Indigenous Groundwater Microorganism Processes That Influence the Decay of Enteric Viruses

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ABSTRACT

The aim of this research was to further investigate the interactions between autochthonous groundwater bacteria (AGB) and the enteric viruses Poliovirus type 1, Coxsackievirus B3 and Adenovirus B41. It is established that these viruses reduce in number in the presence of AGB but the mechanisms behind this interaction were unknown (Gordon, 2001; Gordon and Toze 2003; Jansons et al. 1989; Keswick and Gerba 1980; Toze and Hanna 2002; Wall, 2001; Yates et al. 1985). Experiments were designed to examine the AGB individually and to assess the conditions under which virus removal was observed in order to determine the mechanisms. Four groundwater isolates were screened against poliovirus type 1, coxsackievirus B3 and adenovirus B41 under various conditions. The results of screening isolates 1G, 3A, 4B and 9G under heat treatments or with the addition of enzyme inhibitors showed similar results for the reduction of all three viruses numbers with little to no decay. Filtering reduced viral decay, whilst the metabolic inhibitor sodium azide had less influence on reducing viral decay. Identification was attempted for these four selected bacterial isolates. Three out of four isolates (3A, 4B and 9G) were sequenced and analysed using partial 16S rRNA sequences to determine their phylogenetic relationships compared to related organisms. Presumptive identifications to genus level were attempted based on phylogenetic relationships and a limited range of phenotypic and metabolic characteristics. Isolate 3A was assigned to the Burkholdaria genus, isolate 4B was placed in the recently identified genus Dokdonella, and isolate 9G was placed in the genus Ensifer.

The results of the experiments summarised above confirm the hypothesis that AGB are the major influence for the enhanced decay of poliovirus type 1, coxsackievirus B3 and adenovirus 41 in groundwater. The results also show that the influence of individual AGB vary for both virus type and the individual bacteria in question. Viral decay appeared to be of an enzymatic nature and may be comprised of a two-step system involving both proteases for breakdown of viral coat proteins and RNase or DNase enzymes for breakdown of nucleic acids. Results from this study have major implications for maintaining water quality and supply by managed aquifer recharge as water continues to become a more highly valued commodity. Water reuse is on the increase in Australia and results indicating the ability to predict and control the decay of potential waterborne pathogens can only aid in bolstering public support.