*Special Conference Edition, November, 2017*
http://dx.doi.org/10.4314/bajopas.v10i1.29S

*Bayero Journal of Pure and Applied Sciences, 10(1): 142 - 145*
**ISSN 2006 – 6996**

# AN ASSESSMENT OF THE MICROBIOLOGICAL QUALITY OF SOME BOTTLE WATER SOLD IN KANO METROPOLIS, NIGERIA

**[1]*Iliyasu, H.,[2]Abdullahi, B.A. and [3]Kawo, A.H.[1]**
Department of Science Education (Biology), Kano University of Science and Technology, Wudil, Nigeria
[2]Department of Biological Science, Bayero University, Kano, Nigeria
[3]Department of Microbiology, Bayero University, Kano, Nigeria
*Correspondence author: hwiliyasu@gmail.com 08065579204

***ABSTRACT***
***Bottled water like any drinking water used for human consumption should be safe and of standard quality to ensure adequate public health significance. The aim of the study is to assess the quality of some bottle water sold in Kano Metropolis and compare the result with some national and international standards. Studies on the microbiological parametric standards, was conducted. A total of 40 samples comprising of 4 different brands were randomly selected using stratified sampling techniques from different sites of Kano metropolis in northern Nigeria. Samples were analyzed for the presence of bacterial indicators of water quality using pour plate and MPN techniques. The result of Total aerobic Plate counts (APC) ranged from $2.06x10^2$ -$3.8x10^2$ cful/ml of the entire brand. All the bottled water brands had a mean (APC) greater than 100cfu/ml of bottled water standard. Total coliform and Eschericia coli were detected in two brands and were above the zero cfu/ per 100milliter of bottled water standard. No pathogenic bacteria were isolated except for Staphylococcus. Effective implementation of WHO water safety plans from the catchment source to the consumer through campaign awareness can reduce level of exposure to stake holders to protect and store bottle water against sunlight exposure, chemicals and cleaning reagents.***
***Key words: Quality, Bottled water, Kano Metropolis***

## INTROODUCTION

The safety perceptional rising trend of bottle water consumption over the last decades in Kano metropolis, Nigeria, cannot be over emphasized only when all hands are put on deck to provide bottle water of safe quality standards for human consumption. Safe drinking water as observed by Kudesia and Ritu (2003) and Wegner *et al*. (2008) as an essential element for providing aesthetic and intellectual stimulation that lift the human spirit and improve health to human society; there by saving 1.8 million lives daily from incidence of water borne infections WHO(2011).

Literally bottled water can be defined as "any portable water that is treated of sanitary quality and intended for public consumption, bottled, distributed and offered for sale" (WHO, 2004 ; 2011) . However, it can be simply referred to as water from some source (natural springs, wells , boreholes , municipal systems) that a company has placed in plastic bottles, vessels, cans, laminated boxes ; ranging from sizes of single serving to large carboys holding up to 80 liters resale for consumption Magda *et al*. (2008).

Globally, in the wake of several major outbreaks involving food and water, there is a growing concern for the safety and quality of drinking-water. While bottled water is widely available in both industrialized and developing countries, empirical studies have shown that, the qualities of some bottled waters sold are not fit for human consumption. Sasikaran *et al*. (2008)

Waterborne diseases remain a major hazard in many parts of the world and are contacted by drinking water that contains pathogenic organisms, usually due to faecal contaminations. Consumption of water contaminated by disease causing agents of pathogens, toxic chemicals as reported by Wegner *et al*. (2008) can cause health problems such as diarrhea, cholera, typhoid fever, dysentery, skin diseases and cancer.

Water quality as a concept means water that has a pleasing taste and appearance obtained from a self- purifying source, not polluted with contaminants and safe to drink (Barbara and Hudson, 1997). The quality of water is most frequently used by reference to set of standards against which compliance can be assessed.

The quality of bottle water can substantially vary among brands as well as with time, with different production runs depending on its source, treatment technology, manufacturing operations, personal hygiene practices and shelf life before use. (Magda *et al*., 2008; Liee, 2011). It is against this background that, the paper is aimed at analyzing samples of bottle water sold within Kano metropolis, assessing its microbiological quality and comparing the result with some national and international standard through survey design and laboratory experiment.

**METERIALS AND METHODS**

A total of 40 bottle waters from 4 different brands were collected fortnightly for six months. All the samples collected were processed and analyzed using standard methods within 6hours of collection (WHO, 2004; APHA, 2005).

**Microbiological Assessment of Water Sample**

Standard method of microbiological analysis of water was used to enumerate, isolate and characterize some microorganisms of public health significance. Aerobic mesophilic bacterial count (APC) was determined by pour plate method and cultured at $37^0$C for 24-72hours as described by Kudesia and Ritu (2003) and APHA (2005). Microorganisms' identification and Coliform enumeration was assessed as described by Atlas (1997) Barbara and Hudson (1997) Burton and Michael (1999). Detection and isolation of Pathogenic bacteria was determined according to the method described by (WHO, 2004; APHA, 2005)

**RESULTS**

**Bacterial Load and Identified Microoganisms**

The result of bacterial laod as shown in (Table 1) below indicated that, Brand A had the highest aerobic mesophilic count of $3.8x10^2$ cfu/ml while brand B had the least aerobic mesophilic count of $2.06x10^2$ cfu/ml; however, the aerobic mesophilic count for all the brands of bottled water were higher than the WHO (2011) and NAFDAC (2004) of 100 CFU/ml of bottled drinking water standards. On the other hand, coliform count of sample brand A and C were found to be higher in the range of <1.8-9.3) while sample B and D were found to be within the limit <1.8 respectively. So also, 5% of the total samples exceed the 0 cfu/100 ml of excellent treated bottled water. *E. coli* and *Staphylococcus* spp. was identified in brand A while *Klebsiella* spp. and *Staphylococcus* spp. were detected in brand C

**TABLE 1: Microbial Count (Cfu/Ml) and Identified Microorganism of Bottled Water Samples**

| Brands | APC | CC | *E. coli* | *Salmonella* | *Shigella* | *Staphylococcus* | *Enterobacter* | *Klebsiella* |
|---|---|---|---|---|---|---|---|---|
| | (Cfu/ml) | (MPN/ml) | | | | | | |
| A | $3.8X10^2$ | <1.8-9.3 | + | - | - | + | - | - |
| B | $2.06X10^2$ | <1.8 | - | - | - | + | - | - |
| C | $3.25X10^2$ | < 1.8-6.8 | - | - | - | + | - | + |
| D | $2.55X10^2$ | <1.8 | - | - | - | + | - | - |
| WHO/NAFDAC Standard | $1.0x10^2$ (100CFU/ml) | 0 (zero) | | | | | | |

KEY: CC: Coliform Count; MPN: Most Probable Number; APC: Aerobic Plate Count

**Mean Microbiological Parameters of Bottled Water Sample**

The result of the mean microbiological parameters of bottled water (Table 2) showed that, no coliform of feacal origin was isolated at the time of the study. All brands exhibit insignificant load of *Staphylococcus* spp. in the range of $0.4x10^1$cfu/ml - $1.0x10^1$cfu/ml.

**Table 2: Means of Microbiological Parameters of Bottled Water Samples**

| Sample Brand | APC (Cfu/ml) | CC(MPN/100ml) | *Feacal coliform* | *Salmonella* | */Shigella* | *Staphylococcus* |
|---|---|---|---|---|---|---|
| Brand A | $3.8x10^2$ | <1.8-9.3 | Nil | 0 | 0 | $1.0x10^1$ |
| Brand B | $2.06x10^2$ | <1.8 | Nil | 0 | 0 | $0.8x10^1$ |
| Brand C | $3.25x10^2$ | <1.8-6.8 | Nil | 0 | 0 | $0.4x10^1$ |
| Brand D | $2.55x10^2$ | <1.8 | Nil | 0 | 0 | $0.4x10^1$ |
| WHO/NAFDAC Standard | $1.0x10^2$ (100) | 0 (zero) | 0 (zero) | 0 (zero) | 0 (zero) | n/a |

**Key**:
APC= Aerobic Mesophilic count
CC= Coliform count; MPN= Most Probable Number
n/a = Not available

**DISCUSSION**

The aerobic mesophilic count in all the sampled brands exceeded the 100 colony forming unit of bottled water standard of WHO/ NAFDAC (2004). High aerobic mesophilic bacterial count might be as a result the normal flora of the water source as well as inadequate bottled water treatment for example, failure of ozonation or ultraviolet radiation (UV) of equipment and water disinfection method and poor hygienic condition of the water handlers along the channels of distribution. Poor storage of water at longer duration of elevated temperature by retailers can also increase the re-growth of the microorganisms. Bottled water may be in distribution at elevated temperature and poor storage condition for several weeks which may adversely affects its quality. Similar studies conducted by Magda *et al*. (2008) in Egypt, Liee (2011) in South Africa, Oyedeji (2012) in Ile Ife, Nigeria, Sasikaran *et al*. (2012) in Sri Lanka as well as Timilshina *et al*. (2012) in Kathmandu , all recorded high Aerobic Mesophilic Count range that exceeded the 100cfu/ml standard of bottled drinking water as recorded by the researcher.

Coliform count of 5% from brand A and C above the zero permissible limits was found to be unfit for human consumption as it exceeds the 0 cfu /100ml of excellent treated bottled water. Contamination might be as result of normal flora as well as poor storage on the parts of the water handlers due to stock rotation along the channels of distribution, colonization by microorganisms of bottling plant equipment's as rubber seals, lining or coating, washers and even disinfection soaps may provide nutrients for these organisms. Liee (2011). Moreover, a parallel analysis carried out in the National reference laboratory in 2014 using membrane filtration technique revealed a coliform count of 56cfu/ml. The presence of indicator organisms is an indication of recent feacal pollution which renders the water unfit for human consumption. Presence of *Staphylococcus* spp. in water samples was so insignificant to cause disease as there was no evidence of transmission through the consumption of such water (LeChevallier and Seidler, 1980). Similar studies conducted by Magda *et al*. (2008) in Egypt recorded total coliform above standard. The result of Liee (2011) in South Africa differs from that of the researcher in terms of total colifom but was in line with the result of this work as no coliform of feacal origin was detected in all the sample brands. Oyedeji , (2012) in Ile-Ife, Nigeria detected total coliform and *E. coli* in only one brand and this was in line with the result of this work. Sasikaran *et al*. (2012) in Sri Lanka found that 14 (9%) out of the 22 bottle water brands were unfit for human consumption as they contain feacal count of either *E. coli* or *Staphylococcus* exceed the WHO standards. Timilshina *et al*. (2012) Kathmandu valley, recorded ranges above the WHO 100cfu/ml standard in bottled drinking water.

**CONCLUSION AND RECOMMEDATIONS**

In conclusion, high aerobic mesophilic bacterial and coliform counts which were found to be above standard might render the bottled water unfit for human consumption. It is recommended that research should be conducted on the raw water source as the number of bottled water companies are on the increase.

**REFERENCES**

APHA, (2005) : Eaton, A.D. Clesceri , L. S . , Rice, E. W. and Greenberg, E. A. (eds.) : Standard Methods for Examination of Water and Waste Water 21st Edition Washington D.C 20001- 3710 .

Atlas, R. M. (1997). Principles of Microbiology 2nd Edition: Printed by Win. C. Brown Publishers: 2460 Ker per Blud , USA America.

Barbara, K. and Hudson, M. T (ASCP), CLS (1997) Explorations in Microbiology: A discovery based Approach: Montana State University Prentice Hall Upper Saddle River, New Jersey 07459.

Burton, E.P. and Michael, J. L., (1999) Exercise for the Microbiology Laboratory Morton Publishing Company 925W, Kenyon Ave., Unit 12 Eaglewood, Colorado 8011: Pp. 176. http://www.morton-pub.com.

Kudesia , V.P and Ritu , J. (2003) . Water Pollution: (Principles of Disinfection of Drinking Water and its Analysis) 5th Edition. Published by K. T. Mittal for Pragati Prakashan; Printed at Rat Printers, Meerut: pp. 738.

LeChevallier, M.W and Seidler R.J. (1980) . *Staphylococcus aureus* in rural drinking-water: *Applied and Environmental Microbiology*, 39:739–742.

Liee, Y. L. (2011): Is shell life of bottled water a cause for concern? *Thesis in Masters* in Technology: Faculty of Applied and Computer Science, Val University of Technology. (VUT)

Magda , M.A. AbdulEl-Salam, Engy, M.A., ElGhitany, and Muhammad, M.M. Kassem, (2008). Quality of Water bottle brands in Egypt and Biological Water examination. Institute of Public Health: Alexandria University, Egypt. .

NAFDAC, (2004) . Guide lines for Registration of Packaged Water in Nigeria. National Agency For Drug Administration Control: Decree no. 20 of 1999.

Oyedeji , O. Olutiola , P .O. and ,Moninuola , M . A. (2012) . Microbiological Quality of Packaged Drinking Water Brands Marketed in Ibadan Metropolis and Ile-Ife City in Southwest Nigeria Department of Microbiology; Obafemi Awolowo, University, Ile-Ife Nigeria *Microbiology Research* vol. **4** (2) : 096-102

Sasikaran , S . , Sritaran, K., S. Balakuna and V. Arasoratnam. (2012).Physical, Chemical and Microbiological Analysis of Bottled Drinking Water Sold in Jaffna Peninsula in Sri Lanka: Ceylon *Medical journal* 09/2012**57**(3):111.6.**Doi:10.4038/cmj. v57i3, 4149.** Source**:** Pub Med**.**

Timilshina , M. Dahal , I and Thapa , B.(2012).Microbial Assessment of Bottled Drinking Water Of Kathmandu Valley: *International Journal Infective Microbiology*; **1**(12);84-86:Genesis Laboratory Research Kathmandu Nepal: Kathmandu Medical College; Katmandu, .Nepal.

Wegner, I., Marsalek , J and Breil , P. (2008).Aquatic Habitat in Sustainable Urban Water Management Science Policy and Practice: *Urban Water Series* Vol.4, Published Jointly by UNESCO, Taylor and Francis Group 7 Place de Fonteyn 75007 Pans France: pp. 32-46.

WHO, (2004).Guide lines for Drinking Water Quality, 3rd Edition, Geneva; Available at http://www.who.int/water-sanitation-health/dwq/en: (Last accessed January, 20

WHO,(2011). Guide lines for Drinking Water Quality, fourth Edition; Geneva: Available online At http://wholipdoc.who.int/publication/ 2011/9789241548151-eng.pdf.Assessed: (Last assessed on 25th March, 2012).