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ASSESSMENT OF COMMERCIALLY PACKAGED WATER FOR FAECAL BACTERIAL INDICATORS IN KANO METROPOLIS AND ITS ENVIRONS

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ABSTRACT
A total of 60 commercially packaged drinking water comprising of 48 sachet and 12 bottled water samples were randomly collected and tested for bacterial indicators of fecal contamination. Escherichia coli type 1, Streptococcus fecalis and Clostridium perfringes were used as indices to evaluate potability, using Presumptive and Differential Coliform Counts. The results obtained were analyzed using McCrady's Statistical Table of Probability to ascertain the Most Probable Number (MPN) of Coliform organisms per 100mls of the water. Of the 48 sachet water analyzed, 2 (4.2%) were positive for Presumptive Coliform Count (PCC) with the first and second water samples showing a count of 160 MPN/l00mls and 30MPN/100mls respectively. All the bottled water analyzed were negative for PCC. Since the need for consumption of packaged water cannot be underestimated, it is of great necessity that the waters are properly treated in order to meet the bacteriological Standards for Potable drinking water.
Key words: Packaged water, Bacterial Indicator, Kano metropolis.

INTRODUCTION

Accessibility to safe drinking water, particularly among low income communities, is still a problem in developing countries. Worldwide, it has been shown that water-borne diseases are responsible for over 12 million deaths per year (Hinrichsen, 1998). This is mainly due to poor sanitation facilities and unsafe drinking, washing and cooking water (Hinrichsen, 1998). Millions of people across the world have little access to sanitary Waste disposal infrastructure or clean water (Hinrichsen, 1998). As a result, millions of people are at risk of being infected with water-related diseases (Hinrichsen, 1998). Many water sources in developing countries are unhealthy because they contain harmful physical, chemical and biological agents (Cairncros, 1993). Most of the mortality and morbidity associated with water related disease in developing countries is due directly or indirectly to infectious agents (Cairncros, 1993). However, it would be far too complex to try and detect pathogenic bacteria, viruses and other micro-organisms on routine basis and, in any case many of the pathogens may only be present in small numbers or not at all (Cairncros, 1993). Therefore, the normal practice is to look for Indicator bacteria. These are bacteria, which are always excreted in large numbers in the feces of warm-blooded animals, whether they are healthy or sick. Their presence indicates fecal contamination (Cairncros, 1993).

For decades, faecal coliform bacteria, comprising of mainly *Echerichia coli* have been used as indicator organisms in monitoring of public and private drinking water sources and distribution systems (Cheesebrough, 2000).The ultimate aim is to ensure that the water is free from pathogenic bacteria. *Escherichia coli* is a sub-group of total *Coliforms* and occurs almost entirely in the feaces. The majority are not pathogenic although some strains can cause diarrhea e.g *E.coli* type l (Cheesebrough, 2000).

The inadequacy of pipe-borne water in Kano is almost endemic. This inadequacy is both in quantity and quality of public water supplies. As an alternative to water supply, small-scale industries concerned came up with packaged (sachet and bottled) water widely patronized by the low and middle-class Nigerians. To maintain good health, however, not only a water supply be safe to drink, it must be available in sufficient quantity; easy and safely accessible by all communities; available all the time and meet local standards for taste, odour and appearance (Cheesebrough, 2000).

This research work therefore focused on the assessment of packaged drinking water for indicator bacteria of fecal origin. The results obtained would serve as baseline data reflecting the fitness of commercially packaged water consumed in Kano metropolis and its environs. By this, appropriate recommendations would be made *to* the producing industries and other authorities concerned.

MATERIALS AND METHODS

Study Area

The Study Area was the Municipal area of Kano City which is made up of six local government areas comprising of Fagge, Dala, Gwale, Tarauni, Nassarawa and Ungogo. Kano, being the State capital of Kano state is located in North-West geo-political zone of Nigeria. It's on latitude 12°N and longitude 9°E at a distance of 442km from Abuja, the FCT, 1150km from Lagos(the biggest industrial and commercial nerve centre of the country) and 615km from Lake Chad (Kenmore, 2004).

The area is the commercial nerve centre of northern Nigeria. However, the area is characterized by low level of environmental sanitation, shortage of potable water supply and improper management of wastes, especially in most of the high density and low income areas. From the recent (2011) population cencus, Kano population is11,058,300, which ranks kano state as the most populated in Nigeria (Ado-Kurawa, 2003).

Sample Collection and Processing

A total of sixty samples from twenty brands of packaged water were randomly collected from Kano metropolis for a period of four months between January and April, 2008, and transported to Bacteriology Laboratory, Federal College of Veterinary and Medical Laboratory Technology, Vom, Plateau State avoiding microbial contamination. The random collection of water sample was achieved by obtaining ten water samples from three brands of packaged water at each local government from different water vendors during the sampling period. The samples were preserved and bacteriological analysis in relation to its potability was carried out. The packaged water samples were aseptically transferred into sterile glass bottles of 200mls capacity containing 0.1ml of 1.8% (w/v) aqueous solution of sodium thiosulphate. That amount of Sodium thiosulpahte was added to neutralize any chlorine present in 100ml of water. The water samples collected were packed ice box and transported to the Laboratory for analysis (Ochei, 2000).

Bacteriological Analysis

Presumptive Coliform Test

Double and single strength MacConkey broth was used for the presumptive Coliform test. Fifty (50) mls of each water sample was inoculated into fifty (50) mls of double strength MacConkey broth with an inverted Durham's tube; a set of five bottles containing 10mls each of double strength MacConkey broth with inverted Durham tubes was inoculated with l0mls of each sample; and a set of five bottles containing l0mls of each single strength MacConkey broth with inverted Durham's tubes was inoculated with 1ml of each water sample respectively. It was incubated at 37°C for 48 hours. The production of acid, which was detected by a colour change of the medium from pink to yellow; and gas which was seen by the empty space at the upper limit of the fluid-filled Durham's tube was indicative of a positive result (Cheesbrough, 2000; Zvidzai *et al.,* 2007).The most probable number (MPN) of Coliforms was ascertained according to McCrady's statistical table of probability (Adekunle *et al.,* 2004). Positive and Negative controls were set up. The Positive control used was a previously identified 24 hours culture of *Escherichia coli* inoculated in 50mls of sterile MacConkey broth while the Negative control was 50mls of sterile MacConkey broth (Ochei, 2000).

Differential Coliform Test

Subcultures were made from positive presumptive coliform tubes into Brilliant green lactose bile (BGLB) broth containing an inverted Durham's tube and peptone water. It was incubated at 44°C for 24 hours and observed for the production of acid and gas, and Indole production at 44^0C in peptone water. *Escherinchia coli* type 1 produced Indole with acid and gas at 44°C while other Coliforms did not (Adekunle *et.al.,* 2004).

RESULTS

Out of 48 samples of 16 different brands sachet water analyzed, only 2 were positive for presumptive Coliform test with the most probable count of 160 and 30 per 100ml water (Table 1) . Out of 12 bottled water samples analyzed, none was positive for the presumptive Coliform test. One sample of a brand of sachet ,water in group 5 shows turbidity indicating presence of other organism apart from Coliform. From the results of the analysis carried out, all presumptive Coliform positive samples were lactose fermenting, producing acid and gas at 37°C within 48 hours of incubation. Table 2 shows the differentiating test (Eijkman test) carried out on positive presumptive tubes to differentiate between E. coli type 1 fecal origin and other Coliforms. The differentiating tests gave counts of 20 and 17 MPN/100ml water.

Table 1: Presumptive Coliform Test on Sachet Water Samples

Sample Number	50ml tubes Positive	10ml tubes Positive	1ml tubes Positive	MPN / 100ML
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	1	5	4	160
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	1	4	3	30
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0

Table 2: Differentiating Coliform test (Eijkman test) for positive coliform tubes in Table 1.

Name	50ml tubes Positive	10ml tubes Positive	1ml tubes Positive	MPN / 100ML
Brilliant green broth	10	3	4	20
Peptone water	10	3	4	20
Brilliant green broth	10	4	1	17
Peptone water	10	4	1	17

DISCUSSION

The result of bacteriological analysis of packaged drinking water from Kano metropolis showed that some of the satchet water are contaminated with indicator bacteria. In evaluation of drinking water, some members of Coliform group such as *Escherichia coli* type 1, *Streptococcoccus faecalis and Clostridium perfringes* are usually used as indicator bacteria of faecal pollution (Lechavallier *et. al.,*1996). Out of 48 satchet water samples analyzed, 2 gave positive for presumptive Coliform test, which was indicated by a change of colour of MacConkey broth from pinkish to pale yellowish colour. Contamination of satchet drinking water could be due to improper treatment to eliminate Coliform bacteria or inability to retain disinfectant residual dose in treated water or could also be due post-prodution contamination. The outcome of this work, support an earlier observation that some treated water being produced are of questionable quality. Of treated water examined by Giovani *et al.,*1999), Coliform bacteria were found in 171 it of 1,033 sampling reservoirs. The occurrence of insufficient treatment and re-growth is suggested by the observation that more than 17% of treated drinking water contain Coliform bacteria (Giovani *et al .,* 1999). For Presumptive Coliform Test, WHO guidelines for treated water sample is 0 per 100mls, up to 5 Coliforms per 100ml are allowed for tropical Countries, but this should not occur repeatedly. If occurrence is frequent, and sanitary condition cannot be improved, a better alternative water source must be searched for (W.H.O., 2002).

Agada and Ademoroti (1998) in Ibadan, Nigeria also analyzed 78 sachet water and 5 produced bacterial growth after 18 hours of incubation (Agada, and Ademoroti,1998). The sachet water are produced at an alarming rate, such that it floods the markets and motor parks in this part of the Country and many others.

Likewise, Satchet water is the product of middle class entrepreneurs and some small scale business ventures. The producers most often are people who may not know or care very little about the quality of water sachets they produced. Some even imitate other good products or buy already prepared sachets and carrying labels, then fill and seal them for sale. Most of the sachet water do not have NAFDAC numbers and some may have numbers not given to them by NAFDAC. Yet some approval from NAFDAC may still be of lower quality and yet are they sold and distributed to the public.

Most of the small scale producers of satchet water may not be able to afford the price or space for a bore hole in their premises, hence they still depend on water from other doubtful environmental sources such as well or river for use in packaging their products, some of them under poor environmental condition (Adekunle *et* al*.,* 2004). In terms of purity, bottled water seems preferable to sachet water. Out of 12 samples of bottled water analyzed, none showed positive for Presumptive Coliform Count but in the case of sachet water, 2 out of 48 samples were positive.

If the source of water is good and of high hygienic standard coupled with adequate treatment, contaminants will be completely eliminated or highly reduced to the bearest minimum. The result of Differential Coliform test showed positive for *Escherichia coli* type 1 from virtually all the initial presumptive positive tubes. *Escherichia coli* type l is usually an indicator of fecal contamination. Apart from improper water treatment to eliminate pathogenic bacteria, contamination of treated water could result from vending machines or from the environment of production. Organisms like *Klebsiella spp, Streptoccocusf eacalis* and *Pseudomonas* have been recovered from vending machines in United States (Adekunle *et al.,*2004).

Research by Calderon *et al.,* (1991) shows that out of 100 samples treated water analyzed, 38 were positive for presumptive Coliform test, indicating a high contamination and risk to public health. There was also the detection of fecal (thermotolerant) Coliform Organisms in 43.28% of positive samples (Calderon *et. al.,* 1991).

CONCLUSION

In Kano municipal, like most urban centers in Nigeria, the Inadequacy of the quality and quantity of public water supply is a major problem. Sachet water is handy, readily available and are sold at an affordable price in every nooks and cranny of the city. However, few of this alternative drinking water source is of questionable quality. Some water-borne diseases could be contracted and spread through drinking contaminated water. A more extensive study relating to water quality criteria to determine chemical and physical constituents should therefore be carried out in order to determine other health hazards associated with consumption of packaged water.

RECOMMENDATIONS

Since findings from this research work revealed that the quality of sachet water on market is doubtful, it is therefore recommended that:

a. The producers of sachet water should ensure appropriate and adequate treatment of their products before packaging.
b. High standard of hygiene and sanitation should be maintained in the water production sites and by the Industries.

c. The community in conjunction with the regulating professional bodies (e.g NAFDAC, SON) should take practical steps to discourage the sales of sub-standard sachet water.

d. Water sources should be in appropriate places that cannot be polluted by external sources.

e. There should be regular inspection of water producing industries by NAFDAC to assess the quality of their product, and disciplinary measures be allotted to the faulty producers.

f. The consuming public needs to be informed about this menace and the consequences of consuming packaged water that do not conform with NAFDAC standards. Proper sanitary checks on drinking water supply must be executed regularly in view of its great public health significant as well as good observance of, personal household hygiene.

COMPETING INTERESTS

Authors have declared that no competing interest exist.

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