

Poisonous Plants & Residues

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(materials from Michael E. Mount)

Topics

- Poisonous Plants
 - Cassava & Bitter Almond
 - Water Hemlock
 - Poison Hemlock
 - Death Camas
- Drug Residues

Poisonous Plants – Cassava

- Scientific name: *Manihot esculenta* (C)
- Family: Euphorbiaceae
- Other names: yuca, manioc, and mandioca
- It originated in South / Central America.
- Two distinct types of cassava exist — the sweet and the bitter.

Cassava – Background

- A perennial woody shrub.
- Grown as a root crop in the tropics.
- The 4th most important source of calories for humans among crops produced in the tropics.



Cassava – Production

- An important staple for about 800 million people worldwide.
- ~ 172 million tons produced worldwide in 2000.
 - Africa accounted for 54%.
 - Asia 28%.
 - Latin America and the Caribbean 19%.



Cassava – Production

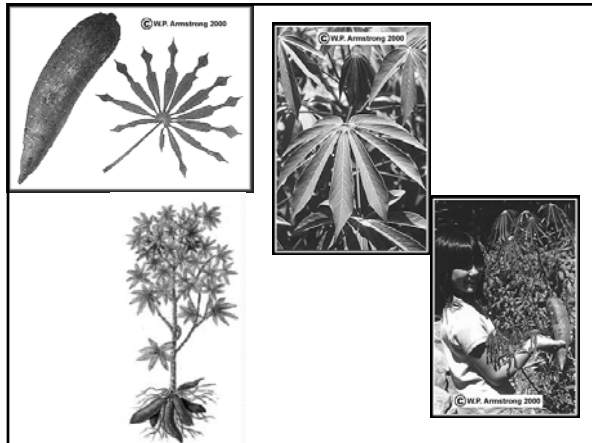
- Cassava.
 - important basic energy source for humans.
 - that can be produced on marginal agricultural lands.
- Addresses growing food deficits.
 - poverty-stricken regions.
 - third world countries.
- Other Uses.
 - animal feed.
 - industrial production of starch.

Cassava – Drawbacks

- Undesirable food that contains little besides carbohydrate.
- **Cyanide** present in the plant.

Cassava – Drawbacks

- Cyanide toxicity occurs only in certain areas of Africa.
- Associated with severely deficient diets.
- Under-processing of cassava as a food source.
 - Harvesting the crop.
 - Time of drying and loss of the HCN.



Cassava – Characteristics

- Planted by cutting woody part of the stem.
- Grows well in low fertility soils.
- Tolerates long periods of drought.
- The roots develop into starch storage at about three months of age.

Poisonous Plants – Cassava

- Harvest can be anytime following this or up to 2–3 years.
- Roots stored in the ground from up to 24 months, some varieties up to 36 mo.



Poisonous Plants – Cassava

- Raw cassava has two cyanogenic glycosides.
 - Linamarin.
 - Lotaustralin.
 - These are not considered directly toxic.
 - Release prussic acid (hydrogen cyanide; HCN).

Poisonous Plants – Cassava

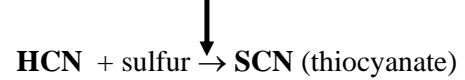
Following ingestion:

Linamarin → Glycoside + Cyanohydrin →
HCN Released (Toxic Agent)

- HCN targets the ferric iron (Fe^{+3}).
 - "a"-cytochrome.
 - Electron transport system in mitochondria.

Poisonous Plants – Cassava

- The body is able to detoxify low levels of cyanide in the body through the action of an enzyme, rhodenase:



- Poisoning occurs when exceed.
 - Acute.
 - Chronic.

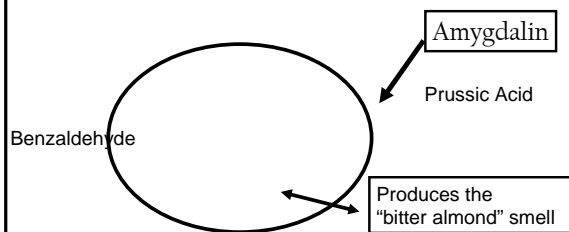
Poisonous Plants – Cassava

- Syndromes:
 - I. Tropical ataxic neuropathy
 - II. Epidemic spastic paraparesis.
 - (Chronic exposure) → goiter

Almonds

- Sweet Almonds
 - *Amygdalus communis var. dulcis*.
 - Confectionery nut.
 - Health food; essential oils.
- Bitter Almonds
 - *Amygdalus communis var. amara*.
 - Commercial source of essential oils.
 - Cake of fruit contains amygdalin.

Cyanide poisoning



Sweet Almond



Bitter Almond



Poisonous Plants – Water Hemlock

- *Cicuta douglasii* (Western water hemlock) and *C. maculata* (Spotted water hemlock) are two plants of concern in California.
- Other species across USA.
- Belong to the Parsley family (*Umbelliferae=Apiaceae*)

Poisonous Plants – Water Hemlock

- Western water hemlock
 - Northern and central California.
- Spotted hemlock
 - Central, southern California/Modoc county.
 - This plant and its varieties are spread across the US.
- Habitat
 - Fresh water streams, ditches, and marshes,
 - The most poisonous plants in Northern Hemisphere.

Poisonous Plants – Water Hemlock

- The plants are perennial herbs.
- The leaves are twice-compound and the segments are not divided.



<http://cal.nbc.upenn.edu/>



Western waterhemlock



Spotted waterhemlock

Poisonous Plants – Water Hemlock

- Roots are tuberous and show a series of cross-partitions containing a yellow liquid.



Poisonous Plants – Water Hemlock

- The flowers are white and in large, open, compound umbels.
- The seeds are flat faced to concave.



www.rce.rutgers.edu

Poisonous Plants – Water Hemlock

- The whole plant is toxic.
 - The root especially contains visible yellow liquid.
 - Leaves are also very toxic early in the spring.
- All domestic and wild animals are susceptible.
- Man is susceptible.
 - **Mis-identification of an edible plant:**
 - Edible parsnip plants (*Pasternica sativa*, *Lomatium* sp., *Sium suave*).



Water hemlock root



Sium suave
Water parsnip root



Water hemlock flower



Sium suave
Water parsnip flower

Poisonous Plants – Water Hemlock

- The plants contain cicutoxin — a neuropoison.
- Clinical signs within 15–60 minutes of ingestion: nausea, salivation, emesis, trismus (tetanic spasm of jaw muscles), toxic-clonic convulsions
- Unconsciousness, cardiac arrest, and peracute death.
- Treatment is invariably futile once signs occur.

Poisonous Plants – Poison Hemlock

- *Conium maculatum* is a common weed, nationwide.
- Poison hemlock is in the *Umbelliferae* family.
 - A tall plant with a long, white, often branched tap root.
 - The stem is stout, smooth, and dotted with irregular purple marks.
 - Leaves finely divided.

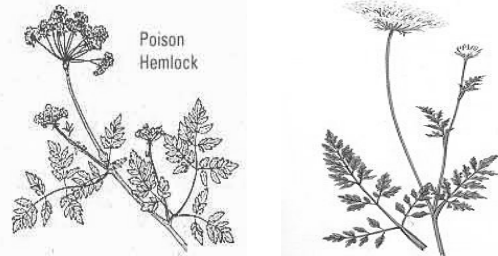
Poisonous Plants – Poison Hemlock

- It has a mouse-like odor.



Poisonous Plants – Poison Hemlock

- The plant is mistaken for wild carrot by persons who desire to "live off the land."



Poisonous Plants – Poison Hemlock

- The roots and seeds are the most toxic, but all parts of the plant are poisonous since the poison accumulates with age in the seeds, roots, stems and leaves.
- The degree of toxicity varies.

Poisonous Plants – Poison Hemlock

- Exposure of pregnant animals causes congenital malformations, particularly in cattle and pigs.
- Other animals can be affected too.
 - Time of exposure during gestation important.
 - Exposure of a woman should not produce problems.

Poisonous Plants – Poison Hemlock

- Used as a lethal agent historically.
- Socrates was forced to drink an herbal of this plant. He then described the course of the poisoning.
- Ascending paralysis leading to arrest of respiration.
- A convulsive syndrome may occur, particularly if roots or seeds are eaten.

Poisonous Plants – Death Camas

- *Zigadenus* sp (Death Camas) is a member of the lily family (Liliaceae).
- A herbaceous perennial plant with onion-like bulbs.
- Has slender folded linear leaves.
- A single showy flowering raceme characterizes the plant with yellowish-white colors.
- Plant sprouts very early in the spring.



Poisonous Plants – Death Camas

- **Clinical signs**

- Vomiting, nausea and abdominal pain within one hour of ingestion.
- Heart rate slows down (bradycardia is present).
- Generally, more serious signs do not develop in adults.
- Severe illness may occur in children.

Poisonous Plants – Death Camas

- **Treatment**

- Removal.
- Correction of hypotension with fluids and vasopressors.
- Atropine to correct bradycardia.
- More serious signs require
 - artificial ventilation
 - drugs to control seizures.
- Patients respond favorably.

Drug Residues

- **Definition:**

The concentrations of drugs or environmental chemicals that are detectable by analytical methods are defined as drug or chemical residues in tissues of food producing animals and other agricultural commodities for human consumption.



Drug Residues

- **Definition:**

Residues refer to the parent drugs or chemicals, their metabolites, and their decomposition products, if formed.

Drug Residues

- The quantity of residue if detected is expressed by weight:

mg of drug present /kg of tissue (ppm)

µg of drug present /kg of tissue (ppb)

units /L when in fluids

Drug Residues

- Residues are either intentional or unintentional.
 - Intentional residues result from a desired usage of the drug in animals or food products.
 - Unintentional residues are caused by events that exposed animals or food products to drugs or chemicals, not intended to be received by them.

Drug Residues

- Importance
- **Federal law** governs the amounts of residues allowed in human foods.
- The Delaney Amendment of the Food, Drug, and Cosmetic Act states that a known [synthetic] **carcinogen is illegal** in foods consumed by man.

Drug Residues

- This is referred to as "**Zero Tolerance**" and infers that no residue of a carcinogen is allowed for edible foods.
- **Analytical sensitivity** determines the "Zero Tolerance." However, absurdity in certain cases has allowed exceptions to be applied to this Amendment.

Drug Residues

- Importance
- Many drugs and chemicals have a finite tolerance considered safe.
- Hence, a "Tolerance Level" is established allowing for sale if equal to or below the the established limit.
- Residues that exceed the "Tolerance Level" are **illegal** and not saleable for human food.

Drug Residues

- Importance
 - Food-producing animals comprise the **largest source of residues**.
 - Over 300 feed additives and antimicrobial agents are in use within the US for applications in livestock and poultry.
 - New drugs are being added annually.

Drug Residues

- Importance
 - Feed additives are drugs, chemicals, biological substances added directly to animal feeds increasing performance or production.
 - Antimicrobial agents are drugs used to treat infectious diseases or other pathogenic agents that produce diseases.

Drug Residues

- Agencies Associated with Residues Food and Drug Administration (FDA)
 - ❖ A federal organization
 - ❖ Regulates the safety of drugs used in the US.
 - ❖ Responsible for setting "Tolerance Limits" of drugs, and dealing with violations of "Tolerance Limits" established for milk.

Drug Residues

- Agencies Associated with Residues
United States Department of Agriculture (USDA)
 - ❖ A federal organization
 - ❖ Responsible to deal with violations of "Tolerance Limits" set by FDA for drugs or for chemicals in meat or poultry products.

Drug Residues

- Agencies Associated with Residues
Environmental Protection Agency (EPA)
 - ❖ Determines the safety of chemicals used within the environment.
 - ❖ Responsible for setting "Tolerance Limits" of chemicals used in the environment – pesticides, fungicides, or industrial contaminants.
 - ❖ Deals with violations of these "Tolerance Limits."

Drug Residues

- Agencies Associated with Residues
Drug Companies
 - ❖ Privately owned enterprises
 - ❖ Every drug (or chemical) that comes upon the market must go through an extremely laborious study in order to determine its toxicological properties and its safe application in man, animals, or other agricultural commodities.

Drug Residues

- Agencies Associated with Residues
Drug Companies (cont.)

Every drug must be qualified for review (by the FDA) by application from the drug company for a "New Drug Application" which entails proof performed by the drug company of the drug's toxic effects, efficacy, and safety.

Drug Residues

- Establishment of Tolerances
 - Tolerances are determined for non-carcinogenic compounds (drugs or chemicals which do not induce cancer).
 - "Acceptable Daily Intake (ADI)" – the daily dose of a drug or chemical residue that a human would be exposed to throughout their lifetime so that no appreciable health risk would exist.

Establishment of
Tolerances
See handouts

Drug Residues

- Carcinogenic
- Mutagenic
- Teratogenic
Drugs

Drug Residues

- Carcinogenic Drugs
 - **Initiators or promoters of cancer**
 - Bind irreversibly with DNA, proteins, and other cellular components to form adducts.
 - Adducts are damaged cellular machinery.

Drug Residues

- Carcinogenic Drugs
 - Drugs are tested for carcinogenicity, and those found to be so are eliminated from development, since no carcinogenic compounds are to be present in human foods.
 - Aflatoxin is an exception. It is an unintentional carcinogen. It has a tolerance limit in peanuts (20 ppb) and milk (0.5 ppb).

Drug Residues

- Mutagenic Drugs
 - Compounds that damage the genetic engineering of a cell or organism.
 - Damage occurs to DNA by point mutation, gene elimination, or chromosomal breakage.
 - Evaluation of mutagenic effects by drug companies is performed by three-generation reproductive studies in various species and other specialized tests.

Drug Residues

- Teratogenic Drugs
 - Produce damage to the developing embryo or fetus during a critical phase of gestation (pregnancy).
 - Congenital malformations affect the structure and bodily functions of the animal tested.

Drug Residues

- Carcinogenic, Mutagenic, and Teratogenic Drugs
 - **Finite tolerances** can be made for mutagenic and teratogenic compounds, but the safety factor used in determining the **ADI** is 1000.
 - When the tolerance is calculated, it will be **10-fold lower** than the finite tolerance for a non-carcinogenic drug that is not mutagenic or teratogenic.

Drug Residues

- Margin of Safety
- Withdrawal Times

Drug Residues

- Withdrawal Times
 - **Time required** for the drug to reach a safe concentration, as determined by tolerance.
 - **A time interval is established from the time of drug removal to the time of slaughter** that allows for the drug to deplete from the body in order **to be within tolerance**.

Drug Residues

- **Some Drugs and Chemicals Assayed for Residues in Edible Foods**
 - Antibiotics
 - These are antimicrobial agents of various types.
 - Used primarily for treatment of acute disease.

The End