WATER SUPPLIES IN SOME RURAL COMMUNITIES AROUND CALABAR, CROSS RIVER STATE, NIGERIA: BACTERIOLOGY OF DRINKING WATERS

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Abstract. Several communities in Nigeria exist without regular water supplies of good quality and quantity. Despite this situation, successive governments have tended to ignore the problem. The water supplies to two rural communities 7-8 km north of Calabar, Cross River State of Nigeria, were examined bacteriologically using standard indicator bacteria (coliforms and streptococci). A contiguous community supplied with treated piped water was also studied in parallel. The rural water supplied was found to be bacteriologically unsatisfactory, having failed to meet the international standards for drinking water as set by the WHO. The geometric mean bacterial counts per 100 ml of serial samples from six sources ranged from $0.12x10^1$ to $1.57x10^2$ for fecal coliforms (*E. coli*) and $0.05x10^1$ to $7.5x10^1$ for the fecal streptococci. Fecal streptococci were particularly recovered in large numbers from one source (Ayip Asikimangfuk) at concentrations of up to $3.0x10^2$ per 100 ml at the onset of the rains. The water supplies from the community with piped water were, in general, bacteriologically satisfactory; fecal coliforms were found only in occasional samples ($0.12x10^1$/100 ml).

INTRODUCTION

Although it is enshrined as a human right, the provision of adequate potable water remains a major problem in most developing countries (Hurst *et al,* 2003). Deaths due to water-related diseases add up to more than 3 million people per year (WHO, 2003a). Infectious diarrhea alone claimed 1.7 million lives in 2002 (WHO, 2003b).

The relationship of disease to water is clearly established and the mechanisms that link different diseases to water have been well described (Feachem, 1975). Most water-related diseases occur in large outbreaks that sometimes assume epidemic proportions. The Broad street cholera episode in London, remains a classical case (Snow, 1856). Outbreaks of typhoid, cholera, and other water-related diseases still occur in endemic areas of Nigeria (Mohammed and Chikwem, 1992; Banwat *et al*, 2003).

The World Health Organization has guidelines for drinking water quality which provide for inspection, surveillance and protection of community supplies (WHO, 1997). Several communities in Nigeria exist without water supplies of good quality and quantity. Despite this situation, successive governments have tended to ignore the problem and laid more emphasis on non-health-related programs.

It is to highlight some of these water supply problems that this study was initiated. The quantities and qualities of water used by six rural communities around Calabar were examined.

Bacteriological assessments of water samples from these sources were made using standard indicator bacteria (WHO, 1993). A contiguous community with treated piped water was studied in parallel.

MATERIALS AND METHODS

Sample collection

Samples were collected in 500 ml sterile flasks from water sources serving six communities in two large villages along the Calabar-Ikom road. These were Ikot Effanga Mkpa (population, 4,500) and Ikot Omin (population, 3,000),7 and 8 km, respectively, North of Calabar, the Cross River State Capital. Calabar itself is located at 4º57’N and 8º19’E. The water supplies were the Idim Agriculture and Idim Ekpu, untreated shallow streams; the Ayip Ikeng, Ayip Asikimangfuk, Ayip Ebarense and the Ayip Efugho springs

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Table 1
Ranges and geometric mean bacterial counts of samples obtained from treated piped waters and untreated rural supplies.

Samples source	Counts per 100 ml		
	Total coliforms	*E. coli*	Fecal streptococci
Piped water (n=6)	$0\text{-}0.8 \times 10^1$ (0.32×10^1)	$0\text{-}0.2 \times 10^1$ (0.12×10^1)	$0\text{-}0.2 \times 10^1$ 0.05×10^1
Idim Agriculture (n=6)	1.45×10^2 - 4.75×10^2 (2.54×10^2)	2.0×10^1 - 1.75×10^2 (6.42×10^1)	$0\text{-}9.5 \times 10^1$ (6.43×10^1)
Idim Ekpu (n=6)	1.5×10^2 - 3.95×10^2 (2.51×10^2)	1.18×10^2 - 2.04×10^2 (1.57×10^2)	3.2×10^1 - 1.16×10^2 (6.7×10^1)
Ayip Ekeng (n=6)	6.0×10^1 - 4.3×10^2 (2.76×10^2)	4.0×10^1 - 7.6×10^1 (5.85×10^1)	0 - 5.9×10^1 (2.22×10^1)
Ayip Asikimangfuk (n=6)	2.3×10^2 - 1.13×10^3 (5.52×10^3)	4.0×10^1 - 1.52×10^2 (1.12×10^2)	$0\text{-}3.0 \times 10^2$ 7.5×10^1)
Ayip Ebarense (n=6)	1.58×10^2 - 5.0×10^2 (3.88×10^2)	7.0×10^1 - 1.48×10^2 (1.09×10^2)	0.6×10^1 - 8.0×10^1 (3.97×10^1)
Ayip Efugho (n=6)	9.0×10^1 - 2.9×10^2 (1.5×10^2)	3.5×10^1 - 8×10^1 (5.87×10^1)	1.0×10^1 - 9.2×10^1 (5.85×10^1)

which issue from the base of hills and settle in muddy unsanitary narrow valleys. Piped, treated water was obtained from taps serving an indigenous community adjoining the University of Calabar campus. All samples were collected with sampling precautious (APHA, 1985) and returned to the laboratory and tested within 1 hour.

Bacteriological analyses and cultures

Water samples were examined by membrane filtration techniques using a Millipore Sterifil system with membrane filters (pore size 0.45 µm) and pads, where appropriate. The membrane enriched Triton agar (0.2TX) (Opara *et al*, 1977) was used for the total and thermotolerant coliform (*E. coli*) counts. Slanetz and Bartley (S&B) agar (OXOID) was used for the enumeration of fecal streptococci. Cultural methods, incubation conditions of media, as well as the identification and confirmation of indicator bacteria, were carried out as recommended in Report 71 (1969) and/or APHA (1985).

RESULTS

Table 1 shows the geometric mean counts of the total coliforms, *E. coli* and fecal streptococci per 100 ml of water, obtained from serial samples taken from seven sources. Six samples were taken from each source: three during the dry season and three at the onset of the rains. All the samples from the piped waters were bacteriologically satisfactory and complied with international standards for drinking water set by the World Health Organization (WHO, 1993). Fecal coliforms were obtained only in occasional samples. The untreated rural waters consistently contained total coliforms and thermotolerant *E. coli* at concentrations well above recommended standards. The geometric mean counts per 100 ml of serial samples from the six sources ranged from 0.12×10^1 to 1.57×10^2 for the fecal coliforms (*E. coli*) and 0.05×10^1 to 7.5×10^1 for the fecal streptococci. The highest mean counts of *E. coli* were obtained from the Idim Ekpu, shallow unprotected brown water. Fecal streptococci and total coliforms were recovered in the highest mean numbers from the Ayip Asikimangfuk water, a percolated muddy source. The mean bacterial counts were 7.5×10^1 and 5.5×10^3 for fecal streptococci and total coliforms, respectively. The terminal values in the ranges of bacterial counts were obtained at the onset of the rains.They were higher than the counts taken in the dry months.

DISCUSSION

The water supplies available to the rural communities were small slow-flowing streams, springs or stagnant water. They were found to be bacteriologically unfit for human consumption, their content of indicator organisms being at levels higher than the recommended international standards. They were also esthetically unsatisfactory. Their location and surrounding environment undoubtedly contributed to their poor quality. Some of these water sources received direct human and animal excrement. The high recovery of fecal streptococci from these sources confirms their contamination from animal sources. This is in agreement with the fecal coliform: fecal streptococci ratios proposed by Feachem (1975). They also served as drinking, bathing and other recreational sources. The spring sources flowed from rock bases or holes dug at the foot of hills. While the original outflow of water from these areas appeared clean, they were secondarily contaminated by the surrounding soil, the body contact of users and dirty containers. This kind of secondary contamination has been documented (Han*,* 1989; Molbak *et al,* 1989; Hurst *et al,* 2003). All these waters received no further treatement before being drunk. Samples of rural water supplies taken at the beginning of the rains, yielded higher bacterial loads than those sampled during dry days. This is expected, since the rural supplies were unprotected and received soil run-off whenever it rained. The bacteriology results confirm the alarming environmental contamination of these sources. As expected the treated and piped water supplies complied with the international water guidelines. Only occasional samples yielded indicator organisms.

This study highlights the alarming water supply problems encountered by rural communities around Calabar. They depend, all year round, on rural water, the bacteriological contents of which are below acceptable standards. It also reveals the contrasting amenities available to communities living contiguous to each other; one provided with piped and treated water, the others dependent on rural sources only. The full impact of this contrasting situation will form part of the second installment of this article.

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