

Bacterial community patterns of domestic water sources in the Gogogo and Nkonkobe areas of the Eastern Cape Province, South Africa

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Abstract

In the present study we have characterised the microbiological quality of the drinking water from different water sources in Gogogo and Nkonkobe areas in the Eastern Cape Province, South Africa. Using both standard microbiological methods and the commercial API 20E assay kit, we have been able to identify 54 different species of micro-organisms, 77.5% of which proved to be human pathogens, 53.2% of them, belonging to the family *Enterobacteriaceae* and 22.5% were non-pathogens. Further investigations revealed a marked difference both in terms of the number and in the variety of organisms during different seasons. Thus the highest number of bacteria, i.e. 45.74% for Gogogo drinking water sources and 48.1% for Nkonkobe was registered in winter, while the lowest, i.e. 14.18%, for Gogogo and 10.94% for Nkonkobe water sources was recorded in spring. Considering the overall bacterial community pattern of domestic water sources in the Gogogo and Nkonkobe areas, it can be concluded that the water is of poor microbial quality and requires extensive purification before any domestic use can be considered.

Keywords: bacterial community pattern, total coliforms, pathogenic bacteria, API 20E assay, Shannon-Weaver index (H)

Introduction

Water-borne diseases are one of the major causes of increased morbidity and mortality in the world, water being known as a carrier of human disease-causing organisms that can pose health risks to people if it is not properly treated. Diseases, such as cholera, salmonellosis, typhoid fever, to name a few, are most often associated with inferior water quality (Briggs et al., 1996).

Many people in rural areas, such as in Gogogo and Nkonkobe in the Eastern Cape Province of South Africa, use water of inferior quality for daily sustenance. The reason is that these people do not have continuous and ready access to treated water supplies and are therefore compelled to use untreated water or water supply of inferior quality for drinking and other domestic uses, such as food preparation and bathing (Von Schirmding, 1992).

Our previous studies (Muyima and Ngcakani, 1998; Zamxaka et al., 2004) have shown that the water from the Gogogo and Nkonkobe water sources is of poor quality and is not safe for human consumption, since its levels of contamination are high and exceed the South African recommended and allowable limits for microbiological indicators (DWAf, 1998). Almost all indicator bacteria counts, namely – heterotrophic, total and faecal coliforms were above the limits imposed in terms of the South African Standards (Zamxaka et al., 2004).

Analysts generally do not directly test for microbial pathogen species in water, since this is a complex and expensive exercise, especially in developing areas. Data on the health related quality of water are generally obtained from affordable alternative methods,

such as the use of classical microbiological indicators of water quality, e.g. *Escherichia coli*. Results from these methods at best offer only a screen of microbial contamination and can at best only indicate the potential of water to infect consumers. Several incidents have been reported, where the absence of indicator organisms, such as *E. coli*, from a test sample does not actually indicate the absence of infection potential.

Both living organisms and bacterial breakdown products (metabolites, such as bacterial endotoxins released after the death of bacteria) can cause adverse inflammatory reactions such as fever and diarrhoea. Most of the screening assays for microbial contamination rely on the presence of the culturable organisms in the water (Mimms, 1990). It is well known that some of the most toxic bacterial breakdown products can withstand most of the treatments that are used to kill living organisms, i.e. chlorination and boiling. While a microbiological screening test might indicate that there are no culturable organisms in a water volume, microbial breakdown products might still be present in sufficient concentrations to cause adverse human health when ingested. Environmental engineers treating water for human consumption need to be sure that water produced in a treatment facility will not cause diseases such as diarrhoea, therefore being fit for human consumption, not merely being free of culturable indicator bacteria.

Methods for testing water for its inflammatory reactivity potential (direct human biomarkers for causing fever and diarrhoea) could supplement classical screening methods for identifying a vast number of both pathogenic and non-pathogenic micro-organisms. One of the best commercial testing kits on the market, ideal for the examination of enteric bacteria (Clayton, 1999), used in our studies, is the API 20E. It contains freeze-dried biochemical substances in small plastic cups, and the test is easy to interpret. This ensures that provisional diagnosis of *Salmonella* and *Shigella*,

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