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**Original article**

# Comparative evaluation of the proximate and mineral compositions of stolothrissa tanganicae and limnothrissa miodon from lake tanganyika

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A R T I C L E   I N F O

A B S T R A C T

Studies on the proximate and mineral compositions of Stolothrissa tanganicae and limnothrissa miodon were carried out using standard methods and procedures. The protein contents was significantly higher ($P<0.05$) in S. tanganicae (63.31-68.76%) .Lipids, moisture and ash were significantly different ($p<0.05$) between the two fish species. Carbohydrate contents were generally low and not significantly different ($P>0.05$) between the two species. Calcium, Phosphorus and Potassium contents were high in the two species (24250-30600ppm), (14914-17458ppm) and (4492.8-11466.8ppm) respectively and significantly different ($p>0.05$).Magnesium, Sodium, Zinc and Iron were not significantly different ($P<0.05$) between the two species. The fish species have good nutritive values which will assist in the remedy of health and nutritive problems among the populace.

## 1. Introduction

Fish is one of the most important sources of animal protein available in the tropics and has been widely accepted as a good source of protein and other vital nutrients for the maintenance of a healthy body (Andrew, 2001). In recent years ,fish lipids have also assumed great nutritional significance owing to their protective role

against the development of cardiovascular diseases and rheumatoid arthritis (Shahidi and Botta,1994).Hence, consumption of fish ,both fresh water and marine , is therefore being encouraged.

Proximate composition of fish generally refers to percentage composition of basic constituents such as water, protein, lipids, carbohydrate and ash. The proximate composition of a species helps to assess its nutritional value compared to other species. The data can also assist nutritionists, dieticians and consumers to estimate the intake of the principal nutrient in the human diet and to have the knowledge of the content of the diet (Abisoye e t al; 2011).

The study of the mineral elements present in fish is of biological importance; since many of such elements take part in some metabolic processes and are known to be indispensable to all living things (Shul'man 1974).The deficiency in these principal elements induces a lot of malfunctioning, as it reduces productivity and causes diseases such as in -ability of blood to clot, osteoporosis, anaemia etc. (Shul'man 1974 and Mills 1980).

Stolothrissa tanganicae (Pellerin) and Limnothrissa miodon (Boulenger) popularly known as "Dagaa" are commonly preferred and consumed by larger economic group of Tanzanian people who are poor. However, most people preferred S.tanganicae, whereas L. miodon (Fig. 1 and 2) which is a bit larger is consumed as an alternative when the former is not available. Therefore, considering this preference and the nutritional benefits associated with fish consumption; it has therefore become important that, the proximate and the mineral compositions of these two important fishes be assessed in order to provide the nutritive information and values to the consumers.

The aim of this study was to determine and compare the proximate and mineral compositions of S. tanganicae and L. miodon from lake Tanganyika.



**Fig. 1.** Stolothrissa tanganicae.



**Fig. 2.** Limnothrissa miodon.

## 2. Materials and methods

### 2.1. Study Area

Lake Tanganyika is located between latitude 3o 20' and 8 o 48' S and between longitude 29o 03'and 31o 12' E (Sven et al; 2006).The four riparian countries that shared the lake in terms of surface area Burundi (8 %) DR Congo (45 %), Tanzania (41 %) and Zambia 6%) (Fig 3.).The lake is an important source of fishing, drinking water, domestic usage as well as transportation route among other uses. Samples were collected from Kibirizi (04o51.559' S, 029o37.365'E) and Katonga or Bangwe (04o 54.884'S, 029o36.720'E) fish landing sites on the Tanzanian side of the lake.
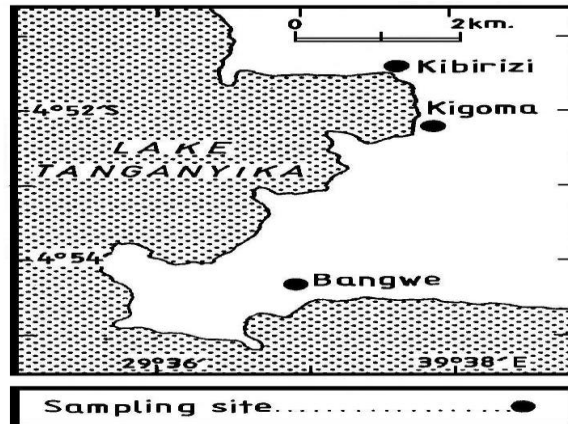


**Fig. 3.** Map of Lake Tanganyika showing the sampling sites.

### 2.2. Fish collection and processing

1,750 samples consisting of 1,000 S. tanganicae and 750 L. miodon were purchased from the commercial catches of the fishermen at the two landing sites between 6:30 – 8:30 am of January, February and March 2013.All samples were immediately placed on ice , kept cool and transported in ice to maintain freshness. Upon arrival at the University of Dar es salaam the samples were weighed for total body weight in grams and total length measured in cm. The samples were washed with de- ionized water oven dried at 109oC pooled and milled into homogenous powder. The samples were put in polythene bags, labelled and transported to the department of animal science production (DASP), Sokoine University of Agriculture (SUA), were triplicate of the samples analyses were carried out.

### 2.3. Proximate analyses

The proximate composition (moisture, crude protein, lipid, carbohydrates and ash) of the three fish species were determined using the standard methods of the Association of Official analytical Chemists (AOAC, 1990). Moisture content was determined based on the differences between the wet weight and the weight after drying to a constant temperature (at 1000C). The protein content was determined in three stages digestion, distillation and titration by micro-kjeldhal method and multiplied by 6.25 to estimate the crude protein content (AOAC, 1990). The lipid was determined by extraction with petroleum ether in a Soxhlet extractor for 4-8 hours, while the crude carbohydrate was calculated by the difference method. The sum of the percentage moisture, ash, crude lipid, crude protein was subtracted from 100 (AOAC, 1990).

The ash content was determined when the white ash was formed and a constant weight maintained. Ten grams of dried powder was placed in a pre-weighed porcelain crucible and ignited in an ashing furnace maintained at 600ºC until a constant weight was obtained.

The calorific values were estimated by multiplying the percentage carbohydrate by 4.1 kcal/g, fat by 9.5 kcal/g and protein by 5.5kcal/g. The sum was taken as the calorific value of each sample (Winberg, 1971).

### 2.4. Mineral composition analyses

The minerals in the ash (samples) powder were brought into solution by wet digestion using concentrated nitric acid (63%), concentrated Hydrocholoric acid (60%) and concentrated sulphuric acid in the ratio 4:1:1 (Harris,

1979). These were digested slowly at moderate heat in a fume cupboard for 15 minutes. After the appearance of white fumes, the solution was cooled and filtered with what man filter paper No. 44 and further diluted with distilled water.

The minerals were determined by Perkin–Elmers Atomic absorbtion spectrophotometer (AAS) (model 29 B Perkin – Elmer Co. Ltd, USA) (AOAC, 1980).

### 2.5. Statistical analyses

The data obtained were subjected to analysis of variance (ANOVA) using Graph pad In stat Demo statistical software at a significant difference level of  P≤0.05 The differences in the means were sorted out by the use of Turkey's -Kramer Multiple comparison.

## 3. Results

### 3.1. Proximate analyses

Table 1 shows the proximate compositions of S.tanganicae and L. miodon from lake Tanganyika for a period of three months (January, February and March 2013).The results were expressed on dry matter bases. Protein compositions of S.tanganicae ranged between 63.31-68.76% and for L. miodon it ranged between 60.67-67.22%. Comparatively, there was significant difference (P<0.05) between the two species with S.tanganicae having more protein than L. miodon. The lipid compositions of S.tanganicae indicated was 8.64% in January, 6.89% in February and 5.82% in March, while for L. miodon it was 6.75%, 9.49% and 4.61% in January, February and March, respectively. There was a statistical significant difference ( P<0.05) in the lipid compositions between the two species.

**Table 1**

Percentage Proximate compositions (100g/ dry weight) of S. tanganicae and L. miodon.

| Month | Protein | Lipid | Carbohydrate* | Moisture | Ash |
|---|---|---|---|---|---|
| Jan. a) S.tanganicae | 63.31 | 8.64 | 7.41 | 6.76 | 13.88 |
| b)L. miodon | 67.22 | 6.75 | 5.03 | 5.44 | 15.56 |
| Feb. a) S. tanganicae | 64.07 | 6.89 | 4.18 | 14.13 | 10.73 |
| b) L. miodon | 60. 67 | 9.49 | 5.51 | 11.05 | 13.28 |
| Mar. a)S. tanganicae | 68.76 | 5.82 | 1.02 | 11.90 | 12.50 |
| b) L. miodon | 63.95 | 4.61 | 1.84 | 14.21 | 15.99 |

*Indicates no significant difference (P>0.05) along the column.

The moisture compositions in dry weight in S. tanganicae ranged between 6.76-14.13% and 5.44-14.21% in L. miodon and there was significant difference (P<0.05) between the two species. The carbohydrate compositions in S. tanganicae ranged between 1.02-7.41% and 1.84-5.51% in L. miodon and there was no significant difference (P>0.05) between the two species. The ash compositions of S.tanganicae was in the range of 10.75-13.88% and 12.5-15.99% in L.miodon and a significant difference (P< 0.05) was observed between the two species.

Table 2 shows the calorific values of the two fishes in the three months (January, February and March, 2013). The calorific or energy values of the two fish species range between 437.65-460.67 kcal/g for S. tanganicae and in the range of 403.06-454.46 kcal/g in L. miodon.

Table 3 shows  the mineral compositions of the two fish species  in January and February, 2013 expressed in Parts Per Million (ppm).Calcium ranged between 24,800-29,400 ppm in S.tanganicae and 24,250-30,600 ppm in L.miodon and these levels were significantly different ( P<0.05)  between the two species. The level of Phosphorus ranges between 16192-16854 ppm in S. tanganicae and 14914-17458 ppm in L.miodon and there was statistical significant difference (P< 0.05) between the two fish species.The level of potassium was in the range of 4573.2-9422.8 ppm in S. tanganicae and 4492.8-11466.8 ppm in L. miodon and there was significant difference between the species. Sodium content ranged between 2597.2-3455.6 ppm in S.tanganicae and 2576.8-3166 ppm in L .

miodon and the difference was not significant (P>0.05) between the species. For the micro-minerals the level of Zinc was in the range of 98.54-124.42 ppm in S. tanganicae and 87.9-122.58 ppm in L.miodon and there was no significant difference (P>0.05) in the level between the species .Similarly, there was no significant difference (P>0.05) in the level of Iron between the two species and it ranged from 21.86-99.88ppm in S. tanganicae and 37.46-96.00ppm in L.miodon.

**Table 2**
Calorific values (Kcal/100g dry weight) of S.tanganicae and L.miodon.

| Month | species | calorific value |
|---|---|---|
| Jan. | S. tanganicae | 460.67 |
| | L. miodon | 454.46 |
| Feb. | S. tanganicae | 438.44 |
| | L. miodon | 446.43 |
| Mar. | S. tanganicae | 437.65 |
| | L. miodon | 403.06 |

**Table 3**
Mineral contents (ppm 100g dry weight) of S. tanganicae and L. miodon.

| Month | Species | Ca | P | K | Na* | Mg * | Zn* | Fe* |
|---|---|---|---|---|---|---|---|---|
| Jan. | a)S.tanganicae | 29,400 | 16854 | 4573.2 | 2597.2 | 1737.6 | 98.54 | 21.86 |
| | b) L. miodon | 30,600 | 17458 | 4492.8 | 2576.8 | 1848.4 | 122.58 | 37.46 |
| Feb. | a) S. tanganicae | 24800 | 16192 | 9422.8 | 3455.6 | 1690.0 | 124.42 | 99.88 |
| | b) L. miodon | 24250 | 14914 | 11467 | 3166 | 1568.0 | 87.90 | 96.00 |

*Indicates no significant difference at (p>0.05) along the column.

## 4. Discussion

The nutritional composition of S.tanganicae and L.miodon showed that the protein composition of the two species were  higher (63.31-68.76%) and (60.67-67.22% ).The protein compositions of the two species were much higher than those reported in beef (18.0g/100g), lamb (16.0g/100g) ,pork (10.0g/100g) and even some marine fish species  such as sardine (20.0g/100g0, mackerel (17.0-23.0g/100g) and Oyster (11.0g/100g). (Otitologbon e t al;1997, Castrilon e t  al;1996).However, the results agreed with the findings of Abdullahi and Balogun (2006), Oyebamiji e t  al;(2008) and Owaga e t  al;(2010) and does not concur with the findings of Adebisi and Fasakin (1997) and  Fawole (2007). The higher protein contents recorded might be as a result of available protein diet (copecoda, cladocera, chironomids pupae, hemipterans, cyanophyta, juvenile clupeids) eaten by L. miodon and (calanoid, copecoda and phytoplankton (cyanophyta)  consumed by S. tanganicae species in the lake. The high value of protein in the flesh of the two species indicated that they are rich sources of concentrated protein to consumers.

Depending upon the level of lipids in the fish flesh or muscles fishes are classified into three categories for instance, fat fish with more than 8% of fat content, average fat fish with fat content varying between 1-8% and lean fish with fat content less than 8% (Srivastava, 1999). From this study it can be said that the two species were lean because their lipids contents were less than 8% in two months. However, the values fall below the recommended dietary allowance of USRDA (1994) of 20- 35g/day. The variation in the monthly composition particularly in lipid among individuals of same or different species of fishes is a common phenomenon (Ssali 1998, Zenebe  e t  al;1998).These variations might be attributed to factors such as availability of food and environmental conditions. The value of lipids of the S.tanganicae and L. miodon indicated that the two species could be useful in controlling diet for diabetics and hypertensive patients.

Carbohydrates formed a minor percentage of the total proximate compositions of the two fish species (1.02-7.41%) in S. tanganicae and (1.84-5.51%) in L. miodon. The low carbohydrates recorded in the present study might be because glycogen in many aquatic animals does not contribute much to the reserves in the body (Jayasree e t al;1994).This finding conforms well to the findings of Abdullahi (2001) and Sutharshiny and Sivasshanthini (2011). The low level of carbohydrates indicated that the fish can be useful for regulating diets in patients with diabetics.

The moisture composition was low in the study. This is because the proximate composition was expressed based on the dry matter or dry weight. This agrees with the findings of other researchers Abdullahi (2001), Mumba and Jose (2005), Effiong and Mohammed (2008).

The percentage ash composition of the analysed fishes were (12.5-15.99%) in S. tanganicae and (10.73-13.88%) in L. miodon. This is an indication of ample mineral contents in the fish species. The ash contents were above the USRDA (1994) values of 12.0g/day. The reason responsible for the levels of ash obtained might be due to the fact that the whole samples were analysed as they are eaten whole.

The sum total of the contributions of each proximate component to the energy value has been reported in Table 2.The calorific values of the two fish species were in the range 437.65-460.67 kcal/g for S.tanganicae and 403.06-454.46 kcal/g for L. miodon. In the month of January the calorific values all the two species were within the recommended values of 450-600kcal/100g, while in February and March the species have values close to the recommended value of USRDA (1994). However, the two species will contribute to the calorific or energy requirement of the consumers.

Fish is a potential source of minerals such as calcium, phosphorus, sodium, potassium, iron, zinc, magnesium etc. These minerals are important in the metabolic and physiological activities and subsequent growth and development of living organisms. The present study recorded high values of calcium (24,800-29400 ppm) and (24250-30600ppm) , high values of phosphorus (16192- 16854ppm) and (14914-17548ppm).The high values of calcium and phosphorus can be attributed to the presence of exoskeletons in the two species. The relative preference of these species for consumption of hard structures could be a contributing factor as observed by Adewoye et al;(2003).The richness in Phosphorus level in the species might also be due to the fact that it is a component of protein (Taylor et al; 2002).The minerals were detected in the descending order Ca>P>K>Na>Mg>Zn>Fe. The variations in the other elements between the two species could have been as a result of the rate at which they are available in the water body and the ability of the fish to absorb these inorganic elements from their diets and water bodies where they live ( Adewoye and Omotosho, 1997).The micro-element recorded least values among the elements, this may be due to the fact that the body need it in trace amounts.

5**. Conclusion**

As fish is becoming an alternative to beef and other animal proteins, this study revealed that S.tanganicae and L .miodon are rich in protein, have average to lean lipid contents and low carbohydrate contents. The study also revealed that the former has more protein than the later. The present study also showed that these species are good sources of minerals in desirable quantities for normal growth, development and as a remedy to nutritional and health related problems.

**Acknowledgement**

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