2017 SCIENCELINE
Journal of Life Science and Biomedicine
J Life Sci Biomed, 7(3): 26-30, 2017

ISSN 2251-9939

The effects of water quality parameters on chemical composition of *Oreochromis niloticus and Bagurs bayad* procured from Jebal Aulia Dam and Lake Nubia

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ABSTRACT

This study aimed to investigate the effect of some water quality parameter including water temperature, pH, dissolved oxygen (DO), chemical oxygen demand (COD) and biochemical oxygen demand (BOD) on chemical composition of *Oreochromis niloticus* and *Bagurs bayad* procured from Jebal Aulia Dam and Lake Nubia. The chemical composition of fish muscles was included protein, moisture, fat, and ash contents, using AOAC method. The findings of fat contents were most elevated in *Bagurs bayad* (10.46+0.47 at Jebal Aulia Dam, and the slightest fat contents were recorded insignificant in *Oreochromis niloticus* (6.32+0.32) appearing differently in relation to Lake Nubia samples, (P< 0.01). Moreover, the protein contents were observed varied slightly in both studied fish at Jebal Aulia and Lake Nubia. Significant contrasts (P< 0.01) likewise acknowledged in the Ash contents and were most appeared in *O. niloticus* in Jebal Aulia. The mean values for moisture content of *Oreochromis niloticus* were observed a significant difference (P< 0.01), at Lake Nubia. Physio-chemical characteristics of the water showed significant variations between the mean values of temperature of Jebal Aulia Dam and Lake Nubia (P< 0.05). While there was no significant different in pH levels between both sites. The slight variations of DO, BOD significant deference (P< 0.05) and COD appeared on both studied lakes insignificantly (P> 0.05).

Original Article
PII: S225199391700005-7

Rec. 30 Apr. 2017
Acc. 10 May. 2017
Pub. 25 May. 2017

Keywords

Lake Nubia, Jebel Aulia, Nile fish, proximate analysis.

INTRODUCTION

Fish as an imperative nourishment, world preparatory generation in 1989 was around one hundred million (i.e. 100,000,000Mt, FAO1995b) in which fifty-five percent (55%) of this production was championed by the developing world. Sudan as one of the developing countries has no special case to the issue of ailing health and malnourishment, albeit invested with various waterways and the Red Sea Coast. The River Nile with its tributaries (Blue and White Niles) amplifying inland, transverses the country from Uganda and Ethiopian border up to the Mediterranean Sea, covering a region of around two million hectares [1] in which the freshwater fishery assets are dispersed in a range of around 100,000km.While the Red Sea which speaks to the marine fisheries has a coastline of

more than seven hundred kilometers roughly [2]. These water bodies constitute a rich species of various types of fresh and Marine fish for many people. Seventy-nine fish families occupy this water of the Sudan [3]. The River Nile alone has around two hundred types of fish from these families, which have high level of flexibility to assorted land and physio-substance conditions.

From the concoction see, fish meat contains fundamentally low lipids and higher water than beef or chicken and is supported over other white or red meats [4, 5]. The nutritional value estimation of fish meat involves the substance of moisture, dry matter, protein, lipids, vitamins, and minerals in addition to the caloric estimation of the fish [6,7,8]. Minerals are fundamental supplements, they are segments of numerous compounds digestion and contributes additionally to the development of the fish [9].

Many dams have been constructed over the River Nile and its tributaries bringing about the making of occasional and lasting supplies that expanded the fisheries resources. Of a specific intrigue is Lake Nubia which speaks to a perpetual supply in the River Nile framework. Located in the outrageous north of the Northern State of the Sudan. The physical, compound and natural normal for water most every now and again utilized by references to an arrangement of models against which consistence can be surveyed. Water quality is utilized to portray the state of the water, including its compound, physical and organic attributes, more often than not as for its reasonableness for a specific reason (i.e., drinking, swimming or fishing). Water quality is likewise influenced by substances like pesticides or composts that can contrarily influence marine life when present in specific focuses [10].

The target of this study is along these lines to look at the impact of some water quality parameters including (water temperature, pH, dissolved oxygen, chemical oxygen demand and biochemical oxygen demand) on chemical composition of (*Oreochromis niloticus* and *Bagurs bayad*) gathered from various water bodies.

MATERIAL AND METHODS

The sampling site was chosen at Jebal Aulia Dam which was constructed near to highly populated city (Khartoum) in the Sudan and Lake Nubia situated in Northern border of Sudan and Egypt. They both aim to provide long term water storage for irrigation and hydroelectric power and possible increase the fishery resources [11].

Water samples were taken from both Dams at a depth of 50 cm below the water surface at morning. The samples were prepared and kept in a plastic containers and transferred to Laboratory for analysis of DO (Dissolved Oxygen), COD (Chemical Oxygen Demand) and BOD (Biochemical Oxygen Demand) according to the standard Winkler method as modified by Grasshoff et al. [12].

Calculations

Calculation of D.O was done using the following formula:

$$\text{Mg/L D.O} = \frac{(\text{mL titrant} \times \text{normality of titrant} \times 8000)}{\text{Equivalent volume of sample titrated}}$$

Biochemical Oxygen demand (BOD)

Biochemical oxygen demand was dictated by incubating a fixed sample of water for five days and measured the loss of oxygen from the earliest starting point to the finish of the test. Tests were diluted preceding incubation in dark laboratory till the microorganisms drain the greater part of the oxygen in the test bottles. The distinction between the two DO levels speaks to the measure of oxygen required for the disintegration of organic material in the specimen.

Chemical Oxygen demand (COD)

Chemical Oxygen Demand is a measure of the aggregate amount of oxygen required to oxidize all natural material into carbon dioxide and water. Chemical Oxygen Demand arrangement was completed by the open reflux Methods and the underneath formula was taken after:

$$\text{CODml/L} = \frac{(A - B) \times M \times 8000}{\text{Ml sample}}$$

A= ml FAS used for blank, B= ml FAS used for sample, m = molarities of FAS

8000 = milli equivalent weight of oxygen x 1000 ml /l

Fish sampling

Two different commercial fish species (*Bagrus bayad* and *Oreochromis niloticus*) were selected and procured from two Dams, Lake Nubia at Northern border between Sudan and Egypt and Jebal Aulia Dam 45 Km lied from Khartoum City at Northern side. These samples were prepared and washed with water to remove any adhering soil, then placed in insulated boxes containing ice for preservation and transferring to laboratory for chemical analysis using chemical composition analysis method as described by the Association of Official Analytical Chemists [13].

RESULTS AND DISCUSSION

The observed temperatures of water at the different sample locations Jebal Aulia Dam (21°C) and Lake Nubia (20°C) and pH levels (Lake Nubia 8.5 and Jebal Aulia 8.7) as shown in (Table 1 and Figure 1). These values were within the range of many results in tropical areas brought by some authors and is slightly higher than the recommendation limit as indicated by Guidelines for Canadian Drinking Water Quality.

Be that as it may, here and in this subtropical country this temperature, it may be within a ranged tropical temperature. These outcomes concur and agreed with Omer et al. [14] found that the level of temperature extended from 20 to 21°C. The pH of pure water is 7. As a rule, water with a pH lower than 7 are viewed as acidic, and with a pH over 7 alkaline. The typical range for pH in surface water is 6.5 to 8.5 [15]. The findings of this study demonstrated that the level of pH systems gone from 8.7 in Jebal Aulia around Khartoum City to 8.5 in Lake Nubia at Northern part of Sudan. In the present outcome, the lower values were recorded in (summer) while the high values were found in cold period in winter. The decreasing in pH values during a hot period in summer since pH of the common water may change because of biochemical processes occurring in the water. These outcomes were in agreed with the findings of Sulieman et al. [11] and Omer et al. [14] who found that pH extended between 7.5 to 8.5.

The estimations of Dissolved Oxygen (DO) in the studied water were demonstrated little varieties resulted about (5.72 ± 0.16 mg/l) at Jebal Aulia around Khartoum city and (5.2 ± 0.19 mg/l) in Lake Nubia. While the high estimation of DO (9.54 ± 0.18mg/l) recorded in winter at the cool time season and the lower values (1.3 ± 0.21mg/l) were recorded in summer. However the demand for oxygen by the microbes is high in summer than the winter, and they are taking that oxygen from the oxygen dissolved in the water. Likewise dissolved oxygen influenced by the solubility of numerous inorganic nutrients and it decreases with elevated high water temperature as found by Fatma et al. [16].

Biochemical Oxygen Demand (BOD) refers to the measure of oxygen that would be expended if every one of the organics in one liter of water was oxidized by microscopic organisms and protozoa [17]. The concentration of BOD in this study was gone from (1.11 ± 0.25) in Jebal Aulia to (1.92 ± 0.28) at Lake Nubia. This variety may be to the presence of nitrates and phosphates in a body of Lake Nubia water which could be contributed to higher BOD levels. Nitrates and phosphates are plant supplements and can bring about vegetation and green growth to develop rapidly. At the point when plants develop rapidly, they likewise, when plants grow quickly, they also die rapidly. This contributes to the natural waste in the water, which is then disintegrated by microorganisms. These could contribute and raise the BOD level. Additionally, the outcome demonstrated that the high estimation of BOD (1.58 ± 0.25) in winter than the (1. 45 ± 0.29) in summer. Since there were not be much natural waste present in the water supply as of now. The aftereffects of this study in a similar line with findings of David (1981), who found that BOD level run between 1.1 to 1.7.

Chemical Oxygen Demand (COD) is the measure of oxygen devoured by natural matter. The result of COD concentration (10.68 ± 0.70) were found in Jebal Aulia around Khartoum city and (11.02 ± 0.41) in Lake Nubia. While the high estimation of COD (17.77 ± 0.79) was found in summer during the hot period and lower value (4.32 ±0.70) in winter at the cold time period. These findings are in the line of Hill et al. [18].

Table 1. Physio-chemical characteristic of the water samples at different water sources.

Water Parameters / Water Sources	Temperature (C^0) Mean±SE	pH Mean±SE	DO (mg/l) Mean±SE	BOD Mean±SE	COD Mean±SE
Jebal Aulia Dam	21±0.45	8.7 ± 0.15	5.72 +0.16	1.11 +0.25	10.68 +0.70
Lake Nubia	20 ±0.52	8.5±0.17	5.2 ±0.19	1.92 ±0.28	11.02 +0.41
Sig.	NS	NS	*	*	NS

DO= dissolved Oxygen. BOD= Biochemical Oxygen Demand. COD= chemical Oxygen Demand, Sig= significant difference. NS = no significant difference (P>0.05).*= level of significant difference at (P ≤ 0.05).

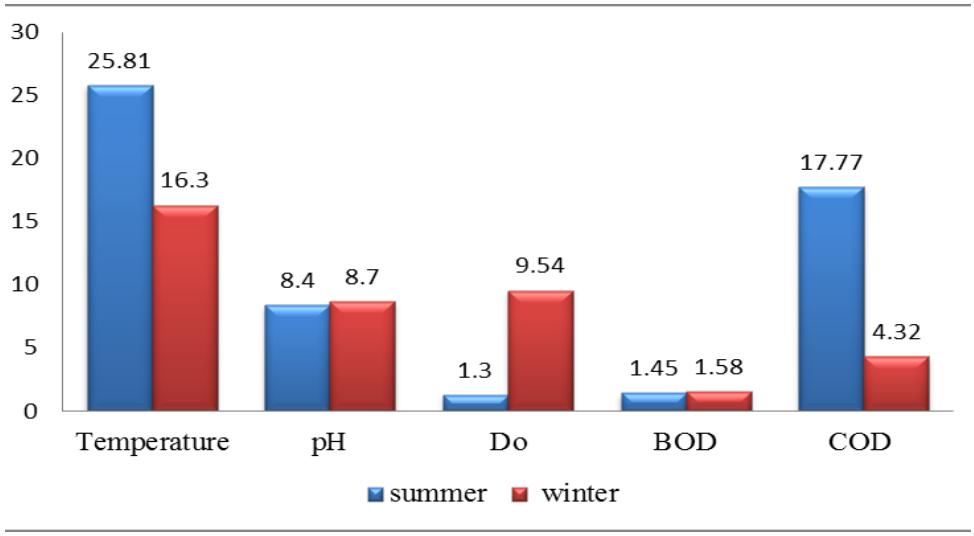

Fig. Distribution of Physico-chemical characteristic of the water affected by different seasons.
DO= dissolved Oxygen. BOD= Biochemical Oxygen Demand. COD= chemical Oxygen Demand,

The findings of chemical composition analysis of fish samples were shown in table 3. The results of chemical analysis of fish flesh showed a higher values of Moisture, fat, Ash and protein (76.63%, 10.46%, 4.52% and 17.33%) respectively in fish samples collected from Jebal Aulia than those collected from Lake Nubia (74.72%, 6.32%, 3.49% and 16.73%). Also the results recorded different variations at different seasons among studied species. However the variation of the chemical composition of fish is closely related to DO (Dissolved Oxygen), COD (Chemical Oxygen Demand) and BOD (Biochemical Oxygen Demand), feed intake, migratory swimming and sexual changes in connection with spawning during period of heavy feeding, as reported by many authors [11,19, 20].

The protein value showed a little variations for all studied samples of both water sources, which were ranged between (16% and 17%). These results were in agreement with results of Clucas and Ward [21]. They reported that protein of fish flesh was contained a considerable values ranged between (15- 24%).

Moisture content values showed a little variations and ranged from 75% to 76% among studied fish species. These values in agreement with the same result of Ali et al. [22] they stated that, the moisture content in fish flesh such as *Labeo sp.* was 76.7 %.

Lipid content revealed some variability among studied samples ranged between (6% and 10%). The lipid value is the component showing the greatest variation .These variations were talked by many authors. The variation within a certain species will display a characteristic seasonal curve with a minimum around the time of spawning as mentioned by Huss [19]. While the findings of fat contents of this study were ranged between (6 and 15%) as found by Ikem [23] who studied characterization of traditional smoked fish in Nigeria.

Ash contents fresh fish flesh of this study resulted in (3% to 4%). While the dried, cured and wet-salted fermented fish product were recorded different percentage values comparing with fresh flesh fish of this study as Agab and Babiker [24] they found that the proximate composition of traditional salted fermented fish of the Sudan were ranged between (18.12–28.5%, 20.7-45.5%, 10.6-22.5% and 3.6-5.2% for moisture, protein, fat and ash) respectively.

Table 2. Proximate analysis of flesh fish samples procured from different water sources.

Water Sources	Fish Species	Chemical composition Mean±SE			
		Moisture %	**Fat %**	**Ash %**	**Protein %**
Jebal Aulia Dam	*O. niloticus*	76.63±0.49	10.46± 0.47	4.52± 0.11	17.33± 0.21
	B. bayad	76.31 ±0.47	6.95±o.323	3.19± 0.92	17.64± 0.15
Lake Nubia	*O. niloticus*	75.05±0.47	9.83±0.323	3.64± o.92	16.42± 0.15
	B. bayad	74.72±0.49	6.32± 0.47	3.49± 0.11	16.73± 0.21
Sig.		**	***	***	*

Sig.= significant; ***= level of significant difference at (P ≤ 0.001); NS = no significant difference (P >0.05).

CONCLUSION

One can conclude that, the study provides a base line data on chemical composition and nutritional value of these species and considered both species as a good source of food with high nutritive value for human consumption, regardless of its sources.

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