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Research Paper

Assessment of Some Commonly Consumed Bottled and Sachet Water in University of Agriculture Makurdi Benue State Nigeria by Microbiological Investigation

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Abstract: *This study investigated the portability of ninety (90) samples each of bottled and sachet water samples from six different manufacturers labelled A to F (bottled water) 15 each and A1 to F1 (sachet water) 15 each .The water samples were selected randomly from various shops within University of Agriculture, Makurdi , Nigeria. The samples were analysed microbiologically using spread plate technique, while physical examination was done by perception with the sense organs. All the samples examined physically were colourless, odourless, and tasteless and contained no visible particles. The most probable number (MPN)/100 ml in samples A, B, C, E, F, B1, C1 and F1 were zero (0) while that of samples D, A1, D1 and E1 were IMPN/100ml each. Klebsiella spp, Pneumococcus spp, Staphylococcus spp and Salmonella typhimurium (A and B) were found not to be prevalent in any of the bottled water samples. Escherichia coli (E. coli) were isolate in sample D. In sachet water samples A1, D1 and E1, Pneumococcus spp, Klebsiella spp and E. coli were isolated. Bottled water samples A, B, C, E and F were portable. Also, bottled water sample D and sachet water samples A1, D1 and E1 were found to be contaminated. There is need for caution in the consumption of commercial bottled and sachet water samples because of the implication on public health.*

Keywords: Coliforms, Portability, Microbial screening, Water samples.

1.0. Introduction

In many underdeveloped countries, provision of portable water has become a serious problem to families and communities. Water is the most widespread natural resources and may be regarded as the second most important necessity of man (Ude *et.al*, 2012). Increase in human population has exerted an enormous pressure on the provision of safe drinking water especially in developing countries (Edberg *et.al*, 2000). Unsafe water is a global public health threat (Maduka *et.al*, 2014a and Maduka, 2005), placing persons at risk for a host of diarrhoea and other diseases as well as chemical intoxication (Edberg *et.al*, 2000).

Water borne related diseases continued to be one of the major health problems globally (Oladipo et.al, 2009). The high prevalence of diarrhoea among children and infants can be traced to the use of unsafe water and unhygienic practices (Tortora *et.al*, 2002). The cost of processing of quality municipal water services in Sub-Saharan countries, especially in the developing countries of West Africa including Nigeria, is enormous resulting in decreased production for the common masses. Most public water boards charged with the responsibility of providing potable water for the populace have also seized to function in the discharge of their duties. The consequence of this abject neglect is the outburst of local factories involved in the production and packaging of various forms of water samples. It is worse in schools, colleges and higher institutions. For this reason, these researchers had examined some of the water samples consumed in an institution of higher learning in another region of the same country, South East (Maduka *et.al*. 2014a) with a view to clarifying them for safety.

Water which has a chemical formular "H_20" is one of the most abundant compounds required by all living organisms for healthy growth. Good quality water is odourless, colourless, tasteless and free from faecal pollution (Shilklomanov, 2000). The microbiological quality of table water is of utmost importance. Hence, this work was aimed at assessing the microbiological quality of commonly consumed bottled and sachet water in University of Agriculture, Makurdi, Benue State, Nigeria.

2.0. Materials and Methods

2.1. Collection of Samples

A total of ninety (90) bottled and sachet water samples each, were obtained from six different manufacturers labelled A to F(15 each) for bottled water and A1 toF1(15 each)for sachet water selected at random from different shops within University of Agriculture, Makurdi, Benue State, Nigeria. These are common places people within the university community purchase water for drinking. The above water samples were taken to the Microbiology laboratory in University of Agriculture, Makurdi, Benue State, for various microbiological analysis. The microorganisms analysed include; *Klebsiella spp*, *Pneumonia spp*, *Escherichia coli*, *Pneumococcus spp*, *Staphylococcus spp* and *Salmonella typhimurium*.

2.2. Physical Examination of Water Samples

The water samples were examined for colour, taste, odour and presence of particles. These were determined by perception with the sense organs upon opening the samples.

2.3. Culture Media Preparation

The culture media used were nutrient agar, cled agar and chocolate agar, which were prepared according to the manufacture's specifications.

2.4. Microbiological Analysis

All microbiological analysis was done using the standard methods as was described by Chessbrough (2000).

3.0. Results

The results of the physical examination of the bottled and sachet water samples are presented in table 1, while those of microbiological examinations are presented in tables 2 and 3. The microbiological analysis carried out includes the most probable number (MPN), microbial screening and coliform count. Physical examination carried out showed that all the water samples (A to F1) were colourless, odourless, tasteless and contained no visible solid (Table 1). The most probable number (MPN) of six different bottled and sachet water samples labelled A to F1 were shown in tables 2. The MPN for samples A1, D1, and E1 were 1/100ml each. The results of the microbial screening showed that no microbial species was isolated in samples A, B, C, E, F, B1, C1 and F1. The number of *E.coli* detected was 2 and 7(Table 3) in samples A1 and E1, while *Pneumococcus spp* was 5 and 6 in samples A1 and E1 (Table 3). Also, Coliform was detected in samples A1, D1, and E1, while *Klebsiella spp* was only detected in sample D1. The results showed that *Staphylococcus spp* and *Salmonella typhimurium* (A and B) were not present in any of the samples, suggesting that the water samples used in this work may not be sources of typhoid infection while at the same time passing all the physical examination tests of odourless, colourless, tasteless with no physical particles.

Table 1: Physical examination of the six different bottled and sachet water samples labelled A to F1

Sample	Colour	Odour	Taste	Presence of particles
A	Colourless	Odourless	Tasteless	None
B	Colourless	Odourless	Tasteless	None
C	Colourless	Odourless	Tasteless	None
D	Colourless	Odourless	Tasteless	None
E	Colourless	Odourless	Tasteless	None
F	Colourless	Odourless	Tasteless	None
A1	Colourless	Odourless	Tasteless	None
B1	Colourless	Odourless	Tasteless	None
C1	Colourless	Odourless	Tasteless	None
D1	Colourless	Odourless	Tasteless	None
E1	Colourless	Odourless	Tasteless	None
F1	Colourless	Odourless	Tasteless	None

Standard limit: Colourless, Not offensive, Tasteless, No visible particles

Table 2: Results of the most probable number of the six different bottled and sachet water samples labelled A to F1

Sample	10ml	1.0m	0.5ml	MPN/100ml
A	0	0	0	00
B	0	0	0	00
C	0	0	0	00
D	1	0	0	1.0
E	0	0	0	00
F	0	0	0	00
A1	1	0	0	1.0
B1	0	0	0	00
C1	0	0	0	00
D1	1	0	0	1.0
E1	1	0	0	1.0
F1	0	0	0	00

Most probable number (MPN) gives an approximate number of Coliforms in a water sample based on theory of probability. Values are mean of fifteen samples each.

Table 3: Results of microbial screening of six different bottled and sachet water samples labelled A to F1

Microorganism	A	B	C	D	E	F	A1	B1	C1	D1	E1	F1
Total coliform	0	0	0	2	0	0	5	0	0	3	12	0
Klebsiella spp	0	0	0	0	0	0	0	0	0	3	0	0
E.coli	0	0	0	2	0	0	0	0	0	0	7	0
Pneumococcus spp	0	0	0	0	0	0	5	0	0	0	6	0
Staphylococcus spp	0	0	0	0	0	0	0	0	0	0	0	0
Salmonella typhimurium (A&B)	0	0	0	0	0	0	0	0	0	0	0	0

Values are mean of fifteen samples each.

4.0. Discussion

The physical examination carried out on the six different bottled and sachet water samples commonly sold and consumed in University of Agriculture, Makurdi, Benue State, showed that all the water samples were colourless, odourless, and tasteless and contained no visible particles. The above parameters are used in the preliminary examination of table water. These findings are supported by the report of Shilklomanov (2000). The most probable number (MPN) of the water samples. A, B, C, E, F, B1, C1and F1 which was zero (0), suggesting the absence of coliform in these samples. In samples D, A1, D1 and E1, the most probable number was 1 MPN/100 ml each. This suggested that

Coliform bacteria were present at 1MPN/100ml in the above samples. This result was in line with *Maduka et.al*, (2014a, 2014b), Oladipo *et al*,(2009) and Adekunle *et.al*, (2004).

Results of microbial screening carried out on the six different bottled and sachet water samples labelled A to F1 showed that only *E. coli* was present in sample D at 2 coliform count/100 ml. *E. coli*, *Klebsiella spp*, and *Pneumococcus spp*, which were detected in samples A_1 D_1 and E_1 suggested that there would have been faecal contamination. The total bacteria count for these bacteria which were 3, 7, 5, and 6/100 ml respectively for samples A1,D1, and E1, may be an indication of contamination of these samples by *E. coli*, *Klebsiella spp* and *pneumococcus spp*. The above findings were supported by the reports of Edberg *et al*, (2000) and Maduka *et al*, 2014a, b). The contaminations though not very significant call for caution in the preparation and consumption of commercial water samples.

However, the presence of *E. coli* in samples D, and E1 may be suggesting the presence of contaminants of faecal origin. *E. coli* has been considered to be the species of Coliform bacteria that is the best indicator of faecal pollution and the presence of pathogens (Edberg *et al*, 2000, Shilklomanov, 2000). According to WHO(1997), *E. coli* count should not exceed 5 *E. coli* count per 100 ml, otherwise investigation should be made on the equipment used for production, water system and the cause of contamination. Based on WHO guideline for drinking water, samples A, B,C, E, F, B1, C1 and F1, having zero (0) coliform count per 100 ml belonged to excellent category while sample D, having less than 3 coliform count per 100ml belonged to satisfactory grade(WHO,1997, 2004). Sample E1, having 12 coliform counts per 100 ml is classified as unsatisfactory and therefore unfit for drinking. Ten (10) coliform counts per 100 ml of sample is classified unsatisfactory and unfit for use (WHO, 1997, 2004). Sample E1, having coliform count of 7 coliform count per 100 ml is classified as intermediate since it is less than ten (10) coliform count per 100ml(WHO,1997,2004).

This study may be suggesting that bottled water samples A, B, C, E, and F were fit for consumption since they were found to be in excellent category. Sachet water samples B1 C1 and F1 were also found to be fit for consumption. Sachet water samples E1 may be unfit for consumption since it belonged to unsatisfactory category while the sachet water samples A1, D1 and bottled water sample D were found to have traces of contamination though they do not belong to unsatisfactory category.

4.1. Conclusion

Since a few of the water samples assessed were shown to have traces of contamination, caution should be exercised during production and consumption of commercial table and sachet water. The facilities and methods used in the production and processing of the water samples for public consumption should therefore, be handled with utmost care.

References

[1] L.V. Adekunle, M.K.C. Sridhar, A.A. Ajayi, P.A. Olawuyi and J.F. Olawuji, Assessment of the health and social economic implications of sachet water in Ibadan, Nigeria: A public health challenge, *Afr.J. Biomed. Res*, 7(2004), 5-8.

[2] M. Chessbrough, Medical Laboratory Manual for Tropical Countries (3rd ed.), Tropical Health Technology and Butterworth, London, 2000.

[3] S.C. Edberg, E.W. Rice, R.J. Karlin and M.J. Allen, Escherichia coli: The best biological drinking water indicator for public health protection, *J. App. Microbial*, 88(2000), 1068-1168.

[4] H.C.C. Maduka, Water pollution and man's health, *The Internet Journal of Gastroenterology*, 4(1) (2005), 1-10.

[5] H.C.C. Maduka, N.C. Chukwu, C.E. Ugwu, C.C. Dike, A.N. Okpogba, P.N. Ogueche and A.A. Maduka, Assessment of commercial bottled table and sachet water commonly consumed in Federal University of Technology, Owerri (FUTO), Imo State, Nigeria, using microbiological indices, *10SR –J. Dental and Medical Sci*, 13(2014a), 86-89.

[6] H.C.C. Maduka, O.R. Onuorah, A.N. Okpogba, C.E. Ugwu, P.N. Ogueche, C.C. Dike and A.A. Maduka, Assessment of some commercial fruit juices commonly consumed in Federal University of Technology – Owerri (FUTO), by microbiological indices, *10SR – J. Pharm. Biol Sci*., 9(2014b), 56-58.

[7] I.C. Oladipo, I.C. Onyenike and A.O. Adebiyi, Microbiological analysis of some vended sachet water in Ogbomoso, Nigeria, *Afr. J. Fd. Sci*, 3(2009), 406-412.

[8] I.A. Shilklomanov, Appraisal and assessment of world water resources, *Water International*, 25(2000), 11-32.

[9] J.G. Tortora, R.B. Funke and L.C. Case, Microbiology: An Introduction (7^{th} ed.), Daryl Fox, (2002), 28-260.

[10] V.C. Udeh, E.I. Akubugwo and F.O. Uhegbu, Biochemical impact of selected well water sources at Ishiagu on liver and kidney of albino rats, *World J. Sci. Technol*, 2(2012), 52-55.

[11] WHO, International Standard for Drinking Water (3^{rd} ed.), WHO, 1211, Geneva 27, Switzerland, 1997.

[12] WHO, Guidelines II for Drinking Water Quality, WHO, 1211 Geneva 27, Switzerland, 2004.