TITLE: THE USE OF Escherichia coli AND Bacteroides thetaiotaomcron AS FECAL CONTAMINATION MARKERS IN GROUNDWATER AFFECTED BY INADEQUATE SANITATION

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ABSTRACT:
In the Brazilian Amazon States, provision of basic sanitation services lags behind with 55.4 percent of residents having potable water from a distribution network and only 10.5 percent having sewer service. As population density increases in the region, greater volumes of contaminants enter the shallow groundwater resources through septic tanks. Watersheds with high septic tanks densities exhibit increased concentrations of fecal indicators and septic systems seem to be the primary driver of the increased fecal bacteria levels. Higher septic system densities are associated with endemic diarrheal illnesses making areas with a lack of sanitary infrastructure and limited access to clean drinking water particularly vulnerable to diseases. We investigate the use of Bacteroides thetaiotaomcron (hereafter B. theta) as a robust human fecal contamination marker for groundwater resources. Thirty household wells within urban Altamira, Pará, were sampled and analyzed for fecal coliform indicators Escherichia coli and B. theta to determine the presence and magnitude of human fecal contamination in the local groundwater resources. We used Aquagenxx’s Compartamental Bag Test, a most probable number (MPN) chromogenic method for E. coli in drinking water. Since E. coli can be found in tropical soils and in the feces of warm-blooded animals, we used microbial source tracking (MST) and quantitative Polymerase Chain Reaction (qPCR) assays targeting the B. theta α–1–6 mannanase gene, which has high human specificity. Nineteen of the homes sampled tested positive for E. coli with concentrations ranging from 1.1 to greater than 100 MPN/100mL and the geometric mean of 10.13 MPN/100mL. Thirteen of homes sampled tested positive for B. theta ranging from 37.02 to 43460.58 copies/mL and geometric mean of 4132.69 copies/mL. Only eight of the homes tested positive for both fecal coliform markers. Based on these results, we conclude that the presence of E. coli in 63% of the sample demonstrates the existence of fecal contaminants in the local groundwater resources. The presence of B. theta in 43% of the homes demonstrates that not all of the fecal contaminants reaching local groundwater resources are human in nature. Considering sanitation both an important societal and environmental issue that affects water quality, and public health and safety, B. theta can be a useful indicator for the likelihood of contaminant intrusion from septic tanks to water wells in the region.

Keywords: septic tanks, qPCR, potability, coliforms, public health