

Assessment of the microbial quality of river water sources in rural Venda communities in South Africa

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Abstract

The microbial quality of several, untreated surface water sources, used by rural communities in the Venda region of South Africa, was assessed to determine its safety for human consumption and to highlight the possible occurrence of water-borne diseases. The water sources studied were six sampling points on the Levubu River, Vuwani, Mutale, Ngwedi, Tshinane, Makonde, Mutshindudi and Mudawali Rivers. Heterotrophic plate counts, faecal and total coliforms, enterococci and somatic coliphage counts were performed according to standard methods to determine the microbiological quality of the water sources. The presence of enteric pathogens such as *Salmonella*, *Shigella*, *Campylobacter*, *Plesiomonas*, *Aeromonas* and *Vibrio* was also determined.

Results obtained showed that the minimum and maximum counts with regard to all the sampling points investigated were 1.5×10^3 cfu·ml⁻¹ and 6.3×10^4 cfu·ml⁻¹ for faecal coliforms, 6.0×10^2 cfu·ml⁻¹ and 3.7×10^4 cfu·ml⁻¹ for total coliforms, 1.8×10^2 cfu·ml⁻¹ and 1.3×10^6 cfu·ml⁻¹ for heterotrophic plate counts, 1.0×10^1 cfu·ml⁻¹ and 2.5×10^4 cfu·ml⁻¹ for enterococci and 0 and 13 pfu·100 ml⁻¹ for somatic coliphages. The results for the indicators were higher than the acceptable maximum limits prescribed by the Department of Water and Forestry of South Africa. According to these guidelines, the maximum values are as follows: 0 cfu·100 ml⁻¹ for faecal coliforms, 5 cfu·100 ml⁻¹ for total coliforms, 1.0×10^2 cfu·ml⁻¹ for heterotrophic plate count, 0 cfu·ml⁻¹ for enterococci and 1 pfu·100 ml⁻¹ for somatic coliphages. *Salmonella*, *Shigella*, *Vibrio*, *Campylobacter*, *Aeromonas* and *Plesiomonas* species were isolated from several of the water sources investigated.

These untreated water sources are used for drinking and domestic purposes and pose a serious threat to the health of the consumers and therefore calls for urgent intervention by government.

Introduction

In developing countries such as South Africa, most of the rural communities are poverty-stricken, lack access to potable water supplies and rely mainly on river, stream, well and pond water sources for their daily water needs (Nevondo and Cloete, 1991). Water from these sources is used directly by the inhabitants and the water sources are faecally contaminated and devoid of treatment (WHO, 1993). Consequently, a significant proportion of residents in rural communities in South Africa are exposed to water-borne disease and their complications (Schalekamp, 1990). These diseases include campylobacteriosis, shigellosis, salmonellosis, cholera, yersiniosis and a variety of other bacterial, as well as fungal, viral and parasitic infections (Grabow, 1996; Genthe and Seager, 1996). These diseases cause crippling, devastating and debilitating effects on rural residents and further exacerbate the already strained health burden and facilities in the country. It is therefore not an option but an imperative to critically monitor the microbial quality of water supply in rural areas in order to highlight the poor quality of water supplies and to provide the impetus for sustained government intervention. Indeed, the centrality of water supply to rural communities is one of the great challenges of sustainable development because it impinges on achieving the objectives of improving health, income, living conditions and ensuring equitable and sustainable use of natural resources and a better life for all in South Africa and other developing countries (Acho-Chi, 2001).

Although government has made some efforts to ensure access to potable water supply by rural residents in South Africa, these

projects have been fraught with financial and human resource constraints, making it unlikely that high-quality water will be made available to the bulk of rural residents in the future (Nevondo and Cloete, 1999). In areas where potable water supplies have been provided, these supplies are unreliable and insufficient, forcing residents to revert to traditional contaminated river sources (WRC, 1993; Nevondo and Cloete, 1999). The major health risk associated with these drinking water sources is contamination by human or animal faeces (Lehloesa and Muyima, 2000). Since it is impractical to test water supply for all pathogens related to water-borne diseases due to the complexity of the testing, time and cost (Lehloesa and Muyima, 2000), indicator organisms are used (Hazen, 1988; Grabow, 2001). However, no simple indicator that complies with all the criteria is available, hence more than one indicator organism is employed (Genthe and Seager, 1996).

In spite of the problem of poor water quality in rural areas, few data exist on the bacterial quality of water supply in these settings, since most studies approach the problem by focusing on urban communities (Nevondo and Cloete, 1999). In this study indicators of pollution (faecal coliforms, total coliforms, heterotrophic plate counts, enterococci and somatic phages) were used to determine the microbial quality of water sources of rural communities in the Venda region and to compare these results with guideline values (DWAF, 1996).

Materials and methods

Study areas

The study sites were rural communities in the Venda region of the Northern Province, South Africa. The main water sources in the rural communities were identified and sampled. They comprised

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