Using Fluorescence Spectroscopy to Detect Low Levels of Pharmaceuticals in Three Maine Rivers.

THE NATIONAL NEED

It is well known that much of what we ingest and use in our daily live is excreted back into our environment. In the era of modern medicine, pharmaceutical and personal care products (PPCP's) are widely consumed and used by human populations and thousands of tons of veterinary compounds are fed to animals every year. These compounds and their metabolites find their way into our drinking water supplies through a variety of routes; treated wastewater, agricultural runoff and biosolids and manure used as fertilizers.

PPCP's are contaminants of emerging concern in U.S. water supplies. Although the concentrations of individual compounds are very low, the sheer numbers of different compounds found are quite large. Very little is known regarding the behavior of these compounds in the water. Additionally, the toxicological effects on human and ecosystem health from chronic exposure to these numerous compounds, as individual compounds and as mixtures, are poorly understood. There is an evident need for cost-effective, rapid monitoring technologies that can detect these compounds at the low concentrations found in the environment for purposes of modeling and assessment.

OVERVIEW & OBJECTIVES

This study will develop a new method using Synchronous Fluorescence Spectroscopy (SFS) and Emission Matrix (EEM) spectroscopy as techniques to identify and characterize PPCP compounds in water samples. Analysis of EEM spectra will be performed using N-way partial lest squares regression-discriminate analysis (NPLS-DA) and parallel factor analysis (PARAFAC). These techniques, if determined robust, provide a cost-effective method of identifying and characterizing, at very low concentrations, what mixture of compounds are present in the water.

If demonstrated successful, the methods in this study will provide specific advantages over current methods used to detect PPCP compounds in water.

- Most current methods require some sort of separation/isolation of the compound from the sample prior to analysis. The fluorescence methods described in this proposal can potentially identify a mixture of compounds from a sample scan and no separation is required prior to generating spectra. Rough filtration of the sample to remove extraneous material is the only sample preparation needed prior to analysis.
- The proposed methods are rapid and less expensive (people and equipment). The potential time and cost benefit of the proposed method will allow for more frequent sampling and allow for the assessment of a wider range of potential contaminants to provide a more accurate analysis of water quality.
- Fluorescence detection probes are common in remote field instruments. If the fluorescent methods are determined to be sufficiently precise and accurate for detection of our compounds, probes can then be deployed in more remote areas. This will result in a more robust data set and allow for a more accurate risk assessment of PPCP's in water supplies.

PROJECT PLAN

This study will first focus on developing the described methods with selected PPCP compounds. The developed method will be used to analyze water samples on a monthly basis from three different natural locations each below sewerage treatment plant outfalls: 1) Stillwater River, Orono, Maine 2) Penobscot River, Bangor/Brewer, Maine 3) St. John River, Fort Kent, Maine. Additional samples will be collected directly form filtered wastewater effluent. These will be collected from the Bangor and Old Town water treatment plants.

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