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Chemical-based fecal source tracking methods: current status and guidelines for evaluation

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ABSTRACT

Fecal source tracking is a rapidly evolving field for which there have been a number of method evaluation studies, workshops, review articles and a book that synthesize information about method efficacy. Chemicals that are specific to human wastewater offer several potential advantages over biologically based methods, but have received less scrutiny. More than 35 chemical analytes have been found to consistently occur in human waste streams, and here we review these potential human-origin indicators in context of 7 evaluation criteria. Some chemical methods offer advantages over microbial methods: they are generally faster to prepare and analyze, more source-specific because they are not confounded by regrowth in the environment, and some may be more geographically and temporally stable. However, they often require specialized equipment and are usually more expensive regarding sample preparation and analysis. Additionally, most chemicals that are specific to human waste-streams occur at concentrations low enough to be diluted below detection limits once the waste-stream enters the ambient environment. These two factors will likely result in chemical measures being used more often as cross-validation supplements or initial screening approaches, rather than replacements for microbial measures. Cross-validation supplements include several chemicals that are highly specific to human sources and can be important contributors when certainties about human sources are critical, such as in drinking water applications. At least one set of chemicals, fecal sterols and stanols, may have potential for identification of other sources in addition to humans. Of all the chemicals examined to date, optical brighteners (OBs) in detergents have shown considerable promise, especially for screening purposes. Optical brighteners are not as sensitive as most microbial assessments, but can be measured with a hand-held fluorometer, providing near real-time and relatively inexpensive tracking of signals in the field, if the human fecal source contains an OB concentration large enough to produce a measurable signal.