.065:1.0	80.737
0.059:1.0	90.798	0.064:1.0	79.824
0.062:1.0	80.480	0.063:1.0	84.466
0.070:1.0	90.797	0.073:1.0	77.848
0.069:1.0	78.193	0.071:1.0	78.724
0.060:1.0	84.437	0.074:1.0	76.441
0.057:1.0	81.838	-	-
0.064:1.0	80.737	0.059:1.0	80.838
0.063:1.0	80.452	0.067:1.0	79.861

Discussion

The differences in proximate composition of fish is related to species, sex, season, location and processing (Shafi^[10]; Mahmoud^[13]). The crude protein and crude fat of *O. niloticus* and *S. galilaeus* from 15 populations was subject to analysis of variance. The analysis showed extremely highly significant differences ($p=0.0000$) between location and species interaction in crude protein. Other parameters were insignificant correlations ($p>0.05$).

In the present study *O. niloticus* showed a mean protein and fat content of $17.12\pm 0.61\%$ and $1.08\pm 0.06\%$, respectively. *Sarethronodon galilaeus* showed a mean protein and fat content of $16.86\pm 0.67\%$ and $1.13\pm 0.07\%$, respectively. Iyabode *et al.*^[14] studied the protein and fat content of *O. niloticus* from Oyan Lake, Nigeria. They reported $13.66\pm 2.19\%$ (protein) and $0.54\pm 0.08\%$ (fat). Their readings are lower than present findings from the Nile in Sudan. Iyabode *et al.*^[14] revealed that female *O. niloticus* had a significantly higher ($p<0.05$) crude protein content than males. This is of practical value in aquaculture. According to Bombata-Fashina *et al.*^[6] in *S. galilaeus* from Epe Lagoon, Nigeria had protein of 18.34% and fat of 0.65%. Daniel *et al.*^[15] reported protein and fat in the range of ($9.03\pm 2.32\%$ - $13.53\pm 0.74\%$) and (0.99 ± 0.33 - $4.54\pm 2.13\%$), respectively in *O. niloticus* from Nigerian wetland

In dry *O. niloticus*, Ahmed *et al.*^[8] found (21.88%) protein and (8.21%) fat. This is due to water loss. Laghari *et al.*^[16] reported 15.02-17.11% protein and 1.8-2.9% fat from *Tilapia zilli* from BarechiL Lake in Pakistan

The chemical composition of fish provides information on its digestibility and calorific content (Babiker^[7]; Ahmed *et al.*^[8]). In addition it is of significance post-harvest treatment and shelf-life keeping (Clement and Lovell^[11]). According to Babiker^[7] and Elsayed *et al.*^[17] low fat to protein ratio is indicative of high digestibility. Consumption of *O. niloticus* and *S. galilaeus* with their low calorific values is advantageous for people who want to keep low calories in their diet. In sun-dried *O. niloticus* Ahmed *et al.*^[8] found (0.375:1.0) digestibility and (167.66) calorific value. Their higher records are due to concentration of protein and fat as a consequence of water loss during drying.

Conclusions

The differences in the proximate composition of fish are related to species, sex, season, location and processing. Analysis of variance showed extremely highly significant differences ($p=0.0000$) between location and species interaction in crude protein. Slight variations in protein and fat contents were found between the 15 populations of *O. niloticus* and *S. galilaeus*. Both species showed low

digestibility and calorific content which are advantageous from nutrient stand point.

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