



PASS Form Information

**Form:
22933**

Title of Experiment: "Comparing Chlorpyrifos Levels in Commercial vs. Organic Parsley"
Principal Investigator: Lucinda Hemmick
Institution: Longwood Sr. High School
Primary Field of Research: Environmental Sciences
Type of Proposal: Rapid Access

On-site Access: Experiment will be performed on-site, in person by the PI's experimenters. The PI (and approved experimenters) may also request remote computer access for operating equipment, data collection and retrieving data.

Research

Abstract of this experiment. This section will be used for funding agency reporting purposes. This information and the proposal title may become public information.:

We propose to compare the levels of the pesticide chlorpyrifos (Dursban) in commercially versus organically grown parsley, using the infrared microspectroscope at NSLS beam line U2B. Recent evidence links exposure to chlorpyrifos (CPF) to higher rates of ADHD and lowered IQ in children due to its neurotoxic effects. CPF levels in commercial parsley are unusually high (Japan only recently lifted enhanced surveillance on U.S. parsley in 2011). Students will purchase parsley samples at local supermarkets and organic farms, prepare concentrated extracts, and use the known IR spectrum of CPF to detect and compare overall levels in the samples. Also, students will use the microspectroscope to compare CPF distribution in the tissues of the original parsley samples. We are not aware of any similar studies related to comparing CPF levels and distribution in produce, so this is a novel application of techniques. This experiment will provide new information on whether consuming organic produce can lower CPF exposure in diets, and will also provide students with valuable experiences in chemical separation techniques, understanding of IR spectra, and ability to apply knowledge of plant biology and structure to explore the uptake patterns of this dangerous pesticide.

Funding Sources

DOE, Office of Workforce Development

Beam Time Request

This Request is for Cycle:

September - December 2012

Current Cycle Request

Comments to Scheduler:

Proposed work, plans and accomplishments for Beam Time in the requested cycle for this PASS Form:

Studies on the effects of pesticide exposure via produce have shown an alarming new trend. Infants and children who had higher organophosphate levels in urine during development have been shown to be at greater

risk for developing ADHD, and have lower IQ's. Organophosphates are neurotoxic, which is thought to explain the higher risks. A major chemical in this class is chlorpyrifos (trade name Dursban). It is widely used to control pests in both rural and urban settings. Certain types of produce have been noted to contain very high levels of chlorpyrifos (CPF). Our research is aimed at detecting and measuring the levels of CPF in one of these types (parsley). We will make concentrated extracts of both commercially and organically grown parsley samples, and compare their CPF levels using the infrared microspectroscope at beam line U2B of the NSLS. In addition, we will investigate the distribution of the CPF within the plant tissues of the parsley. The scientific merit of this study lies in gaining new information about whether purchasing organic produce can reduce pesticide exposure to infants and children during critical phases of development. In addition, we may be able to identify which parts of the plant are highest in CPF, which would be useful information for preparing a commercial product lower in CPF by removing the structures in which the levels are most concentrated.

Experimental methods: Students will purchase batches of parsley from local stores (for the commercial samples), recording data such as the company and the country of origin. For contrasting samples, parsley will be bought from local organic farms common in our region. Small amounts of the original plants will be stored intact until the experiment, and the remainder will be used to extract the CPF. Students have noted that the CPF is most soluble in organic solvents (574 g/100 ml of toluene). They will prepare an extract of each sample by pulverizing a known mass of parsley in a mortar and pestle in the presence of acetone (a less toxic solvent that students can safely handle in a fume hood). We believe that sufficient concentration will lead to near millimolar levels of CPF, easily detected by the method chosen. The samples will be evaporated to dryness in test tubes and stored until the experiment, at which point they (and the original parsley plant samples) will be taken to the NSLS. The teacher will then reconstitute the samples in a small volume of acetone and apply them to microscope slides. From estimates provided by one of the U2B scientists, we believe that a total of 6 samples (3 commercial, 3 organic) can be processed in one day. Students have researched the IR spectrum of CPF. Its strong absorption regions at 1410, 1030, 970, and 870 cm^{-1} should make it easy to detect in the extract samples and in the plant tissues. Each sample will be tested for both relative levels of CPF in the extracts, and also for CPF distribution in the parsley plant tissue from which extracts were prepared.

The educational impact of the project is enormous. Students will be involved in a study that could potentially limit risks by changing consumer behavior. They will also learn chemical techniques involving preparation of a concentrated extract, a process that requires knowledge and application of solution chemistry. They will need to calculate the mass of parsley required to produce an extract expected to contain millimolar levels of CPF, which involves extrapolation of CPF concentrations found in the literature for parsley. Students will use their botany knowledge to appreciate how CPF travels through the parsley tissue, and if there are concentrated regions, they can propose how these regions might be removed by either the grower or the consumer before it is consumed in order to lower CPF exposure. Their scientific involvement in an active environmental topic will motivate them towards future work in the sciences.

Technique

InSynC - Education

Proposal Review Panel: InSynC - Education Rapid Access

Beamline requested (for each Technique, listed in PI's order of preference):

U2B General User Beamtime

Number of days of Beam Time desired for this Technique in this cycle: 1

Minimum number of days needed: (below which experiment cannot be done effectively) 1

Requirements:

Wavelength / Energy Range: 4000-500 cm^{-1}

Spot size on sample: 10 microns

Resolution:

Energy: 4 cm^{-1}

q:

Other:

Characteristics of the beamline chosen are most important (e.g. energy range, focusing, equipment):

high brightness, small spot