Original Research Article

BACTERIOLOGICAL ANALYSIS OF SURFACE WATER OBTAINED FROM UKE RIVER IN KARU, NASARAWA STATE, NIGERIA.

ABSTRACT

Aim: To determine thebacteriologicalproperties of the surface water obtained from Uke River.

Place and Duration of Study: This study was carried out in Uke Community, Karu LGA, Nasarawa state and the Department of Biological sciences, Bingham University, Karu, between March and April 2016.

Materials and Methods: Water samples were collected randomly from five pointsat the Uke River for five weeks.The total heterotrophic bacteria count, fecal coliform count and total coliform count were used to determine bacterial contamination. Biochemical tests and gram reactionwas used toidentify the bacterial isolates.

Results: Six bacterial genera which include*Salmonella*spp*, Staphylococcus*spp*, Escherichia*spp, *Pseudomonas*spp, *Enterococcus*sppand *Klebsiella*sppwere isolated from the water samples. *Escherichia coli* had the highest frequency of23(43%). The mean total heterotrophic count,total coliform count and fecal coliform count were2.3×10^2, 2.4×10^2, and 2.6×10^2 respectively

Conclusion: The bacteriologicalanalysis of the surface water indicates the presence of bacteria which suggeststhe water is not fit for consumption without proper processing.

KEY WORDS: Bacteria, Uke River,Fecal Coliform, Water

1.INTRODUCTION

The accessibility to safe water and sanitary means of excreta disposal are universal needs and indeed basic human rights However, many of the world's population lack access to adequate and safe water [1].

Water is vital to the existence of all living organisms; however, this valued resource is increasingly being threatened as a result of upsurge in human population. Consequently, the demand for high quality water for the both domestic and economic purposes has been noticeably on constant increase [2].Water quality is defined in terms of its chemical, physical and biological contents. The water quality of rivers changes with seasons, human activities and geographical areas. These factors provide basic scientific information about water quality parameters, ecological relevance and toxicological threshold values to protect specific water user [3].

Rivers are the source of freshwater to man. Flooding remains a source of pollution for rivers in Nigeria. Surface waters are heavily polluted from several sources especially after rainfall [4].Sources of pollution include runoff water from farmlands carrying fertilizers, manure, animal and human waste matter, motor oils from the highways and lots of trash from gutters and drainages. World Health Organization (WHO) essential parameters of drinking water quality are fecal *Escherichia coli* and total coliforms, chlorine residue, turbidity, pH, dissolved oxygen content, and temperature [5].

According to UNICEF report, about 800 million people in Asia and Africa are living without access to safe drinking water. Consequently this has caused many people to suffer from various diseases [6]. However, access to safe drinking water has improved overthe last decades in almost every part of the worldespecially Nigeria, but approximately 1.1 billionpeople still lack access to safe water and over2.6

billion worldwide lack access to adequate water and sanitation which causes water illnesses such asCholera, diarrheal disease, Botulism, *E. coli*infection, Dysentery, Legionellosis, Leptospirosis,Salmonellosis, Typhoid fever, and Vibrio illness[7].

The greatest risk to public health from microbes in water is associated with consumption of drinking-water that is contaminated with human and animal excreta [8]. Human faeces can contain a variety of intestinal pathogens which cause diseases ranging from mild gastro-enteritis to the serious dysentery, cholera and typhoid. The most predominant waterborne disease, diarrhea, has an estimated annual incidence of 4.6 billion episodes and causes 2.2 million deaths every year[9].

Faecal coliform bacteriaare used as an indicator for the presence of any of these water borne pathogens. The presence of these indicative organisms is evidence that the water has been polluted with faeces of humans or other warm-blooded animals[4,10] .The Uke River is a source of drinking water to the members of the community and it's characterized with human activities such as bathing,washing, swimming and construction of blocks.Although some studies have been carried out on surface water resources in Nigeria, there is paucity of information on the bacteriological analysis of Uke River which informed this study.

2. MATERIALS AND METHODS

2.1 Study area

This study was carried out in Uke local government area, Nasarawa State. This community is located in the middle belt of Nigeria at longitude 8º32'N 8º18'E and Latitude 8.533ºN 8.300ºE and is characterized by a tropical sub-humid climate with two distinct seasons; wet and dry seasons. Monthly temperature ranges from 20℃ to 34℃ and annual rainfall ranges from 1100mm to about 2000m. Uke is located about 26 kilometers South-East of Abuja, the country's capital town.It is regarded as a suburb of Abuja due to its close proximity to Nigeria's Federal Capital Territory [11].

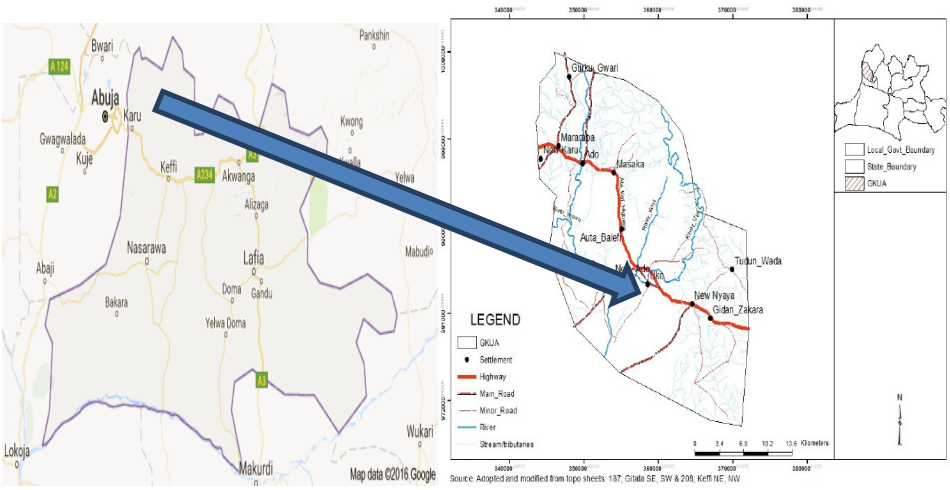

Figure 1. Map of Nasarawa State highlighting the study area (Uke) in Karu Local Government

Source: Chindo et al,2014

2.2 Sample collection

Water samples was collected from five (5) different water sites indicated as location A, B, C, D, E and a COMPOSITE(F) which includes all samples. The water samples were collected at these sites because the inhabitants believe that the cleanest water can be obtained from these points.Water samples from these locations were collected in duplicates into sterile glass bottles (250 ml) which were labeled appropriately and transported to the laboratory for bacteriologicalanalysis.

2.3 Bacteriological Analysis

Blood agar and MacConkey agar were prepared using manufacturers direction [12]. Bacteria isolates were characterized on the basis of the colonial morphology and Gram stain reaction. Biochemical tests such as catalase, Coagulase, Motility, Indole, and Oxidase tests were carried out [13].

2.3.1 Total heterotrophic bacteria count

The spread plate method was used. Ten-fold serial dilution of each water sample was prepared aseptically in physiological saline of 10^{-1} up to 10^{-4} and 0.1 ml aliquot of each dilution was plated on Nutrient agar plates in triplicate. All incubations were conducted at 37℃ for 24 hrs under aerobic conditions and plates containing 30 to 300 colonies were selected and counted. The number of colony-forming units per ml (cfu/ml) was calculated by multiplying the number of colonies by the dilution factor. Also, sub-culture was carried on MacConkey agar and Mannitol Salt agar for identification of bacteria species.

2.3.2 Total coliform count

This was determined by Most Probable Number (MPN) index technique using the three tube assay (3-3-3 regimen). Ten-fold serial dilution of 10^{-1} to 10^{-5} was prepared. The first set of five tubes had 10 ml of double strength broth (MacConkey broth), the second and third set had 10ml single strength broth (Lactose broth). All the tubes contained Durham tubes. The three set of tubes received 10 ml, 1 ml and 0.1 ml of water samples. They were carefully labeled and incubated at 37℃ for 24 hours for estimation of total coliform. Acid production was determined by color change in tubes from reddish purple to yellow and gas production was checked for by entrapment of gas in the durham tubes[13]

2.3.3 Faecal coliform count

Faecal coliform count was determined using Eosin Methylene Blue medium employing the streaking culture technique. A loopful of broth from positive tubes was streaked onto EMB agar plate for pure cultures. The plates were incubated at 37℃ for 24 hrs. Colonies on EMB agar plate were further identified as fecal coliforms. On Eosin Methylene Blue (EMB) agar, *E. coli* strains appeared as greenish metallicsheen colonies [14].

3.RESULTS

Table 1 shows the morphological, biochemical characteristics and Gram reaction of the bacterial isolates.

Table 2 represents the frequency of bacteria isolates recorded in Uke River. *Escherichia coli* had the highest frequency of 23(43%). *Pseudomonas* spp*, Staphylococcus aureus and Klebsiella*spphad a frequency of 18%, 16 %, and 12% respectively.*Streptococcus spp and Bacillus spp*had a prevalence of 6% and 4% respectively.*Enterococcus* sppand *Salmonella* sppshowed the least occurrence of 2%. The mean total heterotrophic count was 2.3×10^{2}cfu/mL. The mean total coliform count was 2.4×10^{2}cfu/100mL. The mean fecal coliform count was 2.6×10^{2}cfu/mlas shown on Table 3.

Table 1Characterization and identification of isolates from Uke River

Isolates	Cat	Coa	Oxi	Ind	Mot	Gram staining	Morphology	Organism present
1	+	-	-	+	+	-rod	Milky colonies	*Escherichia coli*
2	+	+	-	-	-	+cocci	Yellow/gold	*Staphylococcus spp*
3	-	-	-		+	-cocci	milky	*Enterococcus spp*
4	+	+	-	-	-	-rod	Pink mucoid	*Klebsiellaspp*
5	+	-	+	-	+	-rod	Creamy colonies	*Pseudomonas spp*
6	+	-	-	-	+	-rod	White colonies Milky colonies	*Salmonella spp*
7	-	-	-	-	-	+cocci	Pale pink	*Streptococcus spp*
8	+	-	-	+	+	+rod		*Bacillus spp*

Keys: Cat= Catalase,Coa= Coagulase, Oxi= Oxidase, Ind= Indole, Mot= Motility

Table 2. Frequency of bacteria isolated from Uke River

Bacteria	Frequency (%)
Escherichia coli	23(43%)
Staphylococcus aureus	9(16 %)
Enterococcus spp	1(2%)
*Klebsiella*spp	7(12%)
Pseudomonas spp	10(18%)
Salmonella typhi	1(2%)
Streptococcus spp	3(6%)
Bacillus spp	2(4%)
Total	**56**

Table 3.Mean Total Heterotrophic, Total Coliform and Fecal Coliform counts of the water samples takenfor five weeks from theUke River.

Sampling Period	Total Heterotrophic count (TH) (cfu/mL)	Total Coliform count (TC) (cfu/100mL)	Fecal coliform count ($x10^2$cfu/ml)
Week 1	2.3×10^2	2.9×10^2	2.6×10^2
Week 2	2.5×10^2	2.5×10^2	2.2×10^2
Week 3	2.27×10^2	2.2×10^2	1.2×10^2
Week 4	1.8×10^2	1.69×10^2	2.0×10^2
Week 5	2.67×10^2	2.9×10^2	2.3×10^2
Mean	2.3×10^2	2.4×10^2	2.6×10^2

4. DISCUSSION

The bacteriological assessment of UkeRiver reveals the presence of bacterial contaminants and this is in agreement with the findings of Doughari et al [15]and May et al [16] who conducted similar studiesin Gudu stream Abuja,and Ebutte River in Ehor community, Edo state, Nigeria.

Total heterotrophic counts ranged from1.8×10^2 to 2.67×10^2 from the five sampling points of Uke river and these results exceeds the World Health Organization standard for heterotrophic bacteria in potable which states that the total heterotrophic bacteria count should not be more than 100 cfu/ml [17].

The alarming high number of total coliforms and faecalcolifoms per 100 mL obtained from the water samples indicates high level of faecal contamination of the river water which potentially poses a high health risk for the inhabitants of the community. This agrees with Chessbrough [18] who stated thathigh coliform counts are an indication of high faecal contamination.Faecal streptococci counts indicate more contamination with human excrement than animal excrement.

None of the sampling points of the water sources complied with World Health Organization standard for coliform in water.The total coliform and fecal count for all samples were extremely higher than the WHO standard for coliform bacteria in water which is zero total coliform per 100ml of water [19].

Similarly,the health guidelines for the use of wastewater in agriculture and aquaculture states that water to be used forirrigation of crops that is likely eaten uncooked and water to be used for sports and public parks in unrestricted regions should not exceed 10 3per 100 mL faecal coliforms [20].Additionally, the water quality was unacceptable as per EPA's(Environmental Protection Agency) standard of zero (0) fecal colony/100 mL of water to be used in irrigation of any food crops not commercially processed including crops eaten raw [21].

Escherichia coli had the highest frequency (43%) of bacteria isolated from the water which is contrary to the WHO guideline value of zero (0) *E. coli* per 100 mL of drinking water [18]. Similarly, Khalid et al[22] also recorded a high frequency of *Escherichia coli*in Tigris River, Baghdad.

5. CONCLUSION

Thebacteriological analysis of Uke River from this study is a definitive proof that the water is unsafe for consumption as coliform counts were more than the international permissible levels recommended by World Health Organization. Thus, this water is unfit fordrinking, bathing, washing of farm produce or for any other agricultural purpose except if it is adequately treated.Public awareness and a total halt of indiscriminate dumping of refuse and feaces into the river will go a long way to reduce bacterial contamination.

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