Chemical Hazards and Controls

Tim Herrman
Professor, State Chemist and Director
Office of the Texas State Chemist

TEXAS A&M AGRILIFE RESEARCH

Chemical Hazards

- Ways the hazard is introduced into the facility:
  - Incoming raw ingredients
  - Employee practices
    - Batching
    - Mixing
    - Warehousing
    - Load out

Laws and Regulations

- Require that foods are sage and free of adulterants
- The FDA, EPA and USDA enforce provisions of pertinent laws and regulations

Federal Food, Drug and Cosmetic Act

- A food is adulterated:
  - If it bears or contains any poisonous or deleterious substance which may render it injurious to health, or
  - If it bears or contains any added poisonous or deleterious substance.

Mycotoxins Developed in the Field or Storage

5

Pesticide Contamination

6

Cross Contamination in Storage or Processing

7

Contamination from Equipment Carryover

8

Types of Chemical Hazards

- **Mycotoxins**
  - Produced in feeds as byproducts from the growth of specific types of molds
- **Drug residues**
  - Unapproved
  - Exceeding tolerance levels
- **Toxic elements/compounds**
- **Dioxin and PCBs**
- **Pesticide residues**

Fungal Toxins

Fungus	Toxin
Aspergillus flavus, A. parasiticus	aflatoxin
Fusarium species	tricothecenes
F. Verticillioides	fumonisins
F. Graminearum	zearalenone
Penicillium verrucosum	ochratoxins
Claviceps	ergot

Drug Residues

- **Incoming ingredients**
  - DDGS
- **Cross contamination**
  - Mixer
  - Conveyors
  - Holding bins
- **Weighing out wrong ingredient**
  - Hand adds
  - Charging micro-bin with wrong ingredient
  - Formulation error

Heavy Metals

- **Lead (Pb)** is a naturally-occurring neurotoxin. Lead toxicity primarily targets the nervous system, kidneys, bones, heart and blood, and poses greatest risk to infants, young children and pregnant women.
- **Mercury (Hg)** toxicity can affect the central nervous system, kidneys and liver.
- **Arsenic (As)** toxicity seems to predominantly affect the skin, lungs and gastrointestinal system, and may cause nervous disorders, deteriorated motor coordination, respiratory diseases, and kidney damage as well as cancers of the skin, liver, bladder and lungs.
- **Cadmium (Cd)** primarily affect the lungs, kidneys, bones, and immune system.
- **Others** – http://otscweb.tamu.edu/OTSC-Present/2011/Heavy%20Metal%20Analysis-10-21-2011-wei.pdf

Pesticide Residues

Dyfonate Case Study – Found in meat and bone meal in Texas at 0.86 ppm

EPA tolerances for this organophosphate insecticide that were located in 40 CFR 180.221. These tolerances were established for O-Ethyl S-phenyl ethylphosphonodithioate, which is the chemical name for fonofos, and ranged from 0.5 ppm on asparagus to 0.1 ppm on several raw agricultural commodities including corn grain and peanuts. All these tolerances were revoked as of December 31, 2002 so today any quantifiable level of fonofos on a feed ingredient is a technical violation.

Dioxin and PCBs

- **Sources:** clay, citrus pulp, fish meal and oil, other sources of fat and oil, trace metal ingredients manufactured through the smeltering process
- **Testing:** High resolution GC, high resolution mass spectrometry, bioassay technology for screening
- **Recent incidents:** German Agriculture Minister Ilse Aigner on Tuesday urged state officials to implement a federal action plan that aims to prevent future food contamination ahead of special government summit on the dioxin animal feed scandal (Jan 21, 2011).

  The EU pig market is in crisis due to high cereal prices and the dioxine problems in Germany.

- **Hazard:** wasting, skin disorders, immune suppression, enlarged liver, endocrine disruption

Control of Chemical Hazards

- **Products received into the facility**
  - Approved suppliers
  - Pre-requisite programs
    - Visual inspection
    - Sampling and analysis
- **During processing**
  - Employee practices
  - Prerequisite programs

Summary

- Chemical hazards exist in every facility
- HACCP teams must ask themselves:
  - What is the likelihood of the hazard?
  - Do we already have something in place to control that hazard?

Contact Information:

tjh@otsc.tamu.edu

Tim Herrman
Professor, State Chemist and Director
Office of the Texas State Chemist

TEXAS A&M AGRILIFE RESEARCH