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Holiday Plants with Toxic Misconceptions

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Several plants are used for their decorative effect during winter holidays. This review explores the toxic reputation and proposed management for exposures to several of those, namely poinsettia (*Euphorbia pulcherrima*), English holly (*Ilex aquifolium*), American holly (*Ilex opaca*), bittersweet (*Solanum dulcamara*), Jerusalem cherry (*Solanum pseudocapsicum*), American mistletoe (*Phoradendron serotinum*), and European mistletoe (*Viscum album*). [West J Emerg Med. 2012;13(6):538-542]

INTRODUCTION

December is a much-decorated month with many holidays, celebrations, and adornments. These very decorations, however, are allegedly toxic. We review the toxic (or not so toxic, in some cases) characteristics of 7 common holiday plants – poinsettia, English and American holly, bittersweet, Jerusalem cherry, and American and European mistletoe.

PLANTS

Poinsettia (*Euphorbia pulcherrima*)

This flowering plant, indigenous to Mexico and Central America, has large green and red leaves. It was reportedly introduced to the United States in 1829 by J.R. Poinsett, the American ambassador to Mexico at the time.² In the wild it is a large, woody shrub commonly growing 10 feet high. Indoors it is typically much smaller with denser leaves.³ It is commonly used as a Christmas decoration; as a result, the majority (74.9%) of exposures are in the months of December, January, and February.⁴ The most recent annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS) revealed that *Euphorbia* had the 6th highest rate of genus-specific human plant exposure calls in 2010.⁵ The number of poinsettia-related calls for the year was 750, which likely underestimates the actual amount of exposures.⁵

Despite a long-standing belief in the legend of poinsettia toxicity, there is little data to support this. The toxic reputation stems from a single unconfirmed death of a 2-year-old in Hawaii in 1919. While the *Euphorbia* genus contains



Figure 1. Poinsettia (*Euphorbia pulcherrima*)¹

complex terpenes (diterpenes) that are local irritants and cause gastrointestinal upset, the *pulcherrima* species does not contain this toxin.^{6,7}

Poinsettia is in the same plant family as natural rubber latex and shares 2 common allergen proteins. Forty percent of individuals with a latex allergy develop cross-sensitivity with the poinsettia plant.⁸ Symptoms vary from rare immediate hypersensitivity (type I), allergic contact dermatitis (type IV), or irritant contact dermatitis. Case reports of anaphylactic shock from poinsettia in infants with atopic eczema and latex allergies have been published with probable causality, although these are a rarity. Families that include members with atopic eczema or other generalized atopia may want to avoid using poinsettia as a decorative addition to their holiday.⁹

A vast majority of exposures, however, result in either no effect or minor gastrointestinal upset and nausea with

Table. Holiday plants with respective toxin and clinical effects.

Plant	Toxin	Clinical Effects
Poinsettia (<i>Euphorbia pulcherrima</i>)	None identified	Minor gastrointestinal upset/cramping, dermatitis
Holly (<i>Ilex aquifolium</i> and <i>opaca</i>)	Saponin	Gastrointestinal upset/cramping, dermatitis Uncommon: mydriasis, hyperthermia, ataxia, muscle weakness, dyspnea, drowsiness, altered mental status
Bittersweet (<i>Solanum dulcamara</i>), Jerusalem Cherry (<i>Solanum pseudocapsicum</i>)	Solanine	Gastrointestinal upset/cramping Uncommon: salivation, bradycardia, hypotension, altered mental status
	Dulcamarine	Anticholinergic symptoms
Mistletoe (<i>Phoradendron serotinum</i> and <i>Viscum album</i>)	Toxalbumins	Gastrointestinal upset/cramping with necrotic sloughing of gastrointestinal tract Uncommon: bradycardia, delirium, and liver/central nervous system/renal/adrenal toxicity

occasional vomiting.⁷ Contact dermatitis is very rare. Krenzelok⁴ reviewed 22,793 cases of poinsettia exposure that were collected by poison control centers (PCCs) from 1985-1992. Of these, 98.9% were accidental and no fatalities were observed. The vast majority of exposures were ingestions (94.5%), with some dermal exposures as well (4.8%). In part due to the attractiveness of the poinsettia's foliage, nearly all of ingestions are in children (93.3%), with the majority in children younger than 2 years (77.3%). Ninety-six percent were not referred by their respective PCC to a healthcare facility. In addition, 92.4% did not develop any toxicity, and 3.4% only had minor clinical effects.⁴ The clinical effect seen with 1 particularly large ingestion was minor gastrointestinal upset and abdominal cramping.

The overriding results of multiple attempts to analyze potential toxicity using animal models revealed little to no toxicity. One study could not find a lethal dose 50 (dose at which 50% of the exposed subjects expire) in rats. At the highest dose orally administered (25 g/kg) there was no evidence of any symptoms during a 14-day observation period or any toxicity noted on subsequent autopsy. The same study could find local irritation/inflammation on repeated instillation into the buccal cavity of rats and the eyes of rabbits. There was some minor skin irritation with repeated exposure in rabbits.¹⁰ These findings are echoed in other studies.^{11,12}

Nearly all patients do not require any therapy and can be treated without healthcare facility referral. In those that do present to an emergency department (ED), the induction of emesis, decontamination, and the use of dilution appear to be of little or no value and are not recommended.⁴ Supportive care through symptomatic management, such as antiemetics, should be all that is necessary.

Holly (*Ilex aquifolium* and *opaca*)

There are 2 commonly distributed forms of the holly in the United States (U.S.): the English holly (*Ilex aquifolium*) and the American Holly (*Ilex opaca*). Holly is a small tree or shrub that will grow up to 15 m tall and carries scarlet-red berries approximately 10 mm in diameter.³ English

**Figure 2.** Holly (*Ilex aquifolium* and *opaca*)

and American holly are not to be confused with the South American *Ilex* species, *Ilex paraguariensi* and *Ilex guayusa*, which are commonly used to make teas and other drinks for their reported antioxidant properties and caffeine content.^{14,15} These shrubs are most commonly used as holiday decorations, although they can be found in gardens. Holly exposure accounts for the 3rd highest rate of genus-specific human plant exposure calls in 2010, with 877.⁵ The berries containing the toxin saponin are poisonous; the leaves are not.⁷ The toxic component of the berries is saponin.^{7,16} The primary potential biological effect of saponin is a negative interaction with cellular membranes. Saponins can cause hemolysis in erythrocytes and alterations in permeability of small intestinal mucosal cells. Most ingestions cause little or no toxicity. The primary clinical effects observed, which occur exclusively with large ingestions, include nausea, vomiting, abdominal cramping, and occasionally dermatitis. There can be allergic sensitization and worsening dermatitis with repeat exposures.⁷ Rarely, mydriasis, hyperthermia, and drowsiness have also been reported.^{17,18}

Rodrigues et al¹⁹ describes a case of 2 identical twins that

ingested a “handful” of holly berries. One twin vomited 40 times over 6 hours and was drowsy, while the other twin had only 5 episodes of emesis in the same time period without drowsiness. Poisonings most often occur in children, and most cases are harmless. In adults, 1 must eat 20-30 berries before becoming symptomatic, whereas children only have to consume 5.¹⁸

One study attempted to explore management techniques for pediatric ingestions of toxic berries (including holly berries), comparing home observation alone with syrup of ipecac and home observation. Predictably, all of the patients in the ipecac group vomited, while there was no vomiting among the subjects in the home observation alone group. There was more sedation and diarrhea in the ipecac group as well.²⁰ Ipecac is no longer recommended for toxic ingestions in general. ED therapy recommendations for holly berry exposures include symptomatic management, such as antiemetics, along with fluid and electrolyte supplementation for dehydration from rare severe vomiting and diarrhea.^{7,18}

Bittersweet (*Solanum dulcamara*) and Jerusalem cherry (*Solanum pseudocapsicum*)

Bittersweet, or the woody nightshade, is a semi-woody perennial vine introduced from Europe. Common to the northern U.S. and southern Canada,³ it has purple and yellow flowers with 5 spreading petals and red ovoid berries. The Jerusalem cherry, or Christmas orange, is a perennial grown as a decorative houseplant. Originating in the Middle East, it now flourishes in Hawaii and the Gulf Coast states. It also has 5-petaled flowers but typically has yellow-red-orange berries.⁷ *Solanum*-related poison center calls in general are common, and *S. dulcamara* alone made up the 22nd most species-specific U.S. poison center calls, with 406 total.

In both of these plants the immature fruit is more poisonous than the still-toxic ripened fruit due to the glycoalkaloid solanine.³ Solanine may exert toxicity through alteration of mitochondrial potassium and calcium transport, but this mechanism is speculative.⁶ In animals solanine exhibits cholinesterase activity and cardiac glycoside effects, but these effects are not seen in human poisoning.¹⁶

The clinical effects of solanine are primarily gastroenteritis and abdominal cramping. Salivation, bradycardia, tachycardia, hypotension, and altered mental status have also been documented.¹⁷ Symptoms usually occur several hours after ingestion and may persist for several days. The solanine effects seem more potent in children; in adults, solanine has little toxicity. While 1 source reported that just several bittersweet or Jerusalem cherry berries can prove fatal in children, there has been a single authenticated case of death following ingestion of the berries from bittersweet in a 9-year-old female.^{2,3,23} That particular child suffered abdominal pain and vomiting 2-3 days post-ingestion, and subsequently developed pallor with dry skin, hypothermia, tachycardia, but neither delirium nor paralysis. Post-mortem exams revealed



Figure 3. Bittersweet (*Solanum dulcamara*) (left)²¹ and Jerusalem cherry (*Solanum pseudocapsicum*) (right)²²

lesions in the gastrointestinal tract. There have been repeated case series that reported essentially mild solanine symptoms of abdominal distress and other more vague symptoms. The largest case series recorded spanned 319 ingestions; 295 were under the age of 10, and only 9 had likely solanine-related symptoms; none had to be hospitalized.² There have been a couple of other notable reports of pediatric *S. dulcamara* ingestions. A 7-year-old creating “make up” from crushed leaves and berries subsequently experienced gastritis, tachycardia, and mydriasis.²⁴

Case reports document the rare anticholinergic effects of *Solanum*, likely due to dulcamarine, an atropine-like compound.³ A 4-year-old girl had an anticholinergic syndrome treated successfully with physostigmine after she was found playing around a bittersweet plant. Causality in that case was questionable.²⁵ Additionally there are minimally active alkaloids in these plants -- solasodine (in the flowers) and beta-solanine (in the roots).²⁶

Of the plants discussed thus far, it seems as though bittersweet and Jerusalem cherry constitute the most danger. There is little to no data to support serious toxicity to adults, but there may be some real danger to children. Historically, induced emesis was recommended for *Solanum* ingestion, especially in children, but that doesn’t coincide with current decontamination recommendations.¹⁶ Prolonged observation may be necessary for children in the context of high likelihood of ingestion. Management includes intravenous fluids and antiemetics for nausea, vomiting, and dehydration.⁷ Physostigmine could be considered for obvious anticholinergic presentation.

Mistletoe (*Phoradendron serotinum* and *Viscum album*)

There are 2 plants with the common name “mistletoe” – the American mistletoe (*P. serotinum*) and European mistletoe (*V. album*). Mistletoe is a parasitic perennial with white or translucent berries that can be quite sticky. They grow on the trunks and branches of deciduous trees. *P. serotinum* is widespread in the U.S., hence the American mistletoe moniker. *V. album*, endemic to much of Europe, can



Figure 4. Mistletoe (*Phoradendron serotinum* and *Viscum album*)²⁷

occasionally now be found in the U.S., mainly in California.⁷ These plants are common adornments and holiday symbols most commonly sold around Christmas time.

All sections of *P. serotinum* are potentially harmful as they contain phoratoxin, a toxalbumin. Most ingestions result in little physical reaction, although some patients may experience gastrointestinal symptoms. The entire *Viscum spp.* plant is toxic, with the exception of the berries, which are harmless except in very large amounts.⁷ Viscotoxins, similar in structure and effect to the phoratoxin toxalbumins found in *Phoradendron spp.*, inhibit cellular synthesis, thereby affecting cells with rapid turnover like gastrointestinal mucosa. *Viscum* (also called viscumin), from *V. album*, can also cause erythrocyte agglutination in vitro; it is unclear if this also occurs in vivo.⁶ After a latent period of several hours, clinical effects from viscotoxins can develop and are primarily gastrointestinal upset with potential necrotic lesions resulting in sloughing of the gastrointestinal tract. Bradycardia, delirium, as well as toxicity of the liver, central nervous system, kidney, and adrenals can also occur, although the incidence is not known.^{16,17}

Although *Phoradendron* and *Viscum spp.* both contain the common name “mistletoe,” the *Phoradendron spp.* has a relatively lower toxicity compared to *Viscum spp.* The only cases involving deaths likely related to *P. serotinum* are cases in which there were teas infused with the fruits and other parts of the plants.² The literature does include reports of fatalities due to *V. album* ingestion, primarily due to its alleged medicinal qualities resulting in excessive use in herbal/therapeutic teas.²⁹ The only 2 reported deaths from ingestion of mistletoe in the past 25 years were patients who ingested brewed teas.³⁰

A case review of 14 patients with American mistletoe leaf or berry ingestions failed to show any symptoms of toxicity. Based on that series, ingestion of 1-3 mistletoe berries or 1-2 leaves is unlikely to produce serious toxicity.³⁰ Krenzelo et al³¹ compiled the largest case review of mistletoe exposure to date, 1,754 exposures reported to PCCs from 1985-1992.

Accidental pediatric exposures accounted for the majority of cases (94.7% and 92.1% of cases, respectively). Ninety-five percent of cases were due to ingestion rather than exposure via another route. Of the 72 intentional exposures, 11.1% were suicide attempts. Overall, patient outcomes were excellent with no fatalities and 99.2% having no morbidity. Outcomes were not influenced by gastrointestinal decontamination, as 96.2% of treated patients versus 96.3% of untreated patients remained asymptomatic. Seasonal clustering was also seen with 87% of cases seen November through January. The relatively harmless nature of ingestions of *P. serotinum*, at least in small amounts, was shown in previous work as well.²⁹

ED management should be directed toward supportive care for dehydration and vomiting if severe gastroenteritis develops.⁷ Based on reported onset of symptoms, an observation period of 6 hours would be reasonable in asymptomatic patients. According to case reviews by both Krenzelo et al³¹ and Spiller et al³², gastrointestinal decontamination was not deemed to influence patient outcome and is not recommended.

CONCLUSION

Concentrations of the toxic agent vary depending on the portion of the plant ingested. For plant ingestions the amount of toxin ingested is usually unknown. While nearly all ingestions are in children, nearly all are also asymptomatic given the low concentrations of toxin in the plants reviewed. However, steeping the plant in hot water (“herbal tea”) may result in large amounts of ingested toxin.¹⁷ Serum toxin concentrations are not easily available and are not necessary. Because the vast majority of these plant exposures are asymptomatic, home observation with expectant, conservative management is appropriate. However, if severe gastroenteritis does result supportive care with fluid resuscitation and evaluation of electrolytes, glucose, BUN, creatinine, and urinalysis may be useful.¹⁷

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