Measurement of Farmworker Exposure to OP Pesticides through Protein Adducts

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Exposure to OP pesticides and Health

- OP pesticides are still widely used in agriculture.
- The abundant use of OP pesticides world wide causes several hundred thousand poisonings per year\(^1\)
- The primary acute toxicological effect of OP exposure is related to inhibition of cholinesterase enzymes.
- Chronic low-level (non-occupational) exposure to OP pesticides is associated with neurological deficits and behavioral impairment.\(^2\) The mechanism behind these long term health effects is unclear.

Cholinesterase testing for monitoring occupational exposures to OP pesticides

- **Advantages**
  - Relatively fast and inexpensive
  - Test-kits available for use in the field

- **Disadvantages**
  - Need baseline activity measure for each worker
  - Lack of specificity
    - Does not identify specific pesticide
    - High frequency of false positives
  - Lack of sensitivity
    - Does not provide reliable evidence for exposures at inhibition levels < ~20%
Measurement of OP-adducts to plasma ChE by HPLC/MS/MS.

- A “protein adduct” is the compound formed when a chemical binds (irreversibly) to a protein.
- Potential advantages:
  - Specific
  - Sensitive
- Assay initially developed for plasma cholinesterase; could subsequently be expanded to quantify adducts to other proteins
Toxicological Mechanism

Metabolism →

Adduct formation →

Aging →
Farmworker Study

- Study population: handlers & applicators participating in the WA State cholinesterase monitoring program
- Participants had blood drawn prior to the spray season (baseline sample)
- Follow-up blood samples were drawn after working with OP/carbamate pesticides for 30 hrs within a 30 day period
- 128 of these follow up samples were tested for OP adducts. Adduct levels were compared with plasma ChE depression.
Ethyl Adduct Fraction vs BChE Inhibition
In All Samples

\[ y = 1.3875x - 0.0093 \]

\[ R^2 = 0.5629 \]
Project aims: 2011-2016

- Expand the IMB/HPLC-tandem-MS assay to detect OP adducts to BChE and acylpeptide hydrolase.
- Develop a new clinic and field deployable assay to measure OP adducts to BChE, using a modified lateral flow immunoassay (LFIA) approach.
- Utilize the IMB/HPLC-tandem-MS and immunoassays to measure OP exposures in archived blood samples obtained from occupationally exposed farmworkers.
- Research to practice: Evaluate the reliability and suitability for use of the OP-adduct LFIA in health clinics and in the field.
**BChE purification**

MW: molecular weight marker, P: plasma
Comparison of two MS methods for measuring OP adducts

\[ y = 1.4417x + 4.5892 \]

\[ R^2 = 0.5479 \]