Bacteriology of Rural Water Supplies of Mutenda Community District of Chingola, Zambia

O.A. Fayinka, F.I.M.L.S. (London)
Tropical Diseases Research Centre – Ndola – Zambia

SUMMARY

The sources of water supply for drinking and other domestic uses available to the rural population of Mutenda was analysed bacteriologically by standard techniques (Presumptive and Differential Coliform tests (Wilson et al 1935), Ministry of Health (1946). The water sources include wells, bore holes, springs and rivers. Assessment of suitability by standard criteria showed that, the bore hole water was the only source of supply bacteriologically safe for drinking. The need for further research on the microbiology of surface and underground water resources is stressed. Reassessment of the standards for water quality, which have largely been based on the experience from waters in temperate, more developed countries and development of suitable tests for sound epidemiological studies to establish realistic standards applicable to the developing countries is advocated.

INTRODUCTION

Mutenda community is situated in the Chingola District bordering the Solwezi District, and inhabited by about 10,000 people of various social economic status. Medical facility available to the community is a relatively small hospital about 30 kilometres away, run by the Catholic Mission, and a recently opened health centre for the services of the people. The community is one of the study areas chosen by the Tropical Diseases Research Centre (T.D.R.C.) to undertake population based epidemiology surveys.

During the Centre's activities in February 1980, members of Mutenda community requested the Centre for assistance to improve their drinking water supply. Although the Centre is not mandated to address itself to such a request, the Centre took the advantage of its facilities to investigate the bacteriological quality of the water supplies in relation to possible potential health hazard to the local population.

MATERIAL AND METHODS

The main water supply for Mutenda community is derived from the following sources:-

1. Wells;
2. Bore holes;
3. Springs;
4. River Mushinga.

General Descriptions:

1. The Wells

Most wells are about 15 - 20 metres deep with surrounding walls about one metre above ground level. The wells are not covered and are exposed to both birds, small animals (e.g. lizards), insects and possibly human excreta contaminants. In some wells, floating pieces of sugar cane were visible, thus providing available source of nutrient Carbohydrate supply enhancing luxuriant growth of possible contaminating microorganisms. The washing of clothes and kitchenwares is a common scene around the wells. Paradoxically the water appears visually clean and clear.

2. Bore holes

The bore holes are completely sealed off and are not prone to the various possible sources of contamination as described above for the wells. However, due to the rusting pipes, the water from the bore holes was very brown. Human and animal activities around the bore holes were less and the apparent minimal usage of the bore hole seems to increase the iron rust deposit.

3. **Springs**

The springs are shallow waters about 30 - 35 centimetres deep and 25 - 30 centimetres wide. They are surrounded by mud-escarpments some 6 centimetres high, to prevent back flow of water as the springs overflow. The springs are open, some with broken escarpments and are prone to the same contamination risks as the wells. The spring waters are also visually clean and clear.

4. **River Mushinga**

River Mushinga which flows to make the natural boundary of Chingola and Solwezi districts is the one investigated and it originates from a large expanse of swamps – embedded springs in the north-west of Mutenda. The river is relatively clean and washing activities of domestic wares and clothes occur inside the shallow area of the river. These activities add to the factors that predispose the river to possible contamination. Water weeds and plants grow freely on and along the river bank.

Sampling Procedure

Documentation and the description of water sources and environment was the first step taken to avoid mixing up of samples. This was followed by cautious opening of sterile 250 ml screw-cap bottles gently lowered to water surface by aid of a string secured around the neck of the bottle until it was filled with water. The bottle cap was replaced asceptically and transferred into a cold box (+4°C) for transportation to the base laboratory at Tropical Diseases Research Centre, Ndola.

LABORATORY INVESTIGATIONS

Presumptive Coliform Count and Differential Coliform Test

All samples were investigated bacteriologically on the same day of collection. Inoculation of varying quantities of water into MacConkey broths using the multiple tube technique was adopted. Incubation at 37°C waterbath and examination at 24 hours and 48 hours respectively were performed for growth, acid and gas production. All tubes positive in the presumptive tests were subjected to Eijkman Test (the Differential Coliform Test) and incubated at 44°C waterbath and examined for the ability of the Coliforms to produce gas and indole. The number of *Esherichia coli* per 100 ml of water was calculated and recorded according to McCrady (1918).

RESULTS AND DISCUSSION

Table 1 shows the sources of water supply at Mutenda and described various water samples collected from different areas of the community. The results of both the probable number of Coliform bacilli and *Escherichia coli* counts per 100 ml of water were indicated in the following respective order:-

Spring water at Kankomba quarters, >1,800, >1,800; Well water at Kwaseka Grocery, 350, 17; Mushinga River water, 50, 8; Well water at Langamu, 1,600, 5; Bore hole water north of School, O, N.D.; Well water at front of School, 550, 3.

Although the presence of Coliform organisms in any drinking water supply does not in itself constitute any hazard, it does imply an index of a recent pollution of faecal origin. The presence of a high number of Coliform organisms is an indirect index of the possible presence of pathogenic organisms which by themselves may be present in scanty numbers, and which may be presented as technically undetectable for ordinary purposes. However, a significant upsurge in the Coliform count of any water supply is a signal of potential health hazard which must be investigated by the appropriate health authorities. The Presumptive Coliform Count for non-chlorinated unpiped rural water supplies should not exceed 1 per 100 ml in deep well water or 5 per 100 ml in shallow well or upland surface water (Wilson and Miles 1961).

Judging from the above criteria, the only water that is satisfactory for consumption bacteriologically is the supply from the bore hole at the north-end of the School. The other supplies fall below the acceptable bacteriological classification. This situation at Mutenda which may be taken as representative of rural community hygiene in most developing tropical countries, showed no evidence of an outbreak of waterborne diseases at the time of our investigation. However, this judgment does not take into account the possible chemical compostion of the entire water sources. This circumstance notwithstanding, it is well known that water-related infections are much more common in tropical countries and the diversity of infection is considerably greater. The hygienic aspects of water quality therefore merits greater attention, because the levels of faecal contamination in drinking sources are often high. It has been observed that water-related disease cause mortality rate of between 5% – 10% overall in many places (Feachem et al 1977). Here in Zambia preliminary studies have shown that Zambia has an abundance of both surface and underground water resources. However, there are constraints which prevent the effective use of these resources (Ministry of Health, Zambia 1980).

A wealth of information and technology has accumulated over the years regarding the detection and enumeration of specific indicator and pathogenic bacteria and viruses in water distribution systems (Geldreich 1979, Geldreich et al 1972, Reasoner 1979). However, in spite of this, there has been increased incidence of water-borne disease in the United States during 1971 to 1977 (Craum 1979 and Craum 1979). In part, this rise can be attributable to better reporting system of cases to the public health authorities but also to a basic deficiency in our understanding of the specific environmental factors which regulate the occurrence and survival of diverse micro-organisms (both pathogens and non-pathogens) in water distribution systems (Ridgway and Olson 1981). Such lack of information on the species present in the waters in many parts of the world was pointed out by Blum (1956).

As at present, standards for water in the tropical developing countries have largely been based on experience from waters in temperate and more developed countries. There is still a real need for search into the suitability of the various tests and for sound epidemiological studies to establish realistic standards applicable to developing countries. Since individual samples and tests for bacteriological pollution are of little value, because a water which is satisfactory one day may be polluted after another, it is, therefore, desirable when investigating a source of water that a number of samples be taken at different days and routinely tested.

In conclusion, for the developing nations to contribute positively to the objectives of the declaration of the International Water Supply Sanitation Decade (1981 – 1990) by the United Nations, efforts should be directed towards the following:-

(i) Health education on the proper and effective use of water by the people;

(ii) Co-ordination of responsible bodies for water supply and sanitation; and

(iii) The development of appropriate technology in designing simple tests that can be carried out regularly at short intervals to monitor the quality of water in the distribution systems for public consumption.

TABLE I

RESULTS OF THE BACTERIOLOGICAL ANALYSIS OF RURAL WATER SUPPLIES OF MUTENDA VILLAGE

Source of Water	Visual Colour of Water	*Probable number of Coliform bacilli in 100 ml of Water	**Differential Coliform Test Probable number of *E. Coli* in 100 ml of Water	Remarks
		According to (McCrady's Table)		
Spring 1 Kankomba	Clear and Colourless	>1,800	>1,800	Bacteriologically unfit
Kwaseka Well (Grocery)	Clear and Colourless	350	17	Bacteriologically unfit
Mushinga River	Clear and Colourless	50	8	Bacteriologically unfit
Langamu Well	Clear and Colourless	1,600	5	Bacteriologically unfit
Bore Hole North End of School Next to Hill	Very Brown	0	Not done	Bacteriologically fit
Front of School Well Nr. WHO Camp	Clear and Colourless	500	3	Bacteriologically unfit

* Permissible degree of latitude for unpiped rural supplies 10 per 100 ml of water
** Permissible degree of latitude for unpiped rural supplies 2 per 100 ml of water

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