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Bacteriological and Physicochemical Analyses of Aliero Dam Water

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Abstracts: *The study was conducted with the aim of assessing the Physicochemical and bacteriological parameters of Aliero dam water. Temperature, pH, transparency, chloride, nitrite, sulphate and dissolved oxygen were analyzed using standard methods. The bacteriological analysis was carried out using standard plate count. Temperature and sulphate are parameters that WHO has no specific recommended value for drinking water quality. The results revealed that temperature was within the range of 35 to 37^{0}C, Sulphate value ranged from 2.20 to 2.22mg/l. The pH was within the acceptable range of near neutral. Chloride was below the range of 250mg/l, D.O was above the normal value of <4.3mg/l and nitrite values ranged from 1.47 to 1.49mg/l which is within W.H.O's acceptable range of 2mg/l. The total heterophilic count was $1.1\times10^6\pm1.6\times10^a$, $5\times10^5\pm1.1\times10^a$ and $1.3\times10^6\pm1.4\times10^a$ for locations A, B, and C respectively. The bacteria isolated include Yersinia enterocolitica, Staphylococcus aureus with the highest frequency of occurrence of 20% each; Bacillus megaterium, Salmonella sp and Escherichia coli each with 12.5%; Klebsiella, Vibrio, and Shigella spp with the least frequencies of occurrence with 7.5% each. It is concluded that, though most of the physicochemical parameters analyzed were within the acceptable range, the water is grossly contaminated with pathogenic bacteria; drinking such water untreated is therefore, highly discouraged.*

Keywords: *Bacteria, water, dam water, drinking water quality*

1. INTRODUCTION

Water is one of the chief vehicles for the transmission of gastrointestinal diseases [1]. Therefore, water for human consumption is supposed to be free from chemical substances and microorganisms which may cause disease in man. In addition, it should be pleasant to drink. That is, cool, clear, colorless and devoid of disagreeable taste or smell; water is said to be contaminated or polluted when it contains infective and parasitic agents, poisonous chemical substances, industrial wastes or sewage that make it unfit for its intended use [1].

Testing water for broad diversity of pathogens is not feasible because of the difficulty in performing laboratory analysis and their poor qualitative reproducibility [13]. Therefore microbial quality of drinking water is controlled by specified treatment techniques and monitoring for the presence of coli form bacteria [13].

Water quality is the summation of all physical, chemical, biological and aesthetic characteristics of water that influence its beneficial use [6]. Water of good drinking quality is of basic importance to human physiology as well as indispensable to man's continued existence [17]. Its role as a medium of water borne disease which constitutes a significant percentage of the diseases that affect human and animals cannot be underestimated; Water may cause infection even if only a small number of microbes are present. The exact numbers of pathogens necessary to cause disease are functions of the virulence of the pathogen and the general ability of the host to resist infection [21, 24].

Water receives microorganism from air, soil, sewage, organic wastes, dead plants and animals; these may cause negative changes that need to be studied in other to improve the quality of such water [28]. A large number of microorganisms both saprophytes and pathogens are found in water which fall under the group bacteria, algae, protozoa and nematodes [11]. Several animal viruses are also transmitted through water [11]. The majority of bacteria found in water belong to the group fluorescent bacteria (examples are; *Pseudomonas, Alginomonas*), chromogenic rod-like *Xanthomonas,* coli form group, non gas forming, non chromogenic and non spore forming rods [11].

Aquatic environments have varied surface areas and volumes. Microorganisms are found in locations as diverse as the human body, drinks and beverages, and the usual places one would expect rivers, lakes and oceans [12]. They also occur in water-saturated zones in materials we usually describe as soils; these environments can range from alkaline to extremely acidic [12]. A masonry concrete barrier built across to obstruct the flow of stream or river, leading to

formation of a vast impoundment upstream of the barricaded site is refers to as dam. The water level is maintained by discharge through sluice gates or by diverting it to the site where power generation plant or hydro turbines are installed [12]. A reservoir is a manmade lake that is primarily used for storing water. They can also be defined as the specific bodies of water formed by the construction of a dam [7].

This research work was aimed at determining the water quality of Aliero dam. Hence the specific objectives are: To determine the physicochemical and bacteriological properties of the water. To isolate and identify bacteria associated with the water.

2. MATERIAL AND METHODS

2.1 Study Area

Aliero is a town in Aliero Local Government of Kebbi State in northern Nigeria. The town is located in the southeast of Kebbi State on latitude 12°N and longitude 4°E. The population of Aliero is between 5000 and 10000 [15]. April is the warmest with an average temperature of 39.3°C at noon and December is the coldest with an average temperature of 16.1°C at night. Aliero has no distinct temperature seasons, temperatures drop sharply at night [16]. The study site is located at south-west end of the Aliero town just behind Government Girls Secondary School Aliero.

2.2 Sample Collection

Aseptically, cap of the sterile sample bottle was removed and the mouth of the bottle was put into the water (facing upstream). The neck of the bottle was plunged down wards about 30cm below the water surface, then the neck was tilted completely. The cap was carefully replaced as described by Cheesbrough, [9]. A total of about 15 samples were collected (i.e. 5 samples from three different locations). For physicochemical analysis, the cap of plastic bottle (PVC) was opened and the mouth was put into the water facing upstream and samples collected as described by Hiremath *et al,* [14].

2.3 Sample Preparation

Serial dilution of each of the 15 samples was performed. In each case, the tube containing 10^{-4} dilution was used in the inoculation procedure as described by Cheesbrough, [9].

2.4 Physicochemical Analysis

Physicochemical parameters like the temperature, PH, turbidity, chloride and dissolved oxygen were determined using standard methods as described by [5]

2.5 Media Preparation

Various media used were prepared as described by [9]

2.6 Bacteriological Analysis

2.6.1 Enumeration and Isolation Of Bacteria

Bacterial isolates were isolated as described by [11, 20].

2.6.2 Characterization and Identification of Bacterial Isolates

The isolates were characterized and identified based on colonial morphology, cultural characteristics and biochemical tests as described by [9, 20].

2.7 Statistical Analysis

ANOVA statistical analysis was carried out using SPS computer application. The results for temperature, pH, transparency, chloride, nitrate, sulphate, dissolve oxygen and bacterial counts were typed, analyzed and interpreted.

3. RESULTS

3.1 Physicochemical Characteristics of Water

The results of the physicochemical characteristics of the water analyzed are presented in table 1. There was no significance difference (P>0.05) in temperature, nitrate, chloride and transparency among the three locations. The pH, sulphate and dissolved oxygen however showed significance difference (P<0.05) among the three locations.

Table 1: *physicochemical characteristics of water*

	LOCATIONS		
PARAMETERS	**1**	**2**	**3**
Temperature (°C)	35.80±0.45[a]	36±0.00[a]	36.20±0.45[a]
pH	8.40±0.00[a]	8.32±0.04[a]	8.34±0.05[b]
Nitrate (mg/l)	1.48±0.01[a]	1.48±0.00[a]	1.47±0.00[a]
Chloride (mg/l)	1.46±0.15[a]	1.36±0.05[a]	1.34±0.05[a]
Sulphate (mg/l)	2.26±0.05[a]	2.24±0.05[b]	2.33±0.01[b]
Transparency (NTU)	12.21±0.09[a]	12.29±0.004[a]	12.24±0.00[a]
Dissolve oxygen (mg/l)	4.70±0.00[a]	4.66±0.05[b]	4.6±0.00[b]

3.2 Table 2 Heterophilic Bacterial Count.

Table 2 represents the results of heterophilic bacterial count. There was no significance difference (P>0.05) among the locations.

Table 2: *Heterophilic bacterial count of water*

location	Bacterial count (cfu/ml)
A	$1.1\times10^{6}\pm1.6\times10^{a}$
B	$5\times10^{5}\pm1.1\times10^{a}$
C	$1.3\times10^{6}\pm1.4\times10^{a}$

4.3 Frequency of Occurrence and Percentage of the Bacteria Identified from Water

Table 3 represents the frequency of distribution of the bacteria identified from the water samples. *Y. enterocolitica* and *S. aureus* had the highest frequency of occurrence of 20% followed by *B. megaterium, Salmonella sp* and *E coli* with 12.5% then *Klebsiella, Vibrio,* and *Shigella spp* had least frequencies of occurance with 7.5% each.

Table 3: *Frequency of occurrence of identified bacteria.*

Identified organism	**Frequency of occurrence**	**percentage occurrence (%)**
Bacillus megaterium	5	12.5
Salmonella sp	5	12.5
Yersinia enterocolitica	8	20
Escherichia coli	5	12.5
Staphylococcus aureus	8	20
Klebsiella sp	3	7.5
Vibrio sp	3	7.5
Shigella sp	3	7.5

4. DISCUSSION

Microbiological and physical water quality indicators are the major parameters to be monitored in the rivers, dams or boreholes [29]. Sudden changes in the physicochemical parameters may be indicative of changing condition in the water; internal factors, on the other hand are within bacterial and plankton populations in the water body [27, 10, 22].

Temperature and pH are important factors that determine the density and distribution of microorganism in a particular environment. Most microorganisms require between 25 to 35^{o}C as their uptimum temperatures for growth and a pH of near neutral, although many others can strive in extreme environment. Temperature in surface water is influenced by the season and pH is influenced particularly by the change in temperature itself, the CO_2 concentration, carbonate and bicarbonate in the water [2]. In this study, the temperature (^{0}C) values range between 35 to 37^{o}C. High values of temperature recorded can be associated with atmospheric temperature. Arain *et al.,*[4] reported that there is a close relation between the atmospheric temperature and water temperature, air temperature is one of the most important ecological factors which control the physiological behaviour of the aquatic system and distribution of the microorganisms. For the pH, the values range from 8.3 to 8.4 which are all within the limit of W.H.O specification of 6.5-8.5. Similar result was found by Ajit and Padmake [3]. All organisms require nitrogen for the basic process of life to synthesize protein required for growth and reproduction [18]. Nitrate concentration in this research was found to vary from 1.47 to 1.49 mg/L which is within 2mg/l W.H.O specification. The presence of nitrates in the water samples is suggestive of some bacterial action and growth. This finding is in line with the observations of Majumder *et. al*., [23] who reported that presence of nitrate in surface water particularly may be as the result of microbial and other biological activities. Chloride values were found ranging from 1.2 mg to 1.5mg which is too far below the W.H.O 250mg/l specification. Although the concentration is not high, it is an indicator of pollution due to organic waste of animal origin as reported by Mujandar *et al.,* [23]; Kamal *et. al*., [18] observed similar findings in their study on Mouri river.

Sulphate is one of the least toxic anions of which WHO does not have any recommended value for drinking water, but catharsis, dehydration and gastrointestinal irritation have been linked to high sulphate concentrations in drinking water [18]. WHO, [30] therefore suggests an urgent action by health authorities when sulphate in drinking water exceeds 500 mg/l. Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals [25]. Discharge of industrial wastes and domestic sewage tends to increase its concentration [25]. Concentration of sulphate in this research which ranges from 2.20mg to 2.30mg may be due to low level of water and high level of pollution.

The importance of DO was reported by many researchers because DO in aquatic ecosystem brings out various biochemical changes and it influence metabolic activities of organisms. In this research, the DO was found to be 4.6 to 4.7 above normal of <4.3mg/l as recommended by WHO; indicating the presence of organisms in the water or what is well known as biological pollution. The quantity of DO in water is directly or indirectly dependent on water temperature, partial pressure of air. Similar results

were observed by Chaurasia and Pandey, [8] and Sinha *et al*., [26] who reported that DO in water is largely dependent on important environmental factors like the temperature. Water transparency is a measure of how clear the water is [26]. It is important because aquatic plants need sunlight for photosynthesis. The clearer the water, the deeper sunlight will penetrate hence. Light is an important factor in microbial ecology as it affects the distribution of microorganisms in water [26]. Water Transparency in this study ranged between 12.12 to 12.20cms. Lower value of transparency can be attributed to the fact that samples were collected during hot season (April) resulting from low level of water and influx of animal effluents. This finding is in line with the study conducted by reported by Kevita and sheeha, [19] who reported that transparency and turbidity of surface water are affected by the season.

On the bacterial load, pathogenic bacteria were isolated from the three locations. Presence of enteric bacteria like *Salmonella* spp*, Shigella* spp*, Klebshialla* spp*, Vibrio* spp and *E. coli* can be attributed to high level of faecal and municipal waste contamination which may constitute health hazard to the people drinking or using the water for domestic activities or both. A similar conclusion was drawn by Idowu *et al.,*[17]. Presence of *B. megaterium* could be associated with soil as the bacterium is normally found in the soil as its habitat. While *S. Aureus,* could have come into the water, from probably, the noses of individuals who bath/swim in the water as reported by Zamzaka and Muyima [31].

Finally, Looking at the number and type of bacteria identified from the water samples and of course the unacceptable levels of some physicochemical parameters analysed, the following recommendation may be helpful;

- Although the water may be good for plants growth, farmers should avoid irrigating their plants particularly vegetables with the water untreated as it can serve as route of transmitting pathogens to their vegetables and eventually to consumers.
- The public particularly farmers in the area should be sensitised on the health risk associated with drinking of such water.
- Further research should be conducted so as to provide more information on the quality of the water.

5. CONCLUSION

From this investigation, it can be concluded that most of the physicochemical parameters viz; temperature, chloride, sulphate, transparency and pH were found within the range, while the level of nitrate and DO indicated high level of biological activity in the water. The findings clearly indicated that the dam is highly polluted due to discharge of uncontrolled municipal effluents and animal waste leading to eutrophication. It is also clear from the above findings that the bacterial load is particularly worrisome as most of the bacteria isolated are highly pathogenic viz; *Salmonella* spp*, Shigella* spp*, Klebsiella* spp*, Vibrio* spp and particularly *S. aureus.* It can therefore be concluded that the water is not microbiologically safe for consumption without further treatment.

CONFLICT OF INTEREST

No conflict of interest.

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