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OCCURRENCE OF FAECAL COLIFORMS IN WATER SOURCES IN JIMETA-YOLA, NIGERIA

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ABSTRACT *Analysis of water from different sources in Jimeta – Yola, Nigeria for faecal coliforms was carried out. The coliform count was determined using the most probable number (MPN) technique. The results revealed that borehole water had coliform counts ranging from < 2 to 23 coliforms/100ml, whereas tap water sample analysed had a count of ≥ 1600 coliforms/100ml of water sample. Well water had faecal coliform counts ranging from 132 to 220 coliforms/100ml of water sample. Water samples from River Benue had counts of ≥ 1600 coliforms/100ml in each of the sites sampled, indicating high faecal contamination of the river. The bacteria identified as Escherichia coli, Klebsiella spp, Proteus spp and Salmonella spp. E. coli were isolated from all the locations sampled, while Salmonella spp was isolated from all the wells sampled and from the river water. The results suggest that the water sources were contaminated with pathogenic bacteria, particularly the boreholes and river.*

INTRODUCTION

Evaluation of the sanitary quality of drinking water has become necessary because of the increasing demand for potable water supply for domestic, agricultural and industrial purposes. Water supplied to domestic and municipal purposes should satisfy the bacteriological, physical and chemical criteria which indicate the safety of water for consumption and other purposes.

Nwachukwu *et al.* (2000) reported that, if water could be distributed to the consumers in the condition in which it is produced following treatments, the microbial load would be reduced to a safe level. Unfortunately, during distribution, significant physical, chemical and microbiological changes occur. These include microbial growth, microbiologically induced chemical changes and contamination. Drinking water is critical part of the human diet and contamination of the municipal water with pathogenic microorganisms constitutes a serious threat to public health (Stender *et al.*, 2001). Perhaps the greatest problem associated with drinking water, is contamination by human excrement. If such excreta contains pathogenic microorganisms, the consumers of the water may become infected by the diseases caused by the pathogens. Several disease outbreaks have been known to occur following contamination of drinking water with infective microorganisms (Blake *et al.*, 1980; Umoh *et al*; 1983; Mims *et al*; 2005). The presence of faecal organisms in water indicates that pathogens are probably present (Uche and Ikwuegbu, 1988). Not all bacteria in water are indigenous. Some are derived from soil and sewage and a proportion of these organisms will survive the water treatment process (Ampofo, 1994). Other organisms gain access at the time of assembly or repair of pipelines (Anon, 1996). The drinking water of most communities in Nigeria that lack standard water treatment facilities are obtained from springs, streams, rivers, wells; such water sources are likely to be polluted by human and animal faeces, Urine and other wastes. Other sources of microbial pollution of water are industrial effluents, agricultural sources, air environment and domestic waste water. Sewage contains pathogenic bacterial agents of several diseases such as typhoid fever and cholera. Underground water, which is one of the major sources of drinking water in towns and villages

in Nigeria results from percolation of mainly rain water into the soil. The degree of pollution of underground water varies and this is due to the fact that as the water percolates microorganisms are filtered as it goes down. The purity, therefore of underground water is determined by the amount of filtration it receives, the depth of the impervious layers and the packing particles (Okafor, 1985).

This study was designed to determine the faecal coliform load in water from different sources in Jimeta – Yola and to ascertain the extent of contamination of the water by the indicator organisms.

MATERIALS AND METHODS

Sample Collection

Fifty five (55) water samples were collected from the different locations. The sources and number of samples collected at each site is shown in Table 1. Water sample was collected in a 100ml capacity sterile sample bottle with a metallic cork. In collecting water sample from the boreholes and tap, the mouth of the tap was swabbed with cotton wool soaked in methylated spirit. This was done in order to disinfect the mouth of the tap. The tap was allowed to run for few minutes and the sterile bottle was used to collect the water and quickly corked. In the case of some boreholes, hand pump was used before water could flow from the tap connected to the borehole. The samples were kept in an ice box and transported to the laboratory. The mean depth of the boreholes varied from 71 to 75 meters while the depth of the wells ranged from 2.0 to 3.80 meters. The depth of impervious layers and packing particles of the soil is relatively tight, since domestic waste and rain water are mostly found in the soil for sometimes before they percolate into the soil. For the river water samples, the water was collected 1.5 meters below the surface at five different points with a distance of 20 meters each, before and after, where human activities take place facing the water current using a sterile sample bottle. The sampling was done from July to September, which marks the on-set of rainy season in Yola, Adamawa State.

In collecting the well water sample, a sterile bottle with a wide mouth was tied at the end of a rope that was already disinfected with methylated spirit and used to collect the water sample from the wells. The bottles were corked and transported in an ice box to the laboratory for analysis.

Processing of Samples

The Most Probable Numbers (MPN) technique (multiple tube technique) was used to determine the number of coliform bacteria most probably present in 100ml of the water sample according to the Standard Methods for the Examination of Water and Waste Water. (SMEWW, 1992). Serial dilution of the water sample was made and 0.1ml of the diluted sample was inoculated into five (5) test tubes containing 10ml of sterile single strength lactose broth with inverted Durham's tube for the collection of gas produced after 24 – 48 hours incubation at 35 – 37°C. The above procedure was repeated using 10ml single strength lactose broth and 1.0ml of water sample; and 10ml of double strength lactose broth inoculated with 10ml of water sample. Coliforms most probably present in 100ml of the water samples analysed were ascertained based on the number of positive tubes in each group using the Mc Crady's Table (SMEWW, 1992). The demonstration of the greenish metallic sheen with dark center colonies, Gram-negative, non-spore forming, rod shaped bacteria from the Eosine methylene blue (EMB) agar and the formation of gas production in the Lauryl tryptose broth constituted a positive result for the completed test (SMEWW, 1992).

Characterization and Identification of Isolates

The various isolates obtained were characterized based on growth on differential/selective media and biochemical tests including Gram's reaction, indole, methyl red, voges-proskauer, citrate utilization, motility test and utilization of

carbohydrates (SMEWW, 1992). The bacteria were identified by comparing their characteristics with those of known taxa using the Bergey's Manual of Determinative Bacteriology (Buchanan and Gibbons, 1974).

RESULTS

The physical appearances of the water samples from all the borehole and wells was clear and colourless. The exception was the sample collected from the tap (Jimeta treatment plant) at the Federal College of Education, Yola, which was turbid and from River Benue which was brown and turbid. After 24 – 48hours at 37°C, a gas was produced by coliforms in some of the test tubes that covered the concavity of the Durham's tubes and constituted the positive presumptive test. The results revealed that borehole water had coliform counts ranging from < 2 to 23coliforms/100ml whereas tap water had a count of ≥ 1600 coliforms/100ml of water sample. Well water had faecal coliform counts ranging from 132 to 220 coliform/100ml of water sample. Water samples from River Benue had counts of ≥1600 coliforms/100ml of water sample in each of the sites sampled indicating high faecal contamination of the river. It was observed that 80 – 100% water samples from boreholes were contaminated with fecal coliforms. Similar results were obtained for the wells and river (Table 2). Four genera of bacteria were isolated from the different locations sampled, these are *Escherichia*, *Klebsiella*, *Proteus* and *Salmonella* (Table 3). *E. coli* was isolated from all locations with the exception of Government Girls Secondary School, Yola and Jimeta Township Public Borehole, while *Salmonella* was isolated from Jimeta township and Sangere village private wells as well as River Benue. *Klebsiella* was isolated from River Benue, some boreholes in Adamawa State Polytechnic, Yola and some wells in Jimeta township while *Proteus* was isolated from River Benue samples only (Table 3).

Table 1: Sources and number of water samples collected

Location	Sources of water	Number of samples collected
Federal University of Technology, Yola (FUT)	Borehole	5
Federal Polytechnic Mubi, Yola Campus (FPM)	Borehole	5
Federal College of Education Yola (FCE)	Borehole	4
	Tap water	1
General Murtala Mohammed College, Yola (GMMC)	Borehole	5
Adamawa State Polytechnic, Yola (ASP)	Borehole	5
Government Girls Secondary School, Yola (GGSS)	Borehole	5
Federal Government Girls College, Yola (FGGC)	Borehole	5
Jimeta Township Public borehole	Borehole	5
Jimeta Township Private Well	Well	5
Sangere Village Private Well	Well	5
River Benue	River	5
Total		55

Table 2: Occurrence of coliforms in water samples from sampling sites by various sources

Location	Total Coliform counts/100ml	Sources of water			
		Borehole	Tap	Well	River
Federal University of Technology, Yola (FUT)	2 – 23	5(100%)	-	-	-
Federal Polytechnic Mubi, Yola Campus (FPM)	0 – 2	5(100%)	-	-	-
Federal College of Education Yola (FCE)	2 – ≥1600	4(80%)	1(20%)	-	-
General Murtala Mohammed College, Yola (GMMC)	0 – 2	5(100%)	-	-	-
Adamawa State Polytechnic, Yola (ASP)	2 – 6	5(100%)	-	-	-
Government Girls Secondary School, Yola (GGSS)	0 – < 2	5(100%)	-	-	-
Federal Government Girls College, Yola (FGGC)	0 – 2	5(100%)	-	-	-
Jimeta Township Public borehole	0 – < 2	5(100%)	-	-	-
Jimeta Township Private Well	0 – 132	-	-	5(100%)	-
Sangere Village Private Well	0 – 220	-	-	5(100%)	-
River Benue	0 – ≥ 1600	-	-	-	5(100%)

Counts are average of 5 samples

Table 3: Bacteria isolated from water samples in the various locations.

Location	Bacteria isolated
Federal University of Technology, Yola (FUT)	*E. coli*
Federal Polytechnic Mubi, Yola Campus (FPM)	*E. coli*
Federal College of Education Yola (FCE)	*E. coli*
General Murtala Mohammed College, Yola (GMMC)	*E. coli*
Adamawa State Polytechnic, Yola (ASP)	*E. coli, Klebsiella spp.*
Government Girls Secondary School, Yola (GGSS)	No bacteria isolated
Federal Government Girls College, Yola (FGGC)	*E. coli*
Jimeta Township Public borehole	No bacteria isolated
Jimeta Township Private Well	*E .coli, Klebsiella spp, Salmonella spp*
Sangere Village Private Well	*E. coli, Salmonella spp*
River Benue	*Proteus spp., E. coli, Klebsiella spp., Salmonella spp.*

DISCUSSION

Results obtained in the present study indicate that water samples from the various sources were contaminated with faecal coliforms. However, the borehole water is relatively fit for drinking because coliform count falls within the WHO recommended standard that, no sample should contain more than 10 coliform organisms per 100ml of water sample (WHO, 1971). However, one of the boreholes in the Federal University of Technology, Yola had 23 coliforms/100ml of water and the tap water in the Federal College of Education, Yola had ≥ 1600 coliforms/100ml. The high coliform counts in the boreholes could be due to poor fortification of the boreholes. For the tap, it could be due to damage on the pipeline which gives way for contamination from the environment where the pipelines are laid. The results of this study are comparable to those of a similar study carried out by Okoronkwo and

Zoaka (1998) on borehole and well water in Katarko village, Yobe State, Nigeria. The investigators found high faecal coliforms contamination of borehole and well water sampled in various locations. Other investigators have reported the microbial contamination of borehole water in Nigeria (Bako, 1978; Olutiola *et al.*, 1982; Adesiyun *et al.*, 1983). None of the 10 samples collected from Jimeta township and Sangere village private wells were fit for consumption because their coliform counts far exceeded the 10 – 25 coliforms per 100ml recommendation for potable water (WHO, 1971., Freedman, 1977). This agrees with the reports of Bako (1978), Olutiola *et al.* (1982) and Adesiyun *et al.* (1983). Among the factors contributing to the contamination of these wells are that a good number of the wells were not lined with concrete. Parapets, apron and cover were lacking in some of the wells while others had no permanent vessel for drawing water. These lapses are veritable sources of contamination. Feachem (1980) reported that wells in Bukina Faso were contaminated by seepage of a pool of water around well-head and that the pool was contaminated by pig faeces. In the same study, well water was shown to have been polluted by dirt on tins and bucket that were lowered into it as well as seepage of splash and rain water. The private wells in Jimeta township and Sangere village were located close to toilets and water points were less than 30 metres away from pit latrines. Lewis *et al.* (1982) and Cairncross and Feachem (1993) reported that location of wells too close to pit latrines, soakaways or refuse dumps could pollute ground water. Similarly, Kolo and Garba (2004) reported high microbial counts in wells in Minna, Nigeria and attributed it to the fact that many of the wells were not far away from soakaway, pit latrines, bathroom passages and sewage. In River Benue where five different sites were sampled at a distance of 20 meters between each sampling station, the water had coliform counts as high as $\geq$ 1600 coliforms/100ml in all the sites sampled. This indicates high level of contamination of the river probably due to direct indiscriminate defaecation in or around the river by humans and animals. Besides, various human recreational activities, like swimming, bathing and washing could contribute to high coliform counts of the river. Human and animal wastes harbouring coliforms were washed into the river by run-off especially during the rainy season when the study was conducted. This finding is in line with the report of Nwachukwu and Otokunefor (2003) who found high coliform counts during raining season in Rumuji stream in Rivers State. Nigeria.

CONCLUSION AND RECOMMENDATION

The study has indicated that some of the borehole water samples had coliform counts within the maximum acceptable limits for potable water and therefore fit for consumption. The well, river and tap water samples were found to be unfit for human consumption because the faecal coliform counts were not within the recommended limits for potable water. It is therefore recommended that all pipelines leading to the taps should be well fortified and soakaway should not be built near boreholes and wells. The wells should be provided with covers, permanent fetching vessel, hand pumps and concrete lining of the inside to prevent seepage of contaminated matter into the wells. There is also the need to improve personal and environmental sanitation. Consumption of water from contaminated sources should be discouraged. However, if water from these sources must be consumed, it should be boiled and filtered or treated by adding alum to avoid microbial waterborne infections.

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