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BACTERIOLOGICAL QUALITY OF WATER SAMPLES IN OSOGBO METROPOLIS

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The bacteriological qualities of samples of some sachet water, tap water and well water were examined. Some physicochemical parameters (pH and suspended solids) indicative of water quality as well as the total bacterial and total coliform counts were examined. The pH of the samples range between 6.5 and 7.2. Suspended solids content ranged between 3.3 and 18.5 x 10^{-2} g/ml. The total bacterial counts ranged between 7.0 to 12.0 x 10^{1} CFU/ml for sachet water, 0 to 20 CFU/ml for tap water and 2.0 to 20 x 10^{3} CFU/ml for well water. The coliform count (MPN) ranged between 0 to 1 coliform/100ml for sachet water, 0 to150 coliform/100 ml for tap water and 1200 to 1800 coliform/100ml for well water. A total of six bacterial species: *Escherichia coli, Bacillus cereus, Proteus vulgaris, Streptococcus faecalis, Enterobacter aerogenes* and *Staphylococcus aureus* were isolated. Their distribution among the samples and the public health implication are discussed. The well water samples examined were found to fall short of the WHO recommendation for drinking water, while the tap water was adjudged fit for consumption.

INTRODUCTION

Man's initial assessment of the value of water is very low until he finds himself without it. Human water needs are usually met by water obtained from rainfall, streams, well, boreholes or tap depending on the locality and available technology. The availability of water in any given locality is however usually constant (1). Most organized society depends on piped treated water to meet their water requirement. It is often taken for granted that such water supplies are potable. However, it has been recommended by World Health Organization that the source of such water should be examined daily for coliform organisms, turbidity and pH at the point at which the water enters the distribution system. The piped water should contain no coliform organisms and no faecal coliform in 100 ml (2).

Ground water sources usually serve as alternative sources of water largely due to shortage of piped water or erratic supply. For this category of water, protection of the source by lining and covering, diversion of surface drainage, catchments protection to restrict human and animal access and paving of surroundings, have been recommended as means of preventing pollution of the water (2). The WHO guidelines also stipulate a coliform count of less than 10 per 100 ml (2). In contemporary time, the sale and consumption of bottled and sachet water in a bid to avoid consumption of contaminated water has increased. For bottled water, under which one can place sachet water, it is recommended that the water contains no coliform organism (2).

Water quality and supply affects health (3). To be safe for human consumption, water must be aesthetically acceptable and should be free from apparent turbidity and odour, and from any objectionable taste (4). The presence of faecal coliform or thermotolerant coliform organisms per 100 ml is an indication of some degree of faecal contamination (3). The presence of *E. coli* is particularly taken as

exclusively indicative of faecal pollution of water (5)

Sachet, well and tap water serve as regular sources of water for domestic requirement in Osogbo, Osun State in Nigeria. In this study, the bacteriological quality of sachet, well and tap water samples collected from popular regions were examined to ascertain whether or not they are fit for human consumption.

MATERIALS AND METHOD

Samples of sachet water, tap water and well water were collected from three areas of Osogbo: Oja Oba, Dada estate and Power line. Water samples were taken into bottles containing 3% sodium thiosulphate solution (6). The pH and suspended solid contents were determined as described by ASTM (7). Total bacterial count was determined using pour plate method. The plates were inoculated aerobically at 37°C for 24 hours. The total coliform count was determined as the most probable number (MPN) using multiple tube fermentation test (6). Colonies that developed were purified using the streaking method. The pure cultures were then characterized on the basis of colony morphology, cellular morphology, staining and biochemical reactions and subsequently identified (8).

RESULTS

The water samples were generally near neutral with pH ranging between 6.5 and 7.2. Well water samples were found to contain the highest amount of suspended solid while tap water had the lowest (Table 1). Table 2 shows the total bacterial and total coliform counts. The total bacterial counts ranged between 7.0 and 12.0 X 10^1 CFU/ml for the sachet water, 0 to 2 CFU/ml for tap water and 2.0 to 20 x 10^3 CFU/ml for well water. The coliform count (MPN) ranged between 0 to 1 coliform/100 ml for the sachet water, 0 to 150 coliform/100 ml for tap water and 1200 to 1800 coliform/100 ml for well water.

A total of six bacterial species: *Escherichia coli, Bacillus cereus, Proteus vulgaris, Streptococcus faecalis, Enterobacter aerogenes* and *Staphylococcus aureus* were isolated. Their distribution among the samples is shown on Table 3. *Escherichia coli* was found in tap water samples from Ojo Oba, and in the entire well and sachet water samples. The well water samples were found to contain all the organisms.

Table 1: Physicochemical characteristics of water samples from different locations

Samples	Physiochemical characteristics	
	pH	Suspended solid content (g/ml X 10^{-2})
S1	6.6	3.6
S2	6.8	3.3
S3	7.0	3.3
T1	6.9	4.5
T2	7.2	4.0
T3	7.1	3.7
W1	6.5	17.4
W2	6.6	18.5
W3	6.5	14.6

S1= Satchet water samples from Oja Oba
S2= Satchet water samples from Dada Estate
S3= Satchet water samples from Power Line
T1= Tap water samples from Oja Oba
T2= Tap water samples from Dada Estate
T3= Tap water samples from Power Line
W1= Well water samples from Oja Oba
W2= Well water samples from Dada Estate
W3= Well water samples from Power Line

Table 2: Mean population of bacteria in water samples

Samples	Population of bacteria	
	Total bacterial count (CFU/ml)	Total coliform count (MPN/100 ml)
S1	1.2×10^2	1
S2	1.6×10^1	0
S3	7.0×10^1	0
T1	2.0×10^1	150
T2	0	0
T3	0	0
W1	2.0×10^4	≥ 1800
W2	2.0×10^3	≥ 1200
W3	1.2×10^4	≥ 1800

Table 3: Distribution of bacterial species in water samples

Bacterial species	Sample								
	S_1	S_2	S_3	T_1	T_2	T_3	W_1	W_2	W_3
Bacillus subtilis	+	-	-	+	-	-	+	+	+
Escherichia coli	-	-	-	+	-	-	+	+	+
Staphylococcus aureus	+	-	-	-	-	-	+	+	+
Proteus vulgaris	-	-	-	-	-	-	-	+	-
Streptococcus faecalis	-	-	-	-	-	-	-	-	+
Enterobacter aerogenes	+	-	-	+	-	-	+	+	+

S1= Satchet water samples from Oja Oba, S2= Satchet water samples from Dada Estate
S3= Satchet water samples from Power Line, T1= Tap water samples from Oja Oba, T2= Tap water samples from Dada Estate, T3= Tap water samples from Power Line, W1= Well water samples from Oja Oba, W2= Well water samples from Dada Estate, W3= Well water samples from Power Line
+ = Present; - = Absent.

DISCUSSION

The pH of the water samples was generally within the limit considered suitable for human consumption. The well water was observed to have high suspended solid content and high bacterial count. The high concentration of suspend solids in the well water could be due to the way the water is fetched, which may stir the bottom stratum of the well. This will make materials that had settled at the bottom to be re-suspended in the water and may account for the presence of the bacterial species in the water samples. Another factor that could have accounted for the high bacterial count is the fact that the majority of those who fetch water from the wells are children, most of who are in poor state of hygiene.

The presence of *E. coli* in the sachet water portends serious danger as it is the most commonly consumed forms of water. The tap water was however found acceptable, as the samples were largely free of bacteria. *Bacillus subtilis* and *Staphylococcus aureus* were found in only one of the samples. This is indicative of proper treatment and distribution of the treated water. The presence of *E coli* in one of the samples, which also had a high coliform count (MPN of 150 coliform/100ml), suggests that the distribution network in the area could have suffered leakage at some point. Such leakages have been identified as being responsible for the presence of bacteria in treated piped water (5)

The presence of *E. coli* suggests contamination of the water sample with faecal materials. For the well water, this is most likely to result from cross contamination through the buckets used for fetching water, which are often placed on the ground. The presence of *Staphylococcus aureus* suggests human contamination as the organism is a commensal on the skin and nostril of humans (9). The organism may be associated with food poisoning which involves the elaboration of heat labile toxins (10). The presence of *Bacillus subtilis* in the well water further buttresses the fact that cross contamination of the well water occurred. This organism is a common saprophyte encountered in the soil (10) and could have been carried along with soil that sticks to the containers used for fetching water.

CONCLUSION

The well water samples were particularly observed to fall below the WHO recommendation which states that drinking water should contain no microorganism known to be pathogenic, and should also be free of bacteria indicative of pollution with excreta. The sachet and tap water were found to satisfy this requirement. It can thus be concluded that the tap water supply to Osogbo metropolis is bacteriologically safe for human consumption. However, the conditions under which sachet water are produced and packaged will need to be improved The National Agency for Food and Drug Administration and Control (NAFDAC) will need to properly monitor the production

and certification of these packaged water for domestic consumption. On the other hand, well water should not serve as drinking water without treatment.

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