Poisonous Plants Part II: Oxalates Containing Plants

by

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Goal

The primary goal is to raise the public awareness of the toxicity of a specific group of poisonous plants containing oxalates.

Objectives

• Be knowledgeable of specific poisonous plants containing oxalates
• Be able to differentiate the toxicity of the soluble and insoluble oxalates
• Be able to explain suggested treatments for the symptoms of poisoning from oxalates
• Identify primary parts of the plant which cause poisonings

Introduction

On a daily basis, we come in contact with several thousands of plants, but often many are dismissed as harmless and benign when in fact some of these plants can cause severe toxicity even when touched or ingested. Poisonous plants containing oxalates are one specific category of plants, mostly indoor, that may alter normal body functions and cause great discomfort. Oxalates are the salts of oxalic acid and contain only two carbon atoms (see figure 1). Plants containing oxalates are of two types, the soluble oxalates and the insoluble oxalates.

\[
\begin{align*}
\text{HOOC - COOH} & \quad \text{NaOOC - COONa} & \quad \text{KOOC - COOK} \\
\text{Oxalic Acid} & \quad \text{Sodium Oxalate} & \quad \text{Potassium Oxalate} \\
\text{COO - Ca - OOC} & \quad \text{COO - Mg - OOC} \\
\text{Calcium Oxalate} & \quad \text{Magnesium Oxalate}
\end{align*}
\]
Insoluble Oxalates

Insoluble oxalate salts are present in plants as needle-like crystals of calcium or magnesium. Some common plants that contain insoluble salts or the needle-like crystals of calcium oxalates (raphides) are members of the Araceae family, specifically plants such as jack-in-the-pulpit, dumbcane, and caladium. These crystals or raphides if chewed generally become lodged into the mucosal lining of the mouth and oropharynx along with some of the plant material. The insoluble oxalate salts cause immediate pain, swelling, and edema generating effects that are predominately local. Some of the most common symptoms involve burning and edema of the mouth, tongue, and throat along with increased salivation. Individuals may lose their speech for 24 to 48 hours, thus giving Dieffenbachia its common name of Dumbcane. Edema decreases in roughly four days but unfortunately, the pain remains severe for about eight days. Superficial necrosis of the tongue and buccal mucosa occurs and corrosion may be expected in the esophagus as well as the stomach if plant material is ingested. Furthermore, ocular exposure from the plant sap may cause excessive lacrimation, photophobia as well as corneal abrasions. Finally, respiratory distress may occur if edema of the tongue and oropharynx are severe, and diarrhea may occur if enough of the plant is ingested. Generally a dry weight of 10% oxalate is necessary to cause poisoning.

These symptoms are usually not serious and disappear within 24 to 72 hours, yet complications do occur as a result of secondary infections. There is commonly no danger of systemic toxicity from insoluble calcium oxalates. This is primarily due to the lack of absorption through the wall of the digestive tract.

Treatment

- Wash or rinse mouth to remove the raphides from the mucosa
- Give milk or ice cream to soothe an irritated mouth and throat
- Sucking on ice or a popsicle may relieve the pain
- If pain is severe, analgesics may be administered
- Usually gastric emptying is not needed
- Observation of the throat and tongue is suggested due to the potential of obstruction of air passages from swelling
- Antihistamines such as diphenhydramine may be given to reduce swelling but have been disappointing at best, thus corticosteroids may be a useful alternative
- Eye irritation may be relieved by flushing the eye with tepid water every 15 minutes
- If symptoms persist, the patient should be seen by a physician or health care facility
Plants Containing Insoluble Oxalates

Alocasia species

Alocasia tryphyllum (Elephant’s ear)
- **Toxic part:** leaves and stems
- **Description:** erect perennials have a single, long stemmed spearheaded shaped flowers that are veined and often varicolored. Flowers appear on a greenish spathe
- **Location:** popular house and cultivated plant in the United States and also present in tropical and subtropical areas

Anthurium species

Anthurium andralanum (Anturio, Flamingo Lily)
Anthurium scherzeranum (Pigtail Plant)
- **Toxic part:** leaves and stems
- **Description:** grows about two feet high and has dark green heart shaped, leather-like leaves. The flower has a scarlet, white or green spike which may show colorful berries
- **Location:** house plants in most areas and may be grown as garden plants in Hawaii and Florida. They are native to tropical America

Arisaema species

Arisaema dracontium (Green Dragon, Dragon Root, Dragon Tail)
Arisaema triphyllum (Jack-in-the-Pulpit, Brown Dragon, Bog Onion)
- **Toxic part:** whole plant
- **Description:** *A. dracontium* has a single three foot stalk with 7-13 leaflets at the tip. Several inches below the leaflets, a single green flower emerges from the stalks. The spathe is funnel shaped and berries are orange. *A. triphyllum* has two leaves branching from the stalk with three lance shaped leaflets at the end. The spathe is shaped like a pulpit with a long pointed hood. Berries are red.
- **Location:** wild plants grow in damp shady areas from Quebec to Florida, west to Ontario and southwest to Minnesota and Texas

Arum species

Arum italicum (Italian Arum)
Arum maculatum (Adam and Eve, Cuckoopint, Lords-and-Ladies)
Arum palaestinum (Black Calla, Solomon’s Lily)
- **Toxic part:** whole plant
- **Description:** stemless plants with 8-10 inch ovate leaves and tuberous roots. The flower is dullish purple and encloses a spike on which brilliant red fruits form
- **Location:** house plants in the South. All of the species originated in Europe and the Near East
Caladium species
*Caladium bicolor* (Caladium, Angel Wings, Cananga, Elephant’s Ears)
**Toxic part:** whole plant  
**Description:** show, variegated, prominently veined, heart shaped leaves, colors vary from orange to red to white  
**Location:** cultivated plants in subtropical gardens and popular house plants

Calla species
*Calla palustris* (Water Arum, Female Water Dragon)
**Toxic part:** whole plant and root  
**Description:** small plant has heart shaped leaves that are 4-6 inches long and borne on 10 inch stems; the spathe is about two inches long, inconspicuous green on the outside and white on the inside. Red berries form  
**Location:** wild plants found in wet, boggy areas from Quebec to Alberta to north central Alaska and south central Yukon, south to Colorado, Texas, and Florida

Colocasia species
*Colocasia esculenta* (Taro)  
*Colocasia gigantea* (Elephant’s Ear)
**Toxic part:** leaves  
**Description:** huge heart shaped leaves, edible roots  
**Location:** landscape plants in the West Indies, south Florida, southern California, Guam, and Hawaii; indoor plants elsewhere

Dieffenbachia species
*Dieffenbachia maculata* (Dumbcane)
**Toxic part:** leaves  
**Description:** tall, unbranched plants have large oblong leaves splotched with ivory markings  
**Location:** cultivated outdoor plants in southern Florida and Hawaii. They are also used as decorative pot plants for offices, waiting rooms, and lobbies

Monstera species
*Monstera deliciosa* (Monstera, Breadfruit Vine, Shingle Plant, Window Plant)
**Toxic part:** leaves  
**Description:** woody, stemmed climbers; leaves are perforated with irregularly shaped and placed holes  
**Location:** cultivated plants in the West Indies, Hawaii, Guam and greenhouse plants elsewhere
Philodendron species  
*Philodendron speciousm* (Philodendron)  
**Toxic part:** leaves  
**Description:** climbing vines with aerial roots; leaves are large and variable and two types exist: Those similar to Alocasia (spear-headed) and those that are heart-shaped or oblong with smooth edges  
**Location:** outdoor plants in warm climates and popular house plants in the United States

Symplocarpus species  
*Symplocarpus foetidus* (Skunk Cabbage)  
**Toxic part:** leaves  
**Description:** flowering spathe appears before leaves in spring. The spathe is 3-6 inches long and may have green, purple, or brown stripes or spots; leaves reach 3 feet in length and 1 foot in width; unpleasant odor  
**Location:** wild plants that grow in Quebec to Nova Scotia to North Carolina and Iowa

Xanthamosa species  
*Xanthamosa violaceum* (Malanga, Blue Taro)  
**Toxic part:** leaves  
**Description:** resemble Caladium but leaves are more spear-shaped. The tubes or rhizomes are thick and the sap is milky  
**Location:** cultivated plants in the southern United States, Hawaii, and West Indies, and Guam

Zantedeschia species  
*Zantedeschia aethiopica* (Calla, Calla Lily)  
**Toxic part:** leaves  
**Description:** smooth-edged arrowhead shaped leaves that are sometimes mottled with white and grow on long, stout stalks; the spathe flares out like a lily; may vary in color  
**Location:** outdoor plants in mild climates and greenhouse plants elsewhere

Soluble Oxalate Salts

Soluble salts are sodium, potassium, and ammonium oxalates and exist also as free oxalic acid. These salts may be eaten in sufficient quantity to produce systemic intoxication and the ingestion is more likely to occur with plants containing these substances since little mouth pain occurs, unlike the insoluble salts.

The symptoms occur from 2 to 12 hours and range from gastroenteritis, bloody emesis, and diarrhea to myocardial damage. The primary damage occurs to the kidneys as well as the musculoskeletal system. The most common symptoms of soluble oxalate poisonings are abdominal pains, convulsions, vomiting, drowsiness, muscle twitching, nausea and finally death. Even if the patient recovers from the most benign symptoms, usually liver and kidney damage have already occurred. Since soluble oxalates are readily absorbed from the digestive tract, they react with calcium in the blood forming insoluble calcium oxalate. This action causes an ionic...
imbalance and decreases the coagulation of blood resulting in internal hemorrhage. More significantly, an accumulation of calcium oxalate crystals within the kidney tubules leads to kidney damage, renal failure and nephritis. Furthermore, a calcium deficiency or hypocalcemia may lead to severe tetany.

Some notoriously known plants of the soluble oxalate group are halogeton, beets (tops), spinach, and sorrel. Halogeton glomeratus was accidentally introduced as a weed in Nevada, Utah and Idaho and was known for poisoning herding sheep of the area. It contains 30% dry oxalate content by weight, and the ingestion of only 9 ounces has a potential to kill a mature sheep within ten hours.

Of plants eaten primarily by people, beets are also another common plant containing high amounts of soluble oxalates. Specifically, beet tops contain 12% oxalates by weight. Others like rhubarb, sorrels, and purslane should only be utilized in small to moderate amounts due to there potential for accumulating within the body and causing damage. Rhubarb, especially during WW1 and WWII caused many fatalities. Generally, a significantly large dose is needed to cause toxicity, but in one case an ingestion rate of only 1.3 g/kg of rhubarb lead to death. Plants such as rhubarb, spinach, sorrel and beets all contain soluble oxalates, but certain regions of the plant contain higher concentrations of the oxalates, thus the ingestion of specific parts of the plant also determines the severity of poisoning.

**Treatment**

- Induce vomiting utilizing the gag reflex or with Ipecac syrup
- may need to perform gastric lavage (DO NOT empty stomach if concentrated doses of oxalates have been ingested)
- Give lime water, chalk, soluble calcium salts, milk, calcium lactate orally as a way to bind the oxalic acids
- Monitor heart rate, respiration, and kidney function
- Try to maintain fluid and electrolyte balance
- Administer 10% IV calcium gluconate to relieve calcium deficiency
- Furosemide (diuretics) may be given to alleviate kidney dysfunction

**Plants Containing Soluble Oxalates**

**Beta species**

*Beta vulgaris* (Sugar Beets)

**Toxic part:** tops

**Description:** herbs, leaves are simple in a basal rosette, flower is small in panicle spikes, usually bisexual, greenish or reddish bracted, calyx 5 lobed, petals none, stamens 5, ovary sunken in a disc

**Location:** cultivated plants throughout the United States
Halogeton species

_Halogeton glomeratus_ (Halogeton)

**Toxic part:** whole plant  
**Description:** annual weed (3-24 inches) with small, round, fleshy wiener shaped leaves (0.5 inches) that grows in clusters along reddish or purplish stems; in the fall the leaves are hidden by clusters of fruits enclosed in 5 wing bracts  
**Location:** wild plants in Utah, Nevada, and the Southwest

Psedera species

_Psedera quinquefolia_ (Virgina Creeper, American Ivy)

**Toxic part:** whole plant  
**Description:** high climbing vine with numerous much branched tendrils; the leaf is divided into 5 coarsely toothed stalked leaflets to 6 inches long; it bears clusters of small, black berries resembling tiny grapes  
**Location:** wild plants in Maine to Florida to west Texas and Kansas

Rheum species

_Rheum rhabarbarum_ (Rhubarb)

**Toxic part:** leaves  
**Description:** perennial plant with 1 foot long heart-shaped leaves and red colored stems  
**Location:** cultivated garden plants in North America

Rumex species

_Rumex acetosa_ (Garden Sorrel, Curly Dock)

**Toxic part:** leaves and stems  
**Description:** 3 feet high, leaves are 5 inches long and shaped like arrowheads  
**Location:** naturalized herbs that are cultivated occasionally as garden plants

**Conclusion**

Realizing the dangers that may result from accidental oxalate poisonings and being knowledgeable about the appropriate treatments from such toxicities will enable the pharmacist to play a definitive and essential role in providing information and helping patients within the community to avoid the harmful effects and outcomes of oxalate poisonings.

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