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Determination of water quality in three Sudanese reservoir dams

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Abstract
The main objective of this study is to assess some water quality parameters (ph, dissolved oxygen, total ammonia, water hardness, alkalinity, nitrate, and phosphorus) in Jebel Aulia, Sennar, and Marawi dams up and downstream. Some physical and chemical water characteristics were studied in the three localities Jebel Aulia, Sennar and Marawi dams both upstream and downstream. This shows the variation in Alkalinity, hardness in the three localities in each season but it also indicate the similarly in other parameters e.g. pH, Ammonia and Nitrate and very slight variation in dissolved oxygen.
The levels of the parameters determined were within the acceptable ranges for domestic water purposes and fish production. Statistical analysis was performed using the Analysis of variance one way (ANOVA) and Duncan's multiple Range Test, to determine differences between parameters means at significance rate of (P<0.05). All statistics was carrying out using SPSS version (16).

Keywords: Water, quality, parameters, dams

Introduction
Due to the variety of human activities, the aquatic environment is becoming increasingly threatened by xenobiotics. Many of them may have deleterious effects which could be enhanced by bioaccumulation of heavy metals. In addition, these compounds may become concentrated in the organs of aquatic organisms, especially these at the top of the food chain. Fish meat contains significantly low lipids and higher water than beef or chicken and is favored over other white or red meats [14]. The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals plus the caloric value of the fish [16].The physical and chemical properties of water immensely influenced its uses, the distribution and richness of the biota [20].
Water is the home of the fish and its quality is one of the most over looked aspect of pond management until it affects fish production. Water quality generally means the component of water which must be present for optimum growth of aquatic organisms [6].
Water quality is made up of physical, chemical and biological factors which influence the use of water for fish culture purposes. These factors include dissolved oxygen, pH, hardness, turbidity, alkalinity, ammonia and temperature. Other parameters such as biological oxygen demand and chemical oxygen demand indicate the pollution level of a given water body [6].
Water is the culture environment for fish and other aquatic organisms. It is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion [3], based on this, access to adequate, regular and constant supply of good quality water is vital in any aquaculture project.
According to [15], any water body is a potential medium for the production of aquatic organisms.
Water quality parameters can be divided into three main categories: physical (density, temperature); chemical (pH, conductivity, nutrients) and biological (bacteria, plankton and parasites) [13]. All living organisms have tolerable limits of water quality parameters in which they perform optimally. A sharp drop or an increase within these limits has adverse effects on their body functions [5].
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 fishes that are normally utilized either fresh or preserved dried, salted or smoked. Better knowledge of their Nutritional value, which could contribute to the understanding of variability in meat quality of different species of the Nile fish. Moreover, the measurement of some proximate profiles such

as protein contents, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications [22].

To study the effect of different water resources and it is characteristics on the biological performance and flesh quality of tilapia *Oreochromis niloticus* in Sudan.

Material and methods

This study will be conducted at the Central Laboratory of Fish Biology at Sudan University of Science and Technology, Sudan. Three fish collection sites, will be designated as the first site will includes two collection stations along White Nile River. The second site includes two collection stations that had their water supply along the Blue Nile River. The third site includes two collection stations as well along Nile River main stream, respectively. The first site is Jebel Aulia Dam which is a dam on the White Nile near the capital of Sudan, Khartoum. The second site is Sennar Dam is a dam on the Blue Nile near the town of Sennar, Sudan. The third site is Merowe Dam is a large dam near Merowe Town in northern Sudan, about 350 km (220 mi) north of the capital Khartoum.

Sampling Procedures

Water samples will be taken randomly from each station regularly every month for one year sampling period. The samples were mixed together in a plastic container and analyzed for chemical and physical parameters.

Analytical Methods

The water samples for physico-chemical analysis were collected from three Sudanese reservoirs in the first week of every month from January 2015 to December 2015. Some water quality parameters pH was measured with standard pH meter; while other parameters were analyzed in the laboratory according to the methods suggested by[18] and[1].All Statistical analysis was done using SPSS (Version 16).

Results and Discussion

The physical and chemical water characteristics were studied in the three localities Jebel Aulia, Sennar and Marawi dams both upstream and downstream showing Fig 1 to fig 6 illustrate the comparison of the parameters in three localities during the three seasons winter, autumn and summer.

This shows the variation in Alkalinity, hardness in the three localities in each season but it also indicate the similarly in other parameters e.g. pH, Ammonia and Nitrate and very slight variation in dissolved oxygen.

The hydrogen ion concentration (pH) was found to be (8.30±.14, 7.90±.70, 8.20±.28) and (8.10±.14, 7.60±.28, 7.60±.28) up and downstream in the three localities respectively. This result is in the same line with Boyd who reported pH range of 6.09 - 8.45 as being ideal for supporting aquatic life including fish. Thus, the pH range obtained in this study is within the acceptable level of 6.0 to 8.5 for culturing tropical fish species [10] and, for the recommended levels for drinking water [21] Federal Environmental protection Agency (FEPA) recommended pH 6.5- 8.0 for drinking and 6.0-9.0 for aquatic life.

The dissolved oxygen obtained from this study was found to be (4.22±1.37, 4.87±2.29, 4.95±2.19) and (5.20±1.83, 4.02±1.09, 5.30±2.68) this result showed that there is no significant different at ($p<0.05$) in dissolved oxygen in Jebel Aulia, Sennar and Marawi dams upstream and downstream. This result is agreement with [11] who reported that the dissolved oxygen in the reservoir was higher during the dry season. The high oxygen value for the dry season coincides with periods of lowest turbidity and temperature. The amount of dissolved oxygen in water has been reported not constant but fluctuates, depending on temperature, depth, wind and amount of biological activities such as degradation.

The Ammonia was found to be (.13±.17,.13±.17,.13±.17) and (.62±.53,.12±.17,.00±.00) up and downstream in the three localities respectively and this result showed no significant different at ($p<0.05$) in the ammonia concentration at the three dams up and downstream. The means value of ammonia is in the acceptable range of fresh water fish and biota [6].

The nitrate-nitrogen (N03-N) revealed from this study was found to be (.00±.00,.00±.00,.00±.00) and (.00±.00,.00±.00, 2.50±3.53) in the three dams respectively and there is no significant different at ($p<0.05$) between up and downstream in three dams in nitrate levels. This result is agreement of the finding of [8] who reported that generally, nitrate - nitrogen it is stable over a wide range of environmental conditions and is highly soluble in water. Compared with other inorganic nitrogen compounds, it is also the least toxic. [4], stated that a high nitrate concentration in river and lake is related to inputs from agricultural lands.

The alkalinity was found to be (1.17±24.74, 1.07±60.10, 1.37±17.67) and (1.39±1.41, 1.20±42.42, 1.37±53.53) up and downstream in the three localities respectively. y. The negative correlation values obtained indicate that alkalinity of water increase with decreasing water level. Similar observations have been made by[17] on Rivers Sokoto and Nile in Egypt respectively. The alkalinity is higher in the dry season and lower in the rainy season, when the dam had high water level. This could be due to low water levels with its attendant concentration of salts and the lower value in the rainy season could be due to dilution [19].

Water hardness in the present study was found to be (97.50±31.74, 1.45±7.07, 1.37±7.07) and (1.45±7.07, 1.30±28.28, 1.75±35.35) up and downstream in the three dams respectively. The mean alkalinity agreed with the range value documented by Boyd (1981) for natural water. Also this result is agrees with the result of [12] who reported that water hardness was higher during the dry season than the rainy season. This could be as a result of low water levels and the concentration of ions, and the lower rainy season value could be due to dilution.

Phosphate phosphorus (PO4-P) in this study was found to be (.50±.00,.25±.00, 50±.00) and (5.25±6.71, 5.00±.00,.25±.35) in three sampling station. The high dry season mean value of phosphate phosphorus (PO4-P) could be due to concentration effect because of reduced water volume. It could also be due to lower water hardness, thus less co-precipitation of phosphate with calcium carbonate, a phenomenon that has often been reported to occur in many fresh water rivers [9].

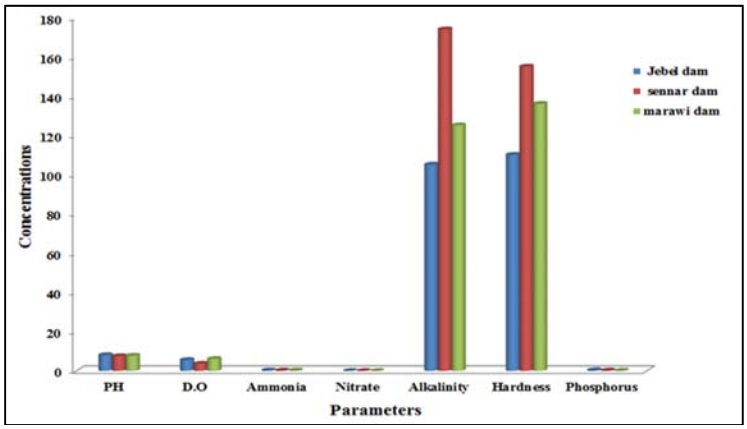

Fig 1: illustrate some parameters of physical and chemical in three habitats compared upstream during the winter season.

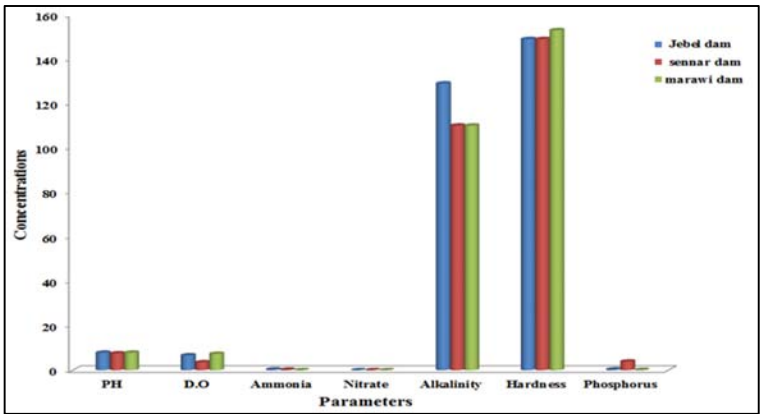

Fig 2: illustrate some parameters of physical and chemical characteristics downstream during the winter season

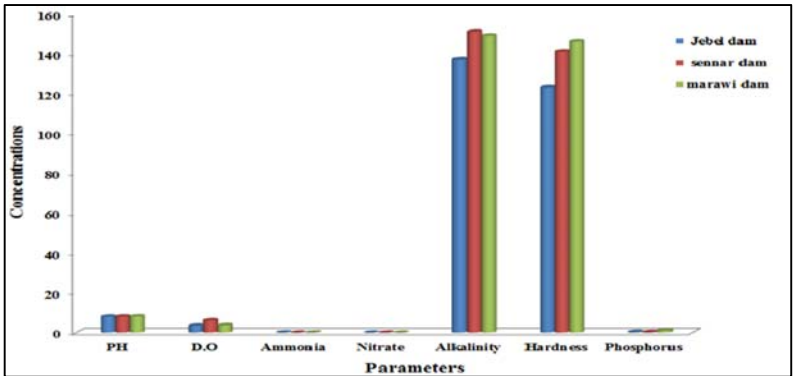

Fig 3: illustrate some parameters of physical and chemical characteristics upstream during the summer season

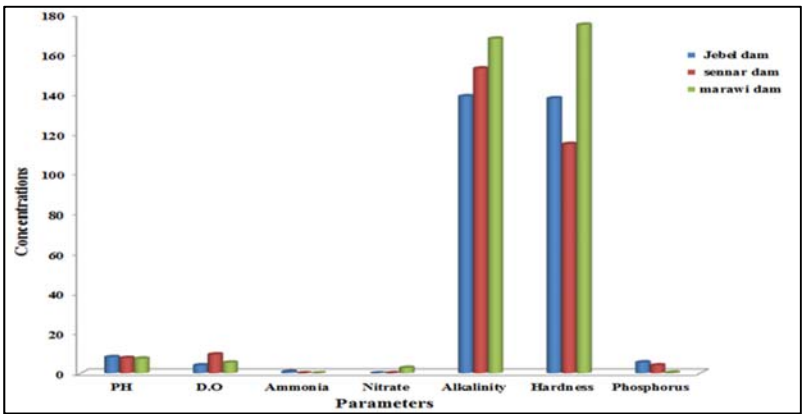

Fig 4: illustrate some parameters of physical and chemical characteristics downstream during the summer season

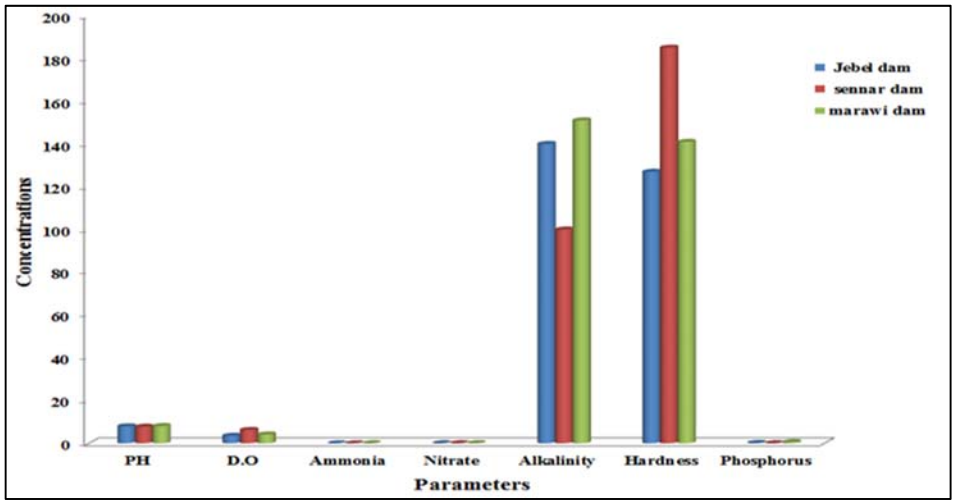

Fig 5: illustrate some parameters of physical and chemical characteristics upstream during the autumn season

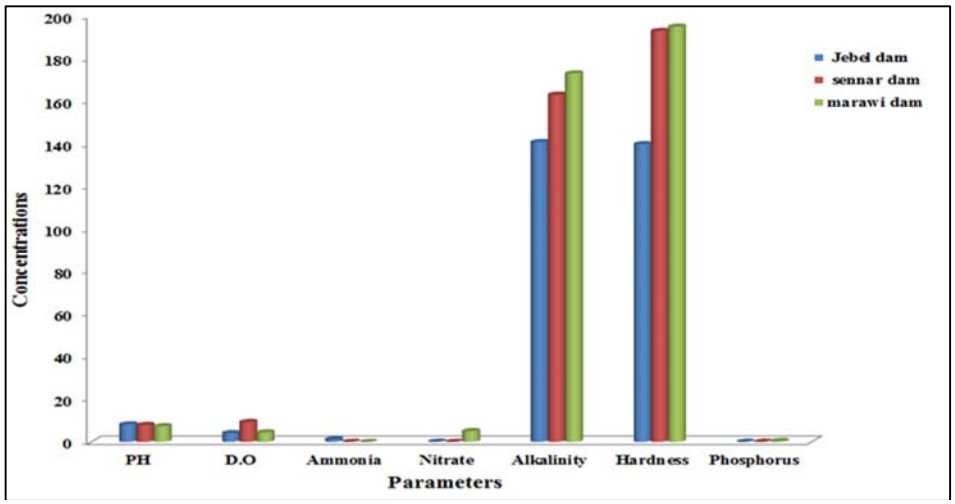

Fig 6: illustrate some parameters of physical and chemical characteristics upstream during the winter season

Conclusion

There are no some marked variations in the water quality parameters observed for the sampling stations and the months in summer season at upstream and downstream in the three dam's reservoir in the present study. The levels of the parameters determined were within the acceptable ranges for domestic water purposes and fish production.

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