Journal of Soils and Sediments

Riverbed sediments in the Apies River, South Africa: recommending the use of both Clostridium perfringens and Escherichia coli as indicators of faecal pollution

Akebe Luther King Abia[1] & Eunice Ubomba-Jaswa[2] & Martella du Preez[2] & Maggy Ndombo Benteke Momba[1]

[1] Department of Environmental, Water and Earth Science, Tshwane University of Technology, Arcadia Campus, 175 Nelson Mandela Drive, Pretoria 0001, South Africa
[2] Natural Resources and the Environment, CSIR, PO Box 395, Pretoria 0001, South Africa

Abstract

Purpose: Sediments have been shown to contribute to the microbial quality of the water column during resuspension and serve as reservoirs for potentially pathogenic organisms. Currently, definitive guidelines regarding microbial indicators that need to be assessed in order to monitor faecal pollution in sediments do not exist. In this study, Escherichia coli (a well-established indicator) and Clostridium perfringens were monitored to determine their suitability as indicators for faecal pollution of sediments.
Materials and methods: Enumeration of E. coli in water was performed using the ColilertTM 18/Quantitray-2000 system from IDEXX. Identification and enumeration of C. perfringens in water was conducted using the boil method followed by the pour plate technique. Real-time polymerase chain reaction (RT-PCR) was used to confirm isolates. E. coli and C. perfringens were enumerated in sediment by firstly using the water displacement approach to dislodge organisms from sediment and then subsequently followed by the same methods as those used for detection and enumeration of the two potential indicators in water.
Results and discussion: The highest concentrations of E. coli and C. perfringens were obtained along the main stem of the Apies River which was characterised by the presence of wastewater treatment works, animal farmlands and informal settlements with inadequate sanitary facilities. The lowest concentration of both organisms was observed along the tributaries of the river, where there was minimal faecal pollution-related activity. Due to the difference in biological characteristics and survival patterns, concentrations of E. coli in sediments fluctuated (higher concentrations in the wet season) during the entire sampling period while concentrations of C. perfringens remained stable. There was a positive correlation between temperature and the presence of both organisms in the sediment, indicating the enabling environment of sediment to aid in bacterial survival.
Conclusions: E. coli and C. perfringens are both suitable indicators of faecal pollution in riverbed sediments. However, both organisms need to be monitored together for accurate assessment of the faecal pollution of sediments. E. coli remains a good indicator of recent faecal pollution and provides insight into the short-term impact of faecal pollution, while C. perfringens gives an indication of the long-term impact of faecal deposition in riverbed sediments due to the organisms' persistence in the environment.