Microbiological Quality of Packaged Drinking Water Marketed within Sokoto Metropolis

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Abstract: *All living things are composed primarily of water and none of the cell either prokaryotic or eukaryotic can develop and grow without water. Drinking of clean and uncontaminated water is essential to quality health and wellbeing. The study was conducted to determine the microbiological quality with a view to ascertain the safety of packaged (sachet and bottled) drinking water marketed within Sokoto metropolis. A total of 165 samples which comprises of three samples each of the packaged water brands (n=55) were randomly purchased and transported in a cool boxes to veterinary microbiology laboratory of Usmanu Danfodiyo university Sokoto, Sokoto state, Nigeria for microbiological analysis. Standard procedure of bacteria examination of water which comprises up of presumptive, confirmatory and completed tests were employed. Similarly, the number of coliform bacteria were estimated using the Most Probable Number (MPN) technique. Out of the total number of samples (n=165) collected and processed; only six were found to contained coliform bacteria emanating from three sachet water brands and none from bottle water brands, with occurrence rate of 3.6%. Escherichia coli was identified in all the positive samples obtained, however, Klebsiella spp., Citrobacter spp. and Escherichia Faecalis were not found in any of the samples analyzed. As promise, a writing recommendations was issued to affected companies on the need to improve the quality and hygiene of the water treatment and processing practices*

Keywords: Coliform bacteria, Most probable number, Packaged water, Microbiological quality

1. Introduction

Water is essential to human life, both for drinking, bathing and other domestic activities, which lead to discriminate demand and production of packaged and sachet water in Sokoto Metropolis. Water testing for microbiological quality or safety rests on the ability of a microbiologist to determine or detect. Coliform bacteria and other contaminants of water from fresh water bodies, streams, lakes, ground or coastal ocean water to be sure that the water is safe for human consumption (Khan *et al* 1992, Welch *et al*, 2000 and Andrew, 1998). However, the available sanitary facilities cannot sustain the growing population and this may also lead to contamination of surface water sources with faecal materials either directly or indirectly. (Calamari *et al.,* 1994).

Coliforms are indicators of other potentially harmful microorganism in drinking water. The organisms belong to the order Eubacteriales and family Enterobacteriaceae. The members of this family are heterogenous small gram-negative rods that ferment sugars with the production of acid and gas, some produces a greenish metallic sheen on Eosin Methylene-blue agar. They give a positive catalase and negative oxidase reaction except a few strain of Erwinia which reduce nitrate to nitrite and in Taumella family which are motile strains that do not exhibit peritrichous flagellation (Douglas, 2006). Collectively, this group of gram-negative bacilli (with exception of proteus) is referred to as "coliform" because they share similar morphological and biochemical characteristics, with the exception of proteus, these organism ferment lactose, which are useful characteristic for differentiating them from salmonella and shigella. Most of these organisms are members of the normal microbial flora of human and animals which are considered as opportunistic pathogens (Douglas, 2006).

Practically, all coliforms are presumed to be of faecal origin unless proved otherwise. They are better indicator than water-borne pathogens because they are constantly present in billions of numbers in the human intestine and being foreign to portable water, their presence is an indication of faecal contamination. They are easily detected by cultures as little as one bacterium per 100mls of water. *Escherichia. coli* which is found in large numbers in faeces of all animals and survives longer much resistant to forces of natural purification than other pathogens (Grant, M.A. 1997). This research is aimed to determine the microbiological quality of packaged water sold within Sokoto metropolis, Nigeria. Water borne diseases are among the implications of drinking untreated water that does not meet the standard and recommendation of the World Health Organization (WHO).

2. Materials and Methods

Sample Collection

Sachet and bottle water brands purchased randomly all over the metropolis were transported in cool boxes to Veterinary Microbiology laboratory of Usmanu Danfodiyo University Sokoto, Sokoto State, Nigeria for analysis. The three stages standardized procedure of bacteriological water quality testing was conducted. The first is presumptive test which is the screening of sampled water for the presence of coliforms bacteria. A series of lactose fermentation tubes are inoculated with the water sample, if the presumptive test is negative, no further testing is performed, but tubes in the series that show acid and gas production are considered as positive. Confirmed test was performed on the tubes showing the positive reaction which serve as second test in

which a selective media Eoisin Methylen Blue agar (EMB agar) is used. Isolated colonies that show a greenish metallic sheen colouration from the E.M.B. agar plates are considered positive confirmatory test. In the last and Completed stage, the colonies with the above characteristic growth were re-inoculated into tubes of Macconkey broth and Nutrient agar slants for lactose fermentation and purity for morphological and biochemical testing, growth characteristics in Macconkey broth as well as reaction to indole, methyl red, voges proskaurer and citrate utilization test were used as confirmatory of presences of *E. coli* (Oyedeji *et al.,* 2010). Likewise a completed test to determine the morphology and gram reaction of the isolates from macConkey tube were subjected to nutrient agar plate and incubated 37°c for 24 hours, colonies from the nutrient

agar plate that shows a non spring producing gram negative rods, lactose fermenters and IMVIC test positive (+ + - -) were completed as indicators of water pollutant (Apha, 1995).

Estimation and Isolation of Coliform (Escherichia Coli)
The number of coliforms was estimated using the most probable number (MPN) method in which nine (9) tubes of lactose broth were inoculated with the sample being tested. A count of the number of the tube showing positive presumptive tubes were compared with MPN standard chart to obtain the count per 100ml. as presented in the table 2 of the result. The Schematics below summarize the microbiological analysis of the packed drinking water in the study
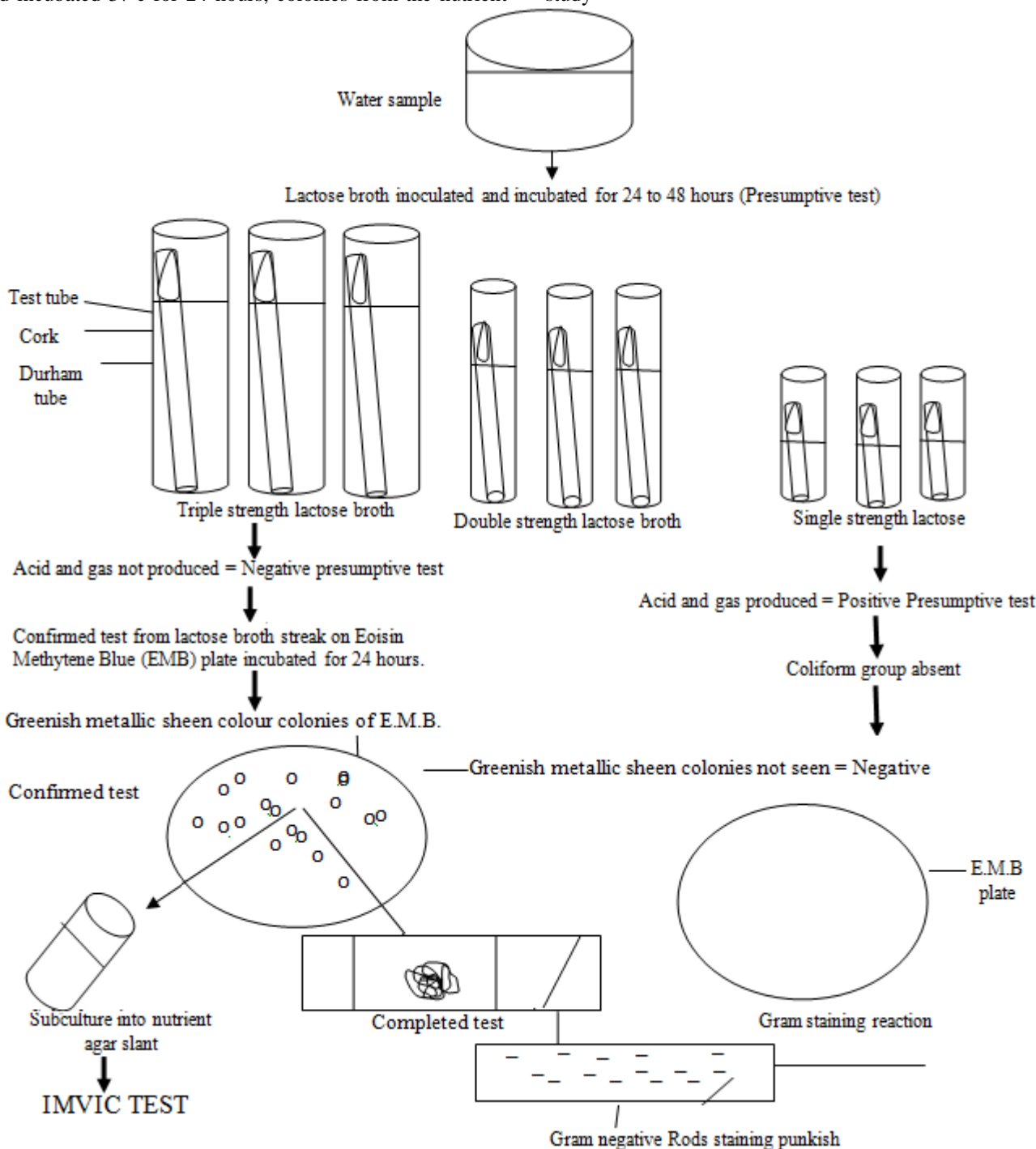
Table 1: Packaged Potable water Produced and Marketed in Sokoto Metropolis, Nigeria

S/N	Packaged Water type	Sample ID	Brand Name	Location of Vendu
1	Sachet Water	D1	High Test Water	Tamaje
2	Bottle Water	D2	Eva Water	Bottled
3	Sachet Water	D3	Nurad Water	Danbuwa
4	Sachet Water	D4	Global Water	Old Airport
5	Bottle Water	D5	Accepted Water	Fodio Road
6	Sachet Water	D6	Bash Saddig	Old Airport
7	Bottle Water	D7	Sidi Water	
8	Bottle Water	D8	Faro Water	
9	Bottle Water	D9	Swam Water	
10	Bottle Water	D10	Anita Water	
11	Sachet Water	D11	Shem Lameck	
12	Sachet Water	D12	B.P. Blessed	
13	Sachet Water	D13	Taram Sainiya	Kofar Taraminiya
14	Sachet Water	D14	Akason	
15	Sachet Water	D15	Humson	
16	Sachet Water	D16	Jireh Water	
17	Sachet Water	D17	Hytex Water	Tamaje
18	Sachet Water	D1	Chiboy Water	Tamaje
19	Sachet Water	D19	Mecca Wter	Old Airport
20	Sachet Water	D20	Mabera Water	Mabera
21	Sachet Water	D21	Royal Lux water	Illela
22	Sachet Water	D22	Sham Rock Water	Illela
23	Sachet Water	D23	Abuchi Wter	Illela
24	Sachet Water	D24	Alfarma water	
25	Sachet Water	D25	Ardo	
26	Sachet Water	D26	Al Saliha	
27	Sachet Water	D27	Almin	
28	Sachet Water	D28	Akason	
29	Sachet Water	D29	Aduwa	
30	Sachet Water	D30	Abdus	UDUS
31	Sachet Water	D31	AB Azama	Offa Road
32	Sachet Water	D32	Habeb	
33	Sachet Water	D33	Freedona	Hajiya Halima
34	Sachet Water	D34	Fajar	
35	Sachet Water	D35	De Mini	
36	Sachet Water	D36	Delure	
37	Sachet Water	D37	Humson	
38	Sachet Water	D38	Imad	Gidan Man Ada
39	Sachet Water	D39	Isfat	
40	Sachet Water	D40	Jemdeb	
41	Sachet Water	D41	Ehiwe	
42	Sachet Water	D42	De Key	
43	Sachet Water	D43	Concept	Abdullahi Fodio Road
44	Sachet Water	D44	Karimci	
45	Sachet Water	D45	Kawara	Kware
46	Sachet Water	D46	Kundila	
47	Sachet Water	D47	Lamiu	
48	Sachet Water	D48	Meyetti	Ringin Sambo
49	Sachet Water	D49	Wasila	
50	Sachet Water	D50	Munasafa	
51	Sachet Water	D51	Rumbukawa	
52	Sachet Water	D52	Sat – wan	
53	Sachet Water	D53	Sidiyah	
54	Sachet Water	D54	Tabliq	
55	Sachet Water	D55	Ultimate	

3. Results

A total number (n=165) water samples were collected from 55 packaged water brands (three samples each per brand) produced and sold in Sokoto metropolis (Table 1). Out of the total samples collected, only six (6) were culture positive, amounting to 4.1% incidence rate (Table 2). All the isolates were identified as *E. coli* but Klebsiella, citrobacter and *E. faecalis* were not found in any of the samples analyzed.

Table 2: Incidence of Coliform Bacteria in Packaged Potable Water Sold in Sokoto metropolis

Type of water	Number of Brands	Number of samples collected	Number of Culture positive	Rate of occurrence
Bottled water	6	18	0	
Sachet water	49	147	6	
Total	55	165	6	3.6%

4. Discussion

The results obtained in this research indicated that, out of 165 water samples collected, only six (3.6%) were contaminated with Coliform bacteria. It is worthy to note that, all the six culture positive samples were from three sachet water brands (three isolates from a single brand, two and one from two different brands) and none is from bottled water. The result of this study highlighted that few samples were found to be contaminated with Coliform bacteria. The absences of faecal bacteria indicators in most of the samples collected could be attributed to quality treatment and processing practices observed by the companies, especially bottled water companies with no single contamination when compared to satchet water companies with few (6/147) contamination. This finding correspond with an earlier study of Ajayi *et al.* (2008) which reported level of contamination of packed drinking water in Ibadan, Nigeria in which larger proportions of sachet water were found to show positive Coliform counts compared to battle waters.

However, the microbial contamination of sachet drinking water in this study could be influenced by factors such as hygiene of the raw water sources and storage facilities, inadequate sanitation and unhygienic practices by the workers and poor treatment practices observed in the production which may account for the major sources of microbial contamination of any potable water as earlier highlighted (Sahota, 2005). Based on these findings, the companies affected were communicated and appropriate advice and recommendation were offered indicating the need for a review and improve on the sanitary and hygienic practices in both the storage, treatment and production plants.

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