SOAR Research Proposal – Summer 2016

Optimizing extraction and analysis using liquid chromatography

Faculty: Alison Holliday, Assistant Professor of Chemistry
Student: Meeghan Rossi
Project Start Date: May 31, 2016
Length of Project: 10 weeks (Meeghan will be shadowing a forensic scientist for 10 days in the summer, but will make up the time.)

Description of the project:

The main focus of Meeghan's research will be the completion of an ongoing research project in the Holliday lab. This project involves the development of an economical interface between a sampling device and an instrument for chemical analysis.

Solid phase microextraction (SPME) uses a very thin fiber to extract chemicals from the surrounding water, similar to a chemical class-specific sponge. It is a portable and easy to use sampling device. The commercial fibers are designed to interface with a gas chromatography instrument; they directly fit into the hot injection port to allow thermal desorption (boiling off) of the collected chemical prior to analysis. However, not all chemicals are stable when heated to high temperatures, and thus not all chemicals can be analyzed by gas chromatography. The most common alternative is to use liquid chromatography.

Commercial interfaces between SPME and liquid chromatography are either very expensive or involve extensive dilution of extracted compound, which could bring a chemical's concentration below the instrument's detection limit. The Holliday lab has been developing a simple and inexpensive syringe-based method using solvent to desorb the chemical from the SPME fiber and introduce it into the liquid chromatography instrument.

For the past year, Adam Struss'16 has been working to quantify the extraction of phenolic compounds from water using SPME. Meeghan would build upon his work to complete the analysis, optimize the extraction and desorption steps, and expand the approach beyond the phenol class of chemicals. We begin with this class, since it can be analyzed both by gas and liquid chromatography. This permits careful comparison of results to the established gas chromatography method in order to determine the efficacy of the liquid chromatograph method.

Roles and responsibilities:

- Alison Holliday will train Meeghan on the use and troubleshooting of the gas chromatography and liquid chromatography instruments, as well as how to run a solid phase microextraction analysis.
- To start each day, Meeghan will have a meeting (~30 minutes) with Alison and the other member(s) of the research group (who will be working on a different project). Results will be reported and discussed and plans for the day will be proposed and discussed.

- Meeghan will maintain a laboratory notebook that will include regular and complete entries, such that another student could follow her experimental progress. This includes ideas behind experiments, details of experiments (including solution preparation), the location of any electronic data files containing results or analysis, and a summary of results from each experiment. The notebook will be submitted to Alison upon completion of the research project.
- Meeghan will prepare a brief (<5 page) report to summarize her summer progress on the project.
- A poster would be presented at the Annual Student Scholarship and Creative Endeavors Day in Spring 2017.

Project timetable

Week 1-2: Learning how to run and troubleshoot the gas chromatography and liquid chromatography instruments, as well as how to analyze the resulting data. Solution preparation and selection of method and chemical(s) for SPME extraction.

Week 3-4: Gas chromatography analysis to characterize SPME extraction efficiency.

Week 4-5: Liquid chromatography analysis of SPME extracts. Learning the syringe-based desorption method. Establishment of detection limits using liquid chromatography.

Week 6-7: Optimization of the syringe-based desorption method. This may include solvent volume, solvent identity, desorption time, desorption temperature, and mixing.

Week 8-9: Modification and application of method for analysis of another class of compounds.

Week 10: Repeat analyses, as required. Write a <5 page report for submission.

Student engagement in discipline-appropriate scholarly research

Analytical chemistry involves the development and testing of new methods or instrumentation to observe and quantify chemical, biological, and physical systems and processes. Meeghan will be engaged in analytical chemistry laboratory research that includes planning and performing experiments involving new instrumental methods, analyzing significant amounts of data, and reading the primary literature to contextualize her findings and guide her choice of experimental conditions.

Contributions to the Discipline and Opportunities to Share Work

This type of research is publishable in analytical chemistry journals, and successful completion of this work should lead to publication. Although economic approaches are not the focus of most analytical chemists (multi-million dollar instruments are always in vogue), there is a need for instrumentation that is accessible to a wider community of scientists.

Meeghan will be sharing her results within the Moravian research group. She may have the opportunity to present her work at a regional conference (the Eastern Analytical Symposium), and will be required to present her results during the Annual Student Scholarship and Creative Endeavors Day in spring of 2017.

Project Title: Optimizing Extraction and Analysis Using Liquid Chromatography

Student: Meeghan Rossi

Major: Chemistry/Psychology (Interdepartmental)

Projected Graduation Date: May 2017

Faculty Mentor: Dr. Holliday, Assistant Professor of Chemistry

On-Campus Housing Requested: Yes

My career goals include attending graduate school to receive my Master's Degree in Forensic Science, most likely following a track in Forensic Chemistry, and then finally, to work in a forensic laboratory as a scientist. I would like to participate in the SOAR Program to refine my research skills. Refining my research skills in chemistry will allow me to be more successful in my field.

Working with Dr. Holliday on this project, "Optimizing Extraction and Analysis Using Liquid Chromatography," will teach me new techniques of extraction and analysis. This extraction technique is important for me to learn, as it allows for extraction of chemicals from surrounding water, at a micro level. This will be useful in graduate school and in my career as some chemicals will need to be extracted in this fashion to be able to analyze them. The analysis technique is liquid chromatography, which is necessary to use in cases where the chemical cannot go through gas chromatography.

I would like to spend my summer working on this project in the hopes of finding a solution to the presented issue with extraction and analysis. In my preparation for graduate school and a career working in a lab where I will need proficient knowledge of instrumentation, this project will allow me to learn techniques I will need to know. Learning these new techniques will broaden my database of instruments that I can use in a laboratory.