A Small Dose of Toxin

An Introduction To The Health Effects of Animal or Plant Toxins
Toxins Around Us

Have you ever eaten too much puffer fish or the wrong mushroom or been bitten by a snake?
399 BC Death of Socrates by Hemlock
Charged with religious heresy and corrupting the morals of local youth.
Active chemical is the alkaloid coniine which when ingested causes paralysis, convulsions and potentially death.
From Romeo and Juliet - act 5

Come bitter pilot, now at once run on
The dashing rocks thy seasick weary bark!
Here’s to my love! O true apothecary!
Thy drugs are quick. Thus with a kiss I die.
**Opium War of 1839-42**

Great Britain has a monopoly on the sale of opium which it forces on China. Eventually getting control of Hong Kong.

Consider our societies current “wars on drugs”.
Animal Toxins

- Arachnids - Scorpions, Spiders, Ticks
- Insects
- Snakes
- Lizards
- Fish, and frogs
Example – Puffer Fish

- Tetrodotoxin
- 100 different species of puffer fish
- Tetrodotoxin used by fish to discourage consumption by predators
- Low dose of tetrodotoxin produces tingling sensations and numbness around the mouth, fingers, and toes
- As little as 1 to 4 mg of the toxin can kill an adult
Scorpions, Spiders, Ticks

- Scorpions – Stinger – low toxicity
- Spider bites
  - Widow spiders — Neurotoxin
  - Brown or Violin — Tissue Damage
- Ticks – Neurotoxin – Transmits other diseases
Insects

- Moths and caterpillars – Irritating to eat
- Ants – Proteins, formic acid – Irritation to allergic response
- Honey bees – Proteins – Swelling, allergic response
- Wasps – Formic acid
Lizards – Irritating to eat

Snakes

- Vipers – Rattlesnakes, Water moccasins, Copperheads – Complex enzymes – Tissue necrosis, allergic response, shock
- Elapidae Cobras, Kraits, Coral Snakes – Proteins – Neurotoxin, paralysis
Marine Animals

- Shellfish (filter-feeding mollusks)
  - Mussels, clams, oysters, scallops
- Jelly fish, anemona, coral
- Sea Snail (cigua) and some fish, oysters and clams
- Puffer Fish (fugu, blowfish, toadfish)
  - ... some frogs, starfish, octopus
- Tuna, shark, sword fish (mercury)
Plant Toxins

- Skin
- Gastrointestinal System
- Cardiovascular Systems
- Nervous System
- Liver
- Reproductive Effects
Example – Jimson Weed

- Deadly nightshade plant (Atropa belladonna)
- Used in the Roman Empire and during the Middle Ages both as a cure and a poison
- Women used preparations to dilate their pupils a sign of allure and beauty
- Atropine is drug responsible for effects
- Counteracts the effects of pesticides and chemical warfare agents that act by inhibiting acetylcholinesterase
Most dangerous mushrooms are the "death cap" (Amanita phalloides) or the "death angel" (Amanita ocreata).

Most susceptible are children less than 10 years of age.

Initial symptoms are nausea, vomiting, diarrhea and irregular heart rate.

Amatoxin, damages the liver cells causing liver and kidney failure and possibly death.

Amatoxin is very potent: only 0.1 to 0.3 mg/kg of body weight results in death.
Plant Toxins - Skin

- **Allergic Dermatitis** – Plant Rashes, itchy skin
  - Philodendron, poison ivy, cashew, bulbs of daffodils, hyacinths, tulips (antibody mediated)

- **Allergic Dermatitis** – Pollen Sniffles & sneezing, runny eyes
  - Ragweed (North America), Mugwort (Europe), grasses (antibody mediated)

- **Contact Dermatitis Oral** – Swelling and inflammation of mouth Skin – pain & stinging sensation
  - Dumb cane (Dieffenbachia) Nettles (Urtica)

- **Contact Dermatitis Skin** – pain & stinging sensation
  - Calcium oxalate crystals coated with inflammatory proteins – contain histamine, acetylcholine
Plant Toxins – Gastrointestinal

- **Direct stomach irritation** - Nausea, vomiting and diarrhea
  - California buckthorn (sacred bark), tung nut, horse chestnut, pokeweed

- **Antimitotic (stops cell division)** – Nausea, vomiting, confusion, delirium
  - Lily family, glory lily, crocus, may apple
  - Colchicine (gout treatment)

- **Lectin toxicity** – nausea, diarrhea, headache, confusion, dehydration, death
  - Wisteria, castor bean (Ricinus communis)
  - Ricin – block protein synthesis very toxic 5 to 6 beans can kill a child
Plant Toxins – Cardiovascular

- **Digitalis like glycosides** – cardiac arrhythmias
  - Foxglove (Digitalis purpurea), squill, lily of the valley
  - Contain glycosides that are similar to digitalis

- **Heart nerves** – decreased heart rate and blood pressure, general weakness
  - Lily, hellebore, death camas, heath family, monkshood, rhododendron
  - Alkaloids, aconitum, grayanotoxin (concentrated in honey)

- **Blood vessel constriction** (vasoconstriction)
  - Mistletoe (berries contain toxin)
  - Toxin is called phoratoxin
Plant Toxins - Nervous System I

- **Seizures**
  - Water hemlock, (parsley family), mint family

- **Stimulation** – Excitatory Amino Acids – headache, confusion, hallucinations
  - Red alga (red tide), Green alga
  - Mushrooms– Amanita family (fly agaric), Flat Pea (Lathyrus)

- **Aberrant behavior** – very excitable, muscle weakness, death
  - Locoweed - Australian & Western U.S. plant

- **Stimulation**
  - Coffee bean, tea, cola nut
  - Caffeine, most widely consumed stimulant in the world
Plant Toxins - Nervous System II

- **Neurotoxic – death**
  - Poison hemlock (Conium maculatum)
  - Coniine – neurotoxic alkaloid – Poison used by Socrates

- **Paralysis – demyelination of peripheral nerves**
  - Buckthorn, coyotillo, tullidora (U.S., Mexico)

- **Atropine like effects – dry mouth, dilated pupils, confusion, hallucinations, memory lose**
  - Solanaceae family – jimsonweed, henbane, deadly nightshade (Atropa belladonna), angles trumpet (atropine and scopolamine)

- **Neuromuscular – mild stimulation to muscle paralysis, respiratory failure (curare), death**
  - Tobacco – South American – Strychnos family (curare)
  - Blue green alga (anatoxin A)
Plant Toxins – Liver

- “Hepatitis” and cirrhosis of liver - From contaminated grain
  - Ragwort or groundsel
  - Pyrrolizidine alkaloids – attack liver vessels – effects humans, cattle but some species resistant

- Liver failure and death
  - Mushrooms – “Death cap” (Amanita phalloides)
  - Amatoxin and phalloidin effects RNA and protein synthesis

- Liver cancer
  - Fungus that grows on peanuts, walnuts, etc…plant
  - Alfaltoxins– produced by fungus in poorly stored grain
Plant Toxins – Reproductive

- **Teratogen** – malformations in offspring (sheep)
  - *Veratrum californicum* – native to North America
  - *Veratrum* – blocks cholesterol synthesis – seen offspring of mountain sheep

- **Abortifacients**
  - Legumes (*Astroagalus*)
  - Bitter melon seeds (*Momordica*)
  - Swainsonine toxin – stops cell division
  - Lectins - halt protein synthesis– used by humans
Be aware of what plants or animals you eat!
Additional Information

Web Sites


This presentation is supplement to “A Small Dose of Toxicology”

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