Bacteroides survival and growth in drinking water distribution systems.


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Bacteroides are the predominant bacterial group in the complex intestinal flora of almost all mammals and have been suggested as alternative indicators of fecal pollution since they are highly abundant in feces and are thought to have limited potential to grow in environment. In recent years Bacteroides have also been the focus of numerous microbial source tracking studies, in part because they are known to have a high degree of host specificity that likely reflects differences in source animal digestive systems.

The use of Bacteroides spp. as indicator organisms, however, has been hindered by the complex cultivation conditions required. The introduction of molecular methods has made it possible to detect bacterial species that belong to the order Bacteroidales, an order that includes the genus Bacteroides, without cultivation. However, despite the potential of Bacteroides as a fecal indicator, recent literature suggests that Bacteroides can potentially survive within water distribution systems.

Experiments were performed to investigate the ability of Bacteroides to survive within water distribution systems by using a laboratory scale model water distribution system consisting of an independent pipe loop constructed of PVC. The model was used to investigate the survival of Bacteroides in water distribution systems. The system was spiked with 109 Bacteroides and water and biofilm samples were collected five times during the first day. The sample collection continued daily
for the first week, and once a week for the subsequent six weeks.

Positive culture results were obtained only from samples collected within the first hour after spiking. PCR assays were performed on biofilm samples collected in week seven and month four. Week seven biofilm samples were PCR positive while month four samples were PCR negative for Bacteroides. The experiment was duplicated with analogous results. In addition, field samples were collected to examine the presence of Bacteroides in drinking water distribution systems. Water meters were collected from water utilities within central Arizona. Upon removal for repair by city personnel, meters were immediately submerged in a clean bucket of water and biofilms were collected by scraping the inlet of each meter using a bleach-sterilized nylon brush. The brush was vortexed in 20 ml of sterile buffer to recover bacterial samples. The samples were then cultured using Bacteroides Bile Esulin agar in Bio-Bag™ Anaerobic Environmental Chambers. Sixty-five samples were analyzed with no positive culture results and 27 of the samples tested positive by PCR assay and were confirmed as Bacteroides by DNA sequencing. Positive PCR amplicons were sequenced and compared to the Genbank database. Sequences showed high homology (97-99%) with uncultured Bacteroides.

The results of this study support the hypothesis that Bacteroides can potentially be found in water distribution systems despite the difficulty of cultivating these bacterial cells. This study suggests the importance of considering biofilm interactions with fecal indicator bacteria when performing molecular assays in environmental samples. Although the significance of biofilm interactions with surface or recreational waters may be small, they are likely important when considering drinking water delivered through distribution systems.