Global Journal of Environmental Sciences. Vol. 4, No. 2, 2005,: 16● - 163
ISSN 1596-6194. Copyright Bachudo Science Co. Ltd. Printed in Nigeria.

# EVIDENCE OF HEALTH RISK IN STORED DOMESTIC WATER IN MAIDUGURI, NORTH EASTERN NIGERIA

N. E. NWAIWU and OLUSEGUN OLANREWAJU

(Received 13 July 2004; Revision accepted 8 November, 2004)

ABSTRACT

In Maiduguri, capital of Borno State, water supply is insufficient despite the fact that the town's sources of water are a treatment plant and deep wells. There is a long dry season and short rainfall period characteristic of an arid region. This makes water very essential especially for domestic purposes. As a result of the above, water storage is a common practice among the populace. The commonest way of storing water is the construction of underground structures traditionally called 'dams'. Water samples from randomly selected 'dams' in a peri-urban part of the town were analysed microbiologically. The organisms isolated were *Escherichia coli, Klebsiella, Enterobacter aerogenes*, and *Clostridium* .It was concluded that the water in these storage systems was faecally contaminated and thus pose a health ris':.

**KEY WORDS:** Water storage, structures traditionally called dams, Maiduguri, microbiological analysis, faecally contaminated water.

## INTRODUCTION

In community water supplies, test for physical and chemical qualities are the two most important types of analyses (Water for the World). Water supply systems are v'¹nerable to infections. (PAHO-OPS , 1998). From these tests, the types and levels of contaminants present in the water samples are evident. In deciding whether a water supply must be treated, this information is essential, because the aim of water analysis is to measure any contamination present, as to determine the need for, and level of treatment. Occasionally however, bacteriological analysis is desirable. Bacteriological contamination causes diseases and it is necessary that it is eliminated by simple chlorination of the water. Impurities in water are responsible for a majority of ill-health, yet up till 1990 only 57% of Africans had access to safe water supply (Chauvin; 1991, Kirkwood, 1998).

Women and girls provide water for households . This creates an opportunity cost of their time which may have been channeled towards other ventu'es. (Nigam *et al*, 1998). Millions of people in the developing world do not have sufficient supply of good water and thousands of children die from diarrhoeal diseases annually. In India, about 20,000 babies do not live up to a year (yearly) because they are brought up on unsafe water (Ali, 1980). In addition one sixth of Ir..lia's children die, before the age of five, of enteric diseases traceable to unclean water while some other victims of debilitating diseases in other parts of the world( Meyers, 1977).

About 80% of countries comprising 40 percent of the world's population already suffer from serious water shortages (Nigam et al., 1998). The tiny fraction of total global fresh water provided by fresh water lakes and rivers (0.26%) is unevenly distributed on earth. This creates a wide range of environments, from arid regions and deserts, to humid areas which experience regular flooding (Nigam et al., 1998). Strain resulting from water scarcity is a major factor in the already hard life experienced by African women. For a successful water supply intervention, it is necessary to adopt specific and detailed plans on water supply services suited to the individual and specific conditions of benefiting communities. (United Nations, 1977). Water storage may be the only means of ensuring a constant availability of water in areas short of regular water supply. In general, local technology is used for the design and construction of storage tanks or reservoirs. In nearly all systems, it will be necessary to store water in covered tanks(UNHCR, 1999) .

A public health problem of water storage structures is that of insect vector breeding especially mosquitoes. The eggs of *Aedes* mosquitos are laid singly on substrates above the water surface of containers. They hatch after the containers become flooded naturally (rainfall) or artificially (human water storage). The *Aedes* larvae generally breed in clean and unpolluted water. However, they have been known to breed in septic tanks and other polluted water sources where polluted water breeding mosquitoes such as *Culex quinquefasciatus* are commonly found. Generally, the immature stage of *Aedes* mosquitos requires about seven days before adult emergence in a tropical environment. As such, any container, natural or artificial,that can accumulate water for that length of time can become a potential breeding habitat for Aedes. The adult female *Aedes* mates and takes its first blood meal about 48 hours after emergence, and can take multiple blood meals between different gonotropic/generational cycles. Engorgement to ovinosition takes two to five days. Generally, a single female ays about 60-100 eggs in initial oviposition. For oviposition, *Ae. aegypti* lays eggs in practically all types of man-made (artificial) containers, and in some natural containers, and *Ae. albopictus* oviposits in both natural and artificial containers. Whatever the type of storage needed, adequate enclosure should be provided to prevent any contamination from humans, animals, dust or any other source. A tight cover and dark storage also prevent algal growth and breeding of mosquito larvae (WHO-OMS, 1995).

In Maiduguri, the capital of Borno state, and former capital of North eastern Region of Nigeria, the water supply is insufficient, despite the fact that the town has two sources of water supply, a treatment plant and deep wells. There is a long dry season and insufficient rainfall characteristic of an arid region, and temperatures are high. Thus water is very essential especially for domestic purposes. Due to the above reasons, water storage is a common practice among the populace. The commonest method of achieving this is the construction of underground concrete structures locally known as 'dams'. These are built with sandcrete blocks to any desired depth and later plastered with cement mortar. Some of these structures are privately owned (i.e., they are sited within a compound) or communally owned (i.e., they are s'ted by the road side or any gathering place e.g. a market). Very often water gets into these structures through water

N. E. NWAIWU, Department of Civil and Water and Resources Engineering, University of Maiduguri, Maiduguri, Nigeria.
OLUSEGUN OLANREWAJU, Dept. of Civil and Water Resources Engineering University of Maiduguri, Maiduguri, Nigeria

**Table 1: Result of MPN test and comparison with WHO Standard**

| 'Dam' number | Most probable Number (MPN) | WHO Standard |
|---|---|---|
| 1 | 7 | 0/100ml |
| 2 | 8 | |
| 3 | 180+ | |
| 4 | 2 | |
| 5 | 2 | |
| 6 | 1 | |
| 7 | 0 | |

**Table 2: Isolates from water samples**

| Samples Number | Isolates |
|---|---|
| 1 | *Escherichia. Coli and Klebsiella* |
| 2 | *Escherichia. Coli* |
| 3 | *Escherichia. Coli, Klebsiella Spp, Enterobacter aerogeres, Clostridium spp.* |
| 4 | *Escherichia. Coli* |
| 5 | *Escherichia. Coli* |
| 6 | *Escherichia. Coli* |

**distribution pipes broken casually by the house owners and channeled** to the 'dams'. In addition, water may also **be purchased** from water vendors and poured into the **dams.** The aim of this research was to determine the **bacteriological** quality of water samples obtained from **some "dams" randomly** selected in a peri-urban part of **Maiduguri metropolis** called Mairi Village. This study is of **great health significance** because the 'dams' constitute a **major storage** facility for domestic water in the **municipality.**

## MATERIALS AND METHODS

**Water was collected** in sterile bottles from 7 "dams" **randomly selected** in the area of study. The **sampling bottles comprised** seven sterilized glass bottles. **Water samples were collected** aseptically and carried to the **laboratory. Each** water sample was subjected to Most **Probable Number (MPN)/Multiple** tube technique test for **coliform bacteria. Inoculum taken** from the positive tubes **was transferred to selective** growth media for *Escherichia coli, **Klebsiella**, and **Clostridium***. The organisms were identified **through biochemical tests** including sugar fermentation. Each **'dam' was sampled once.**

## RESULTS AND DISCUSSIONS

The MPN results in Table 1 shows that only 'dam' number 7 satisfied the WHO Standard for potable water. Organisms were isolated from six of the seven samples collected as shown in Table 2 . Organisms isolated are presented from which it can be seen that six of the samples contained *Escherichia coli* . *Escherichia coli*, is found in intestines of man (Humphries, 1974) and animals (Mara and Oragui, 1985, Wheater, *et al.*, 1979, Wheater *et al.*, 1980 ). *Esherichia coli* coliform bacteria has customarily been used as an indicator of faecal contamination of water. Despite the above, there is increasing evidence that *E. coli* is not a suitable indicator of faecal contamination in the tropics (Gawthorne, *et al.*, 1996, Thornton , *et al.*, 1980). On the basis of the result obtained from this experiment alone, six of the water sources (i.e. the dams) were considered polluted because of the presence of faecal coliform *E. coli*. Enterotoxigenic *E. coli* has been implicated as the cause of travelers diarrhoea and infant dysentery (Twort, *et al.*, 1985, Humphries, 1974 ) as well as urinogenital tract infection in children. In addition *E. coli* 0157: H7 serotype has been found to cause bloody and non-bloody diarrhoea in many areas (Riley, et al., 1983; Arvanitidou, 1996). The presence of *E. coli* gives an indication of a possible presence of pathogens such as *vibrio cholerae*, *salmonella*, *shigella*,etc. Another organism identified in samples 1 and 3 was *Klebsiella* which is usually found in the respiratory, intestinal and urinogenital tracts of man and animals. Although *Klebsiella* is of the coliform group, *Klebsiella pneumoniae* is found associated with pneumonia and other inflammations of the respiratory tract (Humphries, 1974). Klebsiella qualifies also as a pathogen as well as an indicator bacterium in drinking water.

In sample 3, *Enterobacter* and *Clostridium spp.* were identified. *Enterobacter aerogenes* are also found in the intestinal tract of man. *Clostridium perfringens* is another indicator organism. It is usually isolated from cases of gas gangrene and from faeces, milk and soil (Humphries, 1974).

The laboratory analyses in this research did not involve the identification of species, but it is sufficient to note at this point that water in the 'dams' tested is polluted. In this study, *E. coli* , *Klebsiella* and *Enterobacter aerogenes* were confirmed(Table 3)

## CONCLUSION AND RECOMMENDATIONS

The contamination may have come from external sources. Microorganisms may grow freely in the water and

**Table 3: Confirmatory tests for coliform organisms**

| *Tests* | Escherichia. Coli | Klebsiella | Enterobacter aerogenes |
|---|---|---|---|
| Urease | - | + | - |
| Citrase | - | + | + |
| Indole | + | - | - |
| Voges-Proskauer | - | + | + |
| Methyl Red | + | - | - |
| Lactose | + | + | + |
| Manitol | + | + | + |
| Glucose | + | + | + |
| Sucrose | d | + | d |
| Motility | + | - | + |
| Gas | + | + | + |
| Oxidase | - | - | - |

* d= different strains give different results, +=positive, -=negative

form films on the side of the pipe walls rendering them resistant to residual chlorine. Deterioration of water may occur within the distribution system before it reaches the consumers. In addition, water may be contaminated on storage due to poor hygiene of users, and lack of care for the storage facility. The water in the 'dams' is grossly polluted and steps to control the pollution are urgently needed. Breakage of water pipelines should be discouraged. Using a communal container to draw water from the 'dams' may also help prevent faecal contamination from users' personal drawing vessels. The structures should also be firmly covered to prevent mosquito breeding and growth of algae.

## REFERENCES


Ali,S.I.,1980. Unicef News.Issue 103/1 pp10-11.

Arvanitidou M, Constantindus T.C. and Katsouyannopoulus V., 1996. Searching for *Escherichia Coli 0157* in drinking and recreational waters in Northern Greece Water Res., 30 (2): 493 – 494.

Chauvin, J. 1991. Research on water for Development issues IDRC 1991: 5 In (Kirkwood A 1998).

Gawthorne, T, Gibbs R.A Mathew K and Ho, G.E.. 1996. H25 papers as presumptive tests for salmonella contamination in tropical drinking water. Water science and Technology , 34 (7 –8 ) : 187 – 194.

Gray N.F.,1994. Drinking water quality problems and solutions. John Wiley and Sons, Chichester, 315pp.

Humphries J 1974. Bacteriology 1 John Murray Publishers Ltd, London, 88pp.

Kirkwood, A., 1998. Safe water for Africa. Africa Health, 5: 8-10.

Mara D.D. and Oragui J., 1985. Bacteriological methods for distinguishing between human and animal faecal pollution of water : results of fieldwork in Nigeria and Zimbabwe. Bulletin of the World Health Organisation, 63(4): 773-783.

Meyers .M., 1977.1000 million children lack safe water.Unicef News.Water and Children.Issue 91/1977/1pp25-27

Nigam A., Gujja B, Bandyopadhyay J and Talbot R., 1998 Fresh water for India's children and Nature. UNICEF. pp. 82.

Pan American Health Organization (PAHO)/ Organizacion Panamericana de la Salud(OPS) (PAHO-OPS) (1998), Disasters Preparedness and Mitigation - Issue No. 71 January, 8 p.

Riley L. W, Remis R. S. Helyerson S.D.F.C., 1983. Hemorrhagic colitis associated with a rare *Escherichia Coli* Serotype- New England. Journal of Medicine, 30(8): 681 – 685.

Thornton, K.W. Nix, J.F. and Bragg J.D., 1980. Coliform and water quality: use of data in project design and operation: Water Resources Bulletin, AWRA 16(1): 86 – 92

Twort, A.C. Law, F.M. and Crowley, F.W. , 1983. Water supply, 3rd Edition Edward Arnold.

United Nations, 1977, Report of the United Nations Water Conferences, New York pp. 107-109.

United Nations High Commission for Refugees (UNHCR) 1999. Handbook of Emergencies, Second Edition, 414p.

Water for the World.Taking a water sample. Technical Note No. RWS 3. ( 2 ): 1-6.

Wheater D.W.F. , Mara D.D; Jawad, L., and Oragui, J., 1980. *Pseudomonas aeroginosa* and *Escherichia coli* in Sewage and Fresh Water. Water Research, 14 : 713 – 721.

Wheater D.W.F, Mara D.D. and Oragui J. I., 1979. Indicator Systems to distinguish sewage from storm water runoff and human from animal faecal material. In A James. and L Evison (Editors) Biological Indicators of Water quality. John Wiley, Chichester, pp. 21– 27.

World Health Organization (WHO)/ Organizacion Mundial de la Salud(OMS) (WHO – OMS) 1995. Guidelines for Dengue Surveillance and Mosquito Control, 112p.