Natural Toxins in Plant

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Poisonous Plants or Animals

• A plant/an animal is considered poisonous if, when consumed in normal amounts, it evokes responses which prevent, hinder, arrest, or destroy the natural processes in animal or man leading to distress, pathological changes, or death.

• Plants/animals from the same genera may exhibit similar or vastly different toxicities.
Poisonous Plants or Animals

- The amount and the distribution of the toxins present may vary according to the species as well as the geographical conditions where it is grown or found.
- Plants/animals from the same genera may exhibit similar or vastly different toxicities.
- Approx 7000 plants species and 1200 animals species are poisonous and venomous.
- More species of the poisonous plants are found in the hot, humid tropical region than in temperate countries.
Why do plants/animals possess poisonous or toxic compounds?

- Intermediates of plant/animal metabolic stores of energy, or are necessary to the plant/animal in some other ways;
- Incidental metabolic products which have no significance to the plant/animal themselves
- Intermediate of metabolisms, representing unwanted excretory products of the plant/animal
- A protection to the plant/animal, by making it unpalatable, or in extreme cases poisonous, restricting its use as food by animals and man
- As defense mechanisms; or hunt for foods
Classification of plant poisons

- Plant poisons are classified according to the effects produced by the toxic principles. They may contain:
  1) Glycosides
     a) cardiac glycosides
        - pharmacologic and toxicologic effects on the heart
        - digitalis-like action
     b) cyanogenic glycosides
        - liberate free cyanide or hydrocyanic acid (HCN) upon hydrolysis
Classification of plant poisons

2) Alkaloids
   - bitter, water-insoluble, crystalline solids
   - exist as a soluble, organic or acid-alkaloid salt
   - mostly found in Leguminosae and Amaryllidaceae

3) Compounds causing photosensitivity
   a) primary photosensitivity
      - hypericin; Hypericum perforatum (St. John’s-wort)
   b) hepatogenic photosensitivity
      - caused by liver toxin found in the plants
      - polycyclic triterpene; Lantana camara
Classification of plant poisons

4) Phytotoxins
   - or toxalbumins are highly toxic protein molecules found in certain poisonous plants
   - caused severe gastrointestinal irritation, diarrhoea, dehydration, and death
   - Abrin (*Abrus precatorius*);
   - Ricin (*Ricinus communis*);
   - Jatrophin (*Jatropha curcas*)
Classification of plant poisons

5) External Irritants
   - contain irritant saps or latex which are dangerous to the skin and eyes
   - causes severe dermatitis with painful swelling and blisters
   - extremely irritant to the eyes, causing abrasion or conjunctival hemorrhage resulting in blurred vision or temporary blindness
   e.g Pencil tree (*Euphorbia tricucalli*); *Dieffenbachia picta*; potted plant
Examples of Some Natural Toxins

- Glycoalkaloids in potatoes
- Cyanide-generating compounds in bitter apricot seeds and bamboo shoots
- Enzyme inhibitors and lectins in soya beans, green beans and other legumes.
- Tetrodotoxin, a potent marine neurotoxin, is thought to be produced by certain bacteria
- Ciguatoxin that may be found in more than 300 species of fish
- Histamine produced by bacterial spoilage of scombroid fish
**Antiaris toxicoria** (Pokok Upas or Ipoh)

- Main active components of dart poisons are cardenolides from *Antiaris toxicaria* (Pers.)
- These facts suggest that the main components of the milky sap are cardiac glycosides, and glycosides affect Na+ K+-ATPase activity of muscle membrane and heart muscle contraction.
• cardiotonic glycosides of the two poisons came from *Antiaris toxicaria* Lesch.

• Two new cardiac glycosides have been isolated:

\[12 \text{beta}-\text{hydroxycannogenin 3 beta-}\text{O-beta-D-deoxygulopyranoside and}\]
\[3 \text{beta-}\text{O-alpha-L-rhamnopyranoside}\]
• Botanical names: *Manihot esculenta* (ubi gajah; bitter cassava)

• Family: Euphorbiaceae

• Cyanogenic glycosides in plants: linamarin (88% and lotaustralin)

• Cyanogenic potential of the plant depends on the amount of free HCN in the plant before ingestion, the speed of ingestion and the speed of release of HCN during ingestion.

• *Manihot esculenta* are also eaten by people, after prolong cooking and discarding the water.

• Urinary thiocyanate and mean urinary linamarin may indicate exposure to the cyanogenic glycosides
• Botanical name: *Dioscorea daemona* (ubi gadung)
  Family: Dioscoreaceae
• Prickly climber with a bunch of tubers just below the surface of the soil. The tubers is considered the chief famine-food of the tropical East.
• The whole plant is poisonous. Tuberous are rich in starch
• Active toxic principle – alkaloid dioscorine; water-soluble, cooked after removing the alkaloids in running water or after 3 to 4 days of soaking.
• Toxicity – iritate the throat and cause burning sensation, giddiness, bloody vomitting, difficulty in breathing, death
Death normally occurs approx. 6 hours after consuming the tubers.
Dioscorea daemona (ubi gadung

- Edibility; folklore use:
  Traditionally process by keeping in moist sand or rinse, then section into slices and sun-dry or cooked after removing the alkaloids in running water or after 3 to 4 days of soaking.
  Poison: juice of tubers used in criminal poisoning – used as ingredient together with Antiaris toxicoria (pokok ipoh) in the preparation of arrow poisons
• Botanical name: *Solanum nigrum* L
  Family: Leguminosae
• Categorise as common weed
• The raw plant and the unripe green fruits contain glycosides
• Poisonous principle – solanine and solanidine
• Toxicity – can cause giddiness and headache
• The nervous form includes pupil dilatation, delirium, loss of speech and comsciousness, drying of mouth, throat and skin
• In acute cases, convulsion and respiratory paralysis will occur.
Solanum nigrum has always been cooked as a vegetable although people are aware that they are not supposed to eat too much of it.
• Botanical name: *Elateriospermum tapos* (Buah perah; Brazil Nut)

• The aborigines pounded the seeds and buried the paste in the ground, and came back again later to retrieve it, fermented and use it as condiment on their foods or

  - shells are broken, and the seeds are further dried under hot sun, pounded to paste.
  - also eaten by people, after prolong cooking and discarding the water.

Toxicity due to cyanogenetic glycosides
• Botanical name: *Elateriospermum tapos* (Buah perah)
Plants Affecting the Heart

• Botanical name: *Nerium oleander* L.  
  Family: Apocynaceae  
• Ornamental plant/shrub or bush  
• Poisonous principle – all parts of plant  
• Two major glycosides; oleandroside and neroside  
  - cardiac glycosides, similar to digitalis in structure  
• Toxicity can occur in humans eating meat or fish  
  roasted on oleander branches or stems, or drinking  
  honey from bees feeding on their nectar of oleander  
  flowers
Plants Affecting the Nervous System

- **Botanical name**: *Datura fastuosa, Datura metel, Datura stramonium*
- **Family**: Solanaceae
- **Shrub-like herb**
- **All parts of the plant are toxic.**
- **Active principle** – daturine which contains an alkaloid laevoscyamine, hyoscine or scopolamine and traces of atropine
- **Toxicity** – onset of action is immediate
- **A flushed face with dilated pupils, dryness and burning sensation in the mouth, difficulty in swallowing, excitement, delirium, confusion and violent behaviour**
- **Often followed by general weakness, hyperthermia with cold extremities, incoordination and muscular-respiratory paralysis**
Jimson Weed
*Datura stramonium*

- Atropine and scopolamine
Plants Causing Drastic Purgation and Emesis

- Botanical name: *Abrus precatorius* L
- Family: Leguminosae
- Shrub-like herb
- Slender. Twining climber
- Active principle – toxalbumin abrine, found in the immature and mature seeds
- Toxicity – include nausea, vomiting, haemorrhagic diarrhoea, weakness, cold perspiration
- Swallowing cracked or perforated dry seed or immature seed may lead to fatal poisoning
Plants Causing Drastic Purgation and Emesis

- **Botanical name**: *Jatropha curcas L*
  - **Family**: Euphorbiceae
- **Shrub-like herb**
- **Potted ornamental plant**
- **Active principle** – toxalbumin jatrophin (curcin)
- **Toxicity** – ingestion of seeds leads to severe nausea and vomiting, diarrhoea, gastroenteritis, a burning sensation in the throat, collapse and death.
Plants Causing Drastic Purgation and Emesis

• Botanical name: *Ricinus communis* L
  Family: Euphorbiceae

• Shrub-like herb

• Active principle - The seeds are the most toxic containing a phytotoxin ricin. Leaves are less toxic.

• Castor oil itself is not toxic, because the toxin is insoluble in oil.

• Toxicity – chewing of the seeds leads to a burning sensation in the mouth and throat.

• Followed by nausea, vomiting, severe pain in the stomach, excessive thirst, prostration, convulsions, uremia, and death.
• Contain phytotoxins - ricin - inactivated by heat during the production of castor oil
• seeds are the most toxic part of the plant, 2-4 seeds could be fatal in adult
• Clinical signs
  – nausea, violent vomiting and diarrhea, burning sensation in the mouth, hemolysis, renal failure, death
Mitragyna speciosa
(Ketum/Biak)
Mitragynine

2D Mitragynine Molecule
Image by Erowid, © 2004 Erowid.org
A Small Dose of Toxicology

Principles of Toxicology – 3/2/04
Main active component: Mitragynine

- Contains more than 25 psychoactive alkaloids: the most active: mitragynine & 2-OH-mitragynine

- Effects:
  - stimulant, sedative and euphoric
Table 55. Rank and trend of use of selected drugs in Malaysia, 2009

<table>
<thead>
<tr>
<th>Drug type</th>
<th>Rank</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heroin</td>
<td>1</td>
<td>↓</td>
</tr>
<tr>
<td>Cannabis herb</td>
<td>2</td>
<td>↑</td>
</tr>
<tr>
<td>Crystalline methamphetamine</td>
<td>3</td>
<td>↑</td>
</tr>
<tr>
<td>Methamphetamine pills</td>
<td>4</td>
<td>↑</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>5</td>
<td>↑</td>
</tr>
<tr>
<td>Ketamine</td>
<td>6</td>
<td>↑</td>
</tr>
<tr>
<td>Ecstasy-type (MDMA)</td>
<td>7</td>
<td>↔</td>
</tr>
<tr>
<td>Inhalants</td>
<td>8</td>
<td>↑</td>
</tr>
<tr>
<td>Speciosa¹</td>
<td>9</td>
<td>↑</td>
</tr>
</tbody>
</table>

↑ = Increase, ↓ = Decrease, ↔ = Stable

Source: DAINAP
Seizure and Coma Following Kratom (*Mitragyna speciosa* Korth) Exposure

A Drug Fatality involving Kratom
J Forensic Sci, January 2013, Vol. 58, No. S1

Intrahepatic Cholestasis Following Abuse of Powdered Kratom (*Mitragyna speciosa*)
Conclusion

• Need for information and proper monitoring of poisoning incidences involving plants and animals would help in formulating safety health measures

• Successful risk communication and risk reduction measures are critical element in attempting to prevent additional illnesses of poisoning from consumption of poisonous plants or animals
THANK YOU

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