INTRODUCTION

The chemical composition (protein, lipid, moisture and ash content) is traditionally used as indicator of the nutritional value of the fish (Mohgaddam et al., 2007) and the physiological condition of fish and its habitat (Aberoumad and Poursafii, 2010; Shamsan and Ansari, 2010). Proximate biochemical analysis provides information on the nutritional value of fish used as a source of food (Zafar et al., 2004) and it varies widely from species to species and within the same species (Fawole et al., 2007). It is also greatly affected by the feeding habit, sex and seasonal variations (Islam et al., 2005).

The knowledge of chemical composition of fish is essential in order to compare its value as food with other protein foods, to ensure that they are within the range of the dietary requirements and commercial specifications. It is also necessary to have data on the composition of fish, in order to make the best use of them as food and to develop the technology of processing fish and fish products as well as in fish culture activities. Considerable amount of wastes (head, intestine, skin, bones liver) is usually discharged when preparing fillets of the fish. These wastes have high content of nutritive compounds (protein, lipid, vitamins and minerals and essential fatty acids) and can offer a potential substrate of fish meal production. Substantial amount of lipid was extracted from non-consumable parts of the fish and shrimps, such as head, skin, heart, central bones, viscera (Sathivel et al., 2002; Nwanna, 2003; Nargis, 2006). Recent studies indicated that these parts of the fish are rich sources of essential fatty acids such as n-3 polyunsaturated fatty acids (Kwetegyeka et al., 2008; Koddami et al., 2009). However, the chemical composition of many species of the Nile fish in Sudan is not available, except the study of the proximate composition of some species (Mohamed et al., 2010). The muscles and livers from some commercial species of the Nile fish were also analyzed for their fatty acids composition (Mohamed and Al-Sabahi, 2011; 2013) and proved to be a promising potential source of essential fatty acids and valuable for human consumption of healthy diet. The study of head value can also provide information of this part of the fish which is neglected and discharged as waste, and may increase the nutritional value of the fish. Therefore, the main purpose of this study is to determine the percentage of the proximate composition (protein, lipid and ash) and the mineral contents in the muscle tissues of seven commercial Nile fish namely: Barbus bynni, Labeo niloticus, Mormyrops anguilloides, Marcusenius cyprinoides, Mormyrus niloticus, Clarias lazera and Protopterus annectens were, to understand their nutritional value. The second objective of this study is to investigate the head wastes of the Nile fish, by investigating the proximate composition and mineral contents in the head tissues of the same species and compare their contents with the contents of the muscle tissues. As far the concern of the researcher, this

Proximate and mineral composition of muscle and head tissues of the Nile fish: Barbus bynni, Labeo niloticus, Mormyrops anguilloides, Marcusenius cyprinoides, Mormyrus niloticus, Clarias lazera and Protopterus annectens was determined. Protein content was (84%) in muscle tissues of L. niloticus and P. annectens and (66%) in M. cyprinoides, (70, 74 and 76%) in head tissues of M. niloticus, P. annectens and C. lazera, respectively. Lipid content was (23 and 26%) in muscle tissues of M. niloticus and M. cyprinoides, respectively, (46 and 47%) in head tissues of M. cyprinoides and M. anguilloides, respectively. Ash content was (3-9%) in muscle tissues, high in C. lazera, (12 to 33%) in head tissues, high in L. niloticus and least in M. niloticus. Total minerals content was (104.3-176.2 mg/100g) in muscle tissues, high in M. cyprinoides and least in M. niloticus, (117.5-340.6 mg/100g) in head tissues, high in C. lazera and least in M. niloticus. Considerable amount of Ca was detected in head compared to muscle tissues. The study points out that both muscle and head tissues of the investigated Nile fish contain appreciable levels of nutrients, and the head waste may be a valuable source for human consumption and fish lipid. Further research should cover other Nile fish and their discharged wastes, and essential amino acids and fatty acids should be included.
study will be the first of its kind to explore the nutritional status of head tissues from some available Nile fish in Sudan.

**MATERIALS AND METHODS**

**Collection of samples**

Fresh specimens of seven commercial Nile fish namely: *Barbus bynni, Labeo niloticus, Mormyrops anguilloides, Marcusenius cyprinoides, Mormyrus niloticus, Clarias lazera and Protopterus annectens* were purchased from the local fish market in Khartoum. Fish were skinned, gutted, washed and the head were carefully separated. The edible portion of the muscle tissues was removed. Both heads and muscle tissues were freeze dried to constant weight using Freeze Dryer model 230 to -40°C. The dried samples were grounded to a fine powder and used for analysis.

**Proximate analysis**

The standard procedure of Association of Official Analytical Chemists (AOAC, 2005) was used to determine the protein, lipid and ash contents. Nitrogen in the muscle and head tissues was estimated by micro-kjeldhal nitrogen estimation method and the protein value was calculated by multiplying the nitrogen value by the conversion factor 6.25. The lipid was estimated by extracting the sample with ether in a soxhlet extractor for a period of 7-8 hours. Ash content was determined by incineration of one gram from each sample in a muffle furnace at 600°C for 2 hours. All proximate components were analyzed in triplicates and reported as mean on % dry weight basis.

**Mineral analysis**

The concentration of mineral elements (phosphorus, sodium, potassium, iron, calcium, magnesium, barium, zinc and manganese) was determined by Atomic Absorption Spectrophotometer (AAS). All determinations were done in triplicates and calculated as mean mineral content in (mg/100g dry weight). Different mean values were analyzed using the Statistical Package for Social Science (SPSS software program, version 10). The result is considered significant if \( p < 0.05 \).

**RESULTS AND DISCUSSION**

The proximate compositions (protein, lipid and ash) and mineral contents in muscle and head tissues of seven Nile fish, *B. bynni, L. niloticus, M. anguilloides, M. cyprinoides, M. niloticus, C. lazera and P. annectens*, were investigate and compared. The mean percentage of protein, lipid and ash is presented in (Table 1 and Figure 1 and 2). The protein level in the muscle tissues varied from 66-84% while head tissues contained 31-76% of protein of the total dry weight. Lipid content varied from 2-26% in muscle tissues and from 2-47% in head tissues. The result indicated that the ash content of the head was high especially in *L. niloticus and B. bynni* (33 and 29%). The ash content in the tissue ranged between 2 and 9%. Compare with other species, the mean percentage of protein was found at a higher amount in the muscle tissues of *L. niloticus and P. annectens*, and the mean percentage of lipid was found at a higher amount in *M. cyprinoides and M. niloticus*. The higher percentage of ash was found in the muscle tissues of *C. lazera*. The head tissues of *C. lazera, P. annectens and M. niloticus* contained the highest amount of protein, while those of *M. anguilloides and M. cyprinoides* contained the highest amount of lipid. The ratio of head: muscle protein equal one in *M. cyprinoides, C. lazera, and P. annectens* indicating that the head tissues of these Nile fish are good sources of protein.

**Table 1. The mean percentage of protein, lipid and ash in muscle and head tissues of seven species from the Nile fish**

<table>
<thead>
<tr>
<th>Fish species</th>
<th>Muscle tissues</th>
<th>Head tissues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protein %</td>
<td>Lipid %</td>
</tr>
<tr>
<td><em>B. bynni</em></td>
<td>72</td>
<td>2</td>
</tr>
<tr>
<td><em>L. niloticus</em></td>
<td>84</td>
<td>2</td>
</tr>
<tr>
<td><em>M. anguilloides</em></td>
<td>78</td>
<td>3</td>
</tr>
<tr>
<td><em>M. cyprinoides</em></td>
<td>66</td>
<td>26</td>
</tr>
<tr>
<td><em>M. niloticus</em></td>
<td>73</td>
<td>23</td>
</tr>
<tr>
<td><em>C. lazera</em></td>
<td>79</td>
<td>11</td>
</tr>
<tr>
<td><em>P. annectens</em></td>
<td>84</td>
<td>2</td>
</tr>
</tbody>
</table>

**Figure 1. Proximate composition of muscle tissues from seven species of the Nile fish**

**Figure 2. Proximate composition of head tissues from seven species of the Nile fish**

The ratio of head: muscle lipid was high (15.7, 13 and 9.5) in *M. anguilloides, B. bynni* and *L. niloticus*, respectively. The mineral content in the muscle and head tissue is represented in (Figure 3 and 4). Mineral elements detected were in the order Na> K> P> Fe> Ca> Mg> Sr, in the muscle tissues, and in the order P> Na> K> Ca> Fe> Sr> Mg in the head tissues. Trace amounts of zinc, manganese, barium and lead were detected in muscle and head tissues of the seven fish species. Ash content was (3-9%) in muscle tissues highest in *C. lazera*, and (12-33%) in head tissues high in *L. niloticus* and least in *M. niloticus* respectively. Total minerals content was (104.3-
176.2 mg/100g) in muscle tissues, high in *M. cyprinoides* and least in *M. niloticus*. The head tissues contained (117.5-340.6 mg/100g), with highest value in *C. lazera* and least in *M. niloticus*. Considerable amount of Ca was detected in head compared to muscle tissues. As shown in the figures, the head tissues contained higher amount of phosphorus, calcium and iron compared to the muscle tissues.

**Figure 3.** Mineral contents in muscle tissues of seven species from the Nile fish

**Figure 4.** Mineral contents in head tissues of seven species from the Nile fish

The above data on proximate composition compares in general with the data of some freshwater fish from Bangladesh (Kamal et al., 2007 ) but higher than the contents found in muscle and head tissues of some common Saudi species (Tawfig, 2009). The presence of high quantity of lipids in the head tissues provides promising source of essential fatty acids. Fish lipid that contributes to the nutritional needs is currently being extracted from liver and muscles of some commercial Nile fish (Mohamed and Al Sabahi, 2011; 2013), from liver or muscle of herring, mackerel and sardine (Nijinkoue et al., 2002; Khoddami et al., 2009) and other species of marine fish (Tawfig, 2009; Guil-Guerrero et al., 2010). The present results indicated that both muscle and head tissues of the investigated Nile fish is a good sources of protein, lipid and ash as well as minerals, and the head waste may be a valuable source for human consumption, as well as a good substitute source to extract the fish lipid. The main advantage of fish lipid from fish waste is that it is much cheaper compared with fish lipid extracted from flesh. This study only focuses on seven commercially important species of the Nile fish. Further research should cover most of the common Nile fish. Besides protein, lipid, ash, essential amino acids and fatty acids should be included in further studies to investigate the nutritional value of Nile fish and the discharged fish wastes.

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**REFERENCES**


