Environmental Toxicology: Pesticides in Perspective

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Environmental Toxicology

Goal: Think critically about issues related to the detection, occurrence, properties, effects, and regulation of chemical technologies.

Occurrence: Environments

- Personal
- Occupational
- Community
- Global

Toxicology

Scientific study of adverse effects of chemicals

• Effects are a function of dose

• Principle was codified by Paracelsus

 If dose determines a poison, there must be a safe level of everything!

Detection

- Biological responses
 - Food vs Non-food
 - Mind-altering and poisonous properties
- Poisonous Principles: Bioassay
- Chemical analysis and food purity
- Trace environmental chemical analysis
 - Specificity
 - Sensitivity

Regulation: How much is too much? How little is OK?

- LD50
 - ED50
 - Threshold or Low Observed Adverse Effect Level
 - No Observed Adverse Effect Level
 - » No Observed Effect Level
 - Uncertainty factors
 - Species
 - Intraspecies
 - Special (children)
 - o Reference Dose (mg/kg-day)

Pesticides: Physical and Chemical Properties

- A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses.
- Insecticide, fungicide, herbicide, "-cide"
- Active ingredients and products

Environmental Toxicology: Pesticides

- **D**etection
- Occurrence
- **P**roperties
- Effects
- Regulation

- ppm *to* ppt (ND≈0)
- Food residues
- Parent & biomarkers
- Hazards vs Risks
- Aggregate Exposure

Loss of public confidence in chemical technologies, particularly pesticides— Environmentalism of the 1960s and 70s!



Rachel Carson, *Silent Spring*, a novel presented as though it was factual, 1962

Pure foods: RESIDUES Water/Air: **ENVIRONMENT Testing: SAFETY EVALUATION**



Birds have recovered *Much Sooner* than DDT and other chlorinated hydrocarbons have disappeared from foods and the environment—was it really food chains and DDT biomagnification?

We need to Check it out!

"...to be on the safe side, she doesn't buy."

1959

Take this, try that! **Rats and Mice have** had a rough 50 years!



Food as Food Properties Ingredients Chemicals

1865	1892	1910
Paris green copper acetoarsenite paint pigment Colorado potato beetle ca.1942: 4 x 10 ⁶	lead arsenate gypsy moth forest and shade trees 1945: 80 x 10 ⁶	arsenicals nicotine pyrethrum derris (rotenone) lime-sulfur (Bordeaux mixture)

Discovery and introduction of DDT as an insecticide 1942 to 1972 (U.S.)

"Pesticide residues are a condition of production..." Harvey Wiley, founder FDA 1906

Inv MelSuoy

Lead arsenate residues, ca. 1900





Public health experts estimate that there are 11 to 13 million cases of foodborne illness in Canada every year. Many more in the USA...

"How many are caused by *pesticide residues*?" Silence

If apples and pears looked like that, and foodborne sicken and kill, why are pesticides perceived as such a threat to health in developed countries of the world? New perspective on pesticide residues in food...

The public revulsion for pesticides is magnified by the thought they will become part of us. B. Krieger, 2008 Pesticide Exposure Assessment: Occupational and Food Residues

- When pesticides are used, applicators are inevitably exposed at some level. Frequently these exposures can be estimated by urine biomonitoring.
- Daily exposures to pesticide residues of applicators and consumers will be calculated from urine biomonitoring data.
- Problem solving exercises available Jan 12, 2008.

Supplemental Readings: Pesticides

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