

## **A WORD OR TWO ABOUT GARDENING**

### **Some cautionary words about your edible landscape**

[Two previous articles](#) reviewed potentially poisonous plants that may be encountered in local landscapes. The focus was on ornamental plants with showy/colorful fruits, flowers and/or leaves that could prove especially attractive to young children. Edible plants were mentioned only briefly. The present article discusses fruits and vegetables found in Miami-Dade backyards, both common place and not so familiar, that under certain circumstances can be potentially poisonous. Such circumstances include:

- ◆ The wrong part being eaten
- ◆ The particular fruit/ vegetable is not at an appropriate stage of development for consumption (insufficiently or excessively ripe)
- ◆ Improper processing
- ◆ Excessive consumption over a prolonged period
- ◆ Aggravation of a pre-existing illness.

Over the past 12 years evidence has accumulated implicating long term intake of **fruits of the Annonaceae (soursop, sugar apple and cherimoya)** as a factor in the onset of a neuro-degenerative disorder (an **atypical form of parkinsonism**). The toxins involved are believed to be acetogenins, long chain fatty acid derivatives found in annonaceous plant parts including fruit (seeds, juice and pulp). **Acetogenins** are potent inhibitors of mitochondrial respiration, the process responsible for generating most of the cell's ATP (energy source). Brain cells deprived of ATP rapidly die. Animal studies have shown that low levels of acetogenins administered over a period of time caused brain cell damage similar to that seen in elderly persons with atypical parkinsonism. Most of what is known about this atypical form of parkinsonism centers on studies on the island of Guadeloupe (French West Indies). While annonaceous fruits are popular in Miami-Dade, their consumption is far greater in the Caribbean than south Florida – in Guadeloupe this is especially so for soursop. What role environmental factors or a person's genetic pre-disposition to develop neuro-degenerative diseases also plays is not fully understood. As with many other food items moderation would seem to be the best advice at present.

Annona seeds have long been known to be poisonous – when powdered they have traditionally been used as fish poisons and insecticides. Apart from acetogenins, they contain several isoquinoline and pyrrolizidine alkaloids as well as novel cyclic peptides.

**Carambola** is another popular fruit in Miami-Dade. In this instance it is persons with **chronic kidney failure** who are at risk of a possibly fatal outcome. Initial symptoms consist of muscle weakness, persistent hiccups (a frequently reported feature) which can progress to loss of consciousness and repeated sequences of epileptic seizures. Carambola fruit contain **high levels of free oxalic acid**, more so sour as opposed to sweeter tasting varieties. Where renal function is impaired, the oxalic acid present in the fruit is deposited as crystals of calcium oxalate in the kidney leading to further damage. Kidney damage can result in lowered levels of circulating calcium which can then induce seizures. In some parts of SE Asia, where most

cases of carambola intoxication have been reported, there is a preference for juice from sour fruits. Preliminary evidence suggesting the presence of a second, non-proteinaceous, low molecular weight, lipophilic toxin has been presented, but no further details have been forthcoming. Those with kidney disease should avoid carambola pending medical advice from a nephrologist.

**Oxalate** is present in many of the fruits and vegetables we consume, but since most is in an insoluble form (calcium oxalate) any that is present passes through the gut with no injurious results. However in some plants, especially aroids, calcium oxalate occurs as microscopic needle-like crystals (**rhaphides**). As described in a prior article, rhaphides are responsible for the irritant dermatitis following contact with sap from various aroids such as dieffenbachias, aglaonemas and spathyphyllums. The foliage from these plants is not normally consumed, though one person did contact this office after receiving emergency room treatment following consumption of something that 'looked as if it would be good in a salad'. From the description it appeared to be elephant ears (**Alocasia**). One US report from 2003 describes 10 people who became ill (severe burning and swelling of mouth and throat) after consuming what was purported to be an entrée of Chinese vegetables. Examination of plant material present in the entrée revealed the presence of rhaphides – the plant source was not identified however leaves from aroids (for instance taro) are eaten in some parts of the world. Where aroids such as **malanga** (tannia) or **dasheen** (taro) are regularly consumed they are first boiled (mostly the starchy corms but also tender new leaves and stems), using varieties selected as being low in oxalate. Consuming aroid species/cultivars intended for use as ornamentals should be avoided.

Aroids are not usually thought of as producing edible fruits, but the **Swiss cheese plant** *Monstera deliciosa* is an exception. In south Florida, Swiss cheese plant has a long history as a landscape ornamental, less so as a source of edible fruit. Those who have tried it describe a taste that is a mélange of banana, pineapple and strawberry. Like all aroids the inflorescence is a spike consisting of a stout fleshy stem (spadix) bearing numerous closely packed small flowers enclosed in a leafy, hood-like structure (spathe). The *M. deliciosa* spathe is white and with its cream colored flowers resembles a peace lily. Flowering is followed by a syncarp (aggregate fruit made up of many individual fruits) with a thick green peel. As the fruit matures and increases in size, the peel becomes more yellow and eventually individual segments at the base of the fruit begin to separate. At this time final ripening can be accelerated by first removing the fruit and about 1" of the stem, then wrapping the whole in plastic and leaving at room temperature for 4-5 days. Maturing and ripening of the green fruit takes 10 -12 months. Be careful, only fruit segments that have separated are safe with acceptable low levels of oxalate. Some individuals report an unpleasant irritation of mouth and throat even when fruit is ripe – caution is advised if you are consuming *M. deliciosa* fruit for the first time.

It should be noted that soluble and insoluble forms of oxalate are present in a range of both fruit and vegetables, from strawberries and rhubarb to spinach and leeks. Such items are of course perfectly safe to eat, though persons with a history of kidney stones may be advised to

reduce their intake of fruits/vegetables with relatively high levels of soluble oxalate. Cooking a food item with water can leach out soluble oxalate, though heat per se is not destructive.

The fruit of the **akee** (*Blighia sapida*) is also toxic (potentially lethal) if not fully ripened. The seeds and unripe fruit contain a non-protein, cyclic amino acid, **hypoglycin A** (aminomethylene-cyclopropyl-propionic acid) that as such is non-toxic but once ingested forms a toxic metabolite (methylenecyclopropylacetic acid). This irreversibly inhibits co-factors (principally coenzyme A) needed for  $\beta$ -oxidation of fatty acids, the process by which the body uses fat as an energy source. As a consequence there is an increased use of glucose to meet energy needs. This depletes carbohydrate reserves (glycogen – liver starch) which cannot be replenished since the same co-factors required for  $\beta$ -oxidation of fatty acids (now inhibited) are also needed to convert amino acids and other precursors into glucose. The net effect is to cause a rapid lowering of blood sugar (hypoglycemia). In mild cases where little of the toxin has been consumed initial symptoms are severe vomiting, with few further complications. Where larger amounts of hypoglycin are ingested symptoms progress to vertigo, coma and death. Fatalities however are far fewer than in the past, due to improved medical intervention, and those most at risk are adults, unfamiliar with the fruit and when it is safe to eat, and children.

**Akee** trees have become more common in Miami-Dade as a favorite of émigrés from Jamaica (where it is the national fruit) and other parts of the Caribbean. Akee fruit are large, leathery, three-chambered capsules, each chamber containing a large single black seed. As it matures the fruit first yellows then develops a faint red tinge which becomes more intense before the tip of the fruit splits open to reveal each seed partially enveloped in a creamy white aril. Once the sections are more than  $\frac{2}{3}$ " apart arils are safe to eat, providing they are fresh and still firm, hypoglycin content having dropped to barely measurable levels. It is important not to force apart the capsule sections - **only arils from akee fruit that splits open naturally are safe to eat**. Arils must also be free of both seeds and attached membrane.

**Akee** has been brought to the Miami-Dade Extension Office for identification by persons curious as to whether it is edible. On each occasion the person had removed fruit from trees they saw growing close to the sidewalk. While there have been no reports of akee poisoning in Miami-Dade (only 2 in the US), placing trees having such colorful and toxic fruit within easy outside access is a tragedy waiting to happen. Akee trees are available from local nurseries; if you are contemplating planting a tree **make sure it is placed well inside your property and the yard is securely fenced**. Those with no previous experience in cultivating akee should seek guidance from someone familiar with both when and how to remove the arils for consumption. Although the fruit was once excluded from the US, importation of canned akee arils is permitted providing they have been processed by packers meeting strict FDA requirements to exclude unripe arils, seeds, membrane or fragments of rind.

It isn't just exotic fruits that can be toxic. The most popular vegetable overall in the US is the **potato** and the most popular in home gardens the **tomato**; both belong to the Solanaceae a plant family rich in toxic alkaloids. Some members are landscape plants, and those found locally were reviewed in a previous article. Solanaceous vegetables, including potato, tomato and egg plant contain **glycoalkaloids** and/or **calystegines**. Glycoalkaloids consist of a bicyclic

nitrogen containing steroid (the **aglycone**) conjugated to one or more simple sugars. Calystegines are polyhydroxy nortropane alkaloids that as well as occurring widely in solanaceous plants are found in many brassicas as well as members of the Convolvulaceae (including sweet potatoes). Having been recognized only within the last 20 years, calyestegine toxicity is due to their mimicry of sugars. It's not that they are sweet (they're bitter), but their structure allows them to act as potent inhibitors of enzymes involved in processing sugar containing compounds.

**Potato plants** (*Solanum tuberosum*) contain two principal glycoalkaloids, **solanine** and (the more toxic) **chaconine**. Potato tuber glycoalkaloid levels are highest just below the skin and increase dramatically once tubers are exposed to light with a concomitant but unrelated increase in chlorophyll (responsible for them turning green). This is why it is vital not to expose tubers to light both while growing (the reason soil is mounded around the base of the stem – 'hilling') and post harvest. Once harvested, potatoes should be stored in reduced light and kept cool, to minimize increases in glycoalkaloid content. Damaged or blighted potatoes also contain elevated levels of glycoalkaloids and along with those that are green or have sprouted should be discarded – cooking destroys very little of either glycoalkaloid. Elevated levels of glycoalkaloids give potatoes a bitter taste and above 200 ppm are regarded as toxic (sprouts contain 400 ppm).

Poisoning results in damage to intestinal mucosa (nausea, cramps, diarrhea and blood loss); if sufficient toxin is able to pass into the circulatory system it acts as a cholinesterase inhibitor – presenting with reduced heart rate and blood pressure, seizures, respiratory paralysis and death. Fortunately, although highly toxic, glycoalkaloid absorption is slow permitting hydrolysis within the gut to the less toxic aglycones. Severe poisoning is rare and for the most part symptoms involve nausea and diarrhea and may be mistaken for an infectious form of food poisoning. The normally low levels of solanine found in potatoes contribute toward flavor and may have health benefits (protection from colon cancer).

The glycoalkaloid **tomatine**, found in green **tomatoes** (*Solanum lycopersicum*), is of much less concern than either of the above potato alkaloids (estimated to be 100x less toxic than solanine). As tomatoes ripen tomatine is degraded until only minute quantities remain. Some have questioned the toxicity of tomatine (apparent lack of ill effects from fried green tomatoes) and there is evidence that it may help to lower cholesterol and reduce the risk of certain cancers.

**Calystegines** are found in potato skins (little in pith) and as with glycoalkaloids, levels are highly elevated in sprouts. It has been suggested that they may contribute to the intestinal symptoms observed when sprouted potatoes are consumed. Of more interest is concern that over time calyestegines could pose a risk of inducing symptoms analogous to those seen with inherited lysosomal storage diseases. Lysosomes are structures inside cells possessing digestive enzymes that breakdown complex molecules, including those containing sugars, which can then be recycled or excreted. If this function is compromised these substances accumulate, leading to health issues including heart, kidney and joint disease, neurological disorders and anemia. Laboratory studies have found calyestegines to be potent inhibitors of lysosomal enzymes (glycosidases) which process complex sugar containing compounds.

Like calyestegines, the related alkaloid swainsonine is also a potent glycosidase inhibitor. Both alkaloids are found in shrub morning glory *Ipomoea carnea* a known cause of fatalities in

grazing animals due to a form of lysosomal storage disease. At present definitive evidence is lacking that the calystegines found in potatoes present any long or short term risk to human health. Uptake of calystegines from the digestive tract may be too insignificant to be of concern. For those involved in developing new potato varieties it is important that levels of both calystegines and glycoalkaloids are maintained within safe limits.

**Cyanogenic glycosides** are found in more than 2500 plant species and by releasing cyanide when consumed act to deter damage from herbivores (prevents respiration by rapidly binding to and irreversibly inhibiting cytochrome oxidase). As mentioned briefly in a previous article they are present in the kernels of various stone fruits such as cherries, peaches, nectarines, apricots and pears as well as **loquats** (latter popular in local yards). Several other food crops contain cyanogenic glycosides. **Linamarin** is found in **lima beans** (*Phaseolus limensis*, rarely grown in Miami-Dade) and, of more interest locally, **cassava** (*Manihot esculenta*), grown mainly for the starchy storage root (sometimes incorrectly termed a tuber). Cassava is propagated from stem cuttings, and is of two broad types. 'Bitter' types are more liable to contain higher levels of cyanogenic glycosides than 'sweet' types, though this is not an absolute distinction. Glycoside levels can also vary depending on soil type, drought and fertilizer use. In countries where cassava is relied on solely as a source of starch and bitter types are consumed (parts of Africa), chronic cyanide poisoning occurs where processing fails to reduce linamarin to acceptable levels. This is exacerbated by a lack of sulfur containing amino acids (due to protein poor diets) needed to detoxify cyanide to thiocyanate. If too much thiocyanate forms this in turn can interfere with iodine uptake and lead to goiter. For sweet types (those consumed locally) toxin levels are sufficiently low that it is sufficient to first peel away the outer corky layer of the root which can then be cooked in boiling water.

**Lectins** are a class of proteins that selectively bind to specific sugar molecules, most notably those present in carbohydrate containing proteins (glycoproteins) present on the surface of most animal cells. Of ubiquitous occurrence, lectins are mostly of plant origin, and enriched in seeds and storage organs (e.g., potato tubers). Of those found in food items most are not known to be harmful; an important exception are members of the Fabaceae, specifically leguminous vegetables and pulses. Lectins not degraded by cooking (insufficient) and/or digestion bind to and damage cells lining the intestine.

The common bean *Phaseolus vulgaris*, includes both fresh and dried bean varieties all of which contain varying levels of potentially toxic lectins (notably **phyto-haemagglutinin PHA**). Highest levels are found in red kidney beans and their consumption has been associated with severe but short-lived vomiting and diarrhea; in its rapid onset this may be initially confused with some types of bacterial food poisoning. To ensure that dried beans, especially red kidney beans, are safe for consumption it is important to soak them overnight (discard the water) then vigorously boil for at least 10 minutes before adjusting the heat to fully cook. Undercooked beans can prove more toxic than when fresh. Dried beans are not commonly grown in Florida – if you wish to try, plant in late fall, they take about 4 months until ready to harvest.

The majority of pole/bush beans in local home gardens are types grown for their immature pods/seeds (snaps, French or string beans). Being immature when harvested they contain smaller seeds and therefore much lower lectin levels than kidney beans. For this reason much

less cooking is needed before they are consumed. Although not common some varieties of *P. vulgaris* are also used like lima beans as fresh green shell bean as are **scarlet runner beans** *Phaseolus coccineus*. They both need to be adequately cooked. A vigorous perennial vine with showy orangey red flowers, scarlet runner bean is more likely to find use locally as an ornamental rather than grown as a home garden vegetable crop.

Some putatively edible plants found in Miami-Dade yards are present as noxious invasive weeds. The **air potato** *Dioscorea bulbifera* is one of several *Dioscorea* spp. commonly known as yams (not to be confused with sweet potatoes, *Ipomoea batatas*). It is the most extensively distributed of the five species found in Florida (including the native and inedible *D. floridana*). The edible part of a yam is the greatly enlarged storage rhizome, though in *D. bulbifera* it is either absent or much smaller than found in other species. Several biologically active compounds have been found including **saponins** (consist of a sterol/terpenoid core plus one or more sugars). Saponins are usually poorly absorbed when ingested, though some can cause irritation of the gut (vomiting/diarrhea); the sterol component of a saponin that occurs in yams (**dioscin**) is used in the synthesis of various steroids such as progesterone for use in oral contraceptives. Wild yams such as local air potato frequently taste bitter and most of this is ascribed to **diosbulbins** (furanoid diterpenes). They have not been implicated as toxins and there is some evidence that they may exert anti-tumor activity. Some wild yams have been found to contain high levels of calcium oxalate with evidence of raphides (see above) and these could also cause irritation of the gut. A tropane alkaloid (**dioscorene**) is the most toxic compound found in wild yams and has been noted as the cause of convulsions and death.

Levels of all of the above compounds have been found to vary greatly between species and locales – dioscorene levels were found to be much higher in African yams than those from the Americas and Caribbean. Most yams that are routinely cultivated for consumption have been selected for their lack of bitterness and toxicity – extensive rinsing with water is needed to render wild yams palatable though not necessarily free of toxins. The air potatoes (bulbils) of *B. bulbifera* are more likely to be toxic (ranging from gastro-intestinal symptoms to seizures) and in Africa were used traditionally in arrow and fish poisons.

Another invasive weed, and also a vine, **Momordica charantia**, **balsam apple**, is a vigorous perennial that readily re-seeds. Yellow, sickly sweet flowers are followed by spiny green fruits which turns orangey yellow as they ripen, finally splitting open to reveal small flattened white to brown seeds embedded in a sticky red aril. The fruit is consumed while still green since excessive bitterness develops as it ripens. The vines that volunteer locally are a wild type, which bear inferior fruit; in tropical Asia improved commercial cultivars (especially F<sub>1</sub> hybrids) with larger less bitter fruit (bitter melons) are widely grown. For this reason it is difficult to assess accounts of toxicity since information as to the source of the *Momordica* is usually lacking.

**Momordica** seeds have been found to contain several ribosome inactivating proteins two of which (**α and β momarcharins**) proved potent inhibitors of isolated ribosomes (prevented protein synthesis); their limited uptake by intact animal cells restricts actual toxicity. Seeds also contain compounds (probably **momarcharins**) that cause bleeding and miscarriage in mice; for this reason it is recommended that women do not consume bitter melon during pregnancy. Balsam pear seeds contain vicine, a pyrimidine glycoside most often found in a

variety of edible legumes. Vicine is one of several compounds triggering a rare hereditary type of acute hemolytic anemia in persons with glucose-6-phosphate dehydrogenase deficiency, an enzyme essential for the integrity of red blood cells. In the US this is a condition found most often in African American males, though it can also occur in those of Mediterranean ancestry.

As well as avoiding *M.charantia* seeds, ripe fruit is more toxic than green unripe fruit. Pet owners should be aware that the fruit has been implicated in serious poisoning of dogs. Finally apart from its use as a source of food, *M. charantia* has been used in alternative medicine to control blood glucose. This has been ascribed to several compounds with most interest focusing on a hypoglycemic polypeptide (polypeptide p) and two saponins (momordicins). There is however insufficient information as to their degree of efficacy and potential side effects. Consult with a physician before contemplating using bitter melon to lower blood sugar especially if you are already taking a prescription medication for diabetes. Several other substances of interest have been isolated in particular MAP<sub>30</sub>, a protein with anti-tumor properties that also inhibits the human immunodeficiency virus.

Finally a fruit tree from E. Africa which, although now only rarely grown locally, remains of interest as an early introduction to Florida by renowned plant explorer David Fairchild. The **Natal** or **monkey orange** (*Strychnos spinosa*) was the first fruit tree to be planted in the Kampong (Coconut Grove), then David Fairchild's residence. Its cultivation was promoted both in Florida and California before World War 1, but since then local interest in Natal orange has waned though trees are available from at least one south Florida nursery. Growing as a small, thorny, spreading tree, the fruit is a large, round, orangey yellow, hard-shelled berry containing many outsized, flat seeds surrounded by a layer of edible, sweet, jelly like pulp with a pleasant clove like aroma. The fact that Natal orange is in a genus (*Strychnos*) that is the source of the indole alkaloid **strychnine** is no doubt one factor contributing to the fruit's lack of acceptance. The seeds contain strychnine though far less than other species such as *Strychnos nux-vomica*, the principal source of the alkaloid. While consuming unripe fruit has caused purging, the pulp from ripe fruit is safe though vomiting has on occasion occurred if eaten to excess. In order to gain greater acceptance the selection of superior cultivars containing safe alkaloid levels, which can then be propagated vegetatively, is seen as essential. At present Natal orange is consumed in its native southern Africa; both there and in Israel it is seen as meriting further study as a promising, drought resistant, fruit tree.

With fruits and vegetables that are considered edible there is understandably less inclination to think of them being toxic. While it would be irresponsible to overstate the risk of poisoning, being too blasé when consuming unfamiliar items, could at the very least be the cause of unnecessary pain and discomfort. Once more I am indebted to Jeffrey Bernstein MD, Medical Director Florida Poison Information Center Miami Office, for the benefit of his expertise. **If you suspect that you have ingested a poisonous substance including those of plant origin, call Poison Control 1-800-222-1222.**