Other Plants that Affect the Heart (9-Aug-1999)

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Chapter Sections
- Taxus - Yew
- Cassia - Senna, Coffee Senna
- Partridge Pea (Cassia fasciculata Michx.)
- Zigadenus - Death Camas
- Additional Toxicants

**Taxus - Yew**

*Taxus canadensis* - American Yew, Ground Hemlock

*Taxus cuspidata* - Japanese Yew

*Taxus baccata* - English Yew

*Taxus brevifolia* - Western Yew

### Description

- **Taxus spp.**
  - Plant - Evergreen gymnospermous trees of small erect or decumbent shrubs.
  - Stem - Bark, reddish-brown, thin, flaking in thin scales.
  - Leaves - Alternate, needle-like, often shaped like a narrow sickle, spirally arranged, linear, stiff, 1.25 - 2.54 cm long (0.5 - 1 - 1/2 inches), midrib prominent, dark green to yellow-green, spread in 2 ranks; winter buds have overlapping scales; prominent midvein; 2 yellowish green veins on under surface, no resin ducts. Abruptly pointed or gradually long-pointed at apex.
  - *Leaves of Japanese Yew are wider than Canada Yew.*
  - Flowers - Axillary, inconspicuous, unisexual, small.
  - Fruit - Seeds, stony, solitary, borne in cup-shaped, fleshy, bright scarlet, red, thick, ovoid, aril, showy, appear as a red or yellow berry, 1.25 - 1.85 cm (0.5 - 0.75 inches).
Habitat

- *T. canadensis.*
  Kentuck to northeastern states and Canada, native to N. America, Newfoundland to Quebec and Manitoba, South to Virginia, Kentucky, Ohio, Indiana, Illinois and Iowa. Coniferous wooded slopes, ravines, along marshes, bogs, stony deciduous forests and cliffs.
- *T. cuspidata.*
  - Northern states; native of Japan, Manchuria and Korea. Widely used as an ornamental.
- *T. baccata.*
  - Southern states and as far north as New York. Ornamental.
- *T. brevifolia.*
  - Pacific states to Montana, native to North America, coast from Alaska and British Columbia, South to California and eastward to Montana. Forests, wooded slopes, singly or in small groups, deep soils along streams and moist flats near the coast.

Toxic Principle and Mechanisms of Action

- Perhaps an alkaloid, taxine.
- Separated into 2 fractions, taxine A and B.
- Taxine B is present in the greatest amount.
- As many as 10 alkaloids have been isolated.
- The alkaloid does not act as a cardiac glycoside, but depresses conduction of depolarization through the heart.
- No alkaloids found in *T. brevifolia.*
- Also, a volatile oil that acts as a slow acting gastrointestinal irritant.

Susceptible Species

- All livestock, humans, dogs and wild animals.
- Monogastrics are more sensitive.

Toxicity

- General.
  - Wood, bark, leaves, and seeds are toxic in the dry or green state.
  - The concentration of taxine is greater in old leaves, than young leaves.
  - Taxine concentration in leaves is maximal in the winter.
  - The red pulp of berries seems to be harmless.
  - The seed is quite toxic but must be chewed.
  - Large doses are readily consumed by livestock.
  - Clippings from bushes cause most instances of poisoning.
  - Most dangerous of all poisonous trees or shrubs in Great Britain.
  - Toxic all seasons of the year.
  - Common cause of lethal poisonings in large animals in Midwest USA.
- *T. baccata*
  - Green foliage is toxic to monogastric animals at 0.1% of an animal's body weight.
  - Green foliage is toxic to ruminants at 0.5% of the animal's body weight.
  - LD₅₀ in mice is 15 mg/kg.
  - LD₅₀ in rabbits is 8 mg/kg.
- *T. cuspidata*
  - The toxicity of *T. cuspidata* may be greater than *T. baccata.*
  - About 0.1% of a 5 year old Shetland pony's weight of green *T. cuspidata* produced death within 1.25 hours after feeding. The foliage was finely ground and administered via a stomach tube.

Signs

- General
  - Up to 2 days may pass before clinical signs appear but generally occur rapidly.
  - Nervous signs including trembling, dyspnea, incoordination and collapse.
  - Acute cardiac failure, bradycardia.
  - Gastroenteritis, diarrhea.
• Rapid death due to cardiac failure - heart stops.
• Ingestion of small amounts may cause vomiting, nausea, diarrhea, abdominal cramps, trembling, difficulty breathing and dilated pupils.

• Human.
  • Weakness, trembling, diarrhea, and vomiting.
  • Slow heartbeat, difficulty breathing.
  • Hypotension and red spots on various parts of the body.
  • Convulsions and coma.

• Shetland Pony.
  • Paw ground as if hungry for nearby grass.
  • One hour after dosing, lower lip hung limp as if paretic.
  • Tail hung limp.
  • Pulse weak (not palpable over external maxillary artery).
  • Ataxic gait similar to "Equine Wobbler", especially of rear limbs.
  • Intermittent trembling of leg muscles.
  • Audible respiratory grunt.
  • Collapse to knees and lateral recumbency when led about.
  • Short convulsions.
  • Legs and body rigid, followed by 30 seconds of paddling with limbs.
  • Death followed appearance of first signs in less than 15 minutes.

• Cattle.
  • Usually no lesions, death attributed to lightning, etc.
  • Occasionally dependent edema, pulmonary edema, etc., acute in onset.

• Dogs.
  Tetanic epileptiform seizures reported, not experimentally reproduced.

Lesions

• Taxine depresses the conduction system of the heart, therefore there are no significant lesions, although plant material is consistently found in the digestive tract.
• Moderate irritation may be found in the upper GI tract with acute poisoning.
• Pulmonary congestion and edema, and splenic congestion occurred in 7 and 10 year old Brahman-type bulls.

Diagnosis

Identification of *Taxus* spp., in stomach or rumen contents (evidence of consumption) and appropriate clinical signs often including death.

Note

It may be necessary to examine a horse's stomach contents with a dissecting microscope because mastication may make identification otherwise impossible. Examine carefully in any species as foliage can easily be missed.

Treatment

• No specific treatment for taxine.
• Remove animal from source of plant insult.
• Establish respiration.
• Induce emesis unless contraindicated, gastric or rumen lavage.
• Endotracheal intubation preceding gastric lavage in small animals.
• Activated charcoal and saline cathartic.
• Atropine to counter the depressant effect of taxine (must be given early to have any benefit).
• Maintain body fluid and electrolyte balance.
Cassia - Senna, Coffee Senna

*Cassia fasciculata* - Senna
*C. lindheimeriana*
*C. occidentalis* - Coffee senna
*C. tora* - Sickle pod
*C. fistula*

Family - Leguminosae (pulse or bean family)

Images

- Coffee Senna - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Cassia fasciculata* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Cassia lindheimeriana* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Cassia occidentalis* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Cassia Tora* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Cassia fistula* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.

Note - Do not confuse with *Sesbania*.

Description

- *C. occidentalis.*
  - Plant - Annual.
  - Leaves - Leaflets, 4 - 6 pairs, ovate-lanceolate, acute, ovate, gland at base of petiole, drab green.
  - Flower - Bright, golden yellow.
  - Fruit - Pod, long, linear, 4 3/4 inches long, glabrous, green with transverse brown bars.

* Cassia spp.
- Plant - Annual/perennial herb.
- Leaves - Simple, abruptly pinnate, alternate; leaflets, 4 - 6.
- Flower - Mostly yellow, axillary or terminal, conspicuous, slightly irregular; sepals, 5; scarcely united at base; petals, 5; stamens, 5 - 10, unequal, often imperfect, spreading.
- Fruit - Pod, long, many seeded, often with cross partitions, may be 4-sided.

Habitat

- *C. fasciculata.*
  Texas, east of Mississippi river, sandy soil.
- *C. lindheimeriana.*
  Texas to southern Arizona and New Mexico.
- *C. occidentalis.*
  South East of United States, from Virginia and eastern Kansas to Florida and Texas; native to the tropics; eastern half of Texas.
- *C. tora.*
  Eastern United States; Pennsylvania to Kansas, South to Florida, Texas, and Mexico.
- *C. occidentalis, C. tora.*
  - Rich soil, river bottom pastures; weeds of hay and grain crops in Florida; waste places in east and south Texas.

Toxic Principles

- Substituted quinones occur in many species of *Cassia* and may be responsible for cathartic effects.
- *C. fasciculata* seeds have cathartic effects.
- *C. occidentalis, C. tora* causes skeletal and cardiac myodegenerative and sometimes hepatotoxic effects.
- Toxin exists in beans, leaves and stem and is water soluble. It may possibly be a peptide but its identity remains to be established.

Mechanism of Action

- Originally theorized as being due to uncoupling of oxidative phosphorylation in skeletal muscle mitochondria. However, this was disproven since mitochondrial damage was preceded by degeneration of myocardial fibers.
- Abnormal electrocardiographic patterns occur in terminal stages of illness including tachycardia, alteration in QRS complex, displacement of the ST segment and tenting of T-waves. The abnormal EKGs were mainly due to hyperkalemia, and alterations in the conduction of impulses in the heart was not pronounced.
- Thus these proposed mechanisms of action do not appear to be valid.
- The most recent theory indicates a high blockade of electron transport (rather than an uncoupling of oxidative phosphorylation).

Toxicity

- *Cassia occidentalis.*
  - All parts are toxic.
  - Duration of illness is inversely proportional to the daily dose rate, but not directly related to total dose.
  - Dried plant remains toxic.
- *Cassia occidentalis.*
  - One percent of body weight fed for 7 days generally produces clinical toxicosis.
  - Ground beans (*C. occidentalis*) given orally, at rates of 0.05 - 2% of body weight produced toxicosis in 26 beef calves.

Signs

- Afebrile course.
- Anorexia, abdominal pain, diarrhea.
- Death is rare if removed from contact with plant before becoming recumbent (cattle).
- Dehydration, lethargy, altered gait, weakness.
- Muscular tremors.
- Dark red urine.
- Incoordination, recumbency.
- May resemble vitamin E deficiency ("White Muscle Disease").
- Late fall, early winter.
- Acute form may resemble acute leptospirosis.
• Death in 5 - 7 days.
• In 26 beef calves poisoned by *C. occidentalis* findings included:
  • Anorexia, diarrhea.
  • Hyperpnea, tachycardia, progressive muscle incapacitation (associated with increased serum glutamate-oxaloacetate transaminase (GOT) and creatine phosphokinase (CPK) activities as well as myoglobinuria).
  • Death may occur within 24 hours after signs of acute illness and is almost assured in animals that become recumbent.

Lesions

• *C. occidentalis*.
  • Paleness of various skeletal muscles.
  • Microscopic myodegeneration.
  • Moderate hepatic centrilobular necrosis and fatty degeneration.
  • Acute renal tubular degeneration.
  • Generalized pulmonary edema.
• Cattle.
  • In 26 beef calves poisoned by *C. occidentalis* findings included:
    • Myocardial degeneration.
    • Congestive heart failure.
    • Widespread skeletal myodegeneration.
    • Muscles with characteristic transverse stippling.
    • Varying degrees of toxic hepatitis and nephritis.

Diagnosis

• Identification of *Cassia*, evidence of consumption, and appropriate clinical signs and lesions.
• Myodegeneration on microscopic examination.
• Increase in serum creatine phosphokinase (CPK), SGOT, LDH.
• Rule out poisoning due to ingestion of avocados, an ionophore, white snakeroot and gossypol.

Treatment

• Recovery usually follows removal from access to plant but an abnormal gait may remain for weeks.
• With acute myoglobinuria consider fluid therapy and bicarbonate.
• For hyperkalemia consider using insulin and glucose to drive K+ into cells.

Prevention

Cattle should not be allowed access to coffee senna especially when ample good forage is unavailable.

Note

• Poisoning is occasionally encountered in the USA.
• Used in human medicine as a cathartic.
• Useful model of a toxic myodegenerative disease.
Partridge Pea (*Cassia fasciculata* Michx.)

Images


**Family** - Pea (Leguminosae).

**Growth Form** - Annual herb from fibrous roots.

**Stems** - Upright, branched, hairy or smooth, up to 2 feet tall.

**Leaves** - Alternate, divided into 20 - 30 leaflets narrowly oblong to lanceolate, rounded at the tip, but with a short point, tapering to the asymmetrical base, without teeth, hairy or smooth, up to 3/4 inch long.

**Flower Arrangement** - Flowers 2 - 4 from the axils of the leaves.

**Flowers** - Yellow, up to 1 1/2 inches across, borne on slender stalks.

**Sepals** - 5, green, united below.

**Petals** - 5, yellow, 2 of them slightly smaller than the other 3.

**Stamens** - 10.

**Pistils** - Ovary superior.

**Fruits** - Pods narrow, flat, somewhat hairy, up to 2 1/2 inches long.

**Habitat** - Fields, prairies, roadsides, woods.

**Range** - Throughout the state.

**Time of Flowering** - July to September.

**Associated Plants** - Tall Tickseed (*Coreopsis tripteris*), milk spurge (*Euphorbia corollata*), switch grass (*Panicum virgatum*), and black-eyed Susan (*Rudbeckia hirta*).
**Zigadenus - Death Camas**

- **Zigadenus gramineus** - Grassy death camas
- **Z. venenosus** - Meadow death camas
- **Z. paniculatus** - Foothill death camas
- **Z. nuttallii** - Nut Fall's death camas
- **Z. densis**
- **Z. elegans**
- **Z. fremontii**

<table>
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<th>Major Species</th>
<th>Usual Time of Onset</th>
<th>Usual Duration (if survives)</th>
<th>Full Table for Other Plants that Affect the Heart</th>
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<tbody>
<tr>
<td>Most species</td>
<td>Hours</td>
<td>Days (?), often lethal; poisoning is infrequent</td>
<td></td>
</tr>
</tbody>
</table>

**Family** - Liliaceae (Lily family)

**Images**

- Death Camas, *Zigadenus* spp.. Source: Cornell University, Poisonous Plants Informational Database (www.anosci.cornell.edu/plants/index.html). - To view this image in full size go to the IVIS website at www.ivis.org.
- Nut Fall's death camas, *Zigadenus nuttallii* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Zigadenus densis* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Zigadenus elegans* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.
- *Zigadenus fremontii* - Google Image Search. - To view this image in full size go to the IVIS website at www.ivis.org.

**Description**

- *Zigadenus gramineus*.
  - Plant - Bulbous perennial, onion-like.
  - Stem - Tall, single, smooth.
  - Leaves - Narrow, grass-like, not stalked, up to 1 1/2 feet long.
  - Flower - Branched cluster of yellow-white to green-white flowers.
  - Root - Onion-like bulb but no onion aroma in leaves or bulbs.

**Habitat**

- **Z. gramineus**.
  - Saskatchewan to Idaho, south to New Mexico and Utah.
- **Z. venenosus**.
  - West Coast States east to southwestern Idaho, Western Utah, and most of Nevada. Canada south to Florida, Texas, New Mexico, Arizona and Canada.
- **Z. paniculatus**.
- **Z. nuttallii**.
  - Prairies of Eastern Kansas, Eastern Oklahoma, and Eastern Texas to south edge of Edwards Plateau.
Toxic Principle

Contains steroidal alkaloids such as zygacine which is similar to the nonteratogenic alkaloids of *Veratrum* spp.

Mechanism of Action

Cardiovascular effects of similar *Veratrum* alkaloids include lowering of blood pressure due to dilation of arterioles, constriction of venules and slowing of the heart rate.

Toxicity

- Seeds are most toxic.
- Young plants are more toxic than mature plants.
- Bulbs are less toxic than the leaves until flowering time.
- All parts are toxic, particularly the leaves and bulbs.
- Sheep:
  - One-half lb may cause poisoning.
  - Minimum lethal dose is 15 - 20 ounces (400 - 600 g/100 lb body weight).
  - Lethal dose ranges from 0.6 - 6% of BW.

Susceptible Species

- Sheep more susceptible than cattle, horses, chickens.
- Swine vomit quickly and generally do not get poisoned.

Signs

- Often just found dead.
- Signs appear from 1.5 hours to 8 hours after ingestion.
- Salivation.
- Retching, possibly vomiting, and abdominal pain.
- Increased respiration.
- Stiff legs.
- Hyperirritability.
- Muscular weakness, trembling and staggering.
- Weak, fast, irregular pulse.
- Dyspnea, cyanosis.
- Weakness, depression.
- Incoordination - Some recover.
- Convulsions may occur.
- Low temperature.
- Collapse, coma, death.
- Death occurs from within a few hours to 2 days.
- Mortality is high.

Lesions

- Inflammation of GI tract.
- Congestion of lungs and kidney.
- Heart in systole.
- Degeneration of areas of skeletal muscles and myocardium may also be seen.

Diagnosis

Identification of *Zigadenus*, evidence of consumption, and accompanying clinical signs of toxicosis.
How it Affects Livestock

Deathcamas causes marked disturbance in respiration and heart action. A 100-pound sheep may die if it eats 1/2 to 2 pounds of green foliage. The amount of foliage that will cause an animal's death depends on the species of plant eaten. Severely poisoned animals usually die; those less seriously affected may recover.

Deathcamas is a perennial that produces grasslike leaves in groups of three from a deeply burled bulb. The plant may be 4 to 16 inches tall. Yellowish-white flowers grow in clusters atop the stalk. Top, meadow death-camas; bottom, foothill deathcamas.

Meadow deathcamas (yellow blossoms) growing in a grassy meadow, a typical habitat where its density often reaches levels that are hazardous to grazing animals.
Foothill Deathcamas - Note the long slender leaves, scaly bulb, delicate flowers, 3-celled seed pods, and seed (enlarged, lower right) of this deadly plant.
### Additional Toxicants

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<th>Specific Agents</th>
<th>Major Species</th>
<th>Usual Time of Onset</th>
<th>Usual Duration (if survives)</th>
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<td>Avocado (Persea americana) in cage birds</td>
<td>Caged birds, goats, other herbivores</td>
<td>12 hours to 2 days</td>
<td>Days; death usually occurs within 2 days of onset</td>
<td>Full Table for Other Plants that Affect the Heart</td>
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<td>White snakeroot (Eupatorium rugosum) (See Toxicants that Cause CNS Depression)</td>
<td>Horse</td>
<td>Days to chronic</td>
<td>Permanent damage</td>
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<td>Jerusalem cherry (Solanum pseudocapsicum)</td>
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<td>See Cholinergic Blockers</td>
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<td>Kleingrass (Panicum)</td>
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<td>False hellebore (Veratrum californicum)</td>
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<td>Vitamin D-Containing Plants (Solanum malacoxylon and Cestrum diurnum)</td>
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<td></td>
<td></td>
<td>(See Nephrotoxic Plants)</td>
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- *White Snakeroot in the Horse (Eupatorium rugosum) (See Toxicants that Cause CNS Depression)*
- Jerusalem Cherry (Solanum pseudocapsicum) (See Cholinergic Blockers)
- Kleingrass (Panicum) (See Toxicants that Affect the Skin)
- False Hellebore (Veratrum californicum) (See Teratogens)
- Avocado (Persea americana) in cage birds and other species (See Toxicants with Mixed Effects on the Central Nervous System)
- Vitamin D-Containing Plants (Solanum malacoxylon and Cestrum diurnum)

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