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PROXIMATE AND MINERAL COMPOSITION OF SOME COMMERCIALLY IMPORTANT FISHES IN JEBL AWLIA RESERVOIR, SUDAN

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ABSTRACT: *The proximate and mineral composition of the flesh of six commercially important fish species (Lates niloticus , Bagrus bayad , Oreochromis niloticus, Synodontis schall, Labeo niloticus and Hydrocynus froskalii) from Jebl Awlia reservoir, which represent different grades of preference to the Sudanese consumers, were studied to assess their nutritional values in order to gain the knowledge of the risk and benefits associated with the indiscriminate consumption of these fish species. Protein content was in the range (71.46% -89.13 %) in the fish samples, crude fat was (6.34 % - 9.66 %) while moisture and ash were (75.33% -79.33 %) and (3.83 % -7.07 %) respectively. Minerals included potassium (200.0-774.0ppm), calcium (195.0-246.0ppm), sodium (184.0-211.0ppm), magnesium (144.0-105.0ppm) and phosphorus (90.0-240.0ppm) while iron and zinc were present in trace amounts. Levels of mineral elements in fish species were within WHO recommended limit. The data showed that the fishes are of high nutritional value and good source of proteins and minerals*.

KEYWORDS: Proximate composition, mineral, Nile fishes and Sudan

INTRODUCTION

The nutritional characteristics of fish and fishery products are of vital interest to consumers. Fishery products are highly nutritious and excellent means of obtaining dietary essentials, like protein, minerals and vitamins. In recent years, fish has become favorite foodstuff for the majority of societies because of several health reasons (Ali and Kiumars, 2010). Fish is a cheap source of high protein; so there is a need to produce it as an alternative way of fulfilling animal protein requirement for the poor rural communities. Sutharshiny and Sivashanthini (2011) reported that fish received increased attention from time to time as a potential source of animal protein and some minerals for human diets. In addition to nutritional value, fish is also a good source of income. The proximate composition of fish species is different among the fish species. Estimation of the some proximate profiles of a fish such as protein, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications. This knowledge of the biochemical composition of fishes is essential to estimate their energy value and to plan the most appropriate industrial and commercial processing(Tsegay *et al*., 2016)**.** The principal components of fish are; water, protein, lipid and carbohydrate (Waterman, 1980), while the following minerals are commonly found in fish: sodium, potassium, calcium, magnesium, phosphorus, sulphur, iron, chlorine, silicon, manganese, zinc, copper, arsenic and iodine (Dana *et al*., 1985). The study of mineral elements present in living organisms is of biological importance. Many of such elements take part in some metabolic processes and

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are known to be indispensable to all living things (Shul'man, 1974). Fish contains small amount of these micro-nutrients some of which are essential nutrients, being components of many enzymes system and metabolic mechanisms that contribute to the growth of the fish. The most important micro-nutrients in form of mineral salts include Ca, K,P,Mg, Cl, while many others are required in trace amount. The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning as it reduces productivity and causes diseases such as inability of blood to clot, osteoporosis, anemia etc. (Shul'man, 1974, Mills, 1980).

Fish has an important role in food security and poverty alleviation in both rural and urban areas of Sudan, but little is known about the nutritional value of the Nile fish that is normally utilized either fresh or preserved dried, salted or smoked. Better knowledge of their nutritional value, which is expected to be closely associated with fish species, could contribute to the understanding of variability in meat quality of different species of the Nile fish. Therefore, in view of these facts, the present study was carried out on the commercial and most preferred species of the Nile fishes: *Lates niloticus* , *Bagrus bayad* , *Oreochromis niloticus* , *Synodontis schall*, *Labeo niloticus* and *Hydrocynus froskalii* in order to assess their proximate compositions and minerals contents prior to their consumption.

MATERIALS AND METHODS

Sample collection:

The fish samples used for this study include *Lates niloticus* , *Bagrus bayad* , *Oreochromis niloticus* , *Synodontis schall*, *Labeo niloticus* and *Hydrocynus froskalii*. They were obtained from Jebl Awlia reservoir, 45 Km south of Khartoum, Sudan. The fishes collected were virtually of the same size as variability in size stands to affect the proximate composition and the mineral elements concentration. All the samples were collected fresh and refrigerated below 4°C prior to use.

Chemical analysis:

Each fish sample was oven-dried in an electric oven at between 70 – 80°C until the sample had constant weight. From each composite sample, 2g were taken as analytical sample. The determination of the percentage proximate composition was analyzed chemically according to the method of analysis described by the Association of Official Analytical Chemist (AOAC, 1995) while the percentage mineral elemental concentration was determined using (AAS) Atomic Absorption Spectrophotometer and calculated in ppm (µg/g dry weight).

Statistical data analysis:

Data were analyzed by descriptive analysis and one-way analysis of variance (ANOVA) to explore the general trend of the experimental data. SPSS (version 17.0) statistical software package (SPSS, Chicago, USA) was employed in the analysis. Differences were considered significant at an alpha level of 0.05. All means were given with ± standard deviation.

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RESULTS

The result of the proximate composition of the fish samples is shown in Table 1. The values represent the mean of triplicate determinations and standard deviation. The moisture content range between 75.33±1.15 for *Oreochromis niloticus* to 79.30±1.15 for *Synodontis schall* and there was no significant difference ($p>0.05$) between the values for all the fish species. The ash content range between 3.83±0.14 for *Oreochromis niloticus* to 7.07±1.0 for *Lates niloticus,* there was no significant difference ($p>0.05$) between the values for all the fish species. The protein content showed highest value (89.13±2.10) for *Lates niloticus* and least value (71.46±2.0) for *Oreochromis niloticus*. The crude protein content for all the fish species followed a decreasing order: *Lates niloticus* > *Hydrocynus froskalii* > *Bagrus bayad* > *Labeo niloticus* > *Synodontis schall* > *Oreochromis niloticus*. The fat content values showed in significant difference ($p>0.05$) among the fish species with *Synodontis schall* having the highest value (9.66±0.56) and *Hydrocynus froskalii* had the least (6.34±0.87). The crude fat content for the fish species followed a decreasing order: *Synodontis schall* > *Lates niloticus* > *Labeo niloticus* > *Bagrus bayad* > *Oreochromis niloticus* > *Hydrocynus froskalii*.

Mineral contents of all the fish samples are shown in Table 2. The mean values and standard deviation of triplicates are determinations for the mineral content of the fish samples. The Calcium content varies for the fish species with the least value (195.0±0.01ppm) and the highest value (246.0±0.01ppm) obtained for *Lates niloticus* and *Hydrocynus froskalii* respectively. Magnesium ranges from 144.0±0.04ppm in *Hydrocynus froskalii* to 452.0±0.06ppm in *Oreochromis niloticus*. The highest amount of sodium was observed in *Hydrocynus froskalii* (648.3±0.01ppm) while *Bagrus bayad* contains the least amount of sodium (184.0±0.01ppm). Potassium also ranges from 774.0±0.02ppm in *Lates niloticus* to 200.0±0.02 in *Synodontis schall*. The highest amount of phosphorus was observed in *Bagrus bayad* (240.0±0.01ppm) while the least amount was (90.0±0.006ppm) in *Synodontis schall* .The results showed that the most abundant macro elements present in all the fish samples were sodium followed by magnesium , potassium calcium, and phosphorus respectively . Iron was the most abundant micro element in the fish. The iron content of the fish species ranged between 2.0±0.06ppm and 8.0±0.04ppm in *Bagrus bayad* and *Labeo niloticus* respectively. There was no significant difference ($p>0.05$) between the values of the iron contents.

DISCUSSION:

The nutritional composition of freshwater fish is known to vary with species, sex, size, season and geographical location (Zenebe *et al*., 1998)). Additional factors that influence nutritional composition include feed intake and sexual changes associated with spawning (Silva and Chamul, 2000). In the present study, the species investigated are the popular market fishes in Khartoum, and economically belong to the different traditional grades, according to consumer and fishermen preference in Sudan. The nutritional elements showed variable values in the species analyzed; with crude protein recording the highest values and lipid recording the lowest. This makes the Nile fishes important living resources of dietary protein as other sea and freshwater fish (Zuraini *et al*., 2006).

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Generally, the proteins are essential for normal function, growth, and maintenance of body tissue and hence protein content is considered to be an important tool for the evaluation of biochemical and physiological standards of agiven organism.(SK Shahina *et al*., 2016**).** Protein content was slightly higher in the muscle of *Lates niloticus* than in the other five species. Although, slight variations were observed for the protein levels and statistically no significant difference (P>0.05), indicating that protein levels were the same in the species. The results of the range of protein content were within the range of variations reported by Zelibe (1989). The fish species examined belonged to high protein, low fat category, because the protein contents were between 71 to 89%DW and fat 6.0 to 9.0%DW (Stansby, 1982). The high tissue protein content of the fish species in this study may be related to the high protein contents of their common diets as they fed mostly on fish items, crustaceans, molluscs, algae and diatoms (Osibona, 2005).

Crude fat content, in particular has been observed to fall into the category of lean fish (Srivastava, 1999). High lipid fishes had less water and more protein than low-lipid fishes. This is in-line with the report of Steffens (2006), that protein forms the largest quantity of dry matter in fish. The difference in the value of crude fat level in the fish species could be due to water temperature difference, stage of life, environmental salinity, food type, and species (Fabiola & Martha, 2012). This study found the percentage ash content, is an indication of ample mineral content in fish. The ash contents for all samples examined (Table 1) were not significantly different (p>0.05) and the values were not above the World Health standard.

Results showed all the fish samples contained appreciable concentrations of potassium, sodium, magnesium, calcium and phosphorus suggesting that these fishes could be used as good sources of minerals. The variations recorded in the concentration of the different mineral components in the fish examined could have been as a result of the rate in which these components are available in the water body (Yeannes and Almandos, 2003), and the ability of the fish to absorb and convert the essential nutrients from the diet or the water bodies where they live. This is supported by the findings of (Window *et al*. 1987; Prapasri *et al*., 1999; Fawole *et al*., 1996; Ali *et al.,* 2001; Ako and Salihu, 2004 and Fawole *et al*. 2007). The richness in phosphorus level in the five species can also be attributed to the fact that phosphorous is a component of protein. The concentration of the microelement and iron were analyzed for the fish samples, were not statistically different at (p>0.05) between the fish species. Iron is an essential component of the respiratory pigments and myoglobin, also is an important constituent of hemoglobin (Onwordi *et al*., 2009). This microelement is equally important in trace amounts as observed, but they tend to become harmful when their concentration in the tissues exceed the metabolic demands (Fawole *et at*, 1996; Ako and Salihu, 2004).The iron contents for the fish samples are within the World Health standard .

CONCLUSION:

The study of the proximate composition of *Lates niloticus* , *Bagrus bayad* , *Oreochromis niloticus* , *Synodontis schall*, *Labeo niloticus* and *Hydrocynus froskalii* revealed that they are rich in protein, minerals and have average to low lipid contents. This study have shown these fish species from Jubl Awlia, Sudan as good source of nutrients to the consumers and within the

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limits required by the body for healthy growth and development. The study has also provided an insight into the mineral content of these species in line with food safety when consumed. Since the nutritional value of these fish samples have been known, consumers can now know the benefit to derive when these fishes are consumed. The result obtained in this study has provided scientific information and detailed knowledge of the proximate composition and minerals of these six important commercial fish species.

Table 1. The percentage means proximate composition in the body tissue of some selected fish species (g/100g)

Parameter % Fish samples	Moisture	Ash contents	Crude protein	Crude fat
Lates niloticus	77.33±2.3	7.07±1.00	89.13±2.10	9.61±0.56
Bagrus bayad	78.33±2.9	5.74±0.36	84.89±0.80	8.63±0.69
Oreochromis niloticus	75.33±1.15	3.83±0.14	71.46±2.00	8.52±0.69
Labeo niloticus	76.00±2.0	5.50±0.98	75,00±0.10	9.08±0.85
Hydrocynus froskalii	76.66±2.3	4.16±0.14	82.86±3.00	6.34±0.87
Synodontis schall	77.33±2.3	5.11±0.20	78.34±0.37	9.66±0.56
Sign. level	NS	NS	NS	NS

*Values represent pooled means and standard deviations of triplicate determinations of wet weight

**NS values represent not significantly different

Table 2. The percentage means of mineral elements in the body tissue of some selected fish species (ppm)

Elements Fish samples	Potassium K	Calcium Ca	Sodium Na	Magnesium Mg	Phosphorous P	Iron Fe
Lates niloticus	774±0.018	195±0.01	449±0.01	105±0.06	190±0.01	7.00±0.01
Bagrus bayad	219±0.038	242±0.27	184±0.01	241±0.18	240±0.01	2.00±0.06
Oreochromis niloticus	220±0.018	226±0.01	429±0.01	452±0.06	140±0.01	4.00±0.07
Labeo niloticus	321±0.01	237±0.01	369±0.01	258±0.06	210±0.01	8.00±0.04
Hydrocynus froskalii	260±0.018	246±0.01	648±0.01	144±0.040	160±0.06	3.00±0.06
Synodontis schall	200±0.018	196±0.01	211±0.01	235±0.010	90.0±0.06	5.00±0.07
Sign. level	NS	NS	NS	NS	NS	NS

*Values represent pooled means and standard deviations of triplicate determinations of wet weight

**NS values represent not significantly different

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