



Myotoxic Plants

Poisonous Plant Class ADVS 586

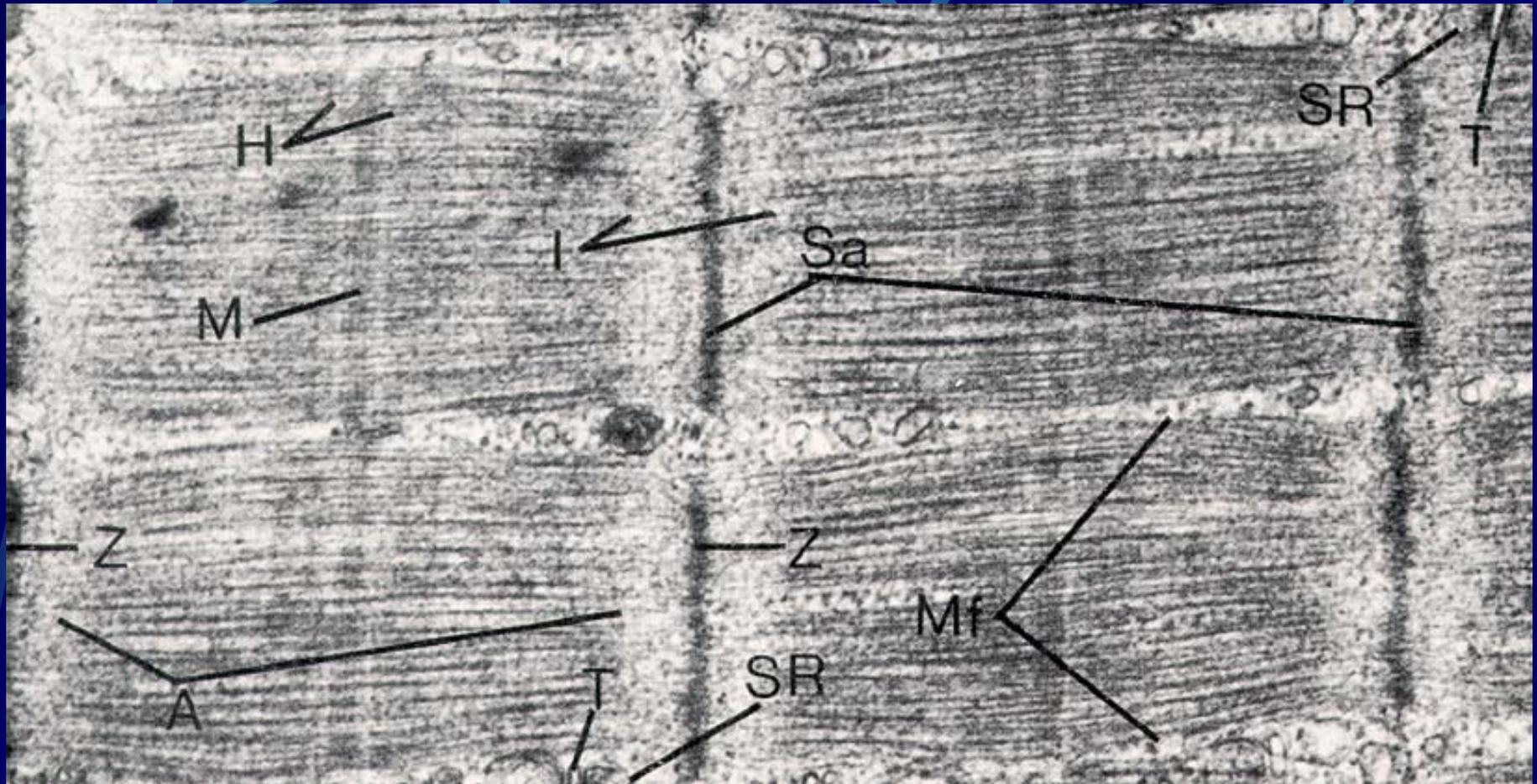
Bryan Stegelmeier
April 3, 2008

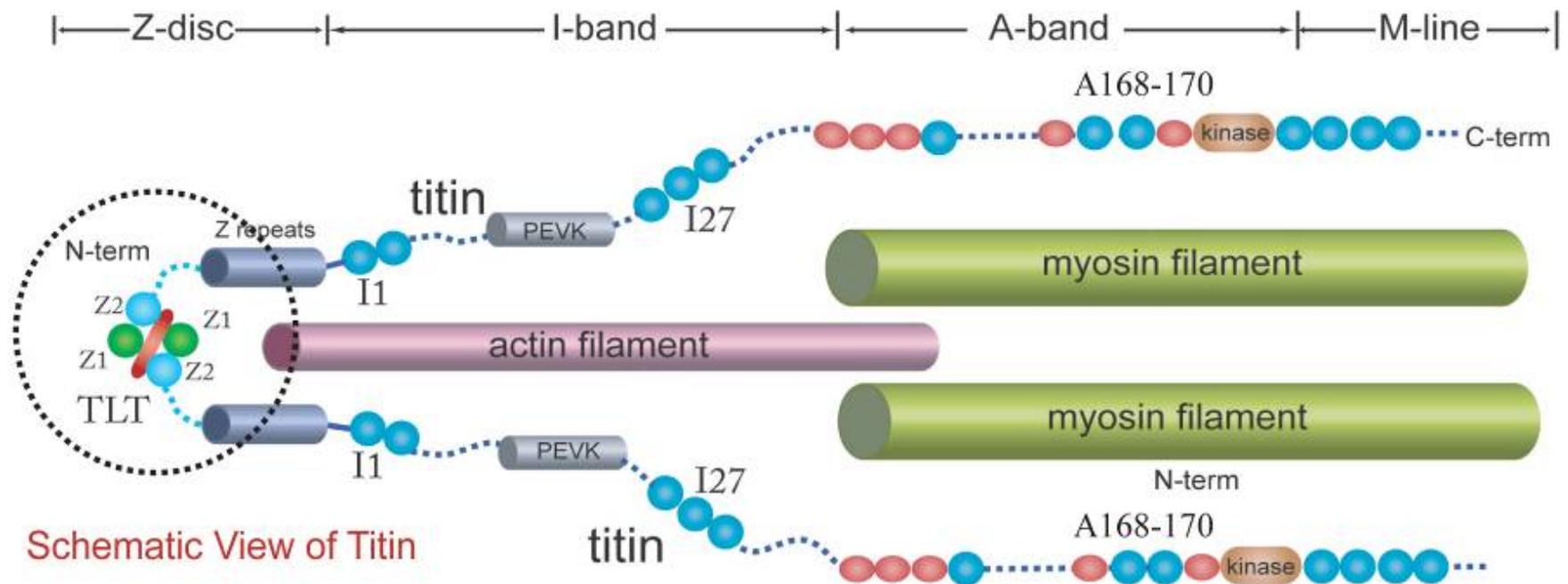
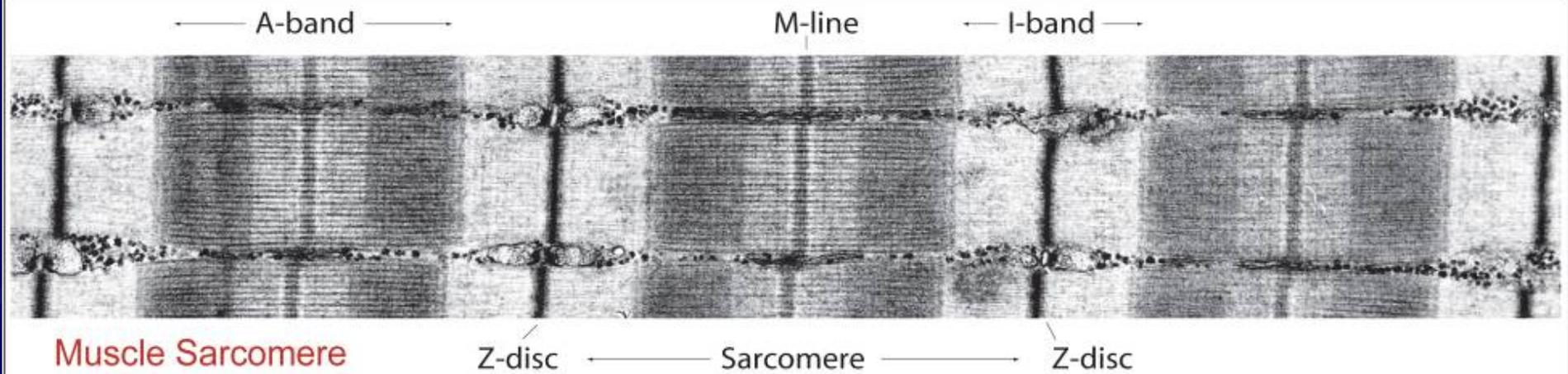
Striated Muscle

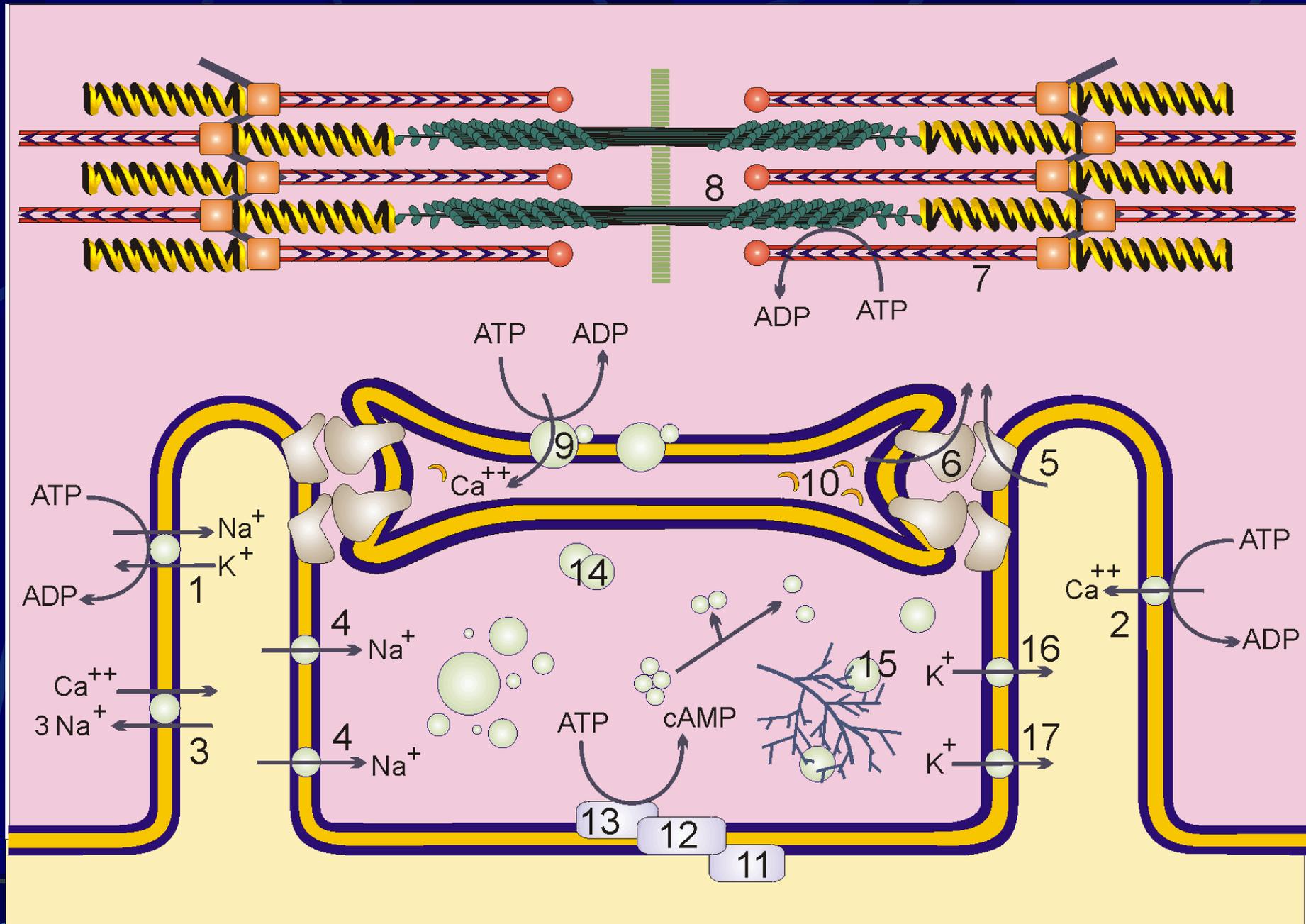
- Types of muscle
- Mitochondria
- Sarcolemma



Ultrastructure







Myotoxic Plants

- Muscle structure and physiology
- Clinical and histologic lesions
- Myotoxic Plants
 - *Thermopsis montana*
 - *Eupatorium rugosum*
 - *Haplopappus* or *Aplopappus* spp.
 - *Cassia occidentalis* *O. obtusifolia*
 - *Kwarwinskia humboldtiana*
 - *Gossypium* spp.
 - *Lathyrus* spp.
 - *Vicia villosa*
 - *Solanum* spp. (enzootic calcification)
- Cardioglycoside Containing Plants
 - *Digitalis purpurea*
 - *Nerium oleander*
 - *Convallaria majalis* and *C. montana*
 - *Apocynum* spp.
 - *Adonis aestivalis*
 - *Rhododendron* spp.
 - *Kalmia* spp.
 - *Pieris japonica* and *P. floribunda*
- Other potential myotoxic plants



Clinical Signs

- Anorexia, depression, droopy ears
- Reluctant to stand or move
- Swollen hard muscle
- Walk with slow, labored gait
- Weakness, trembling, ataxia
- Recumbency, coma, death

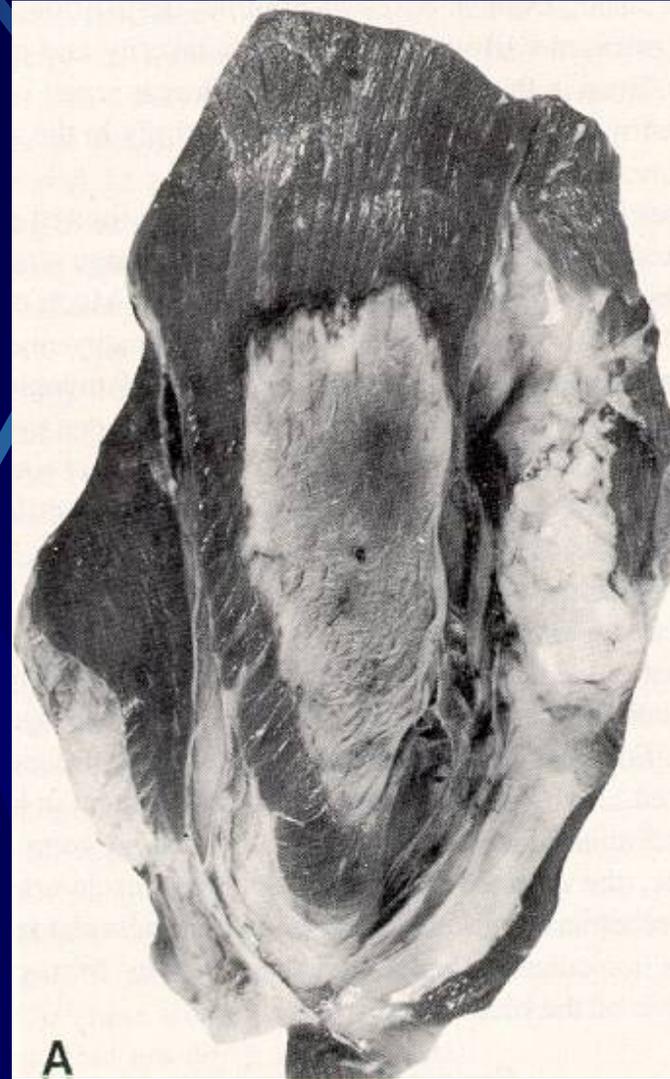


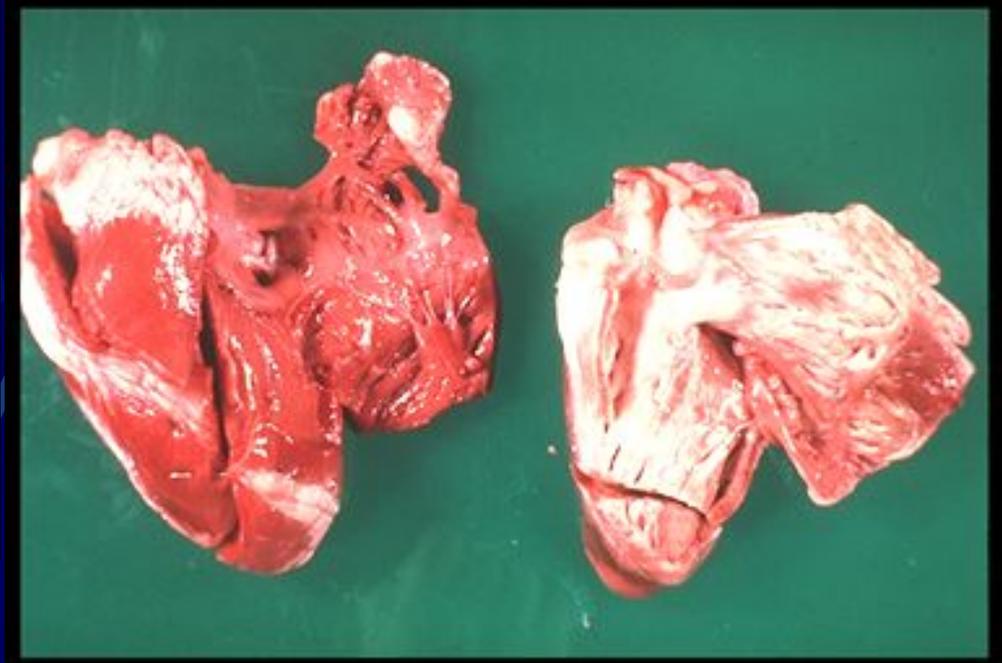
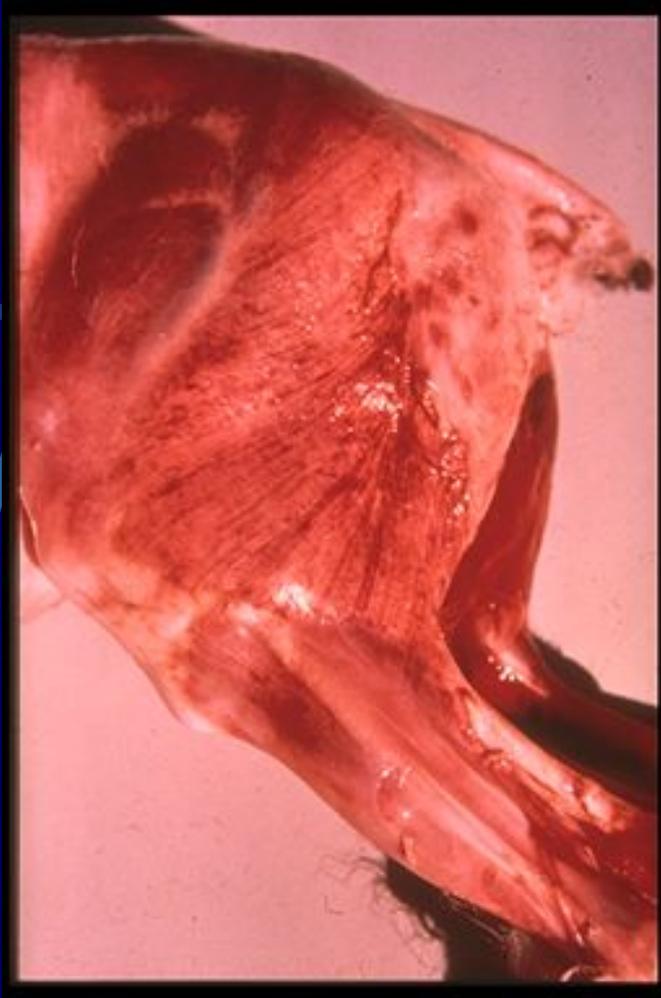
Biochemical Changes

- AST
- CPK
- K
- Myoglobinuria
- Secondary changes

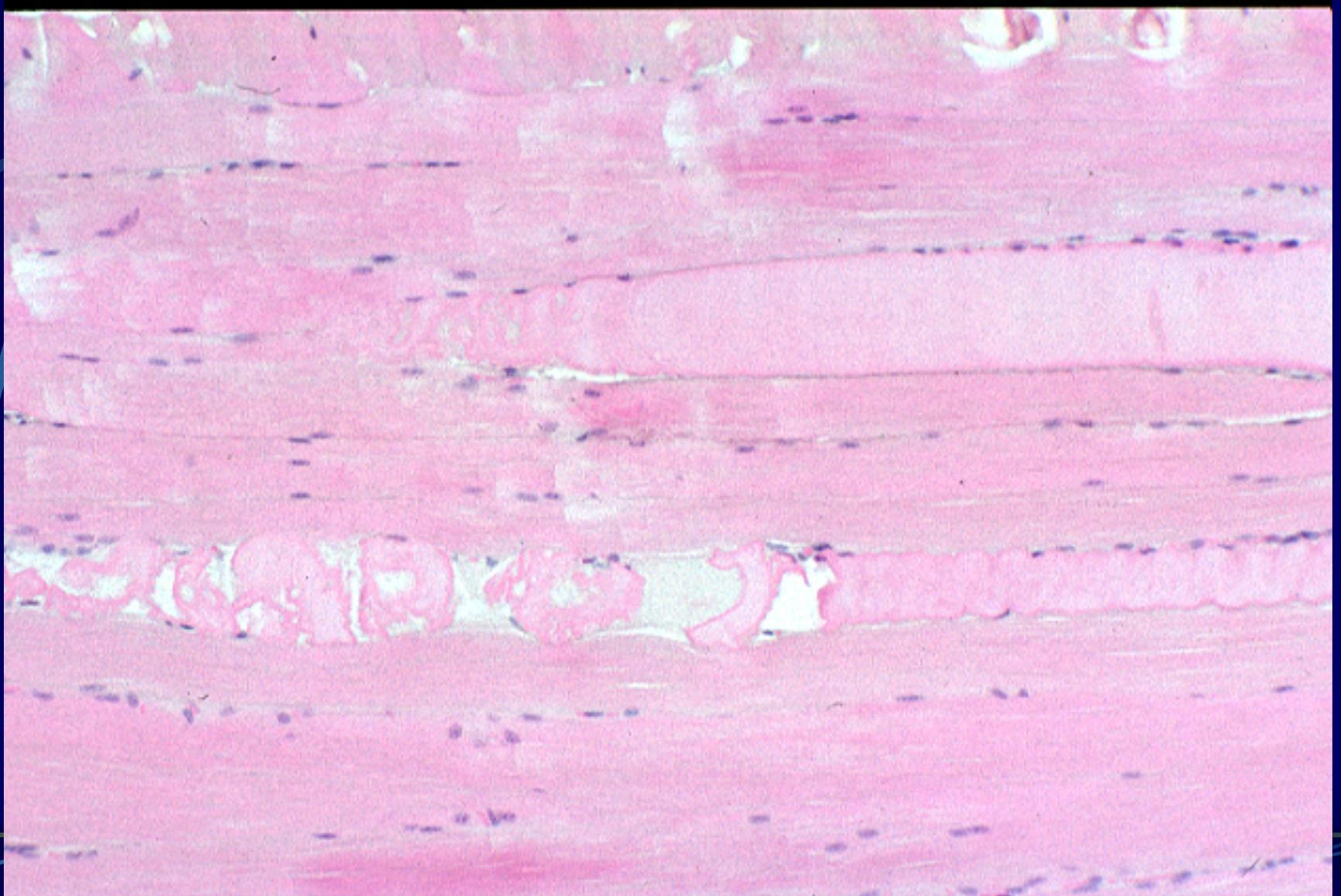
Gross Lesion

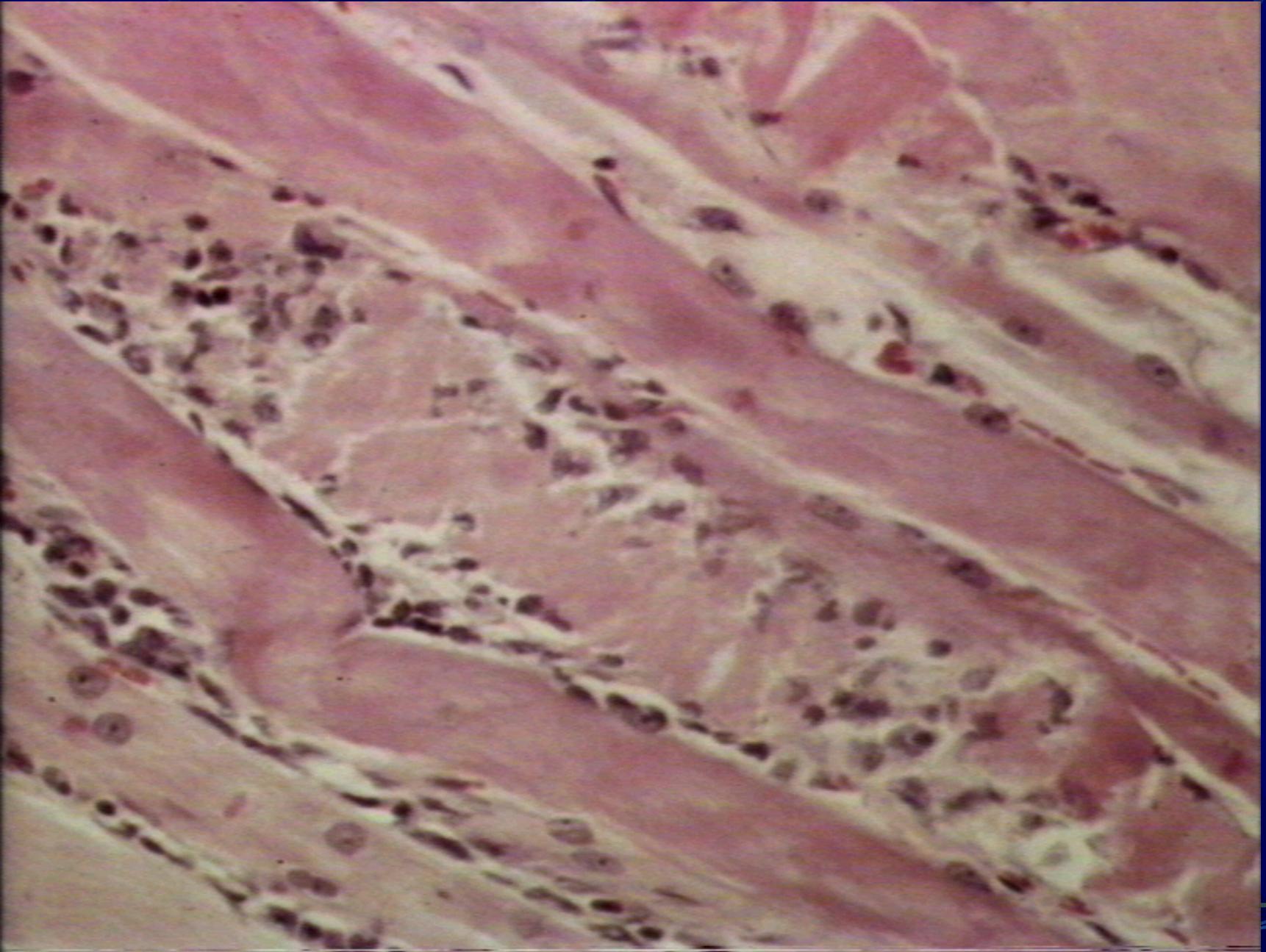
- Hard swollen muscles
- Pale streaking in muscle
- Secondary changes
 - Disuse atrophy
 - Congestive heart failure
 - Nephrosis
 - Hepatic lipidosis

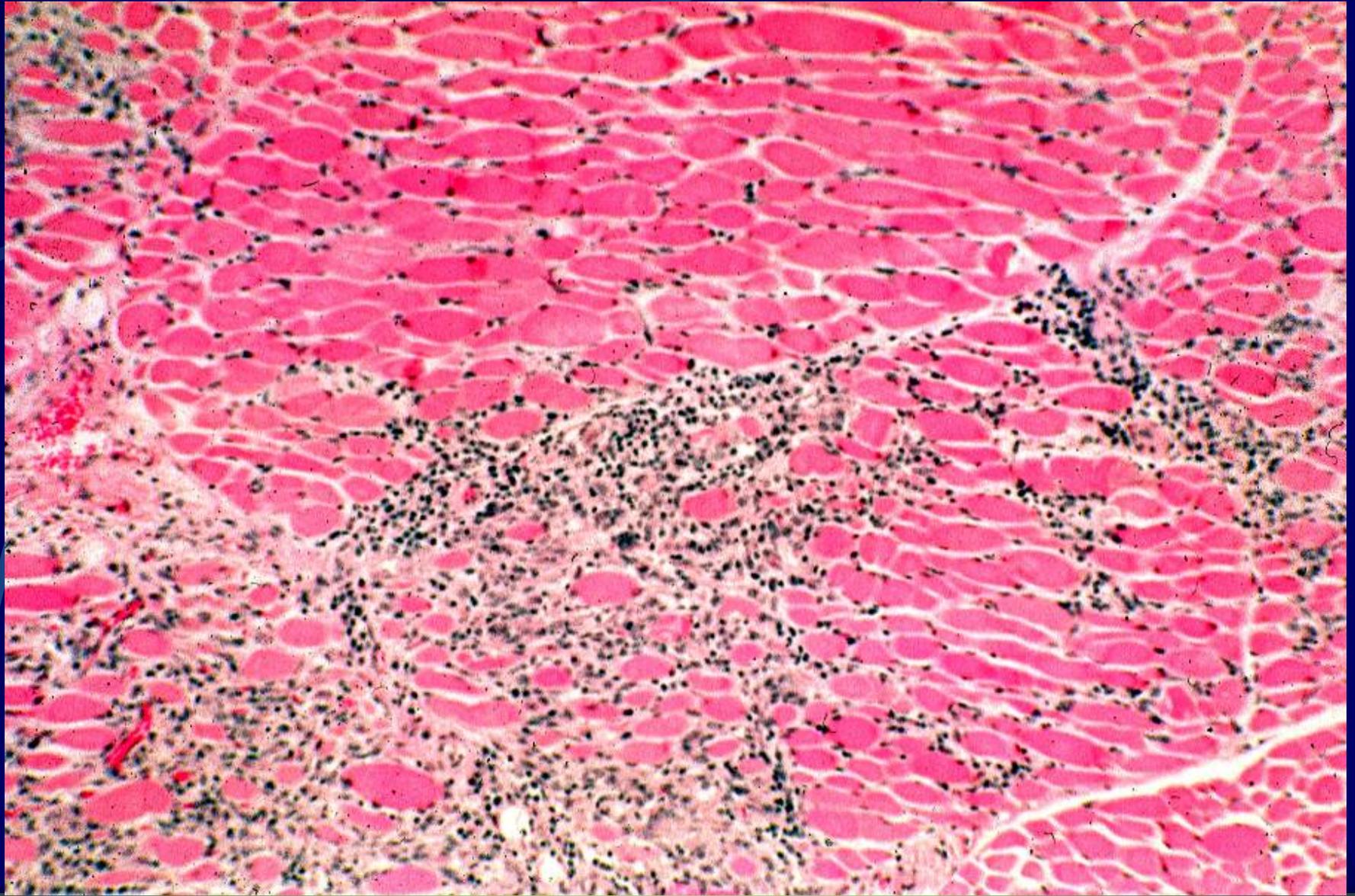




Histologic Lesions







Thermopsis montana of *T. rhombifolia*- Golden Banner, Mountain Thermopsis, False Lupine, Yellow Pea

- A perennial pea like plant with a rhizomatous root system and erect, branching stems that reach a height of 30 to 46 cm.
- Alternate with three leaflets (lupine has 5+).
- Bright yellow flowers in dense racemes from the leaf axils
- Densely haired, erect seed pods that are straight (*T. montana*) or curved (*T. rhombifolia*).





- MO ID OR WA NE UT CO

- Quinolizidine alkaloids:

- n-methylcytisine
- cytisine
- 5,6 dehydrolupamine
- thermopsine
- Anagyrine

- 1 g/kg BW for 2 to 4 days



Signs and Lesions



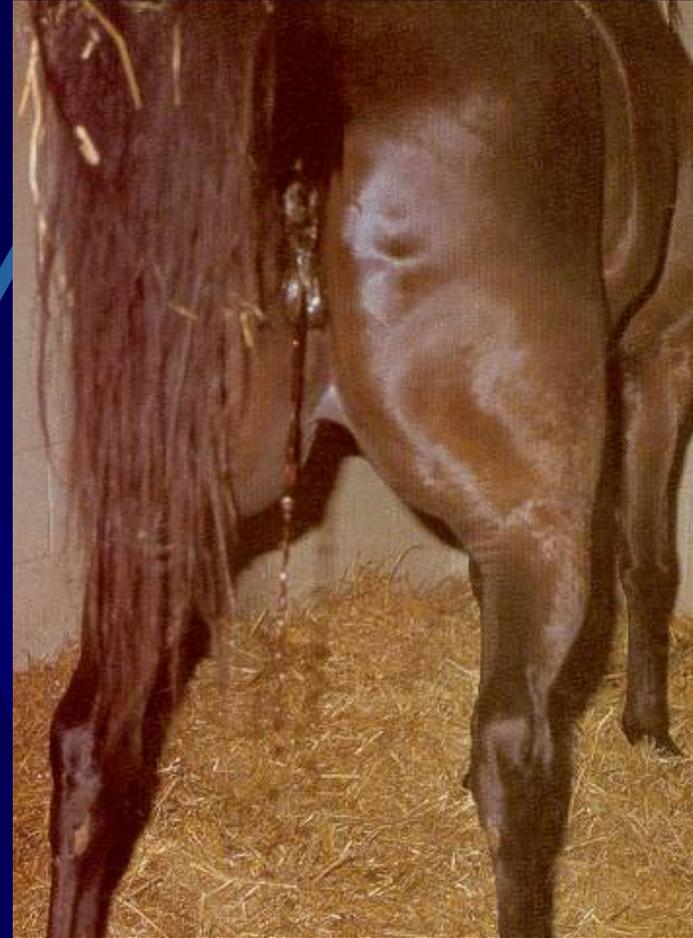
- Depression, weakness, trembling, recumbency and death
- Edema, arched back, swollen eyelids
- Increased serum enzymes
- Muscle degeneration and necrosis

Eupatorium rugosum- snakeroot, white snakeroot, richweed

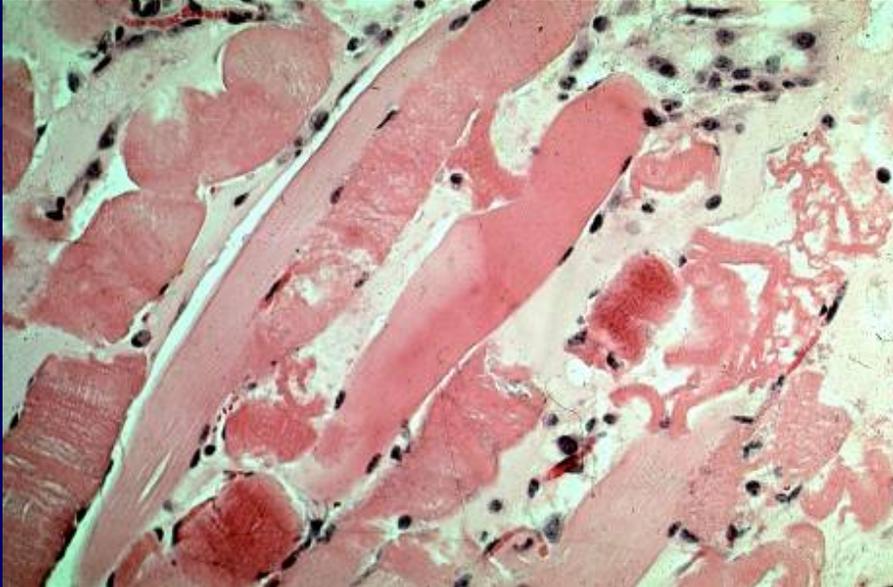


- Epidemics of weakness, nausea, prostration, death
- Milk sickness, 'the slows' (Mrs. Lincoln, General McClellan) 'trembles' in cattle
- 100 years to connect disease with plant
- 1927 Trematol

- Trematol (mixture of tremetone, dehydroytremetone, dihydroytremetone and hydroxytremetone)
- Cytochrome P450 activated and quickly detoxified
- Green, dry and frosted plant are toxic
- Lipid soluble results in relay of secondary toxicity
- Stiffness, depression, ataxia, sternal recumbency, anorexia, tremors, coma, death
- Horses develop CHF



Disease in Livestock



- 0.5-1.5% BW disease in 7-11 days
- 6 month old hay toxic
- Lactating cows protected
- Histology
 - Myonecrosis
 - Hepatic lipidosis
 - Hemorrhages and congestion
 - Gastroenteritis

Jimmy Weed, Rayless Goldenrod, Burrow Weed
Isocoma pluraflora (Isocoma wrightii),
(Haplopappus ...)

- An erect, sparsely branched, woody perennial growing to 1 meter high
- Sticky leaves are linear and alternate
- Yellow numerous flowers form small, terminal flat topped heads of 7 to 15 flowers





PPRL 2008

- Alkaline soils of drier rangeland, river valleys, drainage areas, and irrigation canals
- TX, NM, AZ, and CO
- Horses, cattle, sheep and goats
- 1.5% bw toxic in cattle



Senna or Cassia spp. - coffee weed or coffee sena

- Troublesome weeds southeastern United States, Hawaii, Mexico. Opportunist annuals that grow in waste areas, roadsides, fence lines. Common as weeds of corn and soybean fields.
- Green and dry plants are toxic
- Poison horses, cattle, sheep and goats.

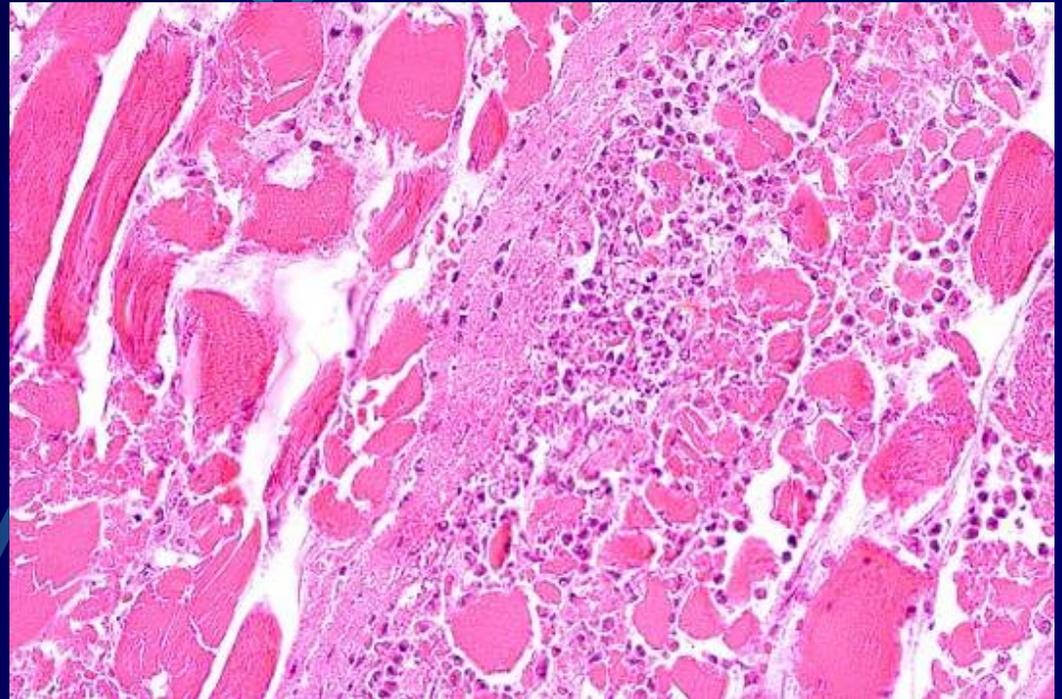


Cassia obtusifolia



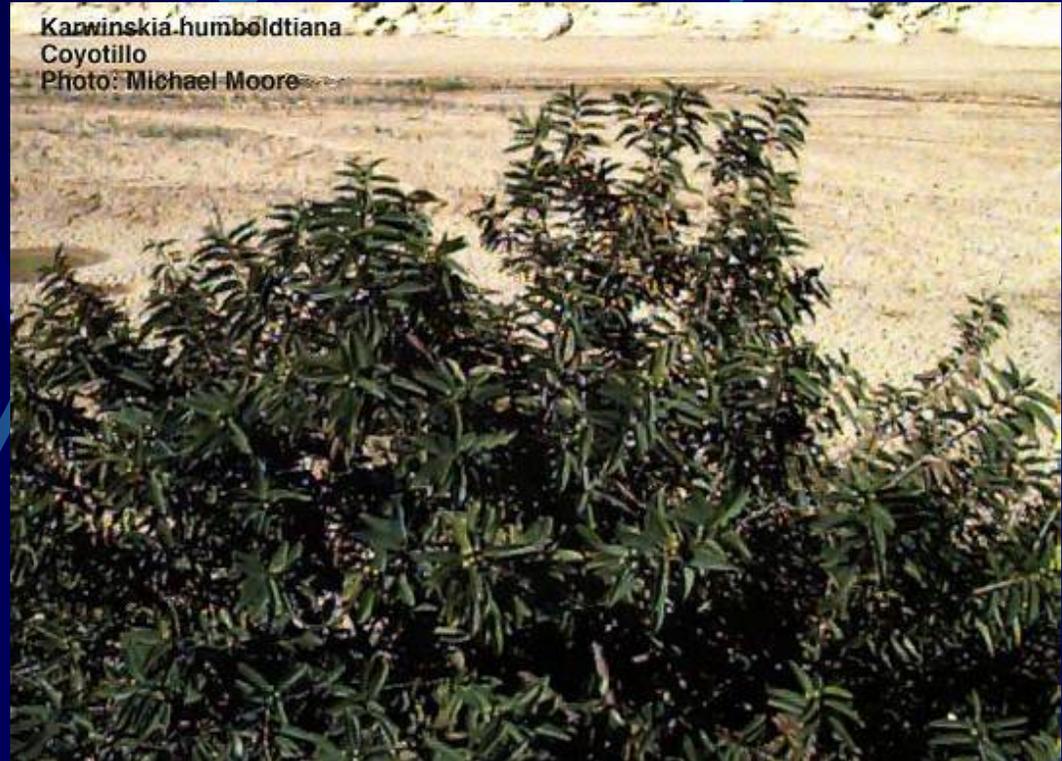
- Woody, erect, lightly branched annual, 2-3 m tall
- Alternate pinnate leaves with 4-5 pairs of leaflets spaced on common stalk
- Flowers are yellow in loose clusters on leaf axils
- Curved seed pods (20 cm) are thick, dark brown and slightly flattened with with pale longitudinal stripes and brown seeds

- Most poisoning in cattle occurs in Nov. and Dec. after frosts. Calves are more susceptible
- Horses may have liver disease sooner than the myonecrosis.
- Toxin is unknown but speculated to be substituted quinones- some evidence it uncouples oxidative phosphorylation.
- 0.4-12% BW toxic
- Skeletal and cardiac toxicity
- Recovery depends on the severity. Rarely does an animal recover once it has become recumbent.



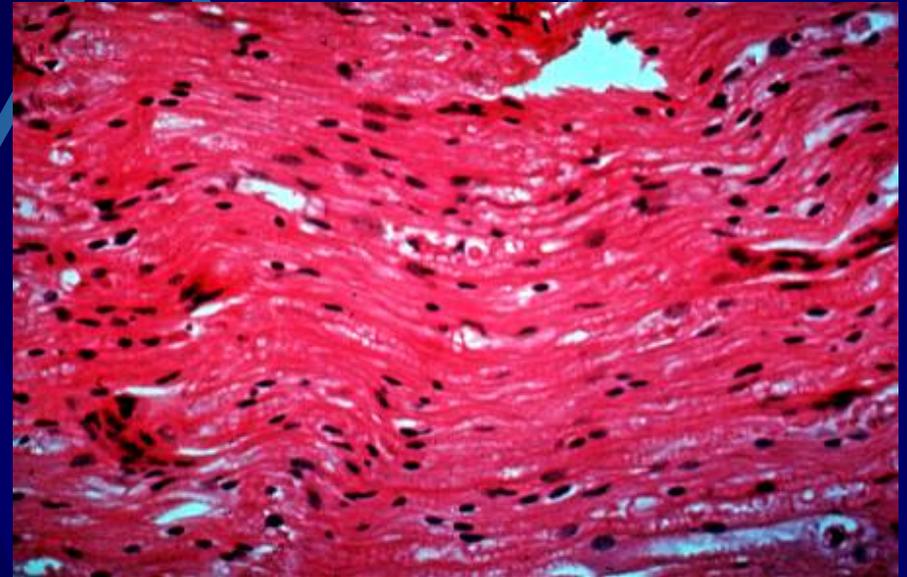
Karwinskia humboldtiana

- Coyotillo, buckthorn, tanglefoot, tullidora
- Woody shrub or small tree
- TX, Mexico and SW States
- Gravelly hills, canyons, and along arroyos
- Polyneuropathy with ascending paralysis
- Anthracenones (T496, T514, T516, T544) usually called tullidinol and possibly other neurotoxins
- Interfere with neuronal synthesis and axonal transport
- Large, long axons most severely affected



Karwinskia humboldtiana

- Cattle most sensitive but poisoning reported in goats, sheep, hogs, fowl, horses and man
- Signs
- Lesions: Demyelinating neuropathy, lymphadenopathy, epicardial hemorrhage, skeletal and myocardial degeneration and necrosis, nephrosis and lipidosis
- Axoplasmal disruption, wallerian degeneration, myelin degeneration



Gossypol

- *Gossypium* spp. (cotton plants)
- Polyphenolic binaphthalene found in the seed
- Monogastrics and young ruminants most susceptible
- Lesions
 - CSM for several weeks
 - Inappetence, weight loss, weakness, ascites, hydrothorax, CHF, skeletal and cardiac muscle degeneration and necrosis, regeneration



Lathyrus spp.

- Europe, Africa, Russia and India
- People eat *Lathyrus* seeds
- *L. hirsutus*, *L. incanus*, *L. pusillus*, *L. sylvestris*, *L. odoratus* used in US
- Horses may be more susceptible
- Beta-(gamma-L-glutamyl)-aminopropionitrile
- Metabolized to aminopropionitrile that is thought to inhibit collagen cross linking (inhibits lysyl oxidase)
- Results in osteolathyrism and angiopathyrism- spinal cord and nerve degeneration, vascular aneurysms



- Cattle- stilted gait, weak, shift weight often
- Horses- severe weakness, laryngeal hemiplegia (roaring disease), lameness, sudden death



Vicia villosa

- Hairy vetch
- OK and midwest
- Myotoxin plus hepatotoxin, and neurotoxin
- Granulomatous inflammation in heart, skeletal muscle, adrenal glands, kidney, thryoid, brain and lungs (hypersensitivity ?)



Cestrum diurnum

- 1,25-dihydroxycholecalciferol
- Increases Ca absorption from GI, increases Ca mobilization from bone, decreases renal Ca excretion
- Hypercalcemia and hyperphosphatemia- >60 product=soft tissue mineralization
- Cardiac, pulmonary, renal, and gastrointestinal mineralization
- Dystrophic calcification



US *Solanum* spp.



- *S. verbascifolium*,
S. torvum,
Nierembergia
veitchii, *Cestrum*
diurnum
(jessamine, wild
jasmine, day
cestrum, king of the
day, Chinese
inkberry) FL



Enzootic Calcification

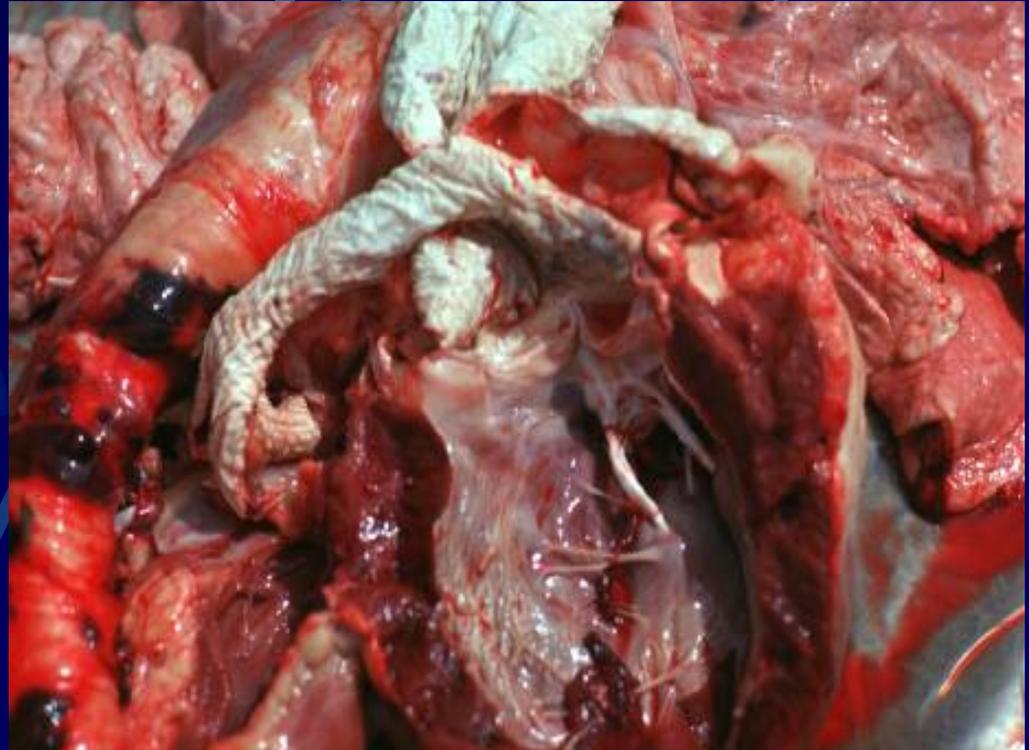
Signs/Lesions:

- Chronic weight loss despite normal appetite
- Stiffness » lameness » recumbency
- Pain in the ligaments and tendons
- Heart murmurs » failure
- Calcification of tendons, ligaments, and elastic arteries » calcinosis of aorta, pulmonary arteries, heart valves, and endocardium



Prognosis

- Recovery is rare if poisoning is chronic
- Less severely poisoned animals will probably recover if they are denied further access to the plant and are given a balanced ration.



Cardiac Glycoside Containing Plants

- Digitalis (model compound)
- 100-200 mg/kg lethal
- 8% use results in toxicity
- Blocks Na/K ATPase causing increased intracellular Na and lowering the membrane potential
- Resulting increased Ca causes a positive inotropic effect
- High doses interfere with the cardiac conduction system especially the SA and AV nodes
- Asystole

Lesions (Cardiac Glycosides)

- Arrhythmias (tachycardia), cold extremities, dilated pupils, blue mucous membranes, sweating, colic, anorexia, vomiting, diarrhea, bradycardia, heart block, asystole, and death.
- Minimal myocardial hemorrhage, myofiber vacuolation with minimal inflammation.

Digitalis purpurea

- Foxglove
- Biennial herb from Europe, common on west coast
- Digtoxin, digoxin, gitoxin
- Toxic green or when dry



Nerium oleander

- Ornamental throughout North America
- Evergreen shrub
- Nerioside, oleandroside, oleandrin, digitoxigenin, neriin, folinerin, oleandromycin, rosagenin, and odoroside that are similar to digitoxin
- Toxic green and dry
- Most poisonings from clippings



Convallaria majalis and *C. montana*

- Lilly of the valley
- Ornamental throughout North America
- *C. montana* native to eastern US
- Convallarin, convallamarin, convallatoxin (cardiac glycosides)
- All parts, green and dry are toxic
- Signs persist for 3 weeks including dermatitis and gastroenteritis



Apocynum spp.

- Dogbane, Indiana hemp
- Perennial erect plant of North America
- Green and dry plant are toxic
- Root used therapeutically

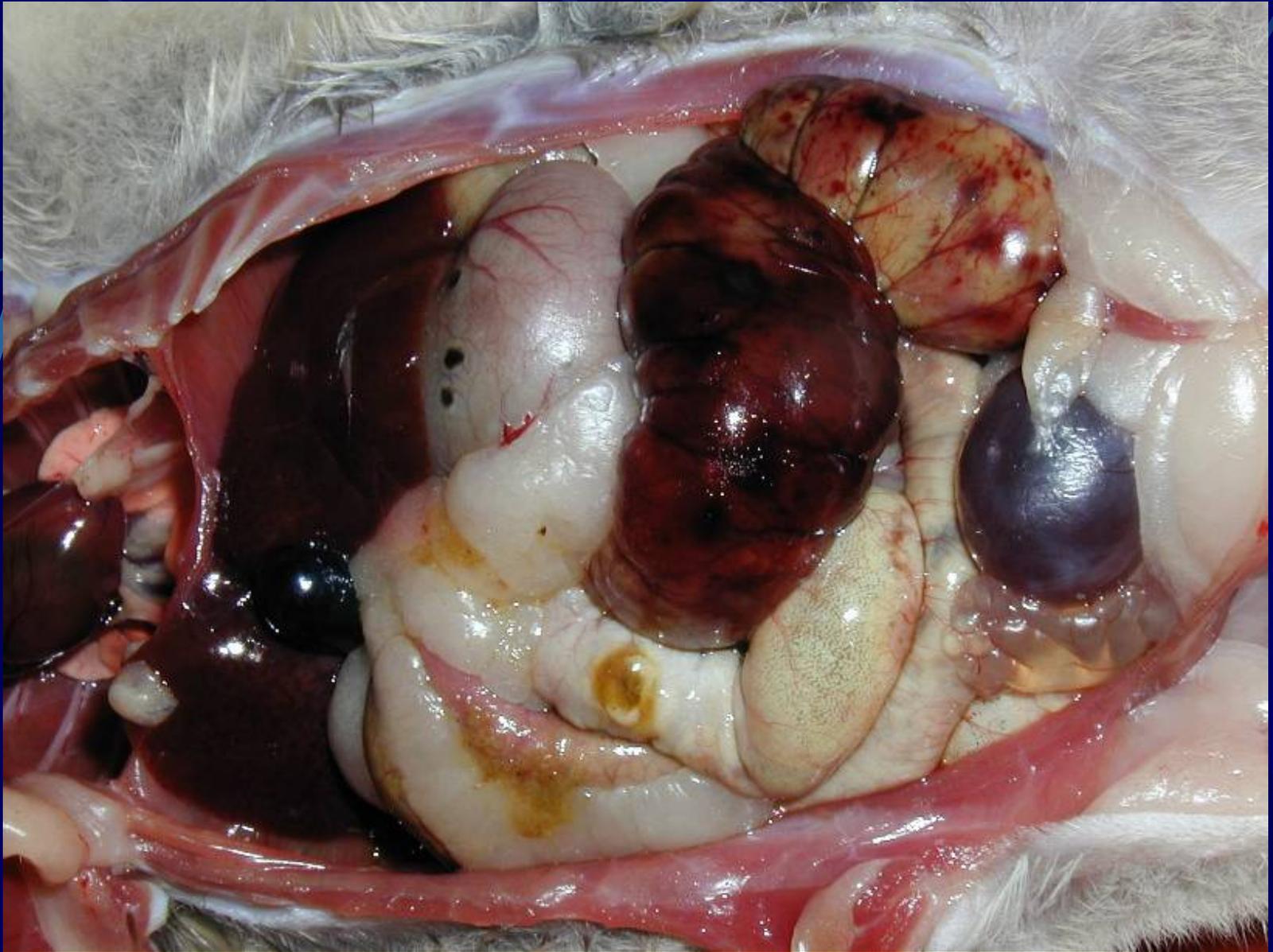


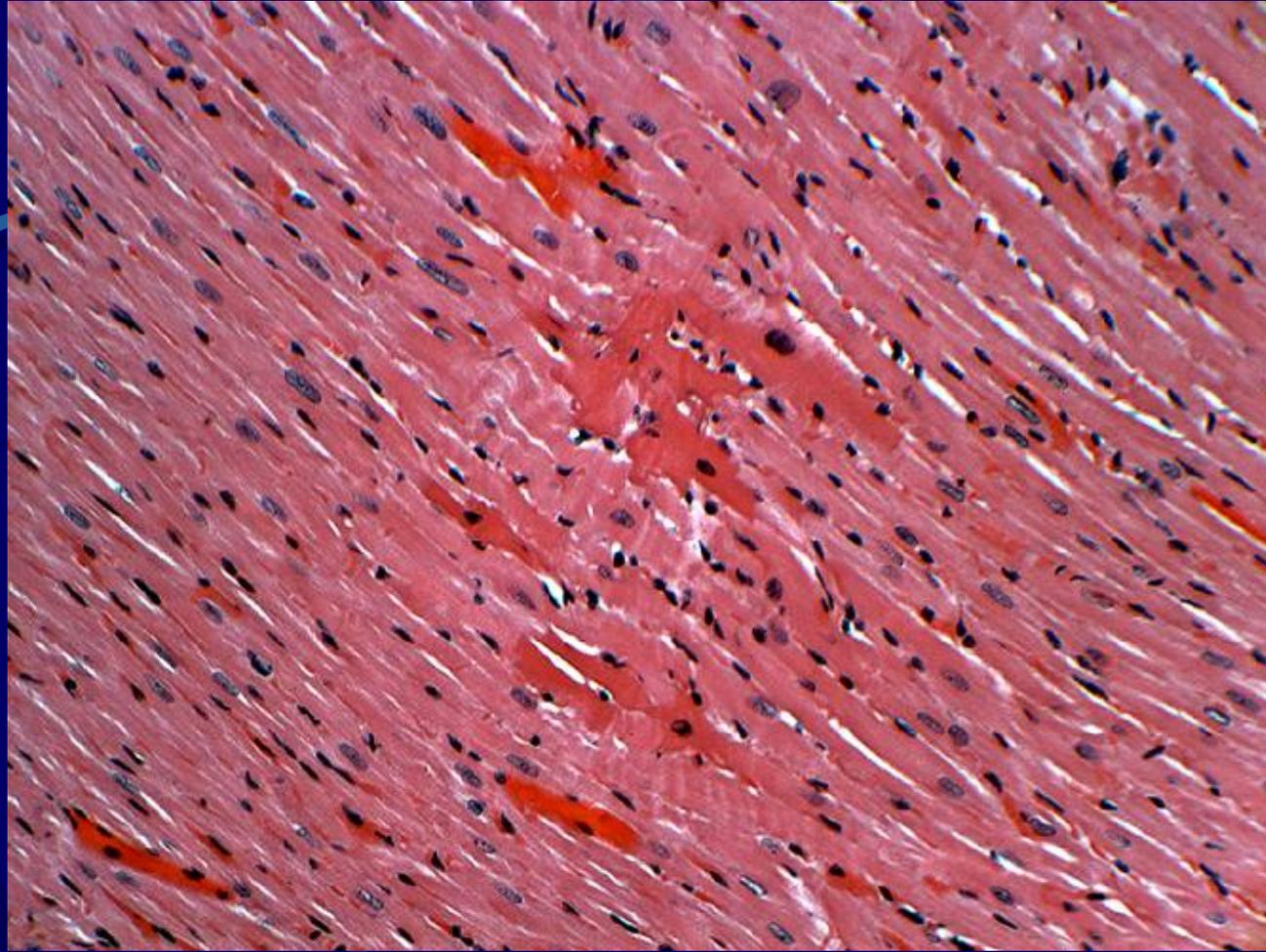
Adonis aestivalis (Pheasant's Eye)

- Less toxic or more toxic?









Rhododendron spp.

- Rhododendron
- Deciduous shrub found throughout North America
- Andromedotoxin, grayanotoxin (Alters Na channels)
- Cattle, sheep, goats, rarely horses and people have been poisoned
- All parts both green and dry are toxic
- Gastroenteritis, colic, salivation, epiphora, anorexia, depression, nausea, vomiting, defecation, weakness, incoordination, paralysis, absent pupillary reflexes, coma, nephrosis, liver degeneration, aspiration pneumonia



Kalmia spp.

- Laurels
- Evergreen shrub
- grayanotoxin



Pieris japonica and *P. foribunda*

- Japanese Pieris
- Woody shrub
- Grayanotoxin



Other potentially myotoxic plants

- *Macadamia* nuts- transient muscular weakness in dogs
- Hops (*Humulus lupulus*)- malignant hyperthermia syndrome in dogs
- *Ixiolaena brevicompta*- Australian plant causing tiring syndrome in sheep
- *Helichrysum argyrophaeum*- South Africa
- *Geigeria ornata*- South Africa
- *Cytisus scoparius*- Scotch broom, leguminous shrub



Disease of neglect

Centauria spp.

Centauria repens or *Acroptilon repens*
(Russian knapweed)





- Creeping perennial with black horizontal roots
- Erect, rather stiff, and branched plant up to 1 meter high
- Stems are covered with soft gray hair or nap
- Lower leaves are linear, alternate with toothed margins
- Lavender-white thistle-like flowers have papery spineless bracts
- The grayish seeds are 1-2 mm with bristles at one

Centauria solstitialis (yellowstar thistle, Barnaby's thistle)



- Annual herbaceous weed, branching from the base up to 30 cm tall
- Winged ascending branches with cottony hair covered, basal, lobed leaves
- Yellow disc flowers tipped with characteristic stiff yellow spines (1 to 2 cm) long



- Aspartic and glutamic acids
- Sesquiterpene lactones, solstitialin A 13-acetate and cynaropicrin
- Dopaminergic neurotoxin, 2,3 dihydro-3, 5 dihydroxy-6-methyl-4 (H) pyran-4-1



- Weeks to months of exposure
- Green yellow star thistle equal to 86 to 200 percent of their body weight before clinical signs develop



Chewing Disease

- Dysfunction of facial, mouth, and throat muscles (chewing disease)
- Facial paralysis that causes “smiling”, tongue lolling, protruding tongue, and head tossing
- Depression, loss of interest in food, dehydration and malnutrition, difficult breathing, incoordination, muscle tremors



Negropallidal encephalomalacia

- Necrosis of the substantia nigra and globus pallidus (negropallidal encephalomalacia)
- As there is no treatment and the disease is irreversible, it is best to avoid exposure.

