ORIGINAL ARTICLE

MICROBIOLOGICAL ANALYSIS OF WATER SOLD BY WATER VENDORS "MAI-MOYA" WITHIN MAIDUGURI, NORTH EASTERN NIGERIA.

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ABSTRACT

Background: Water makes life possible on earth for all living organisms. It is next to air in importance for human existence. All living organisms require a wide variety of inorganic compound for growth, repair, maintenance, and reproduction. Currently, the emergence and proliferation of water vendors using carts with multiple jerry cans in Maiduguri Metropolis is an issue of concern in Public health sectors.
Objectives: The study aimedat ascertaining the microbiological quality of water supplied in jerry cans by vendors in Maiduguri Metropolis.
Methods: Bacteriological analysis was done using multiple tube fermentation technique and parasitological analysis was done using formol-ether concentration technique.
Results: Twenty six samples each of dams and water in jerry cans were analysed microbiologically using multiple tube fermentation test and direct wet preparation using Formol-ether concentration technique. The bacteria encountered were Escherichia coli, Klebsiella specie, Proteus specie and Coliform. Parasites encountered were cysts of Entamoeba histolytica, Ova of Hookworm and Giardia intestinalis respectively.
Conclusion: Regulatory agencies (both governmental and non-governmental) should intensify their efforts towards providing clean and portable water to the public.

KEYWORDS: Microbiological analysis, water vendors, Maiduguri, North-eastern, Nigeria.

INTRODUCTION

Water makes life possible on earth for all living organisms. It is next to air in importance for human existence. All living organisms require a wide variety of inorganic compounds for growth, repair, maintenance, and reproduction. Water is one of the most important, as well as one of the most abundant of these compounds and it is particularly vital to living organisms[1]. The importance of water to life on earth particularly human becomes clearer when one considers its role, or usefulness in various aspects of human endeavours. Even though a lot of resources are being spent for the supply of clean and potable drinking water all over the world, achievement of this aim is still facing serious plight in Nigeria[1].

Currently, the emergence and proliferation of water vendors using carts with multiple jerry cans in Maiduguri Metropolis is an issue of concern in public health sectors especially with common incidence of enteric diseases like typhoid fever, cholera, and dysentery.

Water that has been contaminated by faeces may contain pathogens and transmit serious diseases. Faecal contamination is most commonly detected by assaying water for the presence faecal coliforms, predominantly *Escherichia coli*. The only natural habitat of these bacteria is the intestine of humans and other mammals[2].

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Their presence in water however, indicates faecal contamination and thus the possible presence of water-borne pathogens [2]. It was also observed that a wide variety of microorganisms pathogenic to human beings are transmitted through contaminated water[3]. According to WHO[4]some 300,000 people die every day from water related diseases like typhoid and paratyphoid fever, cholera, bacillary dysentery and gastroenteritis.

In many developing countries, availability of water has become a critical and urgent problem and it is a matter of great concern to families and communities depending on non-public water supply system[4]. Increase in human population has exerted an enormous pressure on the provision of safe drinking water especially in areas of developing countries[5]. Unsafe water is a global public health threat, placing persons at risk for diarrheal and other diseases as well as chemical intoxication[6].

The microbiological quality of drinking water is a concern to consumers, water suppliers, regulators and public health authorities. The potential of drinking water to transmit microbial pathogens to great number of people causing subsequent illness is well documented in many countries at all levels of economic development[7]. The number of outbreaks that have been reported throughout the world demonstrates that transmission of pathogens by drinking water remains a significant cause of illness. However, estimate of illness based solely on detected outbreaks is likely to underestimate the problem. A significant proportion of water-borne illnesses are likely to go undetected by the communicable diseases surveillance reporting system[8]. Nearly 90% of diarrheal-related deaths have been attributed to unsafe water or inadequate water supplies and sanitation condition affecting a large part of the World's population[9]. An estimated 1.1billion persons (one sixth of the World's population) lack access to clean water and 2.6 billion to inadequate sanitation[9,10]. In the microbial World, no single microorganism has been discovered to be active at the extreme lack of water for the single reason that man can't exist without water, it is of paramount importance to monitor domestic water supply[11].

Therefore, in order to substantiate the nation's effort to provide and ensure the provision of safe drinking water, this study was conducted with the aim of ascertaining the microbiological quality of water sold in jerry cans by vendors in Maiduguri Metropolis and to recommend some possible measures of ensuring its portability.

Materials and method

Study area

The research was conducted in Maiduguri, the Borno State capital. Maiduguri, the state capital of Borno, is the largest of the six States in the North-eastern region of Nigeria. It lies on latitude 11° North and 13° East. Borno state shares borders with republic of Niger to the North, Chad to the North-East and Cameroon to the East. The estimated population of Borno according to 2006 population census report is 4,098,391. Maiduguri is a cosmopolitan town which is inhabited by various ethnic groups but the most principal ethnic group is Kanuri[10]

Sample collection

The research was carried out between January and March, 2015.Water samples were collected from each water sources using a sterile glass sample bottle (500ml). The jerry-cans were shaken very well in order to obtain parasite if any. While the samples in dams were obtained using a clean water fetching material and transferred aseptically into the sample bottles. The samples were then transported to the Medical Microbiology Laboratory of University of Maiduguri Teaching Hospital, Maiduguri in an icebox at 4°C for analysis.

Bacteriological analysis

The media used for bacteriological analysis include; Eosin Methylene Blue, Nutrient Agar

and MacConkey broth. All the media used were prepared according to the specified instructions and directions by the manufacturers. The Most Probable Number (MPN) technique which is an important method of estimating microbial populations in waters were done via three stages namely; Presumptive test, Confirmative Test and Completed Test [APHA, 1998]. The total coliform and Total *E.coli* count were also done and compared with standards.

Parasitological analysis

Seven (7ml) of water sample was measured with a sterile disposable pipette and mixed with three (3ml) of Ether which was aseptically dispensed into a sterile centrifuge tube. The tubes were taken into the centrifuge machine and spun at 3000rpm for 5 minutes. The supernatant was decanted and the deposit was taped and dropped on a clean grease free glass slide, covered with a cover slip and observed under the microscope using x10 and x40 objectives. Any parasite seen was reported accordingly.

RESULTS

DAMS

Total coliforms were detected in all the water sampled and *E.coli* was detected in only three (3) of the thirteen (13) wards that were sampled namely; DikwaLowcost(2.1×10^4), Bulumkutu (1.8×10^4) and Moduganari (1.6×10^4)cfu/100ml (Table 1a). The parasitological analyses revealed;Cysts of *E. histolytica,* Ova of *Hookworm and Giardia intestinalis* in four (4) of the thirteen (13) wards sampled, namely; DikwaLowcost (Cyst of *E.histolytica* and Ova of *Hookworm*), Mashamari (*Ova of Hookworm*), Garannam (Cyst of *Giardia intestinalis* and Ova of *Hookworm sp*) (Table 2a).

JERRY-CANS

Total coliforms were detected in all the water sampled and *E.coli* was detected in six (6) of the thirteen (13) wards that were sampled namely; Dikwa Lowcost (3.1×10^4), Mashamari (2.2×10^3), Gwange (2.1×10^5), Bulumkutu (3.9×10^5), Garannam (6.2×10^4), Moduganari (3.6×10^4) (Table 1b). The parasitological analyses revealed; Cysts of *E. histolytica,* Ova of *Hookworm and Giardia intestinalis* in nine (9)of the thirteen (13) wards sampled, namely; Dikwa Lowcost (Cysts of *E.histolytica*, *Giardia intestinalis* and Ova of *Hookworm*), Mashamari (*E.histolytica* and Ova of *Hookworm*),Old Maiduguri (Cysts of *E.histolytica*), Gwange (Cysts of *E.histolytica*, *Giardia intestinalis* and Ova of *Hookworm*), Abbaganaram(Ova of *Hookworm*), Federal Low Cost (Cyst of *E.histolytica* and Ova of *Hookworm*),Garannam (Cyst of *E.histolytica,Giardia intestinalis* and Ova of *Hookworm*), Moduganari (Cyst of *E.histolytica*, *Giardia intestinalis* and Ova of *Hookworm*) (Table 2b).

TABLE 1a: Microbiological Analysis of Water Samples Obtained From Dams

Sampling site	Coliform count on E.M.B (cfu/ml)	Coliform count on Mac. Agar (cfu/ml)	Coliform count on N.A (cfu/ml)	Total coliform count MPN/100ml
DikwaLowcost	2.1×10^4	4.2×10^4	1.0×10^7	1500
Chad Basin	N.D	3.8×10^4	2.7×10^6	2
Mashamari	N.D	1.6×10^5	1.3×10^7	2
Old Maiduguri	N.D	2.2×10^5	2.4×10^6	3
Gwange	N.D	2.7×10^5	1.2×10^7	5
Shehuri	N.D	3.0×10^5	4.0×10^5	6
Abbaganaram	N.D	2.6×10^5	2.5×10^7	4
Lamisula	N.D	3.8×10^5	1.1×10^6	2
Jiddari Polo	N.D	1.2×10^5	2.3×10^6	7
Bulumkutu	1.8×10^4	2.7×10^5	4.0×10^5	13
Federal Lowcost	N.D	N.D	N.D	0
Garannam	N.D	1.9×10^5	1.2×10^6	3
Moduganari	1.6×10^4	2.4×10^5	1.3×10^5	998
WHO STANDARD				0 per 100ml
EPA STANDARD				0

ND - Not detected.

TABLE 1b: Microbiological Analysis of Water Samples Obtained From Jerrycans

Sampling site	Coliform count on E.M.B (cfu/ml)	Coliform count on Mac.A (cfu/ml)	Coliform count on N.A (cfu/ml)	Total coliform count MPN/100ml
DikwaLowcost	3.1×10^4	4.8×10^4	3.0×10^8	1850
Chad Basin	N.D	3.9×10^4	5.7×10^7	8
Mashamari	2.2×10^3	3.8×10^4	2.1×10^6	1123
Old Maiduguri	N.D	2.1×10^6	3.1×10^7	5
Gwange	2.1×10^5	3.7×10^7	2.2×10^6	6
Shehuri	N.D	3.2×10^5	3.4×10^5	8
Abbaganaram	N.D	4.6×10^6	3.5×10^4	6
Lamisula	N.D	4.9×10^5	2.1×10^6	5
Jiddari Polo	N.D	4.2×10^6	3.1×10^6	8
Bulumkutu	3.9×10^5	4.7×10^5	5.0×10^6	32
Federal Lowcost	N.D	1.0×10^4	1.2×10^5	6
Garannam	6.2×10^4	3.9×10^5	2.2×10^6	12
Moduganari	3.6×10^4	3.4×10^5	4.8×10^5	1148
WHO STANDARD				0 per 100ml
EPA STANDARD				0

ND - Not detected.

TABLE 2a: Parasite Encountered in the Water Samples Obtained From Dams

Sampling site	Samples	Parasites encountered
DikwaLowcost	D1	-
	D2	Cyst of *E. histolytica* Ova of *Hookworm*
Chad Basin	D1	-
	D2	-
Mashamari	D1	Ova of *Hookworm*
	D2	-
Old Maiduguri	D1	-
	D2	-
Gwange	D1	Ova of Hookworm
	D2	-
Shehuri	D1	-
	D2	-
Abbaganaram	D1	-
	D2	-
Lamisula	D1	-
	D2	-
Jiddari Polo	D1	-
	D2	-
Bulumkutu	D1	-
	D2	-
Federal Lowcost	D1	-
	D2	-
Garannam	D1	*Giardia intestinalis*
	D2	Ova of *Hookworm*
Moduganari	D1	-
	D2	-

Key: (-) = No parasite, (D) = Dams

Table 2b: Parasite Encountered in the Water Samples Obtained From Jerry-cans

Sampling site	Samples	Parasites encountered
Dikwa Lowcost	J1	Cyst of *E. histolytica* Ova of *Hookworm*
	J2	*Cyst of E. histolytica* Ova of *Hookworm* *Giardia intestinalis*
Chad Basin	J1	-
	J2	-
Mashamari	J1	Cyst of *E. histolytica*
	J2	Cyst of *E. histolytica*
Old Maiduguri	J1	Cyst of *E. histolytica*
	J2	-
Gwange	J1	Cyst of *E. histolytica*
	J2	Ova of *Hookworm*
Shehuri	J1	-
	J2	-
Abbaganaram	J1	Ova of *Hookworm*
	J2	-
Lamisula	J1	-
	J2	-
Jiddari Polo	J1	Ova of *Hookworm*
	J2	Ova of *Hookworm*
Bulumkutu	J1	Cyst of *E. histolytica* Ova of *Hookworm*
	J2	Ova of *Hookworm*
Federal Lowcost	J1	Ova of *Hookworm*
	J2	Cyst of *E. histolytica*
Garannam	J1	Cyst of *E. histolytica* Ova of *Hookworm* *Giardia intestinalis*
	J2	Cyst of *E. histolytica* Ova of *Hookworm*
Moduganari	J1	Cyst of *E. histolytica* Ova of *Hookworm* *Giardia intestinalis*
	J2	-

Key: (-) no parasite was encountered

DISCUSSION

The result for microbiological assessment of water hawked in the areas of Maiduguri Metropolis indicated contamination at both the source (Dams) and the point of delivery to the consumers. All the samples were positive for coliform groups which include;*Escherichia coli, Klebsiella* but the main concern is *E.coli* being an indicator of faecal contaminant in food or water. The count were however higher at the point of delivery to the consumers than at the source. This suggests that the increase in microbial load might be as a result of poor handling of the water or the use of unclean containers (Jerry-cans). This result agrees with the work of researchers in kano[12]who reported that 90% of water hawked in some selected areas in Kano had bacterial counts of 104 cfu/ml and MPN values ranged between 9 and > 180/100ml. This result is also in conformity with the work ofShittu and co-workers[13]who reported that some of the raw water sources from some open wells in Abeokuta had Coliforms up to 15 MPN/100ml.The most probable number (MPN) for the presumptive coliform count of the water sampled from dams ranges between 2 to 1500 MPN per 100ml (Table 1a). While the one sampled from Jerry-cans ranges between 2 to 1850 MPN per 100ml (Table 1b). This indicates that water from Jerry-cans had highest load of total coliform count than those from Dams. None of the water samples met the EPA maximum contamination level in drinking water of zero total coliform per 100ml[13, 14,]

EMB agar yielded growth of Gram-negative short rods, the cultural characteristic showed dark blue-black colonies with the characteristic metallic green sheen indicating lactose fermentation and acid production for samples from Maduganari (1.8 X 10^4 cfu/100ml) and Bulumkutu (1.6 X 10^4 cfu/100ml) and were identified as *Escherichia coli* (*E.coli*). This result suggests that the general quality of the water in these two wards is unacceptable. For water to be considered safe to human health, the faecal coliform counts/100 ml should be zero[13]. The organism isolated from the two wards was *E.Coli* and since *E.coli* is an indicator of faecal pollution, it implies that the dams situated in Bulumkutu and Maduganari is polluted with faeces[5]. This indicates faecal contaminants from the water source or hands of the handlers. MacConkey agar reveals growth of other coliforms, but *E.coli* is the bacteria of concern in water.

Furthermore, the results obtained from Jerry-cans shows conspicuously that people living around these areas of study namely; Dikwalowcost, Gwange, , Bulumkutu, Garannam and Moduganari are exposed to risk of contracting infection by the organisms isolated, which might lead to an outbreak of gastroenteritis and other enteric diseases. The distribution of such important commodity (Water) in the hands of ignorant members of the society who are habitually dirty and always unhygienic may be responsible for the introduction of microbes into the water, because most of the hawkers do not wash their jerry-cans thoroughly and regularly[14].

The entire study area has been known with long history of prominent water scarcity. The inability of the government to provide portable drinking water had contributed immensely to the water scarcity, creating more public health problems. People depend heavily on truck pushers who sell water, some of which were obtained from doubtful sources.

The assessment of the microbiological quality of water samples has helped in determining the public health implication of hawked water sold within Maiduguri Metropolis. The Parasitological examination of both Dams and Jerry-can water (Tables 2a and 2b), reveals Cysts of *Entamoeba histolytica*, Ova of *Hookworm* and *Giardia intestinalis*. These are enteric parasites that are capable of causing parasitic gastroenteritis.

Conclusion

Regulatory agencies (both governmental and non-governmental) should intensify their efforts towards providing clean and portable water to the public. The water vendors should be educated on hygiene and established laws should be enforced on the business of water vending.

Recommendations

The result of these analyses reveals high microbial contamination in the water hawked within Maiduguri metropolis and this calls for concern.

Regulatory agencies (both governmental and non-governmental) should intensify their efforts towards providing clean and portable water to the public. Water hawkers should be encouraged by the regulatory bodies to maintain personal hygiene and should always use clean and leak proof containers for their business. Efforts should be made by the dam owners to improve on the quality of water which is now the source of drinking water for the majority of the population to forestall public health problems.

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