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Some Nutritional Values of Four Fresh Water Fish from Different Localities in White Nile

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Abstract

Fish is considered as an excellent affordable source of nutrients. The objective of the present study was to determine the proximate composition of four fresh water fish namely: *Oreochromis niloticus* (Nile tilapia), *Hydrocynus forskali* (Kass), *Labeo niloticus* (Dabs) and *Chrysichithys auratus* (Abu Reyala) from three sites along the White Nile. Al-dubaseen area Site (2) was considered the site with highest contamination where dumping of effluents, Al-kalakla area Site (1) was 5km south before the dumping area and considered area with least pollution. Al-shagara area Site (3) 5 km north after the dumping area and considered an area with medium pollution. Moisture content, crude protein, crude oil, ash and carbohydrates in flesh of the four species were evaluated by proximate analysis according to [1]. Three vitamins were also determined in the flesh of the four species from the three sites using liquid chromatographic method. Fish collected from the effluent dumping site (site 2) showed lowest percentages in crude protein, crude oil, ash and carbohydrates which were although not significantly different in *O. niloticus. L. niloticus* and *H. forskali* but showed significant lowest percentages in *C. auratus*. In general Vitamin C and E were lowest in fish collected from site (2) when compared to sites (1) and (3). Results revealed no significant alterations in Vitamin A levels in fish species except for *H, forskali* that gave a significantly low levels of Vitamin A from Site 2. The results suggest that effluents dumped in the White Nile caused pollution that contributes to elevation of the chemical composition of fish.

Keywords

Oreochromis Niloticus, Hydrocynus Forskali, Labeo Niloticus, Chrysichithys Auratus, Proximate Analysis, White Nile, Sudan

1. Introduction

Aquatic pollution is recently becoming a global concern. For the ever growing human activities are continuously depositing pollutants and contributing to change in the biochemical composition of aquatic organisms. Fish which are at the top of the aquatic food chain are exposed to higher levels of pollutants directly from the polluted water and by feeding on other fishes who are already exposed to high levels of pollutants in water [2, 3]. On the other hand fish is considered as an excellent source of animal protein. Nutritionally, fish is characterized by a desirable composition of amino acids [4], a rich source of vitamins [5], and fatty acids necessary for optimal human health [6, 7]. Therefore providing information on proximate composition of fish is considered essential for keeping quality and technological characteristics of the fish. [8] stated that the quality of fish is

highly affected by the quality of water. [9] further showed that aquatic pollutants such as heavy metals deplete some essential nutrients in fish. There is substantial evidence that environmental pollution increases oxidative stress [10]. A number of pollutants have been linked with the presence of free radicals which may induce oxidative stress in biological systems [11]. Non enzymatic antioxidants are biological molecules that can act as antioxidants by either quenching a free radical directly or indirectly by promoting a process responsible for radical scavenging indirectly [12]. Some of these non-enzymatic antioxidants include vitamins [9] that could elevate the oxidative stress. Thus vitamins A, C and E can be useful in providing information about the organism's internal environment. Investigation of such parameters under toxic environment is employed as biomarkers of detect aquatic toxicity [13, 14]. The present study aimed at investigating the impact of polluted water on the quality of four fish species namely: *Oreochromis niloticus* (Nile tilapia) *Hydrocynus forskali* (Kass), *Labeo niloticus*

(Dabs) and *Chrysichithys auratus* (Abu Reyala) from area before deposition of waste water (Site 1), dumping area (Site 2) and area after deposition (Site 3) along the White Nile, to detect any biochemical composition changes that can be employed as bio-indicators to aquatic pollution.

2. Materials and Methods

2.1. Study Area

The fish used in this study were collected from three different localities along the White Nile these were: Site (1) (Al-Kalakla) 5 km south before deposition of effluents, a location representing least pollution. Site (2) (Al-Dubaseen) deposition site of industrial effluents represented location of highest pollution. Site (3) (Al-Shagara) 5km north after deposition of effluents represent the location with least risk of pollution.

2.2. Collection of Fish Samples

Fish samples from three sites were collected. A total of 36 samples of fish were collected comprising three fish of each species from each site caught using gill netting method. The fish were placed in ice soon after the catch to keep them fresh. Fish samples were taken to the Department of Zoology Laboratories, Faculty of Science and Technology, Omdurman Islamic University for analysis. Samples of flesh were taken from the dorsal side of each fish and were packed into plastic containers and stored at -20°C prior to laboratory analysis.

2.3. Proximate Analysis

2.3.1. Moisture Content

The moisture content of the fish species was determined using the air oven drying method using a known weight of the fillet at 105°C until a constant weight was obtained [1]. Then the moisture content was calculated using the following formula:

$$Moisture\ \% = \frac{\text{Wet weight} - \text{dry weight}}{\text{Wet weight}} X\ 100$$

2.3.2. Ash Content

Ash content was determined by incineration of the dried sample obtained from moisture determination in a muffle furnace at 500°C for 24hrs, the ash percentage was given by the following formula:

$$\text{Ash}\ \% = \frac{\text{Weight of ash}}{\text{Weight of sample}} X\ 100$$

2.3.3. Protein Content

Crude protein content was calculated by converting the nitrogen content, determined by Kjeldahl's method (6.25 X N) [1]. The protein percentage was given by the following formula:

$$Protein\ \% = \frac{(V_2 - V_1) \times N \times 14 \times 100}{1000 \times wt} X\ 6.25$$

Where:

V_1= Volume of Hcl used in titration

V_2= Volume of Hcl used in blank titration

N= Normality of Hcl used in titration

14/1000= Conversion ratio from ammonium sulphate to nitrogen

Wt = Weight of sample

6.25= Conversion factor from nitrogen to protein.

2.3.4. Oil Content

The fat was determined by extracting the sample with petroleum ether (boiling point 60---80 C^0) for six hours in Soxhelt apparatus. The extract was then dried in an oven at 100—105 C^0 for removal of extra ether traces, following the method by [1]. The fat content was given by the following formula:

$$Oil\ \% = \frac{\text{Weight of ether extracted fat}}{\text{Weight of sample}} X\ 100$$

2.3.5. Carbohydrates

The edible fresh (2.5gm) was stirred with distilled water (10ml) and 52% perchloric acid (13ml) for 20 min. The contents were diluted to 100 ml, filtered into a 250ml volumetric flask and made up to the mark. The diluted filtrate (1.0ml) was heated with 1% w/v anthrone reagent in sulphuric acid for 20 min. and the absorbance at 630 nm was measured in a Shimadzu UV-160 spectrometer. The concentration of glucose in the sample was calculated using a standard curve.

2.4. Vitamin Content

The vitamins A, C and E were determined by a liquid chromatographic method. The vitamins were extracted from the tissues with chloroform and methanol, saponified and separated on a Lichrosorb normal phase column followed by UV detection.

3. Results and Discussion

3.1. Proximate Composition

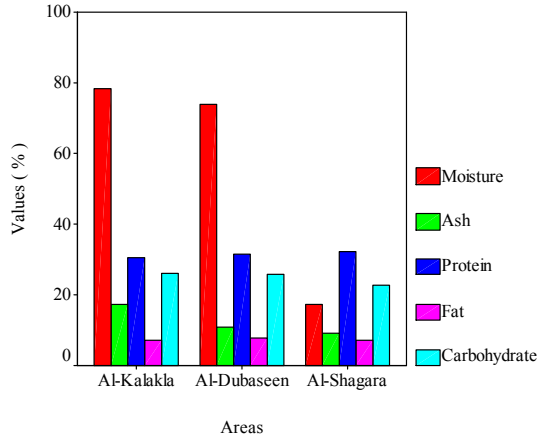

Figure 1. *Proximate composition of O. nilotcus collected from Site (1) (Al-Kalakla) Site (2) (Al-Dubaseen) and Site (3) (Al-Shagara) along the White Nile during November 2017.*

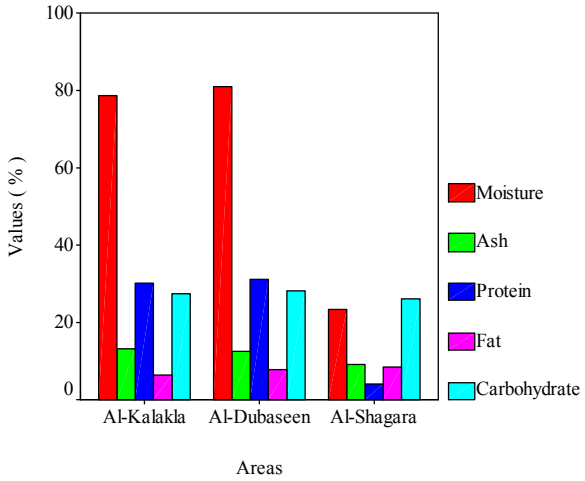

Figure 2. *Proximate composition of L. niloticus collected from Site (1) (Al-Kalakla) Site (2) (Al-Dubaseen) and Site (3) (Al-Shagara) along the White Nile during November 2017.*

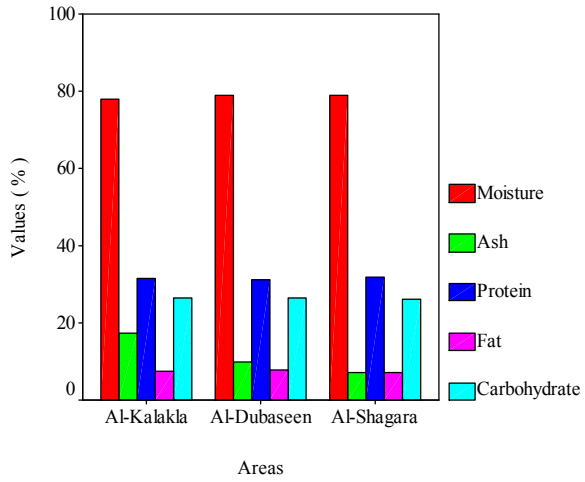

Figure 3. *Proximate composition of H. forskali collected from Site (1) (Al-Kalakla) Site (2) (Al-Dubaseen) and Site (3) (Al-Shagara) along the White Nile during November 2017.*

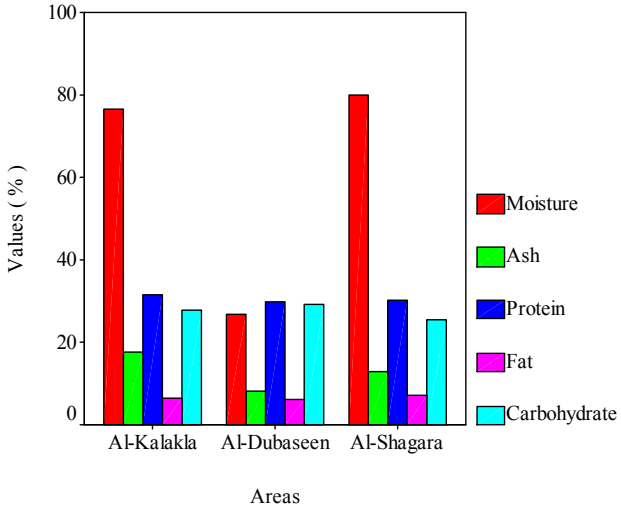

Figure 4. *Proximate composition of C. auratus collected from Site (1) (Al-Kalakla) Site (2) (Al-Dubaseen) and Site (3) (Al-Shagara) along the White Nile during November 2017.*

Proximate composition of the four species are presented in Figures (1-4). Results showed that Moisture, protein, fat, ash and carbohydrates were influenced by the site from which the fish were collected. Fish from Al-Dubaseen area (site 2) showed the lowest levels of moisture, protein, fat, ash and carbohydrates when compared to site (1) and (3) as depicted in figures (1-4). These low levels although not significantly different in *O. niloticus* and *H. forskali*, yet showed a significantly lower levels in *C. auratus*. These findings agreed with [15] who worked with *Oreochromis niloticus* from three ecosystems and attributed the differences observed in fish from the three ecosystems was pollution of sewage and industrial effluents. While [16] stated that differences in nutritional components of the fish could be attributed to the rate at which these components are available in the particular water body. They could also be due to the different capacities of the different fish to absorb and assimilate the essential nutrients from their habitat [17] Moreover [18] working in catfish collected from different sites explained that increase in water pollutants can disturb the biological activity of fish, as well as nucleic acids and ribosomal activity that leads to decrease in protein biosynthesis including those of the muscle content of catfish which were collected from these sites. *C. auratus* showed significantly lower proximate analysis.

3.2. Vitamins Content

Aquatic pollutants are well known stressors to aquatic organisms especially fish which are in high trophic level. The body of fish under stress would fight this stress caused, by antioxidants and non-enzymatic antioxidants such as vitamin A, C and E [19].

Results showed that vitamin A content differ with different sites. There was irregular pattern that showed a non-significant increase or decrease with different sites. Yet *H. forskali* and *C. auratus* showed lowest vitamin A content in fish collected from Site (2) as shown in figure 5. This decline

in vitamin A agreed with the findings of [20] who worked with *Crucian carp* exposed to heavy metals pollutants. On the other hand the irregular pattern can be explained by the findings of [21] who demonstrated that environmental stress cause an increase in the oxidative stress, an imbalance in the antioxidant status. Moreover [9] stated that cellular antioxidant defense systems in biological systems are impaired when exposed to environmental pollutants, but the levels of antioxidants in living organisms can increase in order to restore the imbalance caused by oxidative damage.

All four fish collected from site (2) showed low contents of vitamin E when compared to Sites (1) and (3) as depicted in figure 6. In *H. forskali* vitamin E content was significantly ($p \leq 0.05$) lowest in site (2) than both Sites (1) and (3). Fish collected from Site (3) had the highest vitamin E content except for *H. forskali* Figure 6. This finding agreed with [19] who worked in crayfish from different localities. [22] attributed the reduced vitamin E to the aggressive activation of heavy metals and in the stabilization of liver cell membranes against toxic reactive metabolites provoked by heavy metals.

Results revealed that vitamin C content in both *L. niloticus* and *C. auratus* was lowest in fish collected from site (2). on the other hand all four species collected from Site (3) showed highest content of vitamin C as depicted in figure 7. These finding agreed with [23] who demonstrated how constant production of free radical resulted in increased exploitation of the antioxidants leading to their depletion in which the levels of non-enzymatic antioxidants such as reduced glutathione, vitamins C and E were significantly reduced in the alcohol and PUFA (poly unsaturated fatty acid) treated livers of rats because of their complete utilization due to the oxidative stress.

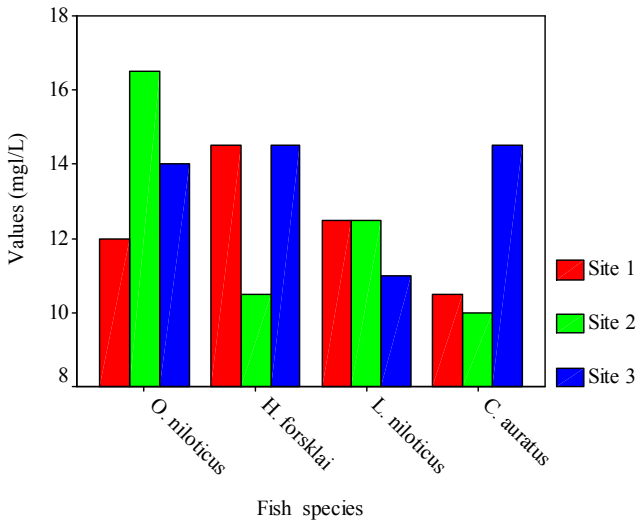

Figure 5. *Vitamin A content in flesh of four fresh water species collected from Site (1) (Al-Kalakla) Site (2)(Al-Dubaseen) and Site (3) (Al-Shagara) along the White Nile during November 2017.*

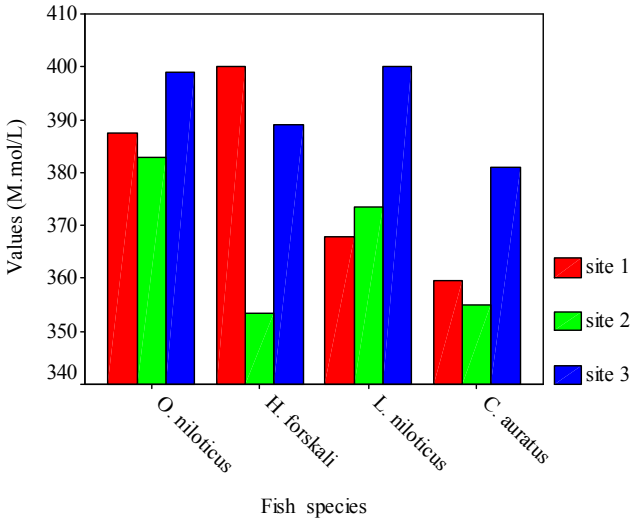

Figure 6. *Vitamin E content in flesh of four fresh water species collected from Site (1) (Al-Kalakla) Site (2)(Al-Dubaseen) and Site (3) (Al-Shagara) along the White Nile during November 2017.*

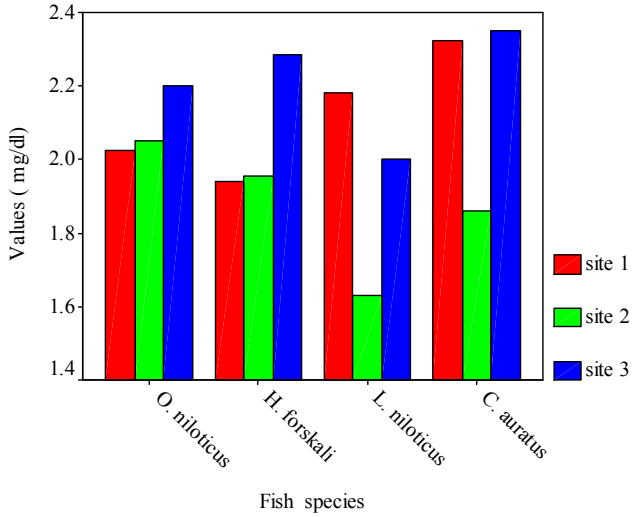

Figure 7. *Vitamin C content in flesh of four fresh water species collected from Site (1) (Al-Kalakla) Site (2) (Al- Dubaseen) and Site (3) (Al-Shagara) along the White Nile during November 2017.*

4. Conclusion

Within the confines of this research it was concluded that aquatic pollution exert some decline in moisture, protein, fat, ash and carbohydrates of fish. The level of the decline depend on fish species as was shown by *O. niloticus, C. auratus and H. forskali* collected from the site with high risk pollution. Site (2).

Levels of vitamins also showed a decline in fish collected from the site with highest risk of pollution. Thus it is possible to use non-enzymatic antioxidants such as vitamins A C and E as biomarkers of oxidative stress to detect aquatic pollution.

Moreover *C. auratus* was found to be the most sensitive fish and it is recommended to be used as a bio-indicator to aquatic pollution.

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