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Proximate/Nutrient analyses of fresh and salt water catfish and tilapia

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Abstract
The nutritional value of fish can be defined in terms of its proximate features (% moisture, % ash, % protein, % lipid, % fibre, % dry matter) and nutrient features (Ca, Mg, Na, K, Fe, Mg, Zn, Cu, and P). In the present study, the qualities of fresh and salt water catfish and tilapia were studied via proximate and nutrient analysis. Salt water tilapia (% moisture, 92.50 ± 0.01; % ash, 3.58 ± 0.01; % protein, 34.50 ± 0.01; % lipid, 4.50 ± 0.01; % fibre, 0.42 ± 0.01; % dry matter, 7.50 ± 0.02; Ca, 0.58 ± 0.01; Mg, 0.32 ± 0.001; Na, 0.96 ± 0.002; K, 0.30 ± 0.02; Mn, 0.10 ± 0.02; Zn, 0.43 ± 0.03; Cu, 0.02 ± 0.002; P, 0.24 ± 0.03). Fresh water tilapia (% moisture, 94.60 ± 0.001; % ash, 3.76 ± 0.001; % protein, 36.40 ± 0.001; % lipid, 5.20 ± 0.01; % fibre, 0.38 ± 0.01; % dry matter, 5.40 ± 0.02; Ca, 0.36 ± 0.01; Mg, 0.23 ± 0.01; Na, 0.70 ± 0.001; K, 0.24 ± 0.01; Mn, 0.10 ± 0.01; Zn, 0.35 ± 0.002; Cu, 0.01 ± 0.01; P, 0.26 ± 0.01). Salt water catfish (% moisture, 92.20 ± 0.02; % ash, 4.00 ± 0.02; % protein, 35.80 ± 0.02; % lipid, 7.36 ± 0.01; % fibre, 0.36 ± 0.01; % dry matter, 7.80 ± 0.02; Ca, 0.42 ± 0.02; Mg, 0.30 ± 0.01; Na, 0.85 ± 0.01; K, 0.36 ± 0.01; Mn, 0.14 ± 0.002; Zn, 0.40 ± 0.02; Cu, 0.30 ± 0.01; P, 0.43 ± 0.001). Fresh water catfish ((% moisture, 94.10 ± 0.01; % ash, 5.64 ± 0.01; % protein, 38.52 ± 0.01; % lipid, 8.52 ± 0.01; % fibre, 0.25 ± 0.01; % dry matter, 6.90 ± 0.001; Ca, 0.24 ± 0.01; Mg, 0.21 ± 0.01; Na, 0.64 ± 0.001; K, 0.32 ± 0.001; Mn, 0.12 ± 0.01; Zn, 0.25 ± 0.01; Cu, 0.01 ± 0.01; P, 0.38 ± 0.01). For the proximate variables, there are significant differences between the fresh water fish samples and the salt water fish samples with less value for the salt water samples except %fibre and %dry matter. The results show significant differences between fresh and salt water samples with higher values for the salt water samples except phosphorus. The salt water fish samples have higher nutrient values than the fresh water fish samples.

Keywords: proximate, analysis, nutrients, fresh water, salt water, fish

Introduction
Fish is known to be one of the cheapest sources of animal protein and other essential nutrients required by many people, especially in developing countries (Kasozi *et al*. 2014) [9]. The salt water fish is generally cheaper and more abundant when compared with fresh water fishes, which are relatively more expensive in Nigeria (Olagunju *et al*. 2012) [13].

Fish is widely consumed because it has high protein content, low saturated fat and also contains omega fatty acids known to support good health (kasozi *et al*. 2014) [9].

Fish meat contains significantly low lipids and higher water than beef or chicken and is favored over other white or red meats. The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals plus the caloric value of the fish (Olagunju *et al*. 2012) [13]. Mineral components, such as potassium, magnesium, calcium, iodine, phosphorus are important for human nutrition.

Although some research work have been done on various species, especially, the nutritional components of the fresh water fishes tend to differ between species, sexes, sizes, seasons and geographical localities (Nurnadia *et al*. 2011 [12]; Salihu-Lasisi *et al*. 2013 [14]; Kwikiriza *et al*. 2016 [10]; Adib *et al*. 2012 [1]; Olagunju *et al*. 2012 [13]; Fawole *et al*. 2007 [7]; Foline *et al*. 2011 [8]; Begum *et al*. 2012 [3]; KasozI *et al*. 2014 [9]; Alfa *et al*. 2014 [2]; Daniel, 2015 [4]; Elagba *et al*. 2010 [6]; Teame *et al*. 2016 [15]; Magami *et al*. 2016; Effiong and Fakunle, 2012 [5]; Joycy and Subbulakshmi, 2016 [11]; Kasozi *et al*. 2014 [9]. Not much work has been done on the comparison of the nutritional values of fresh and salt water fishes. Hence this work was designed to compare the nutrient values of fresh water and salt water catfish and tilapia.

Materials and Method
Sampling
Fresh and salt water catfish and tilapia were bought from Swali Market, Yenagoa, Bayelsa State.

Proximate analytical methods
Moisture content
A clean porcelain crucible was dried in an oven to obtain a constant weight, (a). 5g of the sample was introduced into the crucible, the lid replaced and weighed to obtain the weight, (b). The crucible with content was placed in the oven and the temperature set at 60oC for 24 hours. This was allowed to cool in a desiccator and weighed to have a constant weight (c).

The moisture content was then calculated by equation 1

$$\%\text{moisture} = \frac{b-c}{b-a} \times 100 \quad \ldots 1$$

Ash content
2g of oven-dried sample was weighed in a crucible of known weight. The crucible and content were placed in a muffle furnace and ignited at 550oC for 15 hours. This was cooled to room temperature in a desiccator. The ash and crucible were then weighed.

The ash content was determined using equation 2

$$\%Ash = \frac{\text{weight of ash}}{\text{weight of dried sample}} \times 100 \quad \ldots 2$$

Crude protein content

0.5g of each sample was weighed into a standard 500 mL kjeldahl flask containing the kjeldahl catalyst, 1.5g CuSO4 and 1.5 Na2SO4, some anti-bumps chips and 5mL of concentrated H2SO4. The digestion flask was placed on the digestion rack and heated gently for 1 hour to prevent charring and frothing. The heating was then increased about 4-5 hours until a clear bluish digest was observed. The digest was cooled and quantitatively transferred into a 50mL standard flask and made up to the mark with distilled water. 10mL of this solution was transferred into a kjeldahl distillation flask, treated with 10mL of 40% NaOH, and heated. The gases from this step were actually ammonia which was collected in a conical flask containing 10mL of 5% boric acid into which 2 drops of the mixed indicator was added. The tip of the distillation condenser was positioned in a way that it was immersed into the conical flask, and the distillation continued until about 3 times, the original volume was obtained. The boric acid, mixed indicator solution turned green as ammonia was distilled into it. A blank determination was also done but without the 0.5g sample.

Titration

The distillate was titrated against 0.1M HCl solution and the percent nitrogen and protein were calculated using equations 3 and 4 respectively.

$$\%N = \text{ml HCl(sample)} - \text{ml HCl (blank)} \times M \times \frac{14}{1000} \times \frac{50}{10} \times \frac{100}{0.5} \quad \ldots 3$$

$$\%PROTEIN = \%N \times 6.25 \quad \ldots 4$$

Crude lipid or extract

5 g of the oven-dried sample was accurately weighed into a thimble. About 200mL of petroleum ether was poured into a previously weighed round bottom flask. The soxhlet extractor and the thimble with its contents was fitted into the flask and the set up was placed on a heating mantle. The flask was heated slowly on the heating mantle until the solvent in the extractor was no more coloured. Then the extraction is complete. The thimble was removed and air-dried. The extracted lipid in the flask was concentrated using rotary evaporator. This was further dried in a desiccator and then weighed. The amount of lipid extracted was obtained from difference between the weights of the flask before and after extraction and the percent lipid extracted was calculated using equation 5.

$$\%lipid = \frac{\text{weight of extract}}{\text{weight of sample}} \times \frac{100}{1} \quad \ldots 5$$

Crude fibre

Acid digestion

2 g of fat free sample was weighed and quantitatively transferred into a 400mL beaker which has a mark at the 200 mL line. 50 mL of 1.25% H2SO4 was added and the mixture made up to 200mL mark with distilled water. The beaker was then boiled for 30 minutes. The contents of the beaker were filtered through a Buchner funnel with the hand of a suction pump. The residue was washed severally with hot water until it was acid free.

Base digestion

The residue was then transferred into the 400mL beaker and 50mL 0f 1.25% NaOH solution was added and made up to the 200mL level with distilled water. The mixture was brought to boiling for 30 minutes with stirring. The content were filtered through a Buchner funnel and washed severally with hot water until it was free from NaOH. Finally the residue was washed with 95% ethanol twice, and transferred into a porcelain crucible and dried at 100oC. The percent fibre was determined using equation 6

$$\%fibre = \frac{\text{weight of dried fibre}}{\text{weight of fat free sample}} \times \frac{100}{1} \quad \ldots 6$$

Nutrient analytical methods

Fish samples were acid-digested and analyzed using flame atomic absorption spectrometer.

Results and Discussion

Tables 1 and 2 respectively show the proximate analytical results of tilapia and catfish from both habitats (fresh and salt water). Salt water tilapia (% moisture, 92.50 ± 0.01; % ash, 3.58 ± 0.01; % protein, 34.50 ± 0.01; % lipid, 4.50 ± 0.01; % fibre, 0.42 ± 0.01; % dry matter, 7.50 ± 0.02). Salt water catfish (% moisture, 92.20 ± 0.02; % ash, 4.00 ± 0.02; % protein, 35.80 ± 0.02; % lipid, 7.36 ± 0.01; % fibre, 0.36 ± 0.01; % dry matter, 7.80 ± 0.02).Fresh water tilapia ((% moisture, 94.60 ± 0.001; % ash, 3.76 ± 0.001; % protein, 36.40 ± 0.001; % lipid, 5.20 ± 0.01; % fibre, 0.38 ± 0.01; % dry matter, 5.40 ± 0.02).Fresh water catfish (% moisture, 94.10 ± 0.01; % ash, 5.64 ± 0.01; % protein, 38.52 ± 0.01; % lipid, 8.52 ± 0.01; % fibre, 0.25 ± 0.01; % dry matter, 6.90 ± 0.001).

Table 1: Proximate analytical results of fresh water and salt water tilapia

Nutrient	Habitat	
% moisture	Salt water	92.50 ± 0.01
	Fresh water	94.60 ± 0.001
% ash	Salt water	3.58 ± 0.01
	Fresh water	3.76 ± 0.001
% protein	Salt water	34.50 ± 0.01
	Fresh water	36.40 ± 0.001
% lipid	Salt water	4.50 ± 0.01
	Fresh water	5.20 ± 0.01
% fibre	Salt water	0.42 ± 0.01
	Fresh water	0.38 ± 0.01
% dry matter	Salt water	7.50 ± 0.02
	Fresh water	5.40 ± 0.02

Table 2: Proximate analytical results of fresh water and salt water catfish

Nutrient	Habitat	
% moisture	Salt water	92.20 ± 0.02
	Fresh water	94.10 ± 0.01
% ash	Salt water	4.00 ± 0.02
	Fresh water	5.64 ± 0.01
% protein	Salt water	35.80 ± 0.02
	Fresh water	38.52 ± 0.01
% lipid	Salt water	7.36 ± 0.01
	Fresh water	8.52 ± 0.01
% fibre	Salt water	0.36 ± 0.01
	Fresh water	0.25 ± 0.01
% dry matter	Salt water	7.80 ± 0.02
	Fresh water	6.90 ± 0.001

The statistical analytical results (2-tailed student t-test) comparing the proximate values for tilapia and catfish from both habitats were presented in Table 3. The results show the occurrence of significant differences between the fish samples from salt water and fresh water.

Table 3: Statistical analytical results of proximate variables

Variable	Habitat	N*	Sig (2-tailed), p < 0.05
% moisture	Salt water	7	0.03
	Fresh water	7	
% ash	Salt water	7	0.02
	Fresh water	7	
% protein	Salt water	7	0.03
	Fresh water	7	
% lipid	Salt water	7	0.04
	Fresh water	7	
% fibre	Salt water	7	0.01
	Fresh water	7	
% dry matter	Salt water	7	0.03
	Fresh water	7	

N* = number of replicate samples

The nutrient analytical results for tilapia from both salt and fresh water were presented in Table 4.
Salt water tilapia (Ca, 0.58 ± 0.01; Mg, 0.32 ± 0.001; Na, 0.96 ± 0.002; K, 0.30 ± 0.02; Mn, 0.10 ± 0.02; Zn, 0.43 ± 0.03; Cu, 0.02 ± 0.002; P, 0.24 ± 0.03). Fresh water tilapia (Ca, 0.36 ± 0.01; Mg, 0.23 ± 0.01; Na, 0.70 ± 0.001; K, 0.24 ± 0.01; Mn, 0.10 ± 0.01; Zn, 0.35 ± 0.002; Cu, 0.01 ± 0.01; P, 0.26 ± 0.01).

Table 4: Nutrient analytical results of tilapia

Nutrient	Habitat	Concentration in ppm
Ca	Salt water	0.58 ± 0.01
	Fresh water	0.36 ± 0.01
Mg	Salt water	0.32 ± 0.001
	Fresh water	0.23 ± 0.01
Na	Salt water	0.96 ± 0.002
	Fresh water	0.70 ± 0.001
K	Salt water	0.30 ± 0.02
	Fresh water	0.24 ± 0.01
Mn	Salt water	0.10 ± 0.02
	Fresh water	0.10 ± 0.01
Zn	Salt water	0.43 ± 0.03
	Fresh water	0.35 ± 0.002
Cu	Salt water	0.02 ± 0.002
	Fresh water	0.01 ± 0.01
P	Salt water	0.24 ± 0.03
	Fresh water	0.26 ± 0.01

The nutrient analytical results for catfish from both salt water and fresh were presented in Table 5.Salt water catfish (Ca, 0.42 ± 0.02; Mg, 0.30 ± 0.01; Na, 0.85 ± 0.01; K, 0.36 ± 0.01; Mn, 0.14 ± 0.002; Zn, 0.40 ± 0.02; Cu, 0.30 ± 0.01; P, 0.43 ± 0.001).Fresh water catfish (Ca, 0.24 ± 0.01; Mg, 0.21 ± 0.01; Na, 0.64 ± 0.001; K, 0.32 ± 0.001; Mn, 0.12 ± 0.01; Zn, 0.25 ± 0.01; Cu, 0.01 ± 0.01; P, 0.38 ± 0.01).

Table 5: Nutrient analytical results for catfish

Nutrient	Habitat	Concentration in ppm
Ca	Salt water	0.42 ± 0.02
	Fresh water	0.24 ± 0.01
Mg	Salt water	0.30 ± 0.01
	Fresh water	0.21 ± 0.01
Na	Salt water	0.85 ± 0.01
	Fresh water	0.64 ± 0.001
K	Salt water	0.36 ± 0.01
	Fresh water	0.32 ± 0.001
Fe	Salt water	0.12 ± 0.001
	Fresh water	0.14 ± 0.002
Mn	Salt water	0.14 ± 0.002
	Fresh water	0.12 ± 0.01
Zn	Salt water	0.40 ± 0.02
	Fresh water	0.25 ± 0.01
Cu	Salt water	0.30 ± 0.01
	Fresh water	0.01 ± 0.01
P	Salt water	0.43 ± 0.001
	Fresh water	0.38 ± 0.01

The statistical analytical results (2-tailed student t-test) comparing the nutrient values for tilapia from both habitats were presented in Table 6. The results show the occurrence of significant differences between the fish samples from salt water and fresh water.

Table 6: Statistical analytical results of nutrient variables

Nutrient	Habitat	N*	Sig (2-tailed), p < 0.05
Ca	Salt water	7	0.04
	Fresh water	7	
Mg	Salt water	7	0.02
	Fresh water	7	
Na	Salt water	7	0.03
	Fresh water	7	
K	Salt water	7	0.01
	Fresh water	7	
Fe	Salt water	7	0.03
	Fresh water	7	
Mn	Salt water	7	0.04
	Fresh water	7	
Zn	Salt water	7	0.04
	Fresh water	7	
Cu	Salt water	7	0.01
	Fresh water	7	
P	Salt water	7	0.02
	Fresh water	7	

N* = number of replicate samples

Conclusion

The results show higher proximate values for the fresh water fish samples than the salt water fish samples while the salt water fish samples contain more nutrients than the fresh water fish samples.

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