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DELIVERING WATER, SANITATION AND HYGIENE SERVICES
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Microbial quality of two man-made lakes in Lokpa Abia State, Nigeria

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The microbial quality of two man-made lakes that serve as sources of water to a rural community was investigated. Quantitative examination of microorganisms revealed a total heterotrophic bacterial count range of 2.0 – 5.0 × 10^4cfu/ml and 2.2 – 6.0 × 10^4cfu/ml for Lake 1 and Lake 2 respectively for the months sampled. Total coliform count ranged from 1.5 – 2.6 × 10^4cfu/ml and 1.8- 3.0 × 10^4cfu/ml for Lake 1 and Lake 2 respectively. Salmonella and Shigella species occurred more in the water samples during the rainy season than dry season. The microbial quality of the lakes show that the water is not suitable for drinking and other domestic purposes and poses a public health risk to children and other groups that use it for recreational purposes.

Introduction

The presence of contaminants in freshwater continues to be one of the most important environmental issues in many areas of the world, particularly in developing countries, where several communities are far away from potable water supply (Ayoko *et al*.,2007). Low income communities which rely on untreated surface water and ground water supplies for domestic and agricultural uses are the most exposed to the impact of poor water quality. Unfortunately, they are also the ones that do not have adequate infrastructure to monitor water quality regularly and implement control strategies (Ayoko et al., 2007; Idakwo and Abu, 2004). This problem can be overcome by provision of potable water to rural communities. Water for human consumption should be free from microbiological and chemical contamination. Unfortunately most people do not have access to such water. In rural communities people collect water from surface sources and shallow wells. Since the rural population relies almost exclusively on untreated ground water, streams, rivers, ponds and lakes as sources of drinking water and whereas the local authorities are unable or unwilling to address the issue of inadequate water supply, it is necessary to investigate the microbiological status of rural water supply (Chauvin, 1998). The demand for water in Nigeria far outweighs its supply; the competition for the readily available sources is intense as water is very necessary for life. Human activities around waterbodies are also on the increase as much of the populace struggles for subsistence. The benefit derived from the creation of man-made lakes in Nigeria and other developing countries is usually associated with great risks (Araoye, 2002).

The use of raw water from lakes for washing and drinking without any form of purification by surrounding communities in Nigeria has compounded the problem of water-borne diseases (Araoye, 2002). During the construction of the Enugu-Portharcourt expressway, stone excavation by the Fugerolle Construction Company (Ltd) at Lokpa Umuchieze resulted to formation of two man-made lakes. These twin lakes which are 50 to 70 metres apart now serve as source of water for domestic purposes, recreation, a source of fish for the people of Lokpa. A lot of manual stone quarrying still go on around the lakes and the workers easily wash or bath with water from these lakes or in them after the day’s work. This paper reports the sanitary quality of the water in the lakes in relation to the seasons.

Materials and methods

Water sampling

Water samples were collected with sterile amber bottles from each of the two man-made lakes on monthly basis for one year.

Determination of total viable count (TVC cfu/ml) of Bacteria for the water samples

The method described by Okereke and Kanu (2004) was used. Serial dilutions of the water samples were made, then 0.1-1.0ml of diluted samples were inoculated on molten agar Plate count agar (Merck) and Nutrient agar (Oxoid) at 45ºC. The plate count agar was incubated at 25 ± 2ºC for 48h while the nutrient agar plates were incubated at 37ºC for 18-24h. In each case the counts were made.

Determination of total coliform count (TCC cfu/ml) of water samples

The total coliform count of each water sample was determined by plating 0.1-1.0ml of serially diluted water on McConkey agar plates (Ezeronye and Ugbogu, 2004). The set up was incubated at 37ºC for 18-24h.

Isolation of *Salmonella* and *Shigella* species from water samples

The membrane filter technique (APHA, 1992) was used, the membrane were introduced into flasks with 20ml sterile Selenite-F (Oxoid) and tetrathionate (Oxoid) enrichment media respectively and incubated at 37ºC for 24h and thereafter a loopful of the culture was subcultured by streaking on Deoxycholate Citrate agar (DCA) and Salmonella Shigella agar (SSA) and the plates were incubated for 48h at 37ºC. *Salmonella* and *Shigella* species were differentiated by morphology and motility tests and growth characteristics on Kliger's Iron agar.

Frequency of Occurrence of *Salmonella* and *Shigella* species from the man-made lakes

Forty eight water samples were randomly collected from each lake between the months of January and June and screened for the occurrence of *Salmonella* and *Shigella* species. Two samples were collected each week during the period.

Results

The total heterotrophic count (THC) of bacteria in the surface water of the lakes ranged from 2.0 – 6.0 × 10^4cfu/ml for all the months sampled. The highest count for both lakes was observed in the September sampling. The total coliform count (TCC) ranged from 1.5- 3.0 × 10^4 cfu/ml (Table 1). Statistical analysis show that there was no significant difference in the total heterotrophic counts of the lakes, there was a significant difference (P>0.05) in the total coliform count of both lakes. Microbial counts for both lakes were higher during the rainy season. *Salmonella paratyphi* and *Salmonella typhimirium* were isolated throughout the sampling period. Out of 48 samples examined for *Salmonella* and *Shigella, Salmonella typhi* was isolated from 9 (18.75%), *Salmonella paratyphi* in 28(58.33%). *Salmonella typhimirium* was isolated in 39 (81.25%) and *Shigella* species from 15(31.25%) respectively.

Table 1. Total Heterotrophic (THC) count of water samples from the man- made lakes at Lokpa

Month	THC x 10^4cfu/ml Lake 1	THC x 10^4cfu/ml Lake 2
January	2.0	2.2
February	2.3	2.4
March	2.5	2.6
April	3.4	3.6
May	3.6	4.2
June	4.1	4.7
July	5.3	5.9
August	4.0	5.8
September	5.4	5.8
October	5.6	6.0
November	4.6	4.6
December	2.4	3.0

Table 2. Total Coliform Count (TCC) of water samples from the man- made lakes at Lokpa

Month	TCC x 10^4cfu/ml Lake 1	TCC x 10^4cfu/ml Lake 2
January	1.5	1.8
February	1.7	1.9
March	1.8	2.0
April	2.0	2.2
May	2.1	2.3
June	2.5	2.7
July	2.6	2.7
August	2.3	2.8
September	2.2	3.0
October	2.1	2.6
November	2.0	2.3
December	1.6	2.0

Table 3: Frequency of Isolation of *Salmonella* and *Shigella* species from Lake 1.				
Organism **Month**	***Salmonella typhi***	***Salmonella paratyphi***	***Salmonella typhimirium***	***Shigella* species**
Jan.	0	2	7	0
Feb.	0	2	4	1
Mar.	2	3	4	1
Apr.	2	5	5	3
May	2	8	8	4
Jun	5	8	8	6

Table 4: Frequency of Isolation of *Salmonella* and *Shigella* species from Lake 2 .				
Organism **Month**	***Salmonella typhi***	***Salmonella paratyphi***	***Salmonella typhimirium***	***Shigella* species**
Jan.	0	3	1	0
Feb.	0	4	4	1
Mar.	3	4	4	2
Apr.	3	6	8	4
May	3	8	8	6
Jun	7	8	8	8

Photograph 1. Woman washing sliced Cassava in Lake 1

Source: Field work

Photograph 2. Man- made Lake 1 at Lokpa Abia State, Nigeria

Photograph 3. Man- made lake 2 at Lokpa Abia State Nigeria

Discussion and conclusion

Since the local people use the water for swimming and bathing, washing of sliced cassava (tapioca), the isolation of potential pathogenic coliforms from the lakes is of public health significance. The presence of these organisms can change the quality of water. Their presence could be attributed to the nature of microorganisms and contamination of lakes. These organisms are capable of surviving in the aquatic environment after introduction. The existence of these bacteria in the lakes and other aquatic environments shows their ability to survive in the places in which they are not native (Oliveira *et al*., 2006).

Salmonella typhi , Salmonella paratyphi and Salmonella typhimirium were isolated from both lakes especially during the rainy period. The higher number of coli forms and other microorganisms isolated during the rainy season can be attributed to run offs after rainfall or other activites which introduces faecal matter into the lakes. There is generally lack of proper human and animal waste disposal in the study area.

These organisms are causative agents for human diseases and their presence poses a potential threat to the human population (Nwachukwu and Otukunefor, 2003) especially since the local inhabitations of the area use the lake water without any form of treatment. The microbial quality of drinking water is becoming an increasing cause of concern world wide as the practice of disposing faecal waste on land which must find its way into streams, lakes and streams. Although some of the inhabitants are aware of the health implications of using water from the lakes, for instance the inhabitants use the water for swimming, bathing, cassava processing, and laundry and in some cases drinking, a lack of alternative source of water supply makes it difficult for them to avoid using it. Owing to the risk of public outreaks of diseases, it is important that communities are aware of the potential risks associated with water contact including pathogenic bacteria. This study of the man-made lakes at Lokpa has shown that the water bodies contain bacterial species of public health importance and could therefore serve as focus of infections of the users of such water.

Recommendations

There is need for improved sanitation particularly provision of improved human and animal waste management facilities and provision of potable water supply. Overall, behaviour change can be achieved through continued education and awareness about the public health implications of using such domestic water sources.

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