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Comparative Study of Shelf Life of Some Brands of Bottled Water Sold in Oko

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ABSTRACT

Supply of clean, safe and hygienic drinking water is a health imperative. Five brands of bottle water were bought from open shops in Oko and examined for 3days (Day 1 Day5 and Day10). Three of the bottled water samples had PH which lies within the acceptable PH standard for drinking water which is 6.5 to 8.5 recommended by WHO. The five (5) bottled water samples examined in this study were all positive for the presumptive, confirmatory and complete test. The contaminants were found to be *Staphylococcus aureus* and *Escherichia coli*. The lowest Total bacteria count was for sample IV with 4.6 x 10^2cfu/ml. The Total bacteria count and Total coliform count for all the water samples increased after day 10 on the shelve and the lowest coliform count was 5.2 x 10 cfu/ml for sample IV and highest was 2.8 x 10^3 cfu/ml for Sample II. Sample IV had the least Total Bacteria count and Total Coliform count after 10 days in the shelve so can be said to have the best shelve life from this study.

INTRODUCTION

Water is an essential requirement of all life forms. Satisfactory supply of clean, safe, and hygienic drinking water is imperative for health (Khatoo and Pyrzada, 2010). Access to safe drinking water is vital for human existence. Unavailability of good

quality drinking water is widespread and this has serious health implications (Khanki *et al.*, 2010). Water related diseases continue to be one of the major health problems globally (Onweluzo and Akugbazie, 2010). The high prevalence of diarrhea among children and infants can be traced to the use of unsafe water and unhygienic practices. In developing countries, 80% of all diseases and over 30% of deaths are related to drinking water (Onifade and Ilori, 2008). Any potable water that is intended for public consumption, bottled, distributed and offered for sale, is regarded as bottled water (Ehlers *et al*., 2004). Bottled water can be obtained from natural springs, wells, boreholes, municipal systems or other sources which are considered to be safe, of sanitary quality and fit for human consumption. This is regarded as natural bottled water. Mineralized bottled water is potable water with added salts (Cabral *et al*., 2002).

Bottled water is drinking water which has been packaged in plastic bottles ranging in sizes from small single serving polythene terephthalate bottles of 500ml-1.5-litre capacity to large capacity (20 liters) for water coolers (Raynold, 2005). Water in bottles and sachets are readily available and affordable though in Nigeria bottled water is regarded as being safer than water dispensed and sold in sachet but there are concerns about their purity. The integrity of the hygienic environment and conditions where the majority of the packaged water (bottled and sachet water) produced have also been questioned.

Various reasons have been reported for the higher trend of bottled water use in many countries. Some reasons include: Consumer awareness about increasing water pollution; Deficiencies in municipal water supplies in terms of aesthetic, chemical and microbiological water quality; Successful marketing strategies of bottled water by the bottling companies; The easy availability

and reasonable pricing has popularized the utilisation of bottled drinking water by a number of people who can afford it; and Bottled water is generally considered safe and is taken for granted by people without question. For example 'spring water' is perceived as a pristine, natural source of water. Bottled mineral water has long been consumed as a safer alternative in countries with reticulated water of uncertain quality (Cabral *et al*., 2002). However, consumers should be aware that bottled water is not necessarily safer than tap water (Ehlers *et al*., 2004).

Safe drinking water is essential for human life. It is generally considered that bottled water is safe for usage by people. For long-distance travelers, it serves as the only source of reliable drinking water but several studies have reported that bottled water does not always meet the acceptability standards. Also, Demand for bottled water has resulted in the spring up of several small-scale entrepreneurs involved in its production and distribution. However, with increasing demand, serious concerns about its quality and safety have arisen subsequently. The chemical and microbiological qualities of packaged water of some manufacturers have been found to be in violation of National standards. Therefore the need to investigate the shelf life of some common bottled water sold in Oko, Anambra state.

MATERIALS AND METHOD

Sample Collection

Five brands of bottle water were bought from open shops in Oko and taken to the laboratory within 24 hours for analysis. The bottled water were kept on the bench and examined for 3days (Day 1 Day5 and Day10). All samples will be tested prior to the expiration specified by the manufacturers. Prior to the microbiological

testing samples were taken to the laboratory.

Microbiological analysis

Microbiological tests will be carried out in microbiology Laboratory Federal Polytechnic Oko. The procedures were carried out on the first day of collection then repeated on Day 5 and Day 10

Enumeration and isolation of total and faecal *coliform*

Total *coliforms* were estimated using the most probable number (MPN) method. MacConkey's lactose bile salt broth with bromocresol purple as indicator was used for the presumptive tests. With a sterile pipette, 50ml of each of the water sample was aseptically dispensed into 50ml double strength broth, another 10ml of the sample into each of the five tubes containing 10ml double strength broth and another one ml of the sample was then inoculated into each of the second five culture tubes containing 5ml single strength MacConkey broth with Durham's tubes. Inoculated tubes of MacConkey broth were incubated at 37°C for 24 to 48 hours. After 24-48 hours of incubation, the cultures were observed for the presence of acid production and gas formation. Reference to Mc Crady's table showed the most probable number (MPN) of presumptive *coliform* counts in 100ml of the sample water analyzed. A sterile pipette was used to transfer 1ml of the culture from the positive presumptive fermentation tubes into tubes containing 5ml brilliant green lactose bile broth aseptically and incubated for 24-48 hours at 37°C. Following incubation, culture positive tubes were inoculated into MacConkey agar for total *Coliform* and Eosin Methylene Blue agar for faecal *coliform* and incubated at 37°C and 44°C respectively.

3.3.2 Determination of heterotrophic plate count/ total viable count

Heterotrophic plate count of all water samples were determined using dilution plate method technique and standard plate

count agar medium. Serial dilutions were prepared (using peptone water) and 1 ml of the sample or dilution was transferred to a sterile, empty petri dish. Plate count agar was melted by heating in boiling water and then allowed to cool in a water bath to 44 - 46° C. Approximately 15 ml of the agar medium was poured into the petridish containing the sample. The sample and agar were mixed thoroughly by rotating the plate several times. When the media has solidified, the plates were inverted and incubated at 35 °C for 48 to 72 hours. Following the appropriate length of incubation, suitable plates from different dilutions were selected and the visible colonies were counted using a colony counter. Then the average colonies were counted and expressed as colony forming unit per ml of water.

Isolates were further identified using appropriate biochemical test.

3.4 Identification of isolates

Representative isolates from total coliforms and total viable counts were identified. Standard isolation techniques were employed. MacConkey agar was used to isolate lactose fermenting gram negative bacilli and Mannitol salt agar for the isolation of salt resistant bacteria. Pure isolated colonies were Gram differentiated and then biochemically identified using Indole, Catalase, Citrate, Oxidase, Coagulase and Urease tests.

RESULTS

Three of the bottled water samples had PH which lies within the acceptable PH standard for drinking water which is 6.5 to 8.5 recommended by WHO as a guideline value (WHO, 2008) as seen on Table 1 on and sample III attained the range after 10 days as a result of reduction reaction.

Table 1: PH of Bottled Water Samples

No	Day1	Day5	Day10
I	6.60	6.60	6.80

II	5. 80	5.80	6.30
III	6. 20	6.20	6.50
IV	6.50	6.50	6.50
V	7.40	7.40	7.80

The five (5) bottled water samples examined in this study were all positive for the presumptive, confirmatory and complete test. The contaminants were found to be *Staphylococcus aureus* and *Escherichia coli* from the biochemical test.

The lowest Total bacteria count was for sample IV with 4.6 x 10^2cfu/ml on Day 1 as shown on Table 2. The Total bacteria count for all the water samples increased after day 10 on the shelve as seen on Table 2.

Table 2: Total Bacteria Count (cfu/ml)

Sample	Day1	Day5	Day10
I	4.6 x 10^4	8.4 x 10^3	4 .9 x 10^3
II	6.3 x 10^5	3.5 x 10^3	7.8 x 10^3
III	3.5 x 10^4	4.7 x 10^4	8.2 x 10^4
IV	4.6 x 10^2	5.2 x 10^2	6.3 x 10^2
V	8.4 x 10^3	6.8 x 10^5	7.8 x 10^4

The lowest coliform count was 5.2 x 10 cfu/ml for sample IV and highest was 3.6 x 10^3 cfu/ml for Sample I on Day10 as shown on Table 3. The total coliform count increased steadily on Day 5 and day 10. Sample IV had the least Total Bacteria count and Total Coliform count after 10 days in the shelve so can be said to have the best shelve life from this study.

Table 3: Total Coliform Count (cfu/ml)

Sample	Day 1	Day 5	Day 10
I	2.8 x 10^3	2.4 x 10^3	3.6 x 10^3
II	3.6 x 10^2	4.3 x 10^2	6.5 x 10^2
III	4.4 x 10^2	6.4 x 10^2	4.8 x 10^2
IV	5.2 x 10	2.3 x 10^2	5.6 x 10^2
V	6.8 x 10^2	3.7 x 10^2	3.9 x 10^2

Table 4: Total Staphylococcus Count (cfu/ml)

Sample	Day 1	Day 5	Day 10
I	5.2 x 10^5	4.5 x 10^6	3.4 x 10^7
II	6.8 x 10^4	5.2 x 10^4	8.4 x 10^5
III	7.4 x 10^4	3.6 x 10^6	5.6 x 10^5
IV	4.6 x 10^6	4.4 x 10^6	3.8 x 10^7
V	4.7 x 10^4	2.5 x 10^6	7.2 x 10^6

Discussion

The physical and bacteriological state of packaged water is a very important aspect that should be observed by all the packaging companies. The result from this study showed that all the bottled water samples were contaminated with *Staphylococcus aureus* and *Eschenchia coli*. *Staphylococcus aureus* is seen in water due to poor hygiene or poor handling because *Staphylococcus aureus* is a normal flora on human palms or skin while *E. coli* is recovered from the water as a result of faecal contamination or the water is faecally populated but no contamination with *Salmonella spp*. according to the national industrial standard and WHO standard (NIS, 2007, WHO, 2008). Most of the bottled water samples were within the acceptable PH range for drinking water.

The total bacterial count result of the bottled water were high, exceeding the acceptable range of 1.0 x10^2 CFU/ml recommended by E.P.A and W.H.O which is the standard limit of total bacteria count for drinking water (E.P.A, 2002; WHO, 2008). Sample IV had the least TBC and TCC after ten(10) days on the shelve, hence can be said to have the best microbiological quanlity.

This study is similar to a work by Onweluzo and Akuagbazie (2010), on bottled water

sold in Nsukka 88% of the sample had coliform count above the permissible range (NSDQW, 2015, E.P.A., 2002; WHO, 2008).

In another study Ojekunle and Adeleke (2017), on bottled water sold in Ibadan coliform bacteria was absent until the third week of study.

However this study was done on samples collected from the point of sale contamination could have resulted from handling and place of storage, hence it is imperative that the hygiene of the place of storage and shelves be considered when storing water.

The complete process of drinking water production, packaging and storage should be properly regulated.

Conclusion

Sampled water bottles were all contaminated as a result of poor handling and faecal contamination, therefore it is advised that the bottled water handlers should observe proper hygiene when handling bottled water; especially washing of their hands before working on bottled water and also disinfection of storage bench..

Recommendation

It is recommended that there is need for continuous water quality monitory and steady sanitation in water production plants. There is also need for NAFDAC to intensify in the routine monitorimg of activities in the packaged drinking water industries. The safety of bottled water should be ensured through comprehensive regulatory programs at both federal and state level. NAFDAC regulations for bottled water should be protective of public health and there should be continuous adoption of packaged water quality standards. The used appropriate treatment processes should therefore be utilized for production of quality and safe bottled drinking water. It is also recommended that

there is great need for further research studies on the storage of bottled water.

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