COMPARATIVE BACTERIOLOGICAL ANALYSIS OF DRINKING WATER SAMPLES IN KATSINA STATE

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Abstract
The world health organization has estimated that up to 80% of all sicknesses and diseases in the world are caused by inadequate sanitation, polluted water or unavailability of water. Katsina State had been experiencing recurrent epidemics of Gastroenteritis during the last decade leading to huge economic losses and in most instances fatal cases were recorded especially in infants. So the study was conducted to investigate pathogenic bacterial contamination of drinking water sources used by the communities and to find out the source of water that is considerably safer for drinking and other domestic purposes. A total of 86 water samples were collected from varied drinking sources across the State. Presumptive tests by multiple tube method and confirmative test by identification of bacterial isolates was carried out. Out of the 86 samples collected 29(33.7%) were contaminated with either one or more than one type organisms, results of most probable number test (MPN) showed Pseudomonas as the common cause of contamination about 11(12.8%) while Escherichia coli and Proteus vulgaris 8(9.3%) and Klebsiella 2(2.3%). Contamination from public wells was highest 6(7.0%), Tap 5(5.8%), Earth Dams 5(5.8%) , Bore holes 4(4.7), River 1(1.2%) and River (1.1%) Recommendations were offered in order to improve the water quality such that disease hazards are prevented for the achievement of any meaningful development and national integration.

Keywords: Bacteriological, water, drinking, disease

Introduction
Urban living is the keystone of modern human ecology. Large cities in the less developed countries typically combine the traditional environmental health problems of poverty and infections, particularly respiratory and enteric, with those of poor quality of living conditions. Such populations have long been incubators and gateways for infectious diseases associated with poor sanitation and unsafe drinking water (Michael, 2000)

The drinking water of most communities and municipalities is obtained from surface sources-rivers, streams, and lakes. Such natural supplies, particularly streams and rivers, are likely to be polluted with domestic and industrial wastes, i.e the used water of a community (waste water). Many city dwellers (whose water comes from the rivers) are not aware that a considerable portion of their drinking water may have been used earlier for domestic or industrial purposes.

Municipal water-purification systems have been very effective in protecting the inhabitants against polluted water. At the same time, as population centers grow, pollution problems become more serious. A greater quantity of water is required, and the water must be disposed of generally by returning it to a natural body of water in the vicinity, which in turn may be the water supply source of another community or municipality. Overcrowding and inadequate facilities for human excreta and waste water disposal makes the water distribution system prone to microbial contamination (Chukwurah, 2001).

However, Underground sources (wells and springs) provide most of the water for individual homes in rural areas. Rainwater caught and stored in cisterns is also used to a limited extent. Surface water, however, should not be used for drinking purposes unless it is subjected to purification, since there is constant danger of contamination and consequent transmission of disease.
As it penetrates through the layers of soil, water from wells and springs undergoes filtration which removes suspended particles, including microorganisms. It is of prime importance that the supply of groundwater selected be located a safe distance from possible sources of contamination, e.g., pit providers, cesspools, septic tanks and barnyards. Any government that seek to achieve economic development, national unity, and integration must give emphasis to disease prevention and control. Water that is free of disease-producing microorganisms and chemical substances deleterious to health is called potable water. Water contaminated with either domestic or industrial wastes is called non-potable or polluted water (Pelczar et al., 1993). The objectives of primary concern in providing potable water are freedom from undesirable or harmful chemicals. These standards are applied both to wells and springs serving single families and to water systems serving hundreds of persons.

Water can be perfectly clear in appearance, free from peculiarities of odor and taste, and yet be contaminated. Obviously special procedures are necessary to determine its sanitary quality. As a potential carrier of pathogenic microorganisms, water can endanger health and life. Therefore inspection of a water-producing system by a qualified sanitarian or engineer is necessary in form of what is regarded as sanitary survey. Many of the organisms that cause serious disease, such as Typhoid fever, Cholera and Dysentery can be traced directly to polluted drinking water. These disease causing organisms called pathogens are discharged along with faecal wastes and are difficult to detect in water supplies. Fortunately, less harmful, easily isolated bacteria called indicator organisms can be used indirectly to detect pathogens. Among these indicators are coliform bacteria. They live in the intestine of man and other animals, and are almost always present, even in healthy persons. The presence of the coliforms in water is a warning signal that more dangerous bacteria may be present. Diseases resulting from ingestion of pathogens in contaminated water have the greatest public health impact worldwide (Geildreich, 2005).

Diarrhoeal diseases continues to be a primary cause of child mortality and morbidity in developing countries (WHO, 1993) most of the pathogenic organisms that cause diarrhoea and all the pathogens that are known to be major causes of diarrhoea in many countries are transmitted primarily or exclusively by the faeco-oral route through foods and drinks. Notable among these are the faecal coliforms bacteria. WHO recommends that no faecal coliform be present in 100ml of drinking water.

However, cases of severe watery diarrhea can cause rapid loss of water and electrolytes so that the blood becomes reduced in volume and there is insufficient blood flow to keep vital organs, such as the kidneys, working properly. Severe watery diarrhea can be rapidly fatal, unless the lost fluid can be replaced promptly. Fortunately, despite the inability of the small intestine to control fluid secretion, if glucose is supplied it is still able to absorb fluid and electrolytes in most diarrheal diseases. An oral rehydration solution (ORS) that consist of water, glucose and electrolytes can be a highly effective life saver in severe diarrheas regardless of cause (Pether, 1993). The common features of all routine screening procedures is that the primary analysis is for indicator organisms rather than the pathogens that might cause concern.

Indicator organisms are bacteria such as non-specific Coliforms, *Escherichia coli* and *Pseudomonas aeruginosa* that are very commonly found in human or animal gut and which if detected, may suggest the presence of sewage indicator organisms are used because even when a person is infected with more pathogenic bacteria, they will be excreting many millions time more indicator organisms than pathogens. The microorganisms of concern in contaminated water include the following bacterial agents of Diarrhoea and Gastro enteritis, namely *Salmonella SP*, *Shigella SP*, *Escherichia coli* and *Vibrio cholerae*, protozoal agents of diarrhoea include
Entamoeba histolytica, Giardia lamblia, Balantidium coli and Cryptococcus parvum, Enteroviruses causing various clinical ailments, not necessarily diarrhoea but are transmitted by water include Polio virus, Rotavirus, Hepatitis A Virus and Hepatitis E Virus (Okpplenye, 2005). Bacterial agents in this group are known as the enteric bacteria, belonging to the family enterobacteriaceae, a family that constitute a few bacterial pathogens of man and animals. The family is so named because most species are commonly found in the normal or infected vertebrate gastro intestinal tract. Most species can live or survive for long periods in polluted water, soil, sewage, dairy products.

Methodology
A complex form of cluster sampling technique was adopted in this research i.e Multi stage cluster sampling in which samples were randomly drawn from each cluster as follows. The seven local government areas chosen from the state formed the clusters. Within each cluster, the local government headquarters were sampled from which popular sources of drinking water were further selected randomly and samples were collected aseptically in sterile sampling bottles and taken to the laboratory for the investigations respectively.

Bacteriological analysis of the sample
Because the analysis is always based on a very small sample taken from a very large volume of water, all methods rely on statistical principles. The samples were tested for Bacteriological contamination by coliform organisms using Presumptive coliform count employing the method described by Mackie and Mc Cartney (1978). The most probable number of these bacteria was determined from McCradys probability tables. Samples with MPN more than three were considered unfit for drinking purposes. Most probable number method (MPN); in this technique a 100ml water sample was distributed in culture broth containing Lactose and an indicator (after incubation of the number of tubes which shows lactose fermentation with acid and gas production are counted the lactose fermented by coliform is reported. By reference to probability tables, the most probable number of coliform in 100ml water sample was estimated.

- Presumptive test was done by multiple tube method.
- Confirmative test and identification of organisms up to species level according to Mackie and Mc Cartney.

Results and discussion
Out of 86 samples analyzed 21(24.4%) were contaminated with one type or more type of organism. Pseudomonas aeruginasa was the common cause of contaminated, about 11(12.8%) Escherichia coli and Proteus vulgaris 8(9.3%) and Klebsiella 2(2.3%). Of these samples contamination from public wells was the highest 6(7.0%). Tap 5(5.8%), Bore holes 4(4.7%), Earth Dam 5(5.8%) and River 1(1.2%). Of the seven local governments investigated Mani recorded highest level of contamination. However, the lack of potable drinking water source could lead to overcrowding and over activity on the few available sources leading to contamination. Drinking water is mostly sourced from wells, earth dams and few bore holes. The wells and earth dams are mostly uncovered/ unprotected from contamination from land, animals, wind etc. As such contaminants could easily be washed down these sources. Moreover in the distribution of treated water, in some instances pipe damages as seen in some areas is a major route of contamination by sewage which easily seap into broken pipes thereby contaminating the water consequently leading to spread of water-borne infections.

Furthermore, the scarcity of portable drinking water is a common phenomenon that cut cross the state, as such collection and storage of water constantly increasing which might lead to contamination if unhygienically stored. Therefore, safeguarding water supplies is a major health responsibility. The WHO guidelines placed the greatest emphasis on the microbiological quality of drinking water. The concept of safe water eludes the common man. Consequently, an outbreak of water-borne
diseases remains a great burden on the society. The bacteriological examination of drinking water is a sensitive method to assess its quality though it does not detect contamination with protozoa, virus and fungi.

According to WHO, the lack of safe water supply and of adequate means of sanitation is blamed for as much as 80% of all diseases in developing countries. Sewage containing human excreta is the most dangerous material that pollutes water. The most important microbial diseases transmitted through water are Typhoid fever, Amoebic dysentery, Bacillary dysentery, Cholera, Poliomyelitis and infections hepatitis (Geldreich, 2005).

The prevalence of Pseudomonas aeruginosa could be due to the mixing of sewage water with drinking water as a result of leakage in the pipeline. A regular monitoring of the water quality for improvement not only prevents disease and hazards but also checks the water sources from going further polluted (Manjula et al, 2011).

Table 1: Percentage incidence of Enteric Bacteria among different Sources of drinking water samples.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Water Source</th>
<th>Number Investigated</th>
<th>Number Contaminated</th>
<th>Number Uncontaminated</th>
<th>% Contaminated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tap</td>
<td>26</td>
<td>5</td>
<td>21</td>
<td>5.8</td>
</tr>
<tr>
<td>2.</td>
<td>Well</td>
<td>21</td>
<td>6</td>
<td>15</td>
<td>7.0</td>
</tr>
<tr>
<td>3.</td>
<td>Borehole</td>
<td>33</td>
<td>4</td>
<td>29</td>
<td>4.7</td>
</tr>
<tr>
<td>4.</td>
<td>Earth Dam</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>5.8</td>
</tr>
<tr>
<td>5.</td>
<td>River</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>86</td>
<td>21</td>
<td>65</td>
<td>24.4</td>
</tr>
</tbody>
</table>

Conclusion
This study revealed that the recurrent epidemic and endemic cases of gastroenteritis in Katsina state is partly due to contamination by pathogenic enteric bacteria. The predominant of which is pseudomonas aeruginosa an indicator of sewage contamination and that Borehole water is considerably the best source safe for drinking and other domestic purposes as it was found to contain least level of contaminantion.

Therefore water as good as it is for every form of life ,may also be a good medium for growth of bacteria and other organisms deleterious to health ,or become contaminated by chemical agents that are of serious health hazards if not properly sanitized and protected. In addition to illnesses, a variety of less serious problems such as taste, color and odor are symptoms of water quality problems. Even water that appears problem-free may not necessarily be safe or acceptable .Recurrent epidemics of gastroenteritis in Katsina state may adequately be tackled if sources of water are frequently monitored. A regular monitoring of the water quality for improvement not only prevents disease hazards but also checks the water resources from going further polluted. As such protection and management are all critical strategies in maintaining and improving water supply.

References


