Urinary Metabolites in Environmental Media: A Scoping and Feasibility Study

Start Date: 9/2001 **Completion Date: 9/2005**

Project Purpose:

To determine the extent that urinary biomarkers and their parent compounds occur in food and dust samples from exposure studies for pyrethroid, organophosphate, and carbamate pesticides . In addition, to examine the relationship between the urine concentration of pesticide metabolites and environmental concentrations of pesticide metabolites and parent compounds.

Background:

The interpretation of pesticide urinary metabolite concentration in terms of exposure of an individual to the parent compound has been clouded due to the potential existence of parent compound degradation products in the environmental media (parent pesticide compound degradation in the environment which results in the formation of the same compound as measured in the urine as a metabolite).

As an example, researchers have had many problems with interpretation of the urinary metabolites of chlorpyrifos (the specific leaving group TCPy) since hydrolysis of the parent compound in environmental media (i.e., foods) results in TCPy. Therefore, a person may be exposed to the leaving group (TCPy) without ever being exposed to the much more toxic parent compound. It has been demonstrated that some foods contained levels of the metabolite TCPy which were six times higher than the parent compound of chloropyrifos. At the 2001 ISEA meeting, some participants were stating that this could happen also with many of the other urinary markers (e.g., dialkylphosphate markers). Presently, little supporting data are available regarding this issue. In the case of chlorpyrifos, the relationship between the concentration of the urinary metabolite TCPy and the exposure of the given individual to the parent compound is highly nebulous (e.g., in cases where dietary exposure accounts for a significant portion of the total exposure). Although we know degradation of parent compounds occurs in the environment, the fundamental question is how extensive is this type of phenomenon (environmental degradation resulting in compounds matching the urinary metabolite and in more significant quantities than the parent). This research is intended to answer such questions as: Does this occur, and to what extent in other environmental media, such as house dust, water, air, or soil? What about the urinary metabolite markers for carbamates, pyrethroids, other organophosphate pesticides' specific leaving groups and the dialkylphosphate markers? Do they have the same potential problems as the chlorpyrifos marker?

Project Description:

Initially dust samples from Yuma, Arizona (collected under an EPA STAR grant by the University of Arizona) will be analyzed for both parent and metabolite compounds of pyrethroid, organophosphate, and carbamate pesticides. Parent compound/metabolite ratios will be established for the selected pesticides to determine if metabolite concentration in environmental media could significantly influence the interpretation of exposure as measured by urinary metabolites.

Next, the research will focus on those pesticides that are most frequently detected in surface dust samples (i.e., chlorpyrifos, diazinon, and permethrin) and other pesticides (carbamates) and their

relationship to urinary metabolites. Dust samples (240) will be collected from homes where recent application has occurred. These samples will be collected prior to the application and at 12, 24, and 48 hours after application. Parallel biological samples (urine and salvia) will be collected prior to pesticide application and at 12, 24, 48, and 60 hours after application. The dust samples will be analyzed for all selected parent and metabolite concentrations while the urine samples will be analyzed for the metabolites. Saliva samples will be analyzed for metabolite concentrations. Relationships between parent/metabolite concentrations in environmental media and biomarkers in urine and saliva will be examined.

Future research will greatly depend on the results of these pilot studies. However, it is envisioned that samples (including dust, food, and biological samples) from future field studies will be analyzed for parent and metabolite concentrations for the most frequently applied pesticides.

Accomplishments:

- Fall 2001 - Received dust samples from the University of Arizona. Currently analyzing samples for selected pesticides and their metabolitse.
- Summer 2001 - RFP for dust, urine, and saliva collection and dust extraction of frequently used pesticides.
- Fall 2001 - Awarded contract to Research Triangle Institute for sample collection and extraction - currently seeking IRB approval for the project.
- Fall 2004 – Samples have been collected and extracted – currently waiting for samples to be analyzed.

Expected Outcome(s):

This research will help define the relationship between environmental concentrations and urinary metabolites for frequently-used pesticides. This is vital to the interpretation of urinary biomarker data for exposure assessments. In addition, this research will explore the potential of using saliva as an alternative to urine or blood samples. This would be an obvious advantage to future exposure field studies of pesticides in terms of cost and convenience.

Journal articles will be published detailing the relationship of concentration of metabolites and parent compounds in environmental samples and urine. The first article is scheduled for publication in December 2005.

Project Contacts:

Dana Barr, CDC/NCEH (707) 488-7886 dlb1@cdc.gov

Gary Robertson, EPA/ORD (702) 798-2215 robertson.gary@epa.gov

Participant(s):

CDC/NCEH, EPA/ORD