

Comparative study of proximate composition, minerals and amino acid of some economically species in Sudan

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Abstract: The edible muscle tissue of two marine fish (*Lethrinus nublosus* and *Eipiniphilus coioies*) and two freshwater fish (*Oreochromis niloticus* and *Bagrus bayad*) were analyzed for their mineral, amino acid, and proximate compositions. Wide variation between species in moisture content (marine, 73.0–74.66%; freshwater, 75.33–78.0%), fat content (marine, 3.33–4.16%; freshwater 5.3–13.17%) and protein content (marine, 73.3–78.07%; freshwater, 78.20–77.0%) was observed. The amino acid composition showed that all fish studied were balanced with respect to essential amino acids. Marine and freshwater fish were comparable in their mineral compositions. The content per g muscle was 2920-4305 mg Ca, 7270-7730 mg P, 705-748 mg Mg, 9990-10175 mg K, 2060-2305mg Na and Se 3610 mg for freshwater fish, while marine fish was 3113-5880 mg Ca, 9010-9350 mg P, 687-696 mg Mg, 11550-12100 mg K, 22856-2935mg Na and Se 4328-4565 mg.

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Introduction

Fishes are nutritious food items and are comparatively less expensive meat source available. In developing countries, fish is one of the potential sources of animal protein and essential nutrients for the maintenance of a healthy body (Fawole *et al.*, 2007). Fisheries reduce vulnerability to hunger by providing a complementary food source when other food sources such as agriculture are at a seasonal low. Foran *et al.*, (2005) submitted that, fish is a highly proteinous food consumed by a larger percentage of populace because of its availability and palatability. Today there is an ever increasing awareness about healthy food and fish is finding more acceptances because of its special nutritional qualities. In this context a proper understanding about the biochemical constituents of fish has become a primary requirement for the nutritionists and dieticians. The knowledge of fish composition is essential for its maximum utilization. The nutritional composition of fish varies greatly from one species and individual to another, depending on age, feed intake, sex and sexual changes connected with spawning, the environment and season (Silva and Chamul, 2000). Processing and preservation of fish and fishery products also need correct information on biochemical composition. Information on the biochemical constituents will enable a processing technologist to identify the best possible processing and storage conditions, so that the quality is preserved to the maximum degree (Hindumathy, 2013). The four major constituents in the edible portion of fish are water, protein, lipid (fat

or oil) and ash (minerals). The analysis of these four basic constituents of fish muscle is often referred to as proximate analysis (Love, 1970). Even though data on proximate composition are critical for many applications and investigations on these lines had been carried out from as early as the 1880s (Atwater, 1988). The study of mineral elements present in living organisms is of biological importance. Many of such elements take part in some metabolic processes and are known to be indispensable to all living things (Shul'man, 1974). The body usually contains small amount of these minerals, some of which are essential nutrients, being components of many enzymes system and metabolic mechanisms, and as such contribute to the growth of the fish. The most important mineral salts are that of calcium, sodium, potassium, phosphorous, iron, chlorine while many others are also needed in trace amounts. The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning including reduced productivity, inability of blood to clot, osteoporosis, anemia *e.t.c.* (Shul'man, 1974 and Mills, 1980). In recent years, there has been heightened interest in the chemical composition of fish (Zenebe *et al.*, 1998). Therefore it is necessary to elucidate the major biochemical components like proximate composition, minerals and amino acid composition. Various authors have reported on the proximate chemical composition and seasonal variation of different fish species (Effinog and Mohammed, 2008; Exler, 1987; Gooch, *et al.*, 1987 and Chandrashekar, 1993). Today there is an ever increasing awareness about healthy food and fish is

finding more acceptance because of its special nutritional qualities. In this context a proper understanding about the biochemical constituents of fish has become a primary requirement for the nutritionists and dieticians. But when we consider Sudan, the consumption of these kind of fish are very less, since the nutritional value of such type of fish has not yet studied completely and deeply. Therefore it is necessary to elucidate the major chemical components like proximate composition, mineral, fatty acid composition and amino acids content. And here we made a comparative study of four important fish species, namely two freshwater species, *Bagrus bayad*, *Oreochromis niloticus* and two marine species, *Lethrinus nublousus*, *Eipiniphilus coioies* were chosen for this work based on their economic importance and the fact that they are very abundant in Sudanese markets.

Materials And Methods:

Sample collection:

The fish samples used for this study which include two freshwater species *Bagrus bayad*, *Oreochromis niloticus* and two marine species *Lethrinus nublousus*, *Eipiniphilus coioies*. They were obtained from Khartoum fish market in, Sudan, the samples were collected fresh and refrigerated below 4°C, then were transported to the laboratory, faculty of agriculture and fish sciences. They were beheaded, eviscerated, filleted manually and thoroughly washed. Then, they were minced, homogenized, packaged, labeled and stored in the refrigerator to analysis. Analysis of samples were carried out in triplicate.

Chemical analysis:

Each species of the fish sample was oven-dried in an electric oven at between 70 – 80°C until the samples had constant weight. From each composite sample, 2g were measured and taken as analytical sample. The percentage proximate composition was determined chemically according to the method of analysis described by the Association of Official Analytical Chemist (AOAC, 2000). The percentage mineral elemental concentration was determined using (AAS) Atomic Absorption Spectrophotometer and calculated in ppm ($\mu\text{g/g}$ dry weight). The amino acid content in different samples was analyzed Amino acids composition was determined with an automatic amino acid analyzer (LKB 4151 plus, Biochrom Ltd., Cambridge, UK) according to Bidlingmeyer *et al.*(1987). The degree of variability in different groups of amino acids (according to type of side chain) was

expressed as percentages of total amino acids in each species and the ratio of essential amino acid was determined.

Results

Proximate analysis

As a part of proximate composition, moisture content, crude protein content, crude fat content and ash content of the four different samples were analyzed. The moisture content of *Oreochromis niloticus* and *Bagrus bayad* were 75.33% and 78% respectively, while *Lethrinus nublousus* and *Eipiniphilus coioies* had 73% and 74.56% respectively. The protein content showed highest value 78.20% for *Bagrus bayad* and least value 73.3% for *Lethrinus nublousus*. The protein content values of 77% and 78.07% were obtained for *Oreochromis niloticus* and *Eipiniphilus coioies* respectively. The fat contents of *Bagrus bayad* was 13.17%, which recorded highest value. Least value was 3.33% for *Lethrinus nublousus* was negligible. The fat content in *Oreochromis niloticus* was estimated as 5.3% and it was in *Eipiniphilus coioies*, 4.16%. The highest value of ash 7.7% was recorded in *Eipiniphilus coioies* while lowest value 3.8% in *Oreochromis niloticus*. The ash content in *Bagrus bayad* and *Lethrinus nublousus* were 5.6% and 7.0% respectively. (Fig.1).

Mineral concentration analysis

Sodium, potassium, phosphorus, magnesium, selenium and calcium content were examined in all fish samples. The mineral contents from high to low value were present in the species analyzed in the order: *Eipiniphilus coioies*, *Lethrinus nublousus*, *Bagrus bayad* and *O. niloticus*. Potassium (K+) was the highest followed by phosphorus, calcium, selenium and sodium while magnesium showed minimum concentration in all species (Fig. 2).

Amino acid analysis

The amino acid content in different samples was analyzed. The various amino acids observed were grouped into three categories based on their concentration. The first category had high amino acids ranging from 510.8 to 357.8 ppm. The most abundant amino acid in this group was lysine; followed by leucine. The second category had medium amount of amino acids ranging from 287.9 to 205.1ppm. This category had valine, isoleucine, threonine and phenylalanine, in decreasing order. The third category had low amino acids ranging from 190.5 to 23.76ppm. Third category had methionine, histidine and tryptophan in decreasing order (fig 3).

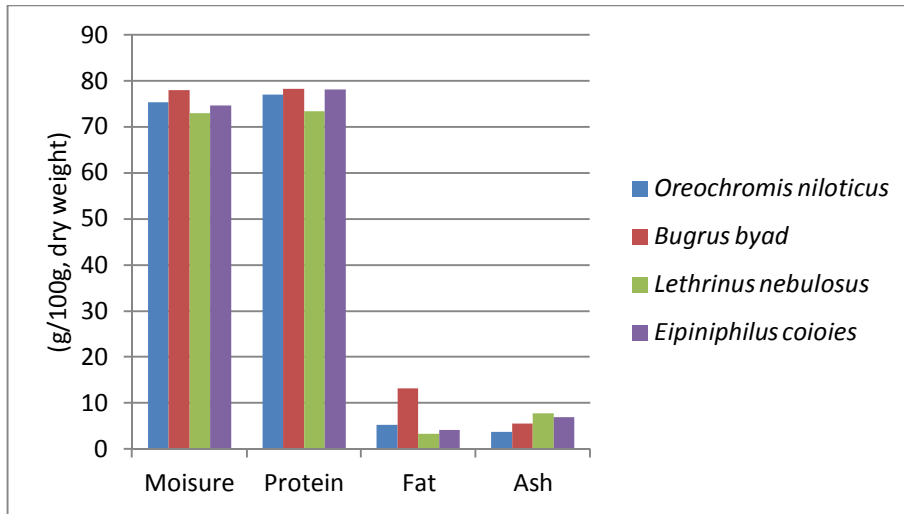


Fig (1) Proximate compositions of four species

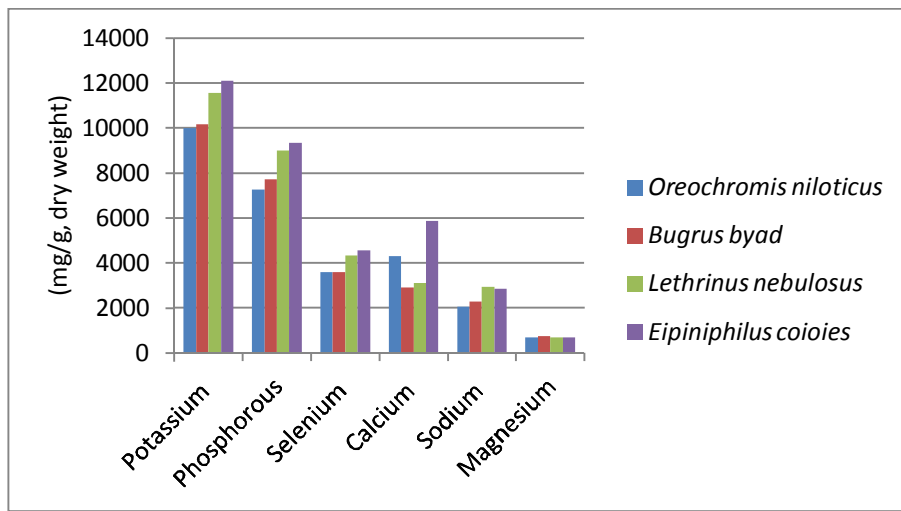


Fig (2) Minerals constituent of four species

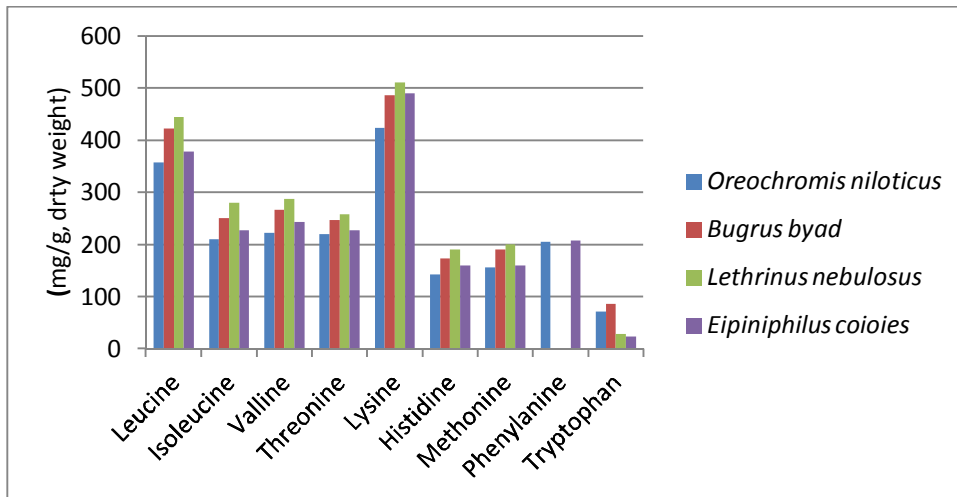


Fig (3) Essential amino acid in muscle tissues of four species

Discussion

A knowledge of chemical composition is essential in order to compare its value as food with other protein foods. It is also necessary to have data on the composition of fish in order to make the best use of them as food and in order to develop the technology of processing fish and fish products. The chemical composition of fish varies greatly from one species and one individual to another depending on sex, age, environment and season. Therefore a substantial normal variation is observed for the constituents of fish muscle. Proteins, lipids and moisture contents as well as the ash contents were the major constituents, which had been considered in evaluating the nutritional value of the species studied. The nutritional elements showed variable values in the species analyzed; with protein contents recording the highest values and lipid recording the lowest. This makes the fish studies important living resources of dietary protein as other sea and freshwater fish (Vlieg and Murray, 1988; Zuraini *et al.*, 2006). This study found out that moisture was inversely related to lipid content. 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. Also the inverse relationship has been reported in marine fishes (Zaboukas *et al.*, 2006) and freshwater fishes (Jafri, 1969). The percentage ash content in the fishes analyzed is an indication of ample mineral content in fish. The mean values of the ash content for the flesh of the fish samples (fig) follow an increasing order *Eipiniphilus coioies*, *Lethrinus nublosus*, (marine species) *Bagrus bayad* and *O. niloticus* (freshwater species). The ash content could be traced to the fact that the fresh water species compared to others which are of relatively higher salinity environment was least. The ash contents for all samples examined were not above the World Health standard. Results showed all the fish samples contained appreciable concentrations of potassium, sodium, magnesium and calcium and that lead to fishes could be used as good sources of minerals. Potassium was observed to dominate other minerals in all samples. The variations recorded in the concentration of the different nutritional 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 findings supported by (Ricardo *et al.*, 2002; Adewoye *et al.*, 2003 and Fawole *et al.*, 2007). The richness in phosphorus level in the four species can also be attributed to the fact that phosphorous is a component of protein. Amino acids are also important in healing processes and the amino acids compositions

in fish and man are similar. People can acquire essential amino acids in abundance and proper balance by eating fish. The essential amino acids cannot be manufactured in human bodies, but can be obtained from food. Nine essential amino acids namely, lysine, leucine, valine, isoleucine, threonine, phenylalanine, methionine, tryptophan and histidine that are very important for human body were present in the four species examined, therefore these species would be very good source of these amino acids in our diet. Essential amino acid concentrations did not vary between fish species (fig 3) and thus, eating any of these species would provide virtually the same type of amino acids in the diet.

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