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Using Q-PCR and Bacteroides-Specific Molecular Markers to Quantify Sources of Fecal Contamination in a Reclaimed Water Irrigation Pond

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Abstract Text:

Increasing demands on limited water resources have made wastewater reclamation for municipal irrigation an attractive option for extending available water supplies. However, there remain public health concerns about the potential risks to humans coming into contact with irrigation water. We are monitoring irrigation water quality in a municipal city park in Maricopa, Arizona, where turf has been watered with reclaimed municipal effluent since the opening of the park in September 2006. The presence of viable bacteria (E. coli and Salmonella) in the irrigation system, and in an adjacent pond where reclaimed irrigation water is held prior to application, are being monitored using standard culture techniques. Through the first twelve months of the study, Salmonella and E.coli levels in the irrigation water averaged 9.9 x 10^2 CFU mL-1and < 0.2 CFU mL-1 respectively, lending the question as to the source of the bacteria. Currently the pond is stocked for recreational fishing and also serves as a haven for waterfowl. Because this municipal pond has many potential inputs for contamination we are using quantitative real-time PCR and Bacteroides-specific primers to quantify and differentiate the sources of fecal bacteria (human vs. other) in the pond and irrigation water. Both SYBR green- and Taq Man-based Q-PCR methods were evaluated to determine their applicability to this study. The Taq Man assay for quantifying human Bacteroides showed significant cross-reactivity with fish feces and thus was not used in this study. The SYBR green assay showed no cross-reactivity with fish, but did not allow us to differentiate between human and dog Bacteroides. Q-PCR results using these primers showed that human and dog Bacteroides accounted for less than 2% of fecal bacteria in the pond and irrigation water. Current work is aimed at separating the dog and human Q-PCR signals, to determine unequivocally whether dog feces have contaminated the pond, or if regrowth of human enteric bacteria in the reclaimed water may have occurred. By identifying the sources of fecal bacteria within the parkland, this work will reveal potential public safety impacts, and ecological benefits, of using reclaimed water for municipal irrigation.

Impact Statement:

The use of reclaimed wastewater for municipal irrigation is increasing throughout the world. Yet, public confidence in the safety of its use is not increasing at a similar rate, as reclaimed water is seen as "recycled toilet water." By using the most modern methods in identifying the sources of fecal bacteria in this parkland, we are working to identify any public health impacts inherent in the use of reclaimed water for irrigation.