



TOXICOLOGY

# Part 1

from page 1- 175

 **zukureview**  **SAVE & EXIT**

[<](#) PREV

NEXT [>](#)

1 <input checked="" type="checkbox"/>	2	3	4	5	6	7	8	9	10
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**Diazepam, atropine** and **pralidoxime** chloride might be used together to treat a dog with which one of the following conditions?

Organophosphate toxicity	HIDE
Permethrin toxicity	HIDE
Ethylene glycol toxicity	HIDE
Inorganic arsenic toxicity	HIDE
Cholecalciferol toxicity	HIDE

NEXT

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV 1

Correct:

Treatment for organophosphate (OPP) toxicity includes seizure control (diazepam, phenobarbital or pentobarbital), Pralidoxime chloride (2-PAM) and Atropine.

Diazepam which on

Organophosphate (OPP) toxicity, is common; Can present with hypersalivation, vomiting, diarrhea, MIOSIS, ataxia, depression, seizures and hyperthermia.

Organop

Remember that Carbamate toxicity looks similar to OPP toxicity.

Permeth

Methocarbamol (Robaxin-V ®) is the Rx of choice to treat Permethrin toxicity in cats.

Ethylene

Refs: Plumb's Vet Drug Handbook, 7th ed. pp. 1131-3, Blackwell's 5-Min Vet Consult

Inorgan

Cholecalciferol toxicity HIDE

NEXT

Navigation icons: Overview, Mark this Question, Lab Values, Definitions, Report a Problem

 **zukureview**  **SAVE & EXIT**

[<](#) PREV

NEXT [>](#)

1 ✓	2	3	4	5	6	7	8	9	10
-----	---	---	---	---	---	---	---	---	----

*Quercus* spp.(Oak) toxicity is most commonly observed in which one of the following animals?

Sheep	HIDE
Pigs	HIDE
Deer	HIDE
Cattle	HIDE
Goats	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



**Correct:**  
Cattle are most commonly affected by Quercus spp.(Oak) toxicity.

Tannins (gallotannin) and phenols are the toxic agents found in Quercus spp.concentrated in buds, young leaves and acorns with highest toxin levels in the spring. Toxicity requires consumption of large amounts of buds, leaves and acorns over 2-3 days or more.

Damage is primary found in kidneys, liver, and the gastrointestinal tract.

Cattle present with signs of anorexia, rumen stasis, and constipation followed by dark tarry diarrhea, a dry muzzle, frequent urination, rapid weak pulse, and finally death. Oak is lethal to young calves.

Sheep  
Pigs  
Deer  
Cattle  
Goats HIDE

BACK NEXT

Overview Mark this Question Lab Values Report a Problem



PREV

1

Quercus animals?

Sheep

Pigs

Deer

Cattle

Goats

HIDE

BACK

NEXT



Cows ingesting oak during months 3-7 of gestation may deliver calves with congenital abnormalities, "acorn calf." Characteristics of an acorn calf are short legs, abnormal hooves, a short nose, and a long narrow head.

Prevent consumption of plants by providing adequate feed especially during Spring and times of drought in areas where oak trees are prevalent.

Click here to see an image of Quercus spp. (Oak) .

Click Here (scroll down) to see a Merck table of Poisonous Range Plants of Temperate North America.

Refs: Forero, Livestock-Poison Plants of CA, U of CA, Davis, ANR, p. 31, Knight and Walter's A Guide to Plant Poisoning of Animals in NA. pp. 273-5. and the Merck



Courtesy of Dr. Lynn James

[Quercus spp \(Oak\)](#)



Navigation: < PREV, NEXT >

1 ✓	2 ✓	3 ✓	4	5	6	7	8	9	10
-----	-----	-----	---	---	---	---	---	---	----

Oxalate urinary calculi in small ruminants can be caused by which one of the following choices?

High sulfur, low thiamine diet	HIDE
Diets with a low calcium to phosphorus ratio	HIDE
<i>Halogeton</i> spp., dock	HIDE
Low protein diet during pregnancy	HIDE
<i>Quercus</i> spp., subterranean clover	HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



PREV

1

Oxalate choices?

**Correct: Halogeton spp., dock**

Oxalate calculi in small ruminants and cattle can be caused by a number of toxic plants, including Halogeton spp., dock (Rumex sp.), sugar beet tops and greasewood (Sarcobatus vermiculatus).

Ruminant urolithiasis is primarily a nutritional disease.

A definitive diagnosis of urolithiasis in one animal suggests that all males in the herd are at risk.

A high sulfur, low thiamine diet may be associated with polioencephalomalacia (PEM).

Refs: Pasquini's Guide to Bov Clin, 4<sup>th</sup> ed. pp. 224 and the Merck Veterinary Manual

Halogeton spp., dock HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



Halogeton glomeratus (Halogeton), flowering plant





Rumex crispus (Curly dock, Dock, Sorrel)



Sarcobatus vermiculatus (Greasewood, black greasewood)



 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

1 ✓	2 ✓	3 ✓	4	5	6	7	8	9	10
-----	-----	-----	---	---	---	---	---	---	----

Which toxic agent causes a severe colic, weakness, salivation, and a pronounced hemorrhagic diarrhea?

Arsenic	HIDE
Lead	HIDE
Chlorinated hydrocarbons	HIDE
Urea	HIDE
Cantharidin	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV

1

Which to hemorrh

- Arsenic
- Lead
- Chlorina
- Urea

Correct:

When you hear arsenic, think severe GI signs, including a hemorrhagic diarrhea. Cattle are exposed to arsenic by pesticide-contaminated foliage. Pets find arsenic in ant baits and in pressure-treated wood (like on backyard decks) or wood preservative.

Urea toxicity causes wildly aberrant behavior ("bovine bonkers"), tremors, acute death. Rx, if time, with VINEGAR.

Lead toxicity causes more CNS signs (encephalopathy, blind), but can see diarrhea or constipation.

Cantharidin toxiciv from blister beetles. is basically a horse disease. Potent irritant:

Cantharidin HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **SAVE & EXIT**

Lead toxicity causes more CNS signs (encephalopathy, coma), but can see diarrhea or constipation.



1

Cantharidin toxicity from **blister beetles**, is basically a **horse disease**. Potent irritant: see colic, renal disease, hematuria, **peracute death**. Follow this link to see a Merck image of hemorrhagic gastritis. Follow this link to see a Merck image of hemorrhagic cystitis.

Which to hemorrh

Chlorinated hydrocarbons (**insecticides** like lindane, methoxychlor) - look for **CNS** depression or stimulation (**convulsive seizures**).

Arsenic

Refs: Pasquini's Guide to Bovine Clinics, 4<sup>th</sup> ed. pp. 202-7, Pasquini's Guide to Equine Clinics, 3<sup>rd</sup> ed. p. 45 and the Merck Veterinary Manual online edition.

Lead

Chlorina

Urea

Cantharidin HIDE

BACK

NEXT

 Overview

 Mark this Question

 Lab Values

 Definitions

 Report a Problem

Cantharidin, hemorrhagic cystitis





Cantharidin, hemorrhagic gastritis





PREV

NEXT

1 ✓	2 ✓	3 ✓	4 ✓	5	6	7	8	9	10
-----	-----	-----	-----	---	---	---	---	---	----

A 20-pound (9.1 kg) male **neutered dog** in the northeastern United States is presented with **vomiting, diarrhea, lethargy**.

The dog is **trembling** and has a **seizure** on the exam table during a physical exam.

The owner relates that the dog **got into the garbage can 4 hours ago**, which contained some **bad salmon**, a bag of **raisins**, several super absorbent **baby diapers**, Styrofoam **peanuts**, a garbage-can **deodorant cake** and a **dead toad**.

**Which item** is most likely to be **causing this dog's signs**?

Dead toad	HIDE
Super absorbent material in baby diapers	HIDE
Raisins	HIDE
Deodorant cake	HIDE
Rotten salmon	HIDE

BACK NEXT LEAVE BLANK



A 20-pound (9.1 kg) male neutered dog in the northeastern United States is presented with vomiting

The dog

The own  
bad salm  
garbage

Which ite

Dead to

Super a

Raisins

Deodora

**Correct: Deodorant cake**

Paradichlorobenzene is an organochlorine insecticide, mainly affecting the CNS found in deodorizer cakes in diaper buckets, garbage cans and in bathrooms.

Typically a problem of dogs, animals present with tremors, salivation, ataxia and seizures.

Toad poisoning mostly causes local (oral) irritant effects like profuse salivation, head shaking, pawing at the mouth, retching and sometimes vomiting.

The marine toad, *Bufo marinus*, an introduced animal established in Texas, Florida and Hawaii has highly toxic venom.

Rotten salmon HIDE

BACK NEXT

-   
Overview
-   
Mark this Question
-   
Lab Values
-   
Definitions
-   
Report a Problem



A 20-pound (9.1 kg) male neutered dog in the northeastern United States is presented with vomiting

The dog **Marine toads** can cause **life-threatening cardiac and CNS** signs with 20-100% mortality in untreated cases.

The owner had bad salmon garbage. **Raisins and grapes** can cause **anuric renal disease** in some dogs.

Which item? **Don't confuse** eating **rotten salmon** (GI upset) with **salmon poisoning**, a **systemic** infectious disease of dogs that usually **occurs 5-7 days after eating infected fish**.

It is associated with flukes and caused by **Neorickettsia helminthoeca**.

Refs: Cote, Clinical Vet Advisor-Dogs and Cats, 2<sup>nd</sup> ed. pp.792-4 and the Merck Veterinary Manual online edition.

- Dead to
- Super a
- Raisins
- Deodora

Rotten salmon HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

1 ✓	2 ✓	3 ✓	4 ✓	5 ✗	6	7	8	9	10
-----	-----	-----	-----	-----	---	---	---	---	----

A rancher has recently obtained a lease for a pasture that has numerous **scrub oak** (*Quercus havardii*) trees. She is worried because she's heard that oak leaves, blossoms, buds, stems, and acorns can all be toxic.

**The rancher has cattle, horses, sheep, goats, and llamas.**

**Which** of her **animals** would be **safest to graze** in this new pasture with the scrub oak?

Horses	HIDE
Sheep	HIDE
Cattle	HIDE
Any of them; oak is not toxic	HIDE
Goats	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

PREV 1 2 3 4 5 6 M 7 8 9 10 NEXT

1 2 3 4 5 6 M 7 8 9 10

**Correct:**  
 Goats are more resistant to *Quercus spp.* toxicity.

The toxic principle is gallotannin, a combination of tannic and gallic acids. Goats and wild ruminants have proteins in saliva that bind tannins, and may have greater levels of tannase enzymes in the rumen mucosa.

Typical clinical signs seen in affected animals are severe gastrointestinal irritation and nephrosis. Oak must comprise over 50% of the diet to produce toxicity.

Cattle are most commonly affected. Horses are susceptible but rarely affected as they infrequently consume enough oak to develop toxicity.

Click this link for info on [oak poisoning](#) in ruminants.

Goats HIDE

BACK NEXT

Overview Mark this Question Lab Values Definitions Report a Problem

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

1 ✓	2 ✓	3 ✓	4 ✓	5 ✗	6 M ✓	7	8	9	10
-----	-----	-----	-----	-----	-------	---	---	---	----

On **necropsy**, what gross lesions might be seen in a **horse** that died of **ionophore toxicity**?

Ulcerating gastroenteritis, right dorsal colon scarring	HIDE
Pulmonary edema, may see ascites	HIDE
Pale myocardium, epicardial hemorrhage	HIDE
Renal infarction, papillary necrosis	HIDE
Hepatic scarring, biliary staining of proximal small intestine	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



- 1 ✓
- On necro
- Ulcerati
- Pulmona
- Pale my
- Renal in
- Hepatic

**Correct: Pale myocardium, epicardial hemorrhage**

Think **rhabdomyolysis** and **cardiomyopathies** in horses with **ionophore toxicity** (e.g.: **Monensin®**, **Lasalocid®**). Look for pale **myocardium, hemopericardium**, epicardial hemorrhages. **Horses** are **uniquely sensitive** to ionophores compared to other species (then pigs, cattle, chickens).

**Horses** suffer from ionophore toxiosis when they are **accidentally fed contaminated feed**. Click here to read a 1-page summary article on [Monensin® and Lasalocid® Toxicity in Horses](#) by Dr. Amanda House, courtesy of the University of FL.

**In cattle** may see ascites, hydrothorax, pulmonary edema.

Refs: Pasquini's Guide to Bovine Clinics, 4<sup>th</sup> ed. p. 201, Osweiler's NVMS Toxicology

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

1 ✓	2 ✓	3 ✓	4 ✓	5 ✗	6 M ✓	7 ✓	8	9	10
-----	-----	-----	-----	-----	-------	-----	---	---	----

Cardiomyopathy can occur in horses as a result of intoxication with which one of the following choices?

Fluoride	HIDE
Bracken Fern	HIDE
Sweet clover	HIDE
Ionophores	HIDE
Pyrrrolizidine Alkaloids	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV

1

Cardiom  
following

Fluoride

Bracken

Sweet c

**Ionopho**

Pyrrrolizidine Alkaloids HIDE

BACK

NEXT



### Correct: Ionophores

Horses are highly susceptible to intoxication with ionophores (more so than cattle). Horses develop anorexia and muscular weakness. The heart is the most affected specific organ in horses.

Degeneration and necrosis of the cardiac muscle occurs acutely, leading to cardiomyopathy, fibrosis, and potential long-term effects.

Chronic fluorosis can cause mottled, stained teeth and damaged bones with exostosis production.

Sweet clover poisoning results from spoilage causing the conversion of coumarins to toxic dicoumarol, leading to impaired coagulation.



PREV

1

Cardiom...  
following

Fluoride

Bracken

Sweet c

Ionoph

Chronic fluorosis can cause mottled, stained teeth and **damaged bones with exostosis** production.

Sweet clover poisoning results from spoilage causing the **conversion of coumarins** to toxic dicoumarol, leading to **impaired coagulation**.

Pyrrolizidine alkaloid toxicity results in **hepatic damage**.

Bracken fern poisoning leads to clinical signs related to **thiamine deficiency**, including anorexia, weight loss, weakness, lethargy, and ataxia.

Refs: Smith, Large Animal Internal Medicine, 3<sup>rd</sup> ed. p. 1647 and the Merck Veterinary Manual online edition.

Pyrrolizidine Alkaloids HIDE

BACK

NEXT



PREV NEXT

1 ✓	2 ✓	3 ✓	4 ✓	5 ✗	6 M ✓	7 ✓	8 ✓	9	10
-----	-----	-----	-----	-----	-------	-----	-----	---	----

A 4-month old heifer is presented that is unthrifty -looking and failing to gain weight. She is somewhat lame, has a rough, light-colored hair coat and depigmented hair around her eyes like spectacles.

She has watery dark diarrhea full of gassy bubbles.

Based on the diagnosis, what is the treatment?

Injectable copper, CuSO4 dietary supplement	HIDE
Injectable copper/iron dextran	HIDE
Injectable iron, FeSO4 dietary supplement	HIDE
CuSO4/Molybdenum/Selenium dietary supplement	HIDE
Injectable Molybdenum/Selenium/vitamin B complex	HIDE

BACK NEXT LEAVE BLANK

Overview Mark this Question Definitions Report a Problem

1 ✓	2 ✓	3 ✓	4 ✓	5 ✗	6 M ✓	7 ✓	8 ✓	9 ✓	10
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**Correct: Injectable copper, CuSO4 dietary supplement**

A 4-mon  
somewh  
like spec

Rx both with Cu injections and supplement diet. If molybdenum content of forage over 5 ppm, can use 1% copper sulfate (CuSO4-5H2O) in salt to get Cu levels back up.

She has  
Based on

This is copper deficiency, which presents with ADR Ain't Doin' Right signs : ACHROMOTRICHIA (depigmented hair, especially around eyes= "SPECTACLES") rough coat, decreased milk yield, lameness and decreased fertility, libido and "Peat Scours" also called "Teart" (severe scours with gas bubbles).

Injectab

Molybdenum toxicosis causes a secondary DEFICIENCY in copper.

Injectab

Injectab

Follow this link to the Zuku Review Top 20 Tox notes.

CuSO4/

Injectable Molybdenum/Selenium/vitamin B complex HIDE

BACK NEXT

- Overview
- Mark this Question
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

1 ✓	2 ✓	3 ✓	4 ✓	5 ✗	6 M ✓	7 ✓	8 ✓	9 ✓	10 M
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Which **agent** is found in **baby food** and is also **toxic to cats**?

Onion powder	HIDE
Sulfate-containing preservatives	HIDE
Papaya fiber	HIDE
Excess sugar	HIDE
Potassium sorbate	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this  Lab  Definitions  Report



**Correct:**  
 Onion or garlic toxicosis can be caused from the chronic overconsumption of garlic powder, such as in cats fed an exclusive diet of baby foods.

Which ac  
 Excessive consumption of plants from the *Allium* genus can cause methemoglobinemia with resultant Heinz body anemia.

Onion p  
 Sulfate- Click here to see a cultivated onion and wild onion (common in North America).

Papaya  
 Excess s  
 Refs: Cote, Clinical Veterinary Advisor-Dogs and Cats, 3<sup>rd</sup> ed. pp. 719-20 and the Merck Veterinary Manual online .

Potassium sorbate

Wild onion

BACK NEXT





Allium spp (Wild onion)



Allium spp (Cultivated onion)

 **zukureview**  **SAVE & EXIT**

[< PREV](#)

[NEXT >](#)

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

Match the toxicities to their respective treatments:

- Organophosphate toxicity is treated with...
- Ethylene glycol intoxication is treated with...
- Permethrin toxicity is treated with...

Yohimbine, Ethanol, Diazepam	HIDE
Midazolam, Procarbazine HCL, Methylene blue	HIDE
Atracurium, Fomepizole, Glycopyrrolate	HIDE
Atropine, Ethanol, Dimercaprol	HIDE
Pralidoxime chloride, Fomepizole, Methocarbamol	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)



PREV NEXT

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

**Correct: Pralidoxime chloride, Fomepizole, Methocarbamol**

Match the Organophosphate (OPP) toxicity (and carbamate toxicity) with pralidoxime chloride (and atropine).

Treat permethrin/pyrethroid toxicity in CATS with methocarbamol (Robaxin®), a centrally-acting muscle relaxant.

Use fomepizole (4 methyl pyrazole, 4-MP) to Rx dogs with ethylene glycol toxicity (EG). Can also use ethanol.

In cats, fomepizole can be a more effective treatment than ethanol when administered at high doses (extra-label) and within 3 hours of ingestion of EG. More than 3 hours after EG ingestion, ethanol is the treatment of choice for cats, (and the prognosis is worse).

BACK NEXT

Overview Mark this Question Lab Values Report a Problem

PREV NEXT

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

Match th

Organop

Ethylene

Permeth

Yohimbi

Midazol

Atracuri

Atropine

Pralidox

More than 3 hours after EG ingestion, ethanol is the treatment of choice for cats, (and the prognosis is worse).

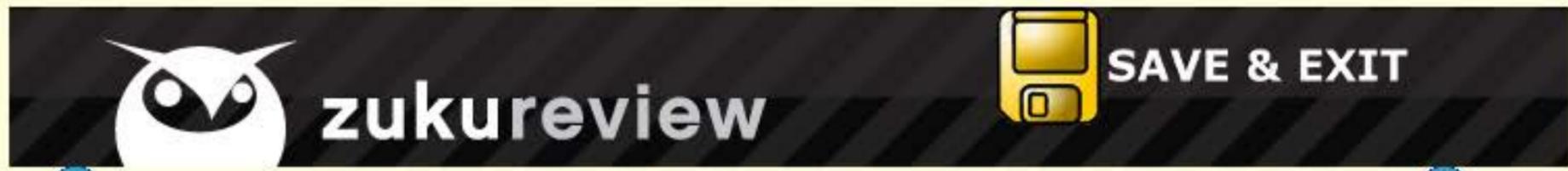
Remember that yohimbine is a reversal agent for xylazine (sedative/analgesic), and amitraz (demodicosis Rx).

Use succimer to chelate lead.

Refs: Cote, Clinical Veterinary Advisor-Dogs and Cats, 3<sup>rd</sup> ed. pp. 335-7, Plumb's Vet Drug Handbook, Pralidoxime chloride, 4 methyl pyrazole and Methocarbamol, 8<sup>th</sup> ed. pp. 604-6, 891-3, 1193-3, Blackwell's 5-Minute Vet Consult Canine Feline, 4<sup>th</sup> ed. pp. 454-55, 998-99, 1168 and the Merck Veterinary Manual online edition.

BACK NEXT

Overview | Mark this Question | Lab Values | Report a Problem



PREV

NEXT

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

Polioencephalomalacia in cattle and sheep is commonly attributed to \_\_\_\_\_.

Nonprotein nitrogen toxicosis	HIDE
Low thiamine and/or high sulfur diet	HIDE
Vitamin A deficiency	HIDE
Low sulfur and/or high thiamine diet	HIDE
Coccidial enterotoxemia	HIDE

BACK NEXT LEAVE BLANK

- Overview
- Mark this Question
- Lab Values
- Definitions
-



PREV

11

Polioence

Nonprot

Low thia

Vitamin

Low sulf

Coccidia

Correct:

The preferred answer is low thiamine and/or high sulfur diet.

Polioencephalomalacia (PEM) is a neurologic disease of ruminants seen worldwide, with a number of etiologies, principally low thiamine (due to thiaminase activity from plants like bracken fern or low thiamine diets) and high sulfur in the diet (which can come from a high molasses-urea diet, corn or sugar cane byproducts, water, or plants like alfalfa, Canada thistle (Cirsium arvense), Kochia, (Kochia scoparia), and lambsquarter (Chenopodium spp.).

Acute lead toxicity, acute sodium toxicity/water deprivation can also cause PEM.

Refs: The Merck Veterinary Manual online edition.

BACK

NEXT



 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

What is the **treatment** of choice for a **cat** that was given **acetaminophen** within the last hour?

Activated charcoal and saline cathartic	HIDE
Induce vomiting (xylazine); gastric lavage	HIDE
Vitamin C and N-acetylcysteine	HIDE
IV fluids; IV dopamine (Inotropin®) IV	HIDE
Na bicarbonate PO to alkalinize urine	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

11

What is t  
hour?

- Activate
- Induce y
- Vitamin
- IV fluids

**Correct:** Induce vomiting (xylazine); gastric lavage

Induction of vomiting (with xylazine or dexmedetomidine) and gastric lavage (activated charcoal) are first priorities within 4 hours of ingestion of acetaminophen.

Major concerns in cats are methemoglobinemia, Heinz body formation, hemolysis, +/- hepatic and renal injury.

Additional Rx: IV fluids and N-acetylcysteine (Mucomyst ®), a sulfhydryl replacement drug that helps address methemoglobinemia.

Consider hepatic antioxidants (e.g., S-adenosylmethionine and ascorbic acid (Vitamin C).

Na bicarbonate PO to alkalinize urine HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



What is t  
hour?

Activate

Induce

Vitamin

IV fluids

Monitor:

-Estimated % methemoglobin (metHb) (normal < 1%):

---Place drop of blood on white filter paper; if paper turns brown, metHb >15%

---Patient dyspneic: metHb = 20-40%

---Neurologic depression: metHb - 40-55%

--->70% metHb: acutely life-threatening

-Liver values

-Hematocrit

Na bicarbonate PO to alkalinize urine HIDE

BACK

NEXT





PREV

11

What is t  
hour?

Activate

Induce

Vitamin

IV fluids

Prognosis:

- Fair to good with early decontamination (**before** onset of clinical signs)
- Guarded once clinical signs develop

As little as HALF a tablet (50-60 mg) of Acetaminophen is toxic to cats. Most common cat toxicity. Occasionally see in dogs.

Refs: Blackwell's 5-Minute Vet Consult Canine Feline, 4<sup>th</sup> ed. pp.10-11, Cote, Clinical Veterinary Advisor–Dogs and Cats, 3rd ed. pp. 12-3, Pasquini's, Tschauner's Guide to Small Animal Clinics, vol 1, 2<sup>nd</sup> ed. p. 731 and the Merck Veterinary Manual online edition.

Na bicarbonate PO to alkalinize urine HIDE

BACK NEXT

Overview

Mark this Question

Lab Values

Definitions

Report a Problem

 **zukureview**  **SAVE & EXIT**

[<](#) PREV

NEXT [>](#)

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

What **two conditions** may cause these signs: peat scours, depigmented hair (especially in "spectacles" around eyes), rough coat, decreased milk yield, **lameness**, **decreased fertility**, and **decreased libido**?

Molybdenum toxicosis, Copper deficiency	HIDE
Selenium toxicosis, Vitamin E deficiency	HIDE
Arsenic toxicosis, Vitamin E toxicosis	HIDE
Molybdenum deficiency, Copper toxicity	HIDE
Gossypol toxicity, Iron toxicosis	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this    Lab    Definitions    Report



What two "spectac and decr

- Gossypc
- Molybde
- Molybde

**CUTEC!**

Molybdenum toxicosis, Copper deficiency.

Molybdenum toxicosis also causes a secondary DEFICIENCY in copper. See ADR (Ain't Doin' Right) signs : ACHROMOTRICHIA (depigmented hair, especially around eyes = "SPECTACLES" ) rough coat, decreased milk yield, lameness, peat Scours or "teart" (severe scours with gas bubbles, and decreased fertility, libido.

Copper toxicity causes a severe gastroenteritis, icterus, hemolytic crisis. On necropsy, gun-metal grey kidneys and port-wine colored urine say "copper tox."

Selenium toxicosis has many presentations depending on animal, dose and length of time exposed. Bottom line: selenium is an essential nutrient but has a narrow margin of safety.

Follow this link to the Zuku Review Top 20 Tox notes.

Selenium toxicosis, Vitamin E deficiency	HIDE
Arsenic toxicosis, Vitamin E toxicosis	HIDE

BACK NEXT

- Overview
- Mark this
- Lab
- Definitions
- Report

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

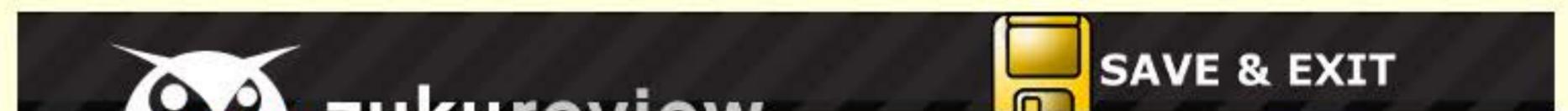
11	12	13	14	15	16	17	18	19	20
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*Centaurea* spp. (Russian knapweed, yellow star thistle) toxicity is most commonly observed in the western U.S. in which one of the following animals?

Goats	HIDE
Cattle	HIDE
Sheep	HIDE
Pigs	HIDE
Horses	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



**Correct**

**Horses** are affected by ingestion of *Centaurea* spp; common names are yellow star thistle and Russian knapweed. These plants are weeds normally found in the Mediterranean area and Russia, but have been introduced into the United States, primarily in the western U.S.

The toxic agent(s) of *Centaurea* spp. are found in fresh and dry plants. Toxicity develops only with chronic ingestion of large volumes; unfortunately, horses may develop a taste for the plant. Ruminants are NOT affected and can be used to control the spread of these weeds.

Sometimes called "chewing disease," the signs of toxicity are quite characteristic - involuntary chewing movements, twitching/curling of the lips, and facial hypertonicity. Affected horses cannot prehend or chew, but they are still able to swallow. They can be seen with their head deep into a water bucket trying to drink.

Goats  
Cattle  
Sheep  
Pigs  
Horses HIDE

BACK NEXT

Lab Values Definitions Report a Problem



swallow. They can be seen with their head deep into a water bucket trying to drink.

A dopaminergic neurotoxin causes malacia of neurons in the globus pallidus and the substantia nigra, hence the name "nigropallidal encephalomalacia." The brain damage is irreversible, and euthanasia is recommended.

Click here to see an image of Centaurea spp.

Click here (scroll down) to see a Merck table of Poisonous Range Plants of Temperate North America.

Refs: Forero, Livestock-Poison Plants of CA, U of CA, Davis, ANR, p. 35, Knight and Walter's A Guide to Plant Poisoning of Animals in NA, pp. 225-8, Pasquini's Guide to Equine Clinics, 3rd ed., pp. 267, 325, and the Merck Veterinary Manual online edition.

- PREV
- 11
- Centaurea in the we
- Goats
- Cattle
- Sheep
- Pigs
- Horses HIDE

BACK NEXT

- Lab Values
- Definitions
- Report a Problem



Centaurea Spp

 **zukureview**  **SAVE & EXIT**

 **PREV**  **NEXT**

11 	12 	13 	14  	15 	16	17	18	19	20
--------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----	----	----	----	----

In September, two Quarter horse mares are presented that are pastured in a group of five in Oklahoma.

The horses eat pasture grass supplemented by alfalfa hay and a small amount of grain.

One mare was found peracutely dead this morning. The other is depressed, anorexic and colicy.

Physical exam reveals dark, congested mucous membranes with small ulcer-like erosions.

The mare makes frequent attempts to urinate, yielding red urine (hematuria) with a urine specific gravity (USG) of 1.006.

She makes repeated attempts to drink small amounts of water and keeps her muzzle submerged in the water trough.

Necropsy of the other mare shows that the stomach and bladder linings are irritated and hemorrhagic.

What is the diagnosis?

The mare makes frequent attempts to urinate, yielding red urine (hematuria) with a urine specific gravity (USG) of 1.006.

She makes repeated attempts to drink small amounts of water and keeps her muzzle submerged in the water trough.

Necropsy of the other mare shows that the stomach and bladder linings are irritated and hemorrhagic.

What is the **diagnosis?**

Value	Normal
102.7 F (39.3 C)	99.0-100.6, 37.2-38.1 C
HR=40 bpm	28-40 bpm
BR=20 brpm	10-14 brpm

<i>Clostridium perfringens</i> type A	HIDE
Enzootic hematuria	HIDE
Arsenic toxicity	HIDE
Cantharidin toxicity	HIDE
Sorghum cystitis	HIDE

DACV NEVT LEAVE DI AMV

The mare makes frequent attempts to urinate, yielding red urine (hematuria) with a urine specific gravity (USG) of 1.006. She makes repeated attempts to drink small amounts of water and keeps her muzzle submerged

Necropsy  
hemorrhage  
What is it

**Correct:**

This is cantharidin toxicity caused by blister beetles (*Epicauta* spp.) which swarm in alfalfa hay during harvest.

Cantharidin is a potent irritant: see colic, renal disease, hematuria, peracute death.

Follow this link to see a Merck image of hemorrhagic gastritis.

Follow this link to see a Merck image of hemorrhagic cystitis.

Enzootic hematuria is a cow disease thought to be caused by bracken fern toxicity.

In horses, bracken fern toxicity presents differently, causing neurologic disease.

Expect thiaminase-related bracken STAGGERS in horses.

Value
102.7 F
HR=40 l
BR=20 t

Clostridi

Enzootic hematuria	HIDE
Arsenic toxicity	HIDE
<b>Cantharidin toxicity</b>	HIDE
Sorghum cystitis	HIDE

BACK NEXT

The mare makes frequent attempts to urinate, yielding red urine (hematuria) with a urine specific gravity (USG) of 1.006.

She makes repeated attempts to drink small amounts of water and keeps her muzzle submerged

In horses, bracken fern toxicity presents differently, causing neurologic disease. Expect thiaminase-related bracken STAGGERS in horses.

When 20%–25% of the diet for three or more months is bracken fern, horses can exhibit anorexia, weight loss, incoordination, and a crouching stance with feet placed wide apart and an arched back and neck.

**Value** Sorghum cystitis/ataxia is characterized by cystitis, urinary incontinence ("dribbling"), posterior incoordination.

102.7 F  
HR=40 l  
BR=20 l  
Refs: Pasquini's Guide to Bovine Clinics, 4<sup>th</sup> ed. pp. 228, Pasquini's Guide to Equine Clinics, 3<sup>rd</sup> ed. pp. 45, 156, 322 and the Merck Veterinary Manual online edition.

*Clostridi*

Enzootic hematuria	HIDE
Arsenic toxicity	HIDE
Cantharidin toxicity	HIDE
Sorghum cystitis	HIDE

BACK NEXT

## Bracken fern ( *Pteridium aquilinum* ) with inset



Bracken fern, growing from large dense woody rhizomes, forms deciduous, stipitate, erect to spreading fronds with nonanastomosing veins. The pinnae are stalked, opposite or subopposite (inset).

*Courtesy of Dr. Bryan Stegelmeier.*

*Pteridium aquilinum* (bracken fern) 📄



*Pteridium aquilinum* (bracken fern).

Courtesy of Dr. Lynn James.

 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

11	12	13	14	15	16	17	18	19	20
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Which of the following is true about LD<sub>50</sub>?

- 50% of this dose is lethal in 100% of subjects HIDE
- All of these are true HIDE
- Lower LD<sub>50</sub> is more toxic than a higher LD<sub>50</sub> HIDE
- Does not depend on species, age, gender of animal HIDE
- It gives information about the bioavailability of a medication HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV

11

Which of

LD<sub>50</sub>.

50% of

All of th

Lower L

Does no

It gives information about the bioavailability of a medication

HIDE

**Correct:** Lower LD<sub>50</sub> is more toxic than a higher LD<sub>50</sub>

The LD<sub>50</sub> is the "lethal dose-50" - the dose that is lethal to 50% of a test group. It is inversely proportional to toxicity - so a lower LD<sub>50</sub> is more toxic than a higher LD<sub>50</sub>.

LD<sub>50</sub> is the most common way to define toxicity and estimate lethality of a substance. It gives a measure of the acute toxicity in a specific species, sex, and age group.

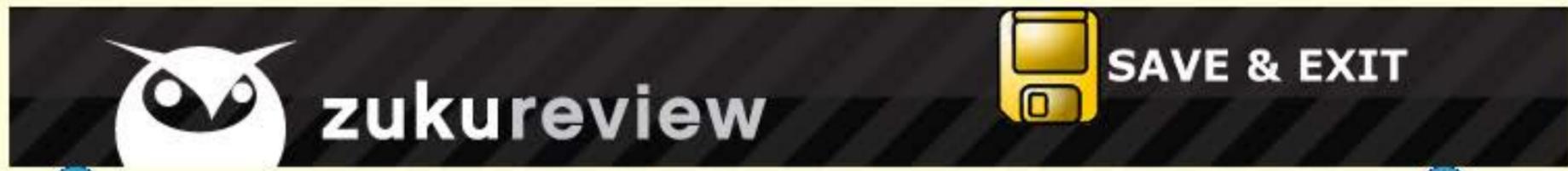
Changing any of these variables can affect the LD<sub>50</sub>.

Refs: The Merck Veterinary Manual online.

BACK

NEXT





PREV NEXT

11	12	13	14	15	16	17	18	19	20
x	✓	✓	M ✓	✓	✓	x	x	✓	✓

Avocado toxicosis is associated with what type of pathology in mammals?

Neutrophilic splenitis, adrenal atrophy	HIDE
Glomerular and hepatic amyloid deposition	HIDE
Squamous metaplasia of the prostate, pulmonary fibrosis	HIDE
Myocardial necrosis, sterile mastitis	HIDE
Interstitial nephritis; neuronal degeneration	HIDE

BACK NEXT LEAVE BLANK

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



PREV

11

Avocado

Squamo

Myocarc

Neutrop

Interstit

Glomerular and hepatic amyloid deposition

**Correct:**  
 Avocado toxicosis can cause myocardial necrosis (in mammals and birds) or sterile mastitis (in lactating mammals). Colic may also occur in horses.  
 Dogs appear relatively resistant to these effects compared to other species. However, ingestion of the avocado pit may cause intestinal obstruction.  
 Refs: Cote, Clinical Veterinary Advisor-Dogs and Cats, 3<sup>rd</sup> ed. pp. 808-9T and the Merck Veterinary Manual online edition.

BACK

NEXT





PREV

NEXT

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

A group of 2 1/2-month-old feeder pigs are presented with non-pruritic keratinized skin lesions and mild lethargy. One severely affected animal is depressed and anorexic.

[Click here to see image 1](#)

[Click here to see image 2](#)

What is the underlying cause of the problem seen in these pigs?

Copper toxicity	HIDE
<i>Sarcoptes scabiei var suis</i> infestation	HIDE
<i>Staphylococcus hyicus</i> infection	HIDE
<i>Microsporum nanum</i> infection	HIDE
Zinc deficiency	HIDE

BACK NEXT I FAVE RI ANK

**THE MERCK VETERINARY MANUAL** **Multimedia**

LOCATION(S) • [Overview of Parakeratosis](#)

**Parakeratosis, typical lesions, pig**

photo size: [small](#) | [high](#)



Parakeratosis lesions are typically confined to the lower and ventral abdomen, thorax, limbs, and feet.

Courtesy of Dr. Ranald D. A. Cameron.



Courtesy of Dr. Ranald D. A. Cameron.



Correct

In pigs, zinc deficiency causes parakeratosis.

Parakeratosis may resemble exudative dermatitis ("greasy pig disease"), caused by Staphylococcus hyicus.

Exudative dermatitis is more typically seen in younger suckling piglets.

Click here to see a piglets with Staph hyicus and exudative dermatitis on the abdomen.

Sarcoptic mange (Sarcoptes scabiei var suis) is typically pruritic.

Refs: Jackson and Cockcroft, Handbook of Pig Medicine, 1st ed. pp. 118-9, 121 and the Merck Veterinary Manual online edition.

Navigation controls: PREV, 11, and a close button (X)

A group lesions a

Click her

Click her

What is t

Copper

Sarcoptes scabiei var suis infestation	HIDE
Staphylococcus hyicus infection	HIDE
Microsporum nanum infection	HIDE
Zinc deficiency	HIDE

BACK NEX



Subacute exudative epidermitis, piglets





Exudative epidermitis, "greasy" lesion, pig



 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

11	12	13	14	15	16	17	18	19	20
----	----	----	----	----	----	----	----	----	----

Which **animal** is the most **resistant** to **salt toxicity**, compared to other animals?

Horses	HIDE
Cattle	HIDE
Sheep	HIDE
Poultry	HIDE
Pigs	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



**Correct: Sheep**

Compared to other animals, sheep are relatively resistant to water deprivation sodium ion toxicosis (salt toxicity), and pigs are the most sensitive.

Salt toxicity has been reported in virtually all animals. In the USA, it is most common in swine, cattle, and poultry.

Refs: Jackson and Cockcroft, Handbook of Pig Medicine, 1<sup>st</sup> ed. p. 140 and the Merck Veterinary Manual online edition.

Navigation: PREV, 11, BACK, NEXT

Buttons: Overview, Mark this Question, Lab Values, Definitions, Report a Problem

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An 8-month male-neutered Australian cattle dog mix is presented recumbent, with a history of worsening vomiting, diarrhea, hematochezia and weakness in the last 6 hours.

The dog is prostrate and has a weak pulse.

The owner relates that the puppy chews on everything and might have eaten some ant traps she had put around the kitchen floor.

What is the treatment of choice?

Value	Normal
T=99.1 F (37.2 C)	99.5-102.5 F, 37.2-39.2 C
HR=140 bpm	60-120
RR=25 brpm	15-34

Copper glycinate	HIDE
D-penicillamine	HIDE
Deferoxamine	HIDE
Succimer	HIDE
Calcium disodium EDTA	HIDE

What is the treatment of choice?

**Value**

T=99.1  
C)

HR=140

RR=25 l

**Correct: SUCCIMER**

The treatment of choice for arsenic toxicity is SUCCIMER (dimercaptosuccinic acid (DMSA)). This drug is administered orally (or per rectum in vomiting animals) for 10 days.

Ant baits contain inorganic arsenic and are sometimes eaten by pets, especially cats. Expect GI presentation- Vomiting, diarrhea, hematochezia, weakness, prostration.

Copper See arsenic in old pesticides, contaminated water near mines, and with overdosage from organic arsenic feed additives in chickens and pigs.

D-penic

Deferox Arsenic is also in wood preservatives (ie: pressure-treated lumber) and in thiacetarsemide, a heartworm adulticide, now superceded by the safer and more effective melarsomine dihydrochloride.

Succime

Calcium

BACK NEXT

Overview Mark this Question Lab Values Definitions Report a Problem

PREV NEXT

21	22	23	24	25	26	27	28	29	30
----	----	----	----	----	----	----	----	----	----

A 2-year-old female spayed American **Staffordshire terrier mix** is presented for acute hypersalivation, vomiting, diarrhea, lacrimation, urination, and dyspnea after having escaped from the yard earlier today.

Physical exam reveals tremors, miosis, muscle weakness, and ataxia.

T: 102.4°F (39.1°C) [normal = 100.2–103.8°F, 37.9–39.9°C];

P: 60 bpm [normal = 70–120 bpm];

R: 48 brpm [normal = 18–34 brpm]

Which of the following is the most likely **cause** of these clinical signs?

Anticoagulant rodenticide exposure	HIDE
Organophosphate toxicosis	HIDE
Molluscicide (snail poison) ingestion	HIDE
Dog was hit by a car	HIDE
Dog drank ethylene glycol	HIDE

Navigation: PREV, NEXT

Progress bar: 21 (red), 22 (green with checkmark), 23, 24, 25, 26, 27, 28, 29, 30

**Correct:**

A 2-year hypersal escaped Physical T: 102.4 P: 60 br R: 48 br Which of

These clinical signs are classic for organophosphate (or carbamate) toxicosis.

Remember: **SLUDGE** (salivation, lacrimation, urination, defecation, dyspnea, and emesis) with organophosphate (OP) toxicosis (ingestion or dermal exposure).

OPs and carbamates competitively inhibit acetylcholine esterase (AChE), causing ACh to build up in the synapse. Causes excessive muscarinic, nicotinic, or central nervous system activity.

Generally, binding of AChE by **OPs** is **irreversible** (so body needs to make new ACh), vs. binding by **carbamates** is **reversible**.

**Dx:** Clinical suspicion; confirm with blood AChE levels.

Anticoagulant rodenticide exposure	HIDE
Organophosphate toxicosis	HIDE
Molluscicide (snail poison) ingestion	HIDE
Dog was hit by a car	HIDE
Dog drank ethylene glycol	HIDE

PREV NEXT

21	22	23	24	25	26	27	28	29	30
----	----	----	----	----	----	----	----	----	----

A 2-year hypersal escaped

Rx: Atropine (helps with muscarinic signs), pralidoxime chloride (2-PAM, helps with nicotinic signs; does NOT help with carbamate toxicosis), decontamination (bath for dermal exposure, gastric lavage and/or activated charcoal for ingestion), and supportive care. Prognosis is good unless there is significant respiratory distress or seizure activity.

Physical  
T: 102.4

Ingestion of molluscicides (e.g., metaldehyde) is characterized by anxiety, muscle tremors, tachycardia, hyperthermia, hyperesthesia, and ataxia, which can progress to depression and hyperpnea.

P: 60 bpm

Anticoagulant rodenticide toxicosis (e.g., warfarin) causes hemorrhage due to the inhibition of vitamin K epoxide reductase in the liver.

R: 48 bpm

Which of

Acute ethylene glycol toxicosis (e.g., antifreeze) is characterized by vomiting, polydipsia and polyuria, stupor, ataxia, knuckling, and decreased withdrawal and righting reflexes.

Anticoagulant rodenticide exposure	HIDE
Organophosphate toxicosis	HIDE
Molluscicide (snail poison) ingestion	HIDE
Dog was hit by a car	HIDE
Dog drank ethylene glycol	HIDE

 **zukureview**  **SAVE & EXIT**

[<](#) PREV

NEXT [>](#)

21 	22 	23	24	25	26	27	28	29	30
--------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----	----	----	----	----	----	----	----

Porcine pulmonary edema (PPE) and equine leukoencephalomalacia are caused by which toxin?

Fescue mycotoxins	HIDE
Slaframine	HIDE
Macrocyclic trichothecenes	HIDE
Fumonisin	HIDE
Aflatoxin	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



**21** **Correct:** Fumonisin is a *Fusarium* spp. mycotoxin associated with moldy corn. In equids, look for CNS disease (equine leukoencephalomalacia). In pigs, see hypertension and pulmonary edema (porcine pulmonary edema-PPE).  
Click here to see a table of [Mycotoxicoeses in Domestic Animals](#).  
Refs: The Merck Veterinary Manual online edition.

Fescue  
Slafram  
Macrocy  
**Fumonisin**  
Aflatoxin

BACK NEXT

- Overview
- Mark this Question
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

 PREV

NEXT 

21 	22 	23 	24	25	26	27	28	29	30
--------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----	----	----	----	----	----	----

Ergot intoxication is primarily associated with which clinical signs?

Estrogenism, vulvovaginitis	HIDE
Salivation, vomiting	HIDE
Necrosis of extremities, gangrene	HIDE
Leukoencephalomalacia, hypertension	HIDE
Icterus, hemorrhages	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

21

Correct:

Necrosis of extremities and gangrene. Ergotism is caused by ingestion of alkaloids in a parasitic fungus, *Claviceps purpurea*, that infects small grains (rye, wheat) and forage plants like bromes, bluegrass and ryegrass.

Ergot int

Look for vasoconstriction with terminal necrosis of the extremities due to thrombosis - affected animals are predisposed to frostbite and gangrene.

Estroger

May have CNS effects, potent oxytocic action, or pituitary effects (decreased prolactin leading to agalactia).

Salivatic

Necrosis

Slaframine toxicosis causes profuse salivation, primarily in horses and occasionally in cattle. Due to the fungus *Rhizoctonia leguminicola* (black patch disease) on red clover (*Trifolium pratense*) especially in wet, cool years.

Leukoer

Icterus, hemorrhages

BACK

NEXT





**Fumonisin** is another *Fusarium* spp. mycotoxin associated with moldy corn. In **equids**, look for CNS disease (equine leukoencephalomalacia). In **pigs**, see hypertension and pulmonary edema (porcine pulmonary edema-PPE).

**Aflatoxicosis** is caused by toxigenic strains of *Aspergillus* (*A. flavus*, *A. parasiticus*) on peanuts, soybeans, corn (maize) and other cereal grains.

The **liver is the major target organ**, with widespread hemorrhages, **icterus** and death in acute cases. Subacute outbreaks are more common, with nonspecific signs of anorexia, weakness, unthriftiness and sudden death.

Click here to see a table of [Mycotoxicoeses in Domestic Animals](#).

Refs: The Merck Veterinary Manual online edition.

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

21 	22 	23 	24 	25	26	27	28	29	30
--------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----	----	----	----	----	----

Swine or young ruminants fed cottonseed meal in feed may experience multisystemic toxic effects (cardiac, hepatic, reproduction, renal) unless the feed is supplemented with iron.

What is this condition called?

Nonprotein nitrogen poisoning	HIDE
Pyrrrolizidine alkaloidosis	HIDE
Nitrite toxicosis	HIDE
Molybdenum poisoning	HIDE
Gossypol toxicity	HIDE

BACK NEXT LEAVE BLANK



Navigation controls: PREV, question number 21

Correct:

Gossypol toxicity.

Swine or effects (

IRON helps to inactivate free gossypol pigment. High intake of protein, calcium hydroxide, or iron salts appears to be protective in animals fed cottonseed meal-containing feed.

What is t

Best action to avoid gossypol toxicity is to remove cottonseed meal from the feed.

Nonprot

By the time see signs and confirm Dx, prognosis is poor because exposure was usually long-term and multi-organ damage is done. No effective treatment.

Pyrrolizi

Refs: Osweiler's NVMS Toxicology pp. 345-46 and the Merck Veterinary Manual online edition.

Nitrite t

Molybdenum poisoning	HIDE
Gossypol toxicity	HIDE

BACK NEXT



 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

21	22	23	24	25	26	27	28	29	30
----	----	----	----	----	----	----	----	----	----

What is the treatment of choice for **arsenic toxicity**?

Copper glycinate	HIDE
Succimer	HIDE
D-penicillamine	HIDE
Deferoxamine	HIDE
Calcium disodium EDTA	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

21

**Correct:**

The treatment of choice for arsenic toxicity is SUCCIMER (dimercaptosuccinic acid (DMSA)). This drug is administered orally (or per rectum in vomiting animals) for 10 days.

What is t

Ant baits contain inorganic arsenic and are sometimes eaten by pets, especially cats. Expect GI presentation - vomiting, diarrhea, hematochezia, weakness, prostration.

Copper

Succime

See arsenic in old pesticides, contaminated water near mines, and with overdose from organic arsenic feed additives in chickens and pigs. Arsenic is also in wood preservatives (i.e.: pressure-treated lumber) and in thiacetarsemide, a heartworm adulticide, now superceded by the safer and more effective melarsomine

D-penic

Deferox

dihydrochloride.

Calcium

BACK

NEXT



 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

21 	22 	23 	24 	25 	26 	27	28	29	30
--------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----	----	----	----

Molybdenum toxicosis causes a deficiency in which one of the following choices?

Potassium	HIDE
Magnesium	HIDE
Selenium	HIDE
Copper	HIDE
Iron	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



- [PREV](#)
- 21
- Molybden
- Potassium
- Magnesium
- Selenium
- Copper**
- Iron

**Correct:**

Molybdenum toxicosis causes a secondary DEFICIENCY in **Copper**, see ADR Ain't Doin' Right signs : ACHROMOTRICHIA (depigmented hair, especially around eyes= "SPECTACLES" ) rough coat, decreased milk yield, lameness and decreased fertility, libido and **"Peat Scours"** also called **"Teart"** (severe scours with gas bubbles).

**Rx** with Cu injections, copper oxide wire boluses and/or supplement diet with copper. If molybdenum content of forage is greater than 5 ppm, can use 1% copper sulfate (CuSO4-5H2O) in salt.

Follow this link to the [Zuku Review Top 20 Tox](#) notes.

Refs: Pasquini's Guide to Bovine Clinics, 4<sup>th</sup> ed. pp. 89, 218-24, Osweiler's NVMS Toxicology pp. 185-6, 199-200, and the Merck Veterinary Manual online edition.

[BACK](#)   [NEXT](#)

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

21 	22 	23 	24 	25 	26 	27 	28	29	30
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Trichothecene (mycotoxin) toxicosis is primarily associated with which clinical signs?

Immunosuppression, vomiting	HIDE
Leukoencephalomalacia, hypertension	HIDE
Lameness, hyperthermia	HIDE
Gangrene, necrosis of extremities	HIDE
Estrogenism, vulvovaginitis	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



Correct:

Immunosuppression and vomiting.

21

Trichothecenes are a group of related cytotoxic mycotoxins associated with many fungi. Think of vomitoxin (and vomiting) and also of immunosuppression.

Trichothe

Refusal to eat contaminated feed is a typical sign, due to taste aversion. Macrocyclic trichothecene-related diseases have several specific names, including the best known, stachybotryotoxicosis.

Immunc

Think of lameness and hyperthermia in cattle and horses with fescue, due to an ergot-like mold on tall fescue grass.

Leukoer

Lamene

Gangrer

Think of reproductive dysfunction (estrogenism, vulvovaginitis) with zearalenone, the only known mycotoxin with primarily estrogenic effects.

Estrogenism, vulvovaginitis

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

**Zearalenone** is produced by *Fusarium* spp. molds on plants and common feed grains like corn, barley and wheat.

Often a second mycotoxin called **deoxynivalenol** is also produced which causes decreased feed intake. The presence of deoxynivalenol may limit exposure to zearalenone if the animal eats less.

**Fumonisin** is another *Fusarium* spp. mycotoxin associated with moldy corn.

In **equids**, look for CNS disease (Equine leukoencephalomalacia). In **pigs**, see hypertension and pulmonary edema (porcine pulmonary edema-PPE).

**Ergotism** is caused by ingestion of **alkaloids in a parasitic fungus**, *Claviceps purpurea*, that infects small grains (rye, wheat) and forage plants like bromes, bluegrass and ryegrass.

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

**SAVE & EXIT**

**21**

**Trichothe**

**Immunc**

**Leukoer**

**Lamene**

**Gangrer**

**Estrogenism, varovaginitis**

**ERGOTISM** is caused by ingestion of alkaloids in a parasitic fungus, *Claviceps purpurea*, that infects small grains (rye, wheat) and forage plants like bromes, bluegrass and ryegrass.

Look for **vasoconstriction** with terminal **necrosis of the extremities** due to thrombosis-affected animals are predisposed to **frostbite and gangrene.**

**May have CNS effects**, potent oxytocic action or pituitary effects (decreased prolactin leading to agalactia).

Click here to see a table of [Mycotoxicoeses in Domestic Animals](#).

Refs: The Merck Veterinary Manual online edition.

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

21	22	23	24	25	26	27	28	29	30
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Which one of the following is associated with causing secondary hypocuprosis (copper deficiency) in cattle and sheep?

Magnesium deficiency	HIDE
Excess zinc in the feed formulation	HIDE
Iron toxicity	HIDE
Selenium toxicosis	HIDE
Molybdenum poisoning	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

21

Which of the following is a deficiency?

- Magnesium
- Excess zinc
- Iron toxicity
- Selenium

Correct:

Copper deficiency (hypocuprosis) may occur secondary to molybdenum poisoning in cattle and sheep.

Excess molybdenum causes poor copper absorption, utilization, and bioavailability AND increases copper excretion.

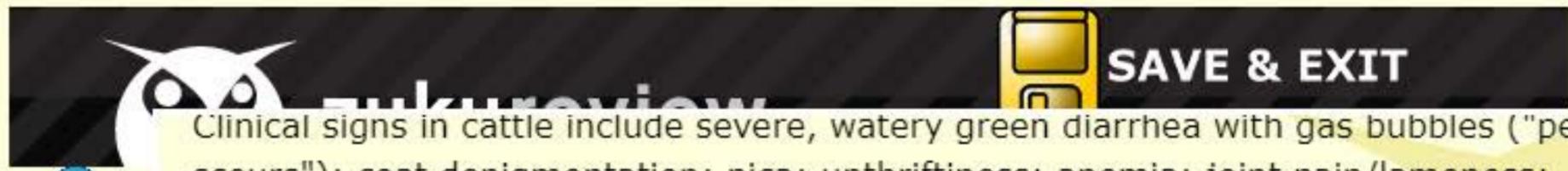
Clinical signs in cattle include severe, watery green diarrhea with gas bubbles ("peat scours"); coat depigmentation; pica; unthriftiness; anemia; joint pain/lameness; osteoporosis/fractures. Reproductive issues include decreased fertility in bulls, infertility, and delayed puberty.

Presents as "enzootic ataxia" or "swayback" in lambs less than one month old - ataxia and stiffness of the hind end.

Molybdenum poisoning HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



Navigation controls: PREV, 21 (question count), and a red close button.

- Which or
- deficienc
- Magnesi
- Excess z
- Iron tox
- Seleniur

Clinical signs in cattle include severe, watery green diarrhea with gas bubbles ("peat scours"); coat depigmentation; pica; unthriftiness; anemia; joint pain/lameness; osteoporosis/fractures. Reproductive issues include decreased fertility in bulls, infertility, and delayed puberty.

Presents as "enzootic ataxia" or "swayback" in lambs less than one month old - ataxia and stiffness of the hind end.

Rx is copper sulfate and removal of molybdenum if possible. Prevent with copper:molybdenum ratio of 6:1.

Refs: Pasquini's Guide to Bov Clin, 4<sup>th</sup> ed. p. 89 and the Merck Veterinary Manual online edition.

Molybdenum poisoning HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

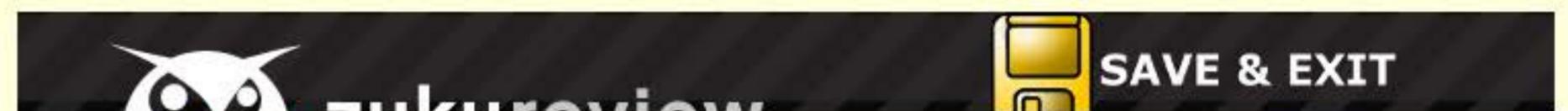
21 	22 	23 	24 	25 	26 	27 	28 	29 	30
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Which one of the following syndromes is caused by ingestion of an ergot alkaloid made by the endophyte fungus *Neotyphodium coenophialum* ?

Fescue lameness	HIDE
Porcine pulmonary edema (PPE)	HIDE
Equine leukoencephalomalacia	HIDE
Facial eczema (pithomycototoxicosis)	HIDE
Ergotism	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

21

### Correct: Fescue lameness

Think of lameness and hyperthermia in cattle and horses with fescue lameness, due to a toxin produced by an ergot-like mold (*Neotyphodium coenophialum*) on tall fescue grass.

Ergotism is caused by ingestion of alkaloids in a parasitic fungus, *Claviceps purpurea*, that infects small grains (rye, wheat) and forage plants like bromes, bluegrass and ryegrass.

Equine leukoencephalomalacia and porcine pulmonary edema (PPE) are caused by fumonisin from *Fusarium* spp. mycotoxins in moldy corn.

Facial eczema (pithomyctotoxicosis) is a photodermatitis of grazing livestock, primarily in New Zealand sheep, though it occurs elsewhere.

Refs: The Merck Veterinary Manual online edition.

- Which of the endo
- Fescue l
- Porcine
- Equine l
- Facial ec

Ergotism HIDE

BACK NEXT

- Overview
- Lab Values
- Report a Problem



PREV

NEXT

31	32	33	34	35	36	37	38	39	40
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Which one of the following conditions is classically associated with a combination of salivation, lacrimation, urination, vomiting and defecation in the cat?

Brodifacoum or bromadiolone poisoning	HIDE
Ethylene glycol poisoning	HIDE
Organophosphate toxicity	HIDE
Strychnine poisoning	HIDE
Arsenic toxicity	HIDE

BACK    NEXT    LEAVE BLANK

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



PREV

31

Which or salivation

- Brodifac
- Ethylene
- Organop
- Strychni

Arsenic toxicity HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

**Correct: Organophosphate toxicity**

Any combination of the signs of SLUDGE (salivation, lacrimation, urination, diarrhea, dyspnea, emesis), plus or minus bradycardia or miosis suggest organophosphate (OPP) toxicity. Cats are particularly sensitive to an OPP called chlorpyrifos.

Remember that carbamate toxicity has similar presenting signs to OPP toxicity.

Refs: Cote, Clinical Veterinary Advisor-Dogs and Cats, 3<sup>rd</sup> ed. pp. 732-3 and the Merck Veterinary Manual online edition.

 **zukureview**  **SAVE & EXIT**

[<](#) PREV

NEXT [>](#)

31 ✓	32	33	34	35	36	37	38	39	40
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Hypomagnesemia in cattle due to lactation, grass diet, and transport stress presents principally with what signs?

Wildly aberrant behavior ( "Bovine bonkers" )	HIDE
Blindness, head pressing, maniacal excitement, death	HIDE
Hyperexcitable, ataxia, convulsions, tetany	HIDE
Weakness, flaccid paralysis, tachycardia	HIDE
Salivation, lacrimation, urination, defecation	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



**Correct: Hyperexcitable, ataxia, convulsions, tetany**

Tetany is the classic presentation of hypomagnesemia in cattle, along with hyperexcitability, ataxia, convulsions and death. Emergency Rx is IV Ca/Mg combo (like milk fever Rx). If cow is already convulsing, may be too late.

"Bovine bonkers" is a common name for ammoniated feed toxicity, which is related to nonprotein nitrogen (NPN)/ammonia poisoning.

Look for weakness, flaccid paralysis, tachycardia with bovine parturient paresis (milk fever).

Blindness, head pressing, maniacal excitement, death are signs more associated with lead poisoning.

Salivation, lacrimation, urination, diarrhea, dyspnea, emesis (SLUDGE), plus or minus bradycardia or miosis are among the classic signs of organophosphate toxicity.

Salivation, lacrimation, urination, defecation HIDE

BACK NEXT

-   
Overview
-   
Mark this Question
-   
Lab Values
-   
Definitions
- 

 **zukureview**  **SAVE & EXIT**

 PREV

NEXT 

31 	32 	33	34	35	36	37	38	39	40
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What **clinical sign** is most associated with **molybdenum** poisoning in ruminants?

Coprophagy	HIDE
Photosensitization	HIDE
Scours	HIDE
Submandibular edema	HIDE
Blindness	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

31

What clin

Blindnes

Scours

Coproph

Subman

Photosensitization



### Correct: Scours

Both molybdenum poisoning and associated copper deficiency cause a gastroenteritis. Look for so-called "peat scours" or "teart" (severe scours with gas bubbles).

Additional possible clinical signs include unthriftiness, emaciation, coat depigmentation, pica, a microcytic hypochromic anemia, joint pain/lameness, and bone fractures (osteoporosis).

Refs: Pasquini's Guide to Bovine Clinics, 4<sup>th</sup> ed. pp. 89, 218-24, Osweiler's NVMS Toxicology pp. 185-6, 199-200, and the Merck Veterinary Manual online edition.

BACK

NEXT



 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

31 ✓	32 ✓	33 <sup>M</sup> ✓	34	35	36	37	38	39	40
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**Fumonisin** intoxication is primarily associated with which clinical signs?

Estrogenism, vulvovaginitis	HIDE
Vomiting, immunosuppression	HIDE
Salivation, retching	HIDE
Leukoencephalomalacia, hypertension	HIDE
Terminal necrosis of extremities, gangrene	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

31

Correct:

Leukoencephalomalacia and hypertension.

Fumonisin is another *Fusarium* spp. mycotoxin associated with moldy corn.

Fumonisin

In equids, look for CNS disease (Equine leukoencephalomalacia).

Estrogen

In pigs, see hypertension and pulmonary edema (porcine pulmonary edema-PPE).

Vomiting

Think of reproductive dysfunction (estrogenism, vulvovaginitis) with zearalenone, the only known mycotoxin with primarily estrogenic effects.

Salivatic

Slaframine toxicosis causes profuse salivation, primarily in horses and occasionally in

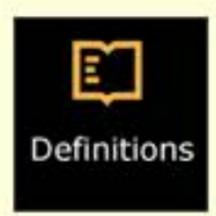
Leukoencephalomalacia

cattle.

Terminal necrosis of extremities, gangrene

BACK

NEXT





31  [PREV](#)

Fumonisin B<sub>1</sub> Think of vomitoxin (and vomiting) and also of immunosuppression.

Estrogen

Vomiting Refusal to eat contaminated feed is a typical sign, due to taste aversion.

Salivary gland hypertrophy

Leukoencephalomalacia Macrocytic trichothecene-related diseases have several specific names, including the best known, stachybotryotoxicosis.

Terminal ileitis Click here to see a table of [Mycotoxinoses in Domestic Animals](#).

Terminal necrosis of extremities, gangrene

Refs: The Merck Veterinary Manual online edition.

BACK NEXT

- Overview
- Mark this Question
- Definitions
- Report a Problem

This plant is the primary forage in a pasture for a herd of horses.

Which one of the following would be the most likely **lesion** seen in these **horses** if toxicity occurred?



Nigropallidal encephalomalacia	HIDE
Hepatic fibrosis and megalocytosis	HIDE
Renal tubular necrosis	HIDE
Hemorrhagic gastroenteritis	HIDE
Diffuse fibrosing alveolitis	HIDE

This plant is the primary forage in a pasture for a herd of horses.

Which or occurred



Nigropallidal encephalomalacia.

Chronic ingestion of *Centaurea spp.* (yellow star thistle or Russian knapweed) causes nigropallidal encephalomalacia in horses (liquefactive necrosis of the neurons in the globus pallidus and substantia nigra).

Ruminants are not affected and can be used to control the spread of these weeds.

Sometimes called "chewing disease," the signs of toxicity are quite characteristic - involuntary chewing movements, twitching/curling of the lips, and facial hypertonicity.

Affected horses cannot prehend or chew, but they are still able to swallow. They may bury their head deep into a water bucket trying to drink.

The brain damage is irreversible, and euthanasia is recommended.

Nigropallidal encephalomalacia	HIDE
Hepatic fibrosis and megalocytosis	HIDE
Renal tubular necrosis	HIDE
Hemorrhagic gastroenteritis	HIDE
Diffuse fibrosing alveolitis	HIDE

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

31 ✓	32 ✓	33 M ✓	34 ✓	35 ✓	36 ✗	37	38	39	40
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What is the effect of sulfa drugs on patients with rodenticide toxicosis?

Bone marrow suppression	HIDE
Increased toxicosis	HIDE
Decreased hemorrhaging	HIDE
Sedation	HIDE
Seizures	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV

31

What is t

Bone m

Increase

Decrease

Sedation

Seizures

**Correct:** Increased toxicosis

Sulfa drugs can displace the [anticoagulant](#) from plasma binding sites leading to increased free toxicant and increased toxicosis. [Anticoagulant rodenticides](#) antagonize [Vitamin K](#), predisposing to hemorrhagic crisis.

Click here to see [thoracic hemorrhage](#) and [mesenteric hemorrhage](#) secondary to anticoagulant rodenticide toxicity.

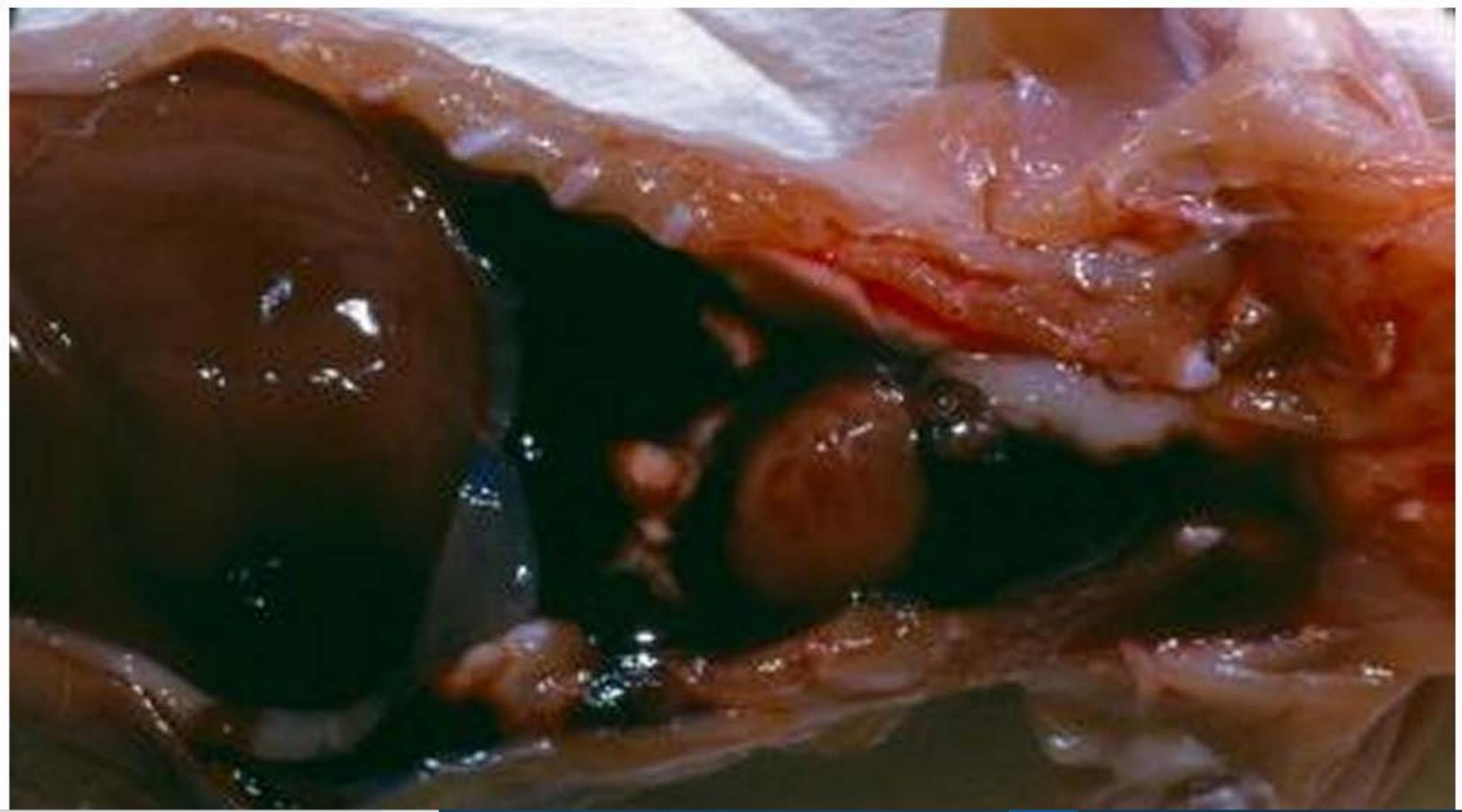
Refs:Cote, Clinical Veterinary Advisor-Dogs and Cats, 3<sup>rd</sup> ed. pp. 76-8 and the Merck Veterinary Manual online.

BACK

NEXT



Thoracic hemorrhage, anticoagulant rodenticide poisoning



Mesenteric hemorrhage, anticoagulant rodenticide poisoning



 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

31 ✓	32 ✓	33 <sup>M</sup> ✓	34 ✓	35 ✓	36 ✗	37	38	39	40
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Which **animal** is **most sensitive** to **ionophore** toxicity?

Dog	HIDE
Horse	HIDE
Pig	HIDE
Chicken	HIDE
Cow	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

31

Which ar

- Dog
- Horse
- Pig
- Chicken
- Cow

**Correct:**  
**HORSES** are the most sensitive by far to **ionophore toxicity** (ie: Monensin®, Lasalocid®). **Ionophores** are used as feed additives/growth promoter for cattle to decrease intake while maintaining weight gain (push gut microflora to make more volatile fatty acids) decreases feedlot bloat and acidosis.

In **HORSES** look for **HISTORY OF EATING CATTLE FEED**. See anorexia, colic, stiffness ("tying up"), tachycardia, posterior paresis, high creatine kinase (skeletal muscle necrosis). Then see cardiomyopathy, **HEART FAILURE**.

Feed concentrations as low as of 100 g/ton and 400 g/ton have been fatal to sheep and cattle, respectively.

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

31 ✓	32 ✓	33 M ✓	34 ✓	35 ✓	36 ✗	37 ✗	38	39	40
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A 2-month old calf suddenly died after vigorous exercise. A necropsy finds endocardial plaques in the left ventricle of the calf's heart.

What is at the top of the differential list of possibilities of death for this calf?

Brisket disease	HIDE
Enterotoxemia	HIDE
Congestive heart failure	HIDE
White muscle disease	HIDE
Copper toxicosis	HIDE

BACK NEXT LEAVE BLANK



PREV

31

Correct:

Think White Muscle Disease when you see **SUDDEN DEATH and endocardial PLAQUES** in a young calf, lamb or kid with a history of recent **VIGOROUS EXERCISE**. Follow this link to a Merck image of pale ventricular myocardium .

A 2-mon  
plaques  
What is a

Typically seen in young, fast-growing animals (ie/: calves 2 weeks-6 mos) Clinical signs may include dyspnea (due to myocardial disease), stiff gait, arched back, weakness, recumbent but BAR (bright, alert, responsive).

**Sudden death** may resemble enterotoxemia, **should see acute bloody diarrhea**, convulsions, opisthotonos in first days of life with enterotoxemia.

Copper  
Congest  
Enteroto

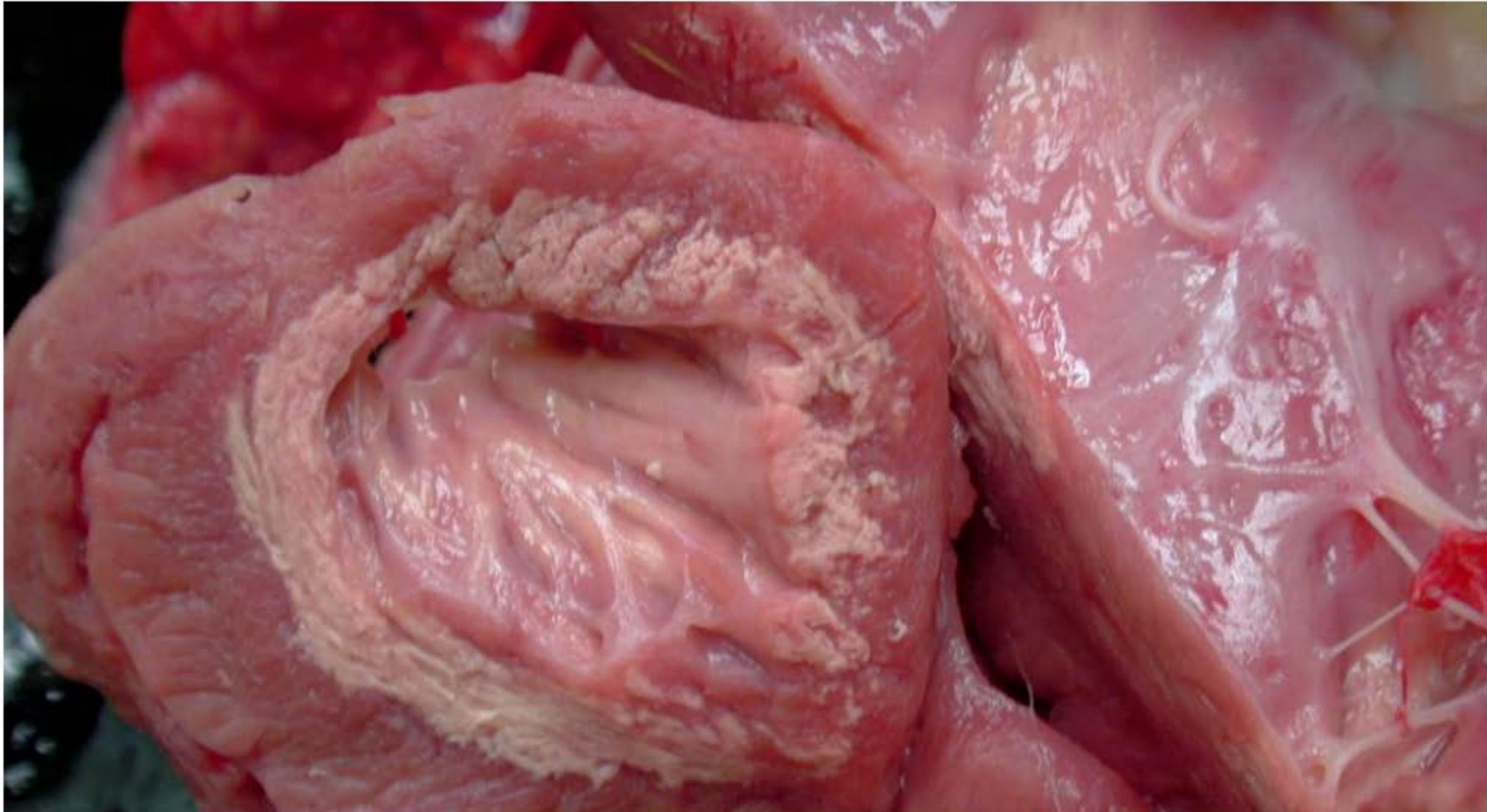
Refs: Pasquini's Guide to Bovine Clinics, 4<sup>th</sup> ed. pp 78, 250 and the Merck Veterinary Manual online edition.

White muscle disease	HIDE
Brisket disease	HIDE

BACK NEXT



White muscle disease



 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

31 ✓	32 ✓	33 M ✓	34 ✓	35 ✓	36 ✗	37 ✗	38 M ✓	39	40
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A various amount of range plants, both browse and nonbrowse-types, have been associated with an increased incidence of **brisket disease** in cattle. **Which** one of the following **plants** has been experimentally shown to induce the prevalence and severity of congestive heart failure?

Swainsonine is the toxin in this plant.

Delphinium, Larkspur	HIDE
Astragalus, Oxytropis	HIDE
Veratrum, Hellebore	HIDE
Tetradymia, Horsebrush	HIDE
Cicuta, Water hemlock	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)



31

A various with an i has beer failure?

Swainson

Delphini

Astragal

Veratrum, Hellebore	HIDE
Tetradymia, Horsebrush	HIDE
Cicuta, Water hemlock	HIDE

BACK NEXT

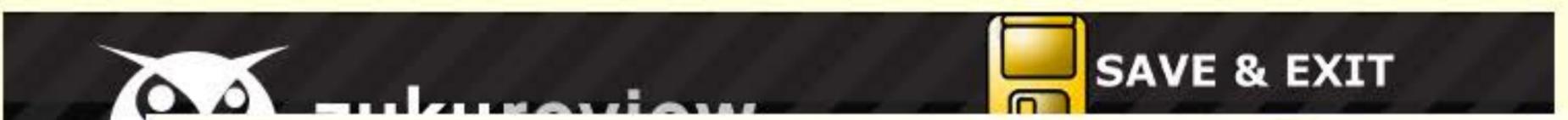
Correct

Remember LOCOWEED (Astragalus and Oxytropis) ingestion worsens brisket disease (due to swainsonine toxin). See marked increase in prevalence and severity of congestive heart failure (CHF) due to high altitude. Condition develops more quickly (1-2 wk), incidence can be 100%.

Locoweed toxin excreted in milk can cause CHF in nursing calves. High mountain disease is essentially right-heart CHF due to pulmonary hypertension from low O2. Causes pulmonary vasoconstriction, so right ventricle is overworked, leading to CHF.

MEMORY AID - "LOCOWeed makes cows HIGH" (altitude sick).

Water hemlock (Cicuta) causes rapid onset convulsions, coma, death (remember Socrates?).



**MEMORY AID** - "LOCOweed makes cows HIGH" (altitude sick).

Water hemlock (Cicuta) causes rapid onset convulsions, coma, death (remember Socrates?).

Horsebrush (tetradymia) causes photosensitization, hepatic damage, "bighead." Larkspur (Delphinium) contains alkaloids causing nonspecific toxicity signs - falling, bloat, salivation, constipation.

False hellebore (Veratrum) contains steroidal alkaloids. See vomiting, salivation, cardiac arrhythmia, bradycardia, dyspnea, muscle weakness, paralysis, coma. See congenital cyclops in lambs from ewes exposed to Veratrum californicum.

Follow this link to a Merck table with images of toxic range plants.

Refs: Osweiler's NVMS Toxicology pp. 367, Pasquini's Guide to Bovine Clinics, 4<sup>th</sup> ed. pp. 70, 82 and the Merck Veterinary Manual online edition



31

A various with an i has beer failure?

Swainson

Delphini

Astragal

Veratrum, Hellebore	HIDE
Tetradymia, Horsebrush	HIDE
Cicuta, Water hemlock	HIDE

BACK

NEXT

 **zukureview**  **SAVE & EXIT**

PREV < > NEXT

31 ✓	32 ✓	33 M ✓	34 ✓	35 ✓	36 ✗	37 ✗	38 M ✓	39 ✓	40
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A flock of sheep has been grazing on **Sorghum halepense** (Johnson grass), *Tetradymia* spp. (horsebrush) and *Artemisia nova* (black sage).

Many of the exposed animals have **edema**, especially in their **heads**. This lamb has edema **around the eyes** and the **ears show hyperkeratinized** tissue.

What is the **photosensitizing** agent responsible for this condition?



many of the exposed animals have edema, especially in their heads. This lamb has edema around the eyes and the ears show hyperkeratinized tissue.

What is the photosensitizing agent responsible for this condition?



Phylloerythrin	HIDE
<i>Artemisia nova</i>	HIDE
<i>Tetradymia</i> spp.	HIDE
Bile acids	HIDE
Chlorophyll	HIDE

BACK    NEXT    LEAVE BLANK

around the eyes and the ears show hyperkeratinized tissue.

What is the photosensitizing agent responsible for this condition?



**Correct:**

Phylloerythrin is a photosensitizing agent derived from microbial breakdown of **chlorophyll** in the GI tract.

If the liver is damaged, then phylloerythrin builds up in the plasma.

This phylloerythrin absorbs and releases light energy in the skin, causing **SECONDARY photosensitization**.

This is the most common type of livestock photosensitization.

So, when sheep eat hepatotoxic *Tetradymia spp.* and *Artemisia nova*, the compromised liver allows toxic photosensitizing phylloerythrin to build up.

Artemis

Phylloer

<i>Tetradymia spp.</i>	HIDE
Chlorophyll	HIDE
Bile acids	HIDE

BACK

NEXT

around the eyes and the ears show hyperkeratinized tissue.

What is the photosensitizing agent responsible for this condition?



**PRIMARY photosensitization** occurs in the absence of hepatic disease when a photodynamic agent is ingested/injected/absorbed.

*Hypericum perforatum* (St. John's wart) is an example of a plant that causes primary photosensitization.

**Tetracycline** is a medication that can cause primary photosensitization.

**Congenital inherited photosensitization** is seen in some breeds of cattle and sheep.

Refs: Blackwell's 5-Minute Consult: Ruminant and the Merck Veterinary Manual online. Image courtesy of [Lucien Mahin](#).

Artemis	
Phylloer	
Tetradymia spp.	HIDE
Chlorophyll	HIDE
Bile acids	HIDE

BACK NEXT

 **zukureview**  **SAVE & EXIT**

 **PREV**

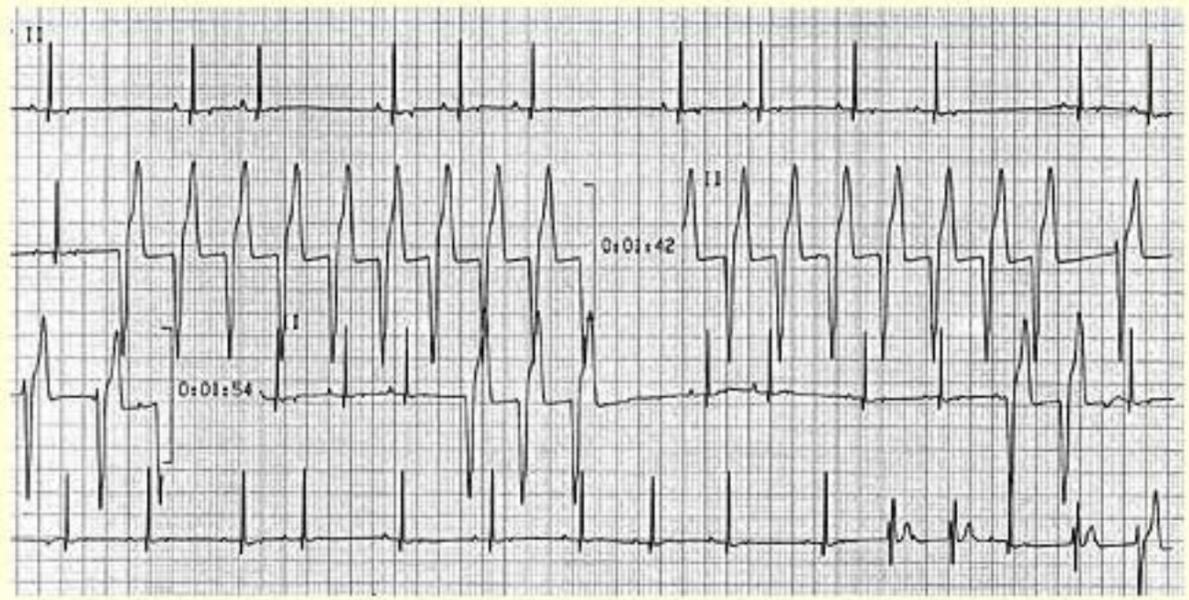
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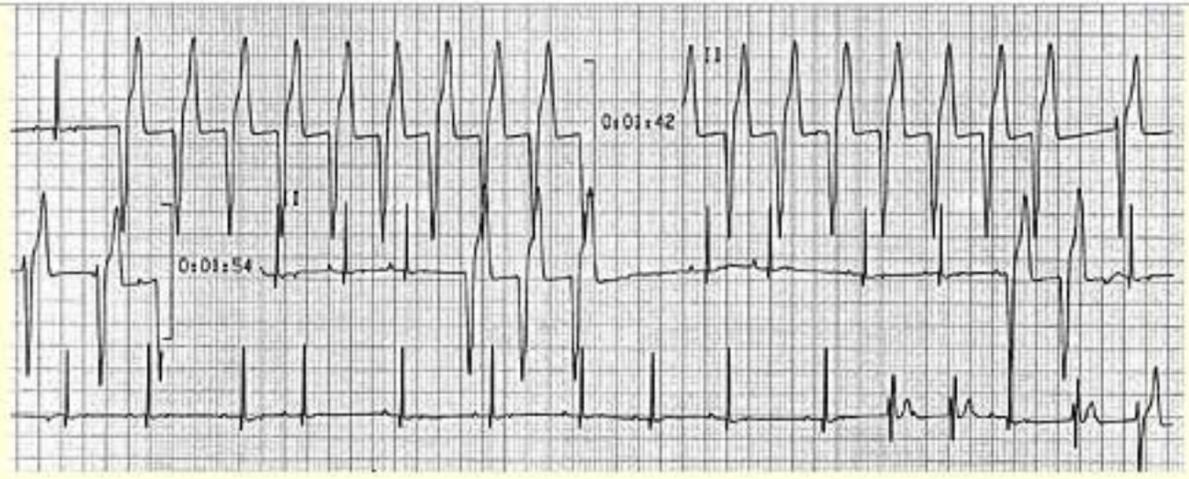
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The night after **Valentine's day**, an obese **male neutered Schnauzer** is presented with a combination of **vomiting, urinary accidents, and diarrhea.**

On physical exam there is **muscle rigidity** and **chocolate wrappers visible in the diarrhea.** The dog has a **seizure** on the exam table. An **ECG is shown** below.

**Which** one of the following **choices** is the best **treatment** plan?

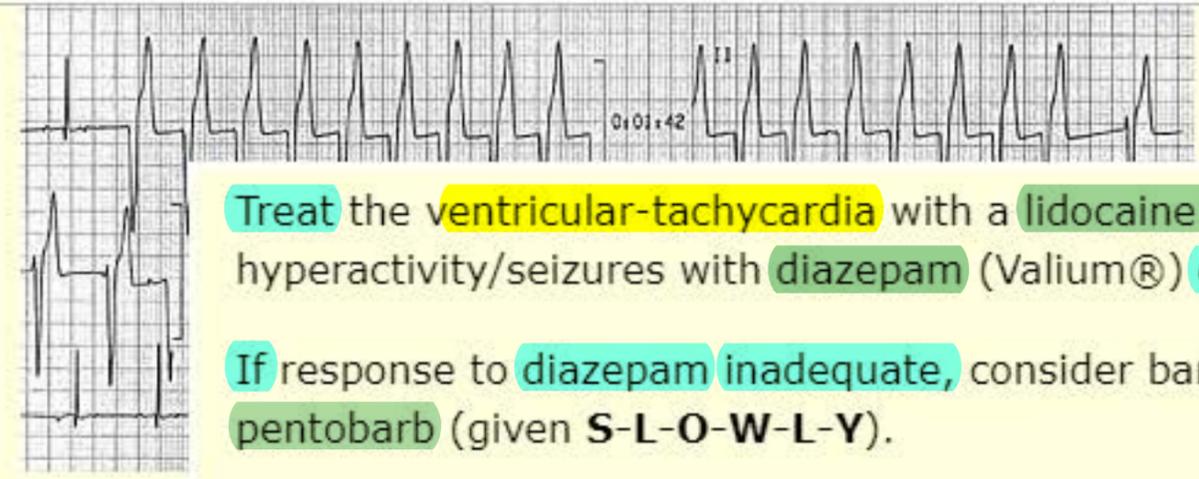




Value	Normal
T=103.2 F (39.6 C)	99.5-102.5 F, 37.2-39.2 C
HR=184 bpm	60-120
RR=40 brpm	15-34

Activated charcoal, sodium sulfate, methocarbamol IV	HIDE
Diazepam, lidocaine drip	HIDE
Ipecac, theophylline, digoxin	HIDE
Apomorphine, gastric lavage, Na-bicarbonate IV	HIDE
Phenobarbital, glycopyrrolate	HIDE

DACV    MEVT    LEAVE DI AMV



**Value**  
 T=103.2  
 C)  
 HR=184  
 RR=40 l

Treat the **ventricular-tachycardia** with a **lidocaine drip** and address hyperactivity/seizures with **diazepam** (Valium®) or **methocarbamol**.

If response to **diazepam** **inadequate**, consider barbiturates like **phenobarb** or **pentobarb** (given **S-L-O-W-L-Y**).

This is a classic presentation of severe **chocolate toxicity**, due to toxic **methylxanthine alkaloids** (e.g.: **theobromine, theophylline, caffeine**).

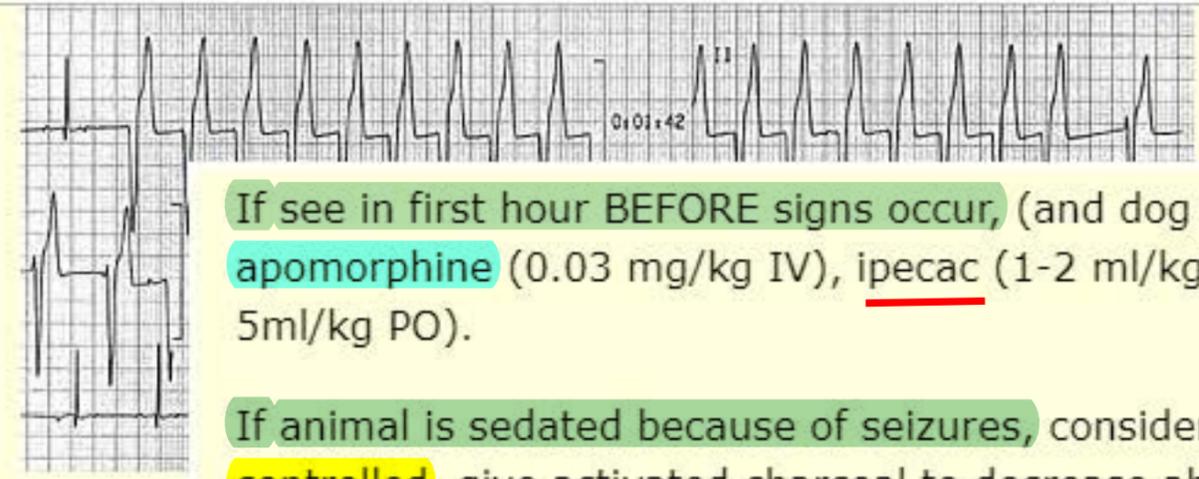
Common around Halloween, Christmas, and Valentine's Day holidays, see **EXCITEMENT, SEIZURES, ARRHYTHMIAS**.

The seizure and ECG which shows **ventricular tachycardia (V-tach)** are the key pieces of **information here**:

Most chocolate toxicities are milder - hyperactivity, vomiting, urinating, diarrhea.

Diazepam, lidocaine drip	HIDE
Ipecac, theophylline, digoxin	HIDE
Apomorphine, gastric lavage, Na-bicarbonate IV	HIDE
Phenobarbital, glycopyrrolate	HIDE

DACV NCVT



**Value**

T=103.2  
C)  
HR=184  
RR=40 l

If see in first hour BEFORE signs occur, (and dog not seizing), induce vomiting with apomorphine (0.03 mg/kg IV), ipecac (1-2 ml/kg PO) or hydrogen peroxide (1-5ml/kg PO).

If animal is sedated because of seizures, consider gastric lavage. If vomiting is controlled, give activated charcoal to decrease absorption of toxic alkaloids and an osmotic cathartic like Na-sulfate (1g/kg PO) to promote elimination.

Rx arrhythmias depending on type - usually a tachycardia; give LIDOCAINE for V-tach or BETA-BLOCKERS (propranolol / metoprolol) for supraventricular tachycardias.

Chocolate toxicity from most toxic to least toxic: cacao beans and baking chocolate are worse than semisweet chocolate which is worse than milk chocolate.

49 grams of baking chocolate (one 2-oz bar) can kill a 7-kg dog. It would take 420 grams of milk chocolate (about eight 2-oz bars) bars to kill a 7-kg dog.

Diazepam, lidocaine drip	HIDE
Ipecac, theophylline, digoxin	HIDE
Apomorphine, gastric lavage, Na-bicarbonate IV	HIDE
Phenobarbital, glycopyrrolate	HIDE

DACV NCVT

What **clinical sign**(s) might you expect to see in cattle chronically consuming the plant seen in this image?



Convulsions	HIDE
Respiratory distress	HIDE
Hematuria	HIDE
Salivation and dysphagia	HIDE
<b>Shifting leg lameness</b>	<b>HIDE</b>

What clinical sign(s) might you expect to see in cattle chronically consuming the plant seen in this image?



**Correct:**

**Hematuria.** The plant pictured is *Pteridium aquilinum*, or bracken fern.

Chronic ingestion of bracken fern is associated with development of enzootic hematuria in cattle and sheep, a syndrome characterized by hemorrhagic cystitis and bladder neoplasms.

Acute toxicity to the bone marrow can also occur, leading to thrombocytopenia and granulocytopenia and consequent coagulopathy and immune dysfunction.

Bracken fern also contains thiaminases that lead to thiamine deficiencies, primarily in horses and swine.

Refs: Smith, Large Animal Internal Medicine, 5<sup>th</sup> ed., pp. 905-6, 1588 and the Merck Veterinary Manual online edition.

Convulsions	HIDE
Respiratory distress	HIDE
Hematuria	HIDE
Salivation and dysphagia	HIDE
<b>Shifting leg lameness</b>	<b>HIDE</b>

 **zukureview**  **SAVE & EXIT**

 PREV

NEXT 

41 	42  	43	44	45	46	47	48	49	50
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**Oxalate** is the toxic agent found in which one of the following plants?

<i>Hypericum perforatum</i> (klamathweed)	HIDE
<i>Solanum</i> spp. (nightshade)	HIDE
<i>Delphinium</i> spp. (larkspur)	HIDE
<i>Sarcobatus vermiculatus</i> (greasewood)	HIDE
<i>Hordeum</i> spp. (foxtail)	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

41

Oxalate

Hypericu

Solanun

Delphini

Sarcoba

Hordeur



Correct:

Oxalates are found in *Sarcobatus vermiculatus* (greasewood). **Halogeton**

Greasewood toxicity is seen primarily in sheep, sometimes in cattle, usually when large amounts are consumed over a short period of time.

Oxalates occur in plants as salts of calcium, sodium, and potassium. Calcium oxalate is insoluble and is lost through the GI tract.

Sodium and potassium oxalates are soluble and either 1) bind to calcium in the rumen and lost through the GI tract, or 2) are absorbed and react with calcium in body fluids.

BACK

NEXT





PREV

41

Oxalate

Hypericu

Solanun

Delphini

Sarcoba

Hordeur

Death is attributed to hypocalcemia and/or kidney failure caused by calcium oxalate crystals in the renal tubules.

Signs of oxalate toxicity include: dullness, lowering of the head, loss of appetite, separation from the herd; followed by excessive salivation with frothing, progressive incoordination; and finally, coma, irregular breathing, and death.

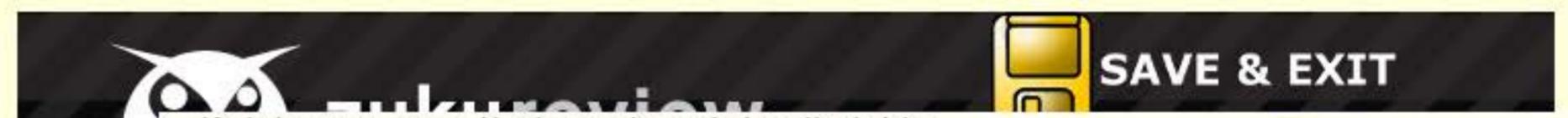
Oxalate containing plants include: Sarcobatus (greasewood), Oxalis (sorrel), Rumex (dock), Halogeton, Amaranthus (pigweed), and Chenopodium (lambsquarter).

Oxalates are also produced by molds (Aspergillus niger) in contaminated feeds.

- Delphinium spp. (larkspur) contain alkaloids.
- Hypericum perforatum (klamathweed) contain hypericin.
- Hordeum spp. (foxtail) cause physical injury.

BACK NEXT

- Overview
- Mark this Question
- Definitions
- Report a Problem



- [PREV](#)
- 41 ✓
- Oxalate
- Hypericu
- Solanun
- Delphini
- Sarcoba
- Hordeur

*Delphinium* spp. (larkspur) contain alkaloids.  
*Hypericum perforatum* (klamathweed) contain hypericin.  
*Hordeum* spp. (foxtail) cause physical injury.  
*Solanum* spp. (nightshade) contain alkaloids.

[Click here](#) to see an image of greasewood.

[Click Here](#) to see the Merck Table of Poisonous Range Plants of Temperate North America.

Refs: Knight and Walter's A Guide to Plant Poisoning of Animals in NA, pp. 263-275, Forero, Livestock-Poison Plants of CA, U of CA, Davis, ANR, p. 22, Pasquini's Guide to Bovine Clinics 4<sup>th</sup> ed., p. 224, and the Merck Veterinary Manual online edition.

BACK NEXT

- Overview
- Mark this Question
- 
- Definitions
- Report a Problem

**greasewood**



 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

41 ✓	42 <sup>M</sup> ✗	43 <sup>M</sup> ✓	44	45	46	47	48	49	50
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Acute bovine pulmonary emphysema and edema is clinically indistinguishable from what mycotoxicosis?

Macrocyclic trichothecenes	HIDE
4-Ipomeanol	HIDE
Aflatoxins	HIDE
Zearalenone	HIDE
Slaframine	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV

41

Correct:

4-Ipomeanol toxicity (moldy sweet potato) is clinically indistinguishable from acute bovine pulmonary emphysema and edema (ABPEE, also known as Fog fever). Fog fever is associated with L-tryptophan in lush pastures, which is converted into pneumotoxic compounds (3-methylindole) that damage respiratory epithelial cells.

Refs: Pasquini's Guide to Bov Clin, 4<sup>th</sup> ed. p. 67 and the Merck Veterinary Manual online edition.

- Macrocy
- 4-Ipome
- Aflatoxin
- Zearalen

Slaframine HIDE

BACK NEXT

- Overview
- Mark this Question
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[PREV](#)

[NEXT](#)

41 ✓	42 M ✗	43 M ✓	44 ✓	45	46	47	48	49	50
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Which one of the following animals is most sensitive to *Pinus ponderosa* (Ponderosa pine) toxicity?

Cattle	HIDE
Chickens	HIDE
Horses	HIDE
Sheep	HIDE
Pigs	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV

41

Which of the following is most sensitive to toxicity?

Cattle

Chicken

Horses

Sheep

Pigs

HIDE

BACK

NEXT



**Correct:**  
**Cattle** are most sensitive to toxicity caused by *Pinus ponderosa* (Ponderosa pine), which causes late term abortion. Pregnant cows are at greatest risk in the last three months of gestation. Mares, ewes, and does are not affected.

Both the needles and bark contain the toxin isocupressic acid which causes vasoconstriction, decreasing blood flow to the uterus and other tissues.

Ischemic necrosis of the corpus luteum results in a lack of progesterone and the pregnancy is lost; abortion occurs 2-21 days after ingestion of 5-6 pounds of pine needles per day for 3 days.



- PREV
- 41 ✓
- Which or toxicity?
- Cattle
- Chicken
- Horses
- Sheep
- Pigs

Just before abortion occurs, edema of the vulva and udder can be seen and a bloody mucoid vaginal discharge is often present. Retained placenta is common following abortion.

Calves that are not aborted are born weak; affected dams also do not produce sufficient colostrum or milk and calves may die from starvation or infection.

Cattle will usually only eat pine needles when forage is scarce, such as during winter snows. The only treatment is prevention of exposure to pine needles during the last three months of pregnancy.

[Click here](#) to see an image of *Pinus ponderosa* (Ponderosa pine).

[Click Here](#) (scroll down) to see a Merck table of Poisonous Range Plants of Temperate North America

HIDE

BACK NEXT

- Overview
- Lab Values

 **zukureview**  **SAVE & EXIT**

 [PREV](#)

[NEXT](#) 

41 	42  	43  	44 	45 	46	47	48	49	50
--------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------	----	----	----	----	----

Swainsonine is a toxic compound present in which one of the following plants?

<i>Pteridium aquilinum</i> (bracken fern)	HIDE
<i>Prunus virginiana</i> (chokecherry)	HIDE
<i>Astragalus flavus</i> (milk vetch)	HIDE
<i>Persea americana</i> (avocado)	HIDE
<i>Nerium oleander</i> (oleander)	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



**Correct:**  
Swainsonine is found in many species of **Astragalus** and **Oxytropis**, called locoweeds, vetches, or milk vetches.

**Ingestion of swainsonine** causes neurologic signs of cerebral disease, called "**locoism**" in livestock. Behavior changes, aggression, ataxia, depression, circling, and vision loss are some of the clinical signs seen.

Recovery is possible with removal of the source, but since locoweed is palatable, animals may eat it again even when other forage is available.

Cattle consuming **locoweed** at high altitudes can develop **congestive heart failure**, called "**high mountain disease**." **Pulmonary hypertension** causes excessive strain on the heart muscle.

Swainsonine  
Pteridium  
Prunus  
Astragalus  
Persea  
Nerium

BACK NEXT

Overview | Mark this Question | Lab Values | Definitions



- [PREV](#)
- 41
- Swainson
- Pteridium
- Prunus
- Astragal
- Persea
- Nerium oleander (oleander)

*Nerium oleander* (oleander) contains cardiac glycosides.  
*Pteridium aquilinum* (bracken fern) contains glycosides and thiaminase.  
*Persea americana* (avocado) contains persin.  
*Prunus virginiana* (chokecherry) contains cyanide.

[Click here](#) to see an image of *Astragalus* spp.

[Click here](#) to see an image of *Oxytropis sericea*.

[Click here](#) to see the Merck Table of Poisonous Range Plants of Temperate North America.

Refs: Pasquini's Guide to Equine Clinics, 3<sup>rd</sup> ed., p. 264, Knight and Walter's A Guide to Plant Poisoning of Animals in NA, pp. 204-11, 306-8, Forero, Livestock-Poison Plants of CA, U of CA, Davis, ANR, p. 27 and the Merck Veterinary Manual online

[BACK](#)   [NEXT](#)

- Overview
- Mark this Question
- Lab Values
- Definitions
-



Astragalus spp.



Oxytropis sericea (White point locoweed)



Oxytropis sericea (White point locoweed)

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

41 ✓	42 M ✗	43 M ✓	44 ✓	45 ✓	46 ✓	47	48	49	50
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Which one of the following choices is the preferred **treatment for ionophore** toxicity?

Cisapride	HIDE
Dimercaprol	HIDE
Neostigmine	HIDE
There is no antidote	HIDE
Metformin	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



PREV

41

Which or

Cisaprid

Dimerca

Neostig

There is

Metform...

Correct:

Unfortunately, there is **NO ANTIDOTE** that will reverse clinical signs of ionophore toxicity. You may slow absorption of ionophores with activated charcoal or mineral oil. Early administration of vitamin E/selenium may lessen muscle damage.

Ionophores are used as feed additives/growth promoter for cattle to decrease intake while maintaining weight gain (push gut microflora to make more volatile fatty acids), decrease feedlot bloat and acidosis.

HORSES are the most sensitive by far to ionophore toxicity (e.g.: Monensin®, Lasalocid®). In HORSES look for **HISTORY OF EATING CATTLE FEED**. See anorexia, colic, stiffness ("tying up"), tachycardia, posterior paresis, and high creatine kinase (skeletal muscle necrosis).

In cattle, toxicity affects multiple organ systems, esp. HEART FAILURE.

BACK

NEXT



 **zukureview**  **SAVE & EXIT**

PREV

NEXT

41 ✓	42 M ✗	43 M ✓	44 ✓	45 ✓	46 ✓	47 ✓	48	49	50
------	--------	--------	------	------	------	------	----	----	----

Which one of the following is the **most effective treatment** for a **cat** presented **two hours** after drinking ethylene glycol?

Chlorthiazide, Supplemental potassium	HIDE
Activated charcoal PO, Dimercaprol IV	HIDE
Pralidoxime chloride (2-PAM), Gastric lavage	HIDE
4 methyl pyrazole (4-MP), IV fluids	HIDE
IV dextrose, Imidocarb dipropionate	HIDE

BACK    NEXT    LEAVE BLANK

 Overview     Mark this Question     Lab Values     Definitions     Report a Problem



**41** **Correct:**

Recent clinical trials suggest that [Fomepizole](#) (4 methyl pyrazole, 4-MP) can be a more effective treatment than ethanol in cats when administered

- At high doses (extra-label) and
- Within three hours of ingestion of ethylene glycol.

More than three hours after ingestion, ethanol is the treatment of choice for cats with [ethylene glycol toxicity](#).

**Do 4 things when you see a case of ethylene glycol toxicity:**

- 1. Decrease EG absorption:** Induce vomiting +/- gastric lavage (or both) followed by activated charcoal, sodium sulfate within one-two hours of ingestion.
- 2. Promote diuresis:** IV fluids

Pralidox  
Activate  
4 methy  
Chlorthi  
IV dextrose, Imidocarb dipropinate HIDE

[BACK](#) [NEXT](#)

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



- 2. Promote diuresis: IV fluids
- 3. Address metabolic acidosis: Add bicarbonate in fluids
- 4. Prevent metabolism of EG: 4-MP or ethanol treatment.

41

EG toxicosis is a medical emergency. The greatest window of opportunity for intervention and a positive outcome is less than 8-12 hours post exposure in dogs, and less than two hours post exposure in cats.

Which or after dri

In all suspected or confirmed case-patients presented within one hour of ethylene glycol exposure, immediate emesis induction and administration of activated charcoal are indicated.

Pralidox

Activate

4 methy

Chlorthi

Refs: Cote, Clinical Veterinary Advisor-Dogs and Cats, 3<sup>rd</sup> ed. pp. 335-7, Blackwell's 5-Minute Vet Consult Canine Feline, 4<sup>th</sup> ed. pp. 454-5, Safety and Efficacy of High-dose Fomepizole Compared with Ethanol Therapy for Ethylene Glycol Intoxication in

IV dextrose, Imidocarb dipropinate HIDE

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



Navigation: < PREV, NEXT >

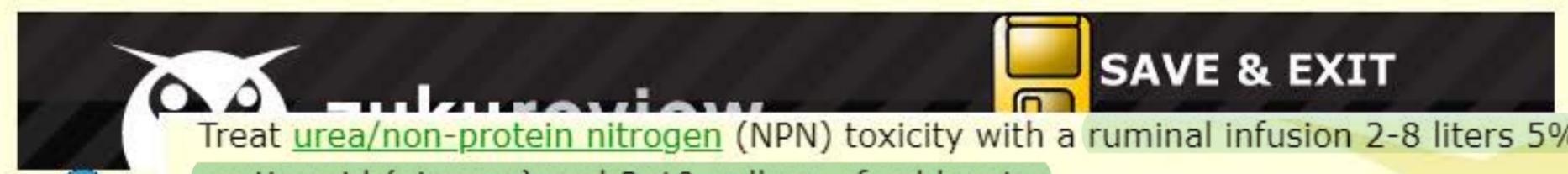
41 ✓	42 M ✗	43 M ✓	44 ✓	45 ✓	46 ✓	47 ✓	48 M ✓	49	50
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A cow is presented on emergency with urea/non-protein nitrogen toxicity.  
What is the treatment of choice?

Rumenotomy	HIDE
Ruminal infusion 2-8 liters vinegar, 3-10 gallons cold water	HIDE
Atropine, Protopam chloride IV q 4-6 hours	HIDE
IV Fluids with MgSO4, Na thiosulfate PO	HIDE
Relieve bloat, drench with 2-8 liters sodium bicarbonate	HIDE

BACK    NEXT    LEAVE BLANK

Navigation icons: Overview, Mark this Question, Lab Values, Definitions, Report a Problem



PREV

41

A cow is  
What is t

Rumeno

Rumena

Atropine

IV Fluids

Relieve bloat, drench with 2-8 liters sodium bicarbonate

BACK

NEXT



Treat urea/non-protein nitrogen (NPN) toxicity with a ruminal infusion 2-8 liters 5% acetic acid (vinegar) and 3-10 gallons of cold water.

The vinegar decreases ruminal pH which slows absorption of un-ionized ammonia.

Repeat Q 6 hours up to 48 hours. Best results if animal is still ambulatory.

It is often impossible to treat these cases before they die because of rapid progression to death.

If possible, Rx with IV fluids. If necessary, relieve bloat.

Urea/NPN toxicity is related to ammoniated feed toxicity which causes so-called "bovine bonkers."

Manage ammoniated feed toxicity by removing the ammoniated feed and treating severe cases with anticonvulsants like diazepam, pentobarbital sodium.

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

41 ✓	42 M ✗	43 M ✓	44 ✓	45 ✓	46 ✓	47 ✓	48 M ✓	49 ✓	50
------	--------	--------	------	------	------	------	--------	------	----

A 5-year-old neutered domestic shorthair cat is presented for lethargy, vomiting and diarrhea.

The owner saw the cat licking up antifreeze spilled while he was flushing his truck's radiator yesterday.

The cat is markedly depressed and dehydrated on physical exam.

Which one of the following choices is the most appropriate treatment?

Activated charcoal	HIDE
Atipamezole	HIDE
Calcium EDTA in 0.9% NaCl	HIDE
Ethanol 20%	HIDE
Pralidoxime chloride (2-PAM)	HIDE



Correct:

More than 3 hours after ingestion, ethanol is still the treatment of choice for cats with ethylene glycol toxicity.

Recent clinical trials suggest that Fomepizole (4 methyl pyrazole, 4-MP) can be a more effective treatment than ethanol in cats when administered

- At high doses (extra-label) and
- Within 3 hours of ingestion of ethylene glycol.

Do 4 things when you see a case of ethylene glycol toxicity:

- 1. Decrease EG absorption:** Induce vomiting +/- gastric lavage (or both) followed by activated charcoal, sodium sulfate within 1-2 hr of ingestion.
- 2. Promote diuresis:** IV fluids
- 3. Address metabolic acidosis:** Add bicarbonate in fluids
- 4. Prevent metabolism of EG:** 4-MP or ethanol treatment.

41

A 5-year diarrhea

The own yesterda

The cat i

Which or

Activated charcoal	HIDE
Atipamezole	HIDE
Calcium EDTA in 0.9% NaCl	HIDE
Ethanol 20%	HIDE
Pralidoxime chloride (2-PAM)	HIDE

 **zukureview**  **SAVE & EXIT**

 PREV

NEXT 

51	52	53	54	55	56	57	58	59	60
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Which of the following toxic agents may cause **diarrhea in dogs, cats, horses, and cattle?**

<i>Epicauta</i> spp	HIDE
Arsenic	HIDE
Pyrrrolizidine alkaloids	HIDE
Chlorinated hydrocarbons	HIDE
Urea	HIDE

[BACK](#)   [NEXT](#)   [LEAVE BLANK](#)

 Overview    Mark this Question    Lab Values    Definitions    Report a Problem



PREV

51

Correct

When you hear [arsenic](#), think severe GI signs, including a hemorrhagic diarrhea. Cattle find arsenic on pesticide-contaminated foliage. Pets find arsenic in ant baits and in pressure treated wood (like on backyard decks) or wood preservative.

[Urea toxicity](#) causes wildly aberrant behavior ("bovine bonkers"), tremors, acute death. Rx if time, with VINEGAR.

[Cantharidin toxicity](#) from blister beetles (*Epicauta* spp.), is basically a horse disease. Potent irritant: see colic, renal disease, hematuria, peracute death.

Follow this link to see a [Merck image of hemorrhagic gastritis](#). Follow this link to see a [Merck image of hemorrhagic cystitis](#).

With toxicity due to [chlorinated hydrocarbons](#) (insecticides like lindane, methoxychlor), look for CNS depression or stimulation (convulsive seizures).

- Which of
- [Epicauta](#)
- [Arsenic](#)**
- [Pyrrolizi](#)
- [Chlorina](#)
- [Urea](#)

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

51	52	53	54	55	56	57	58	59	60
----	----	----	----	----	----	----	----	----	----

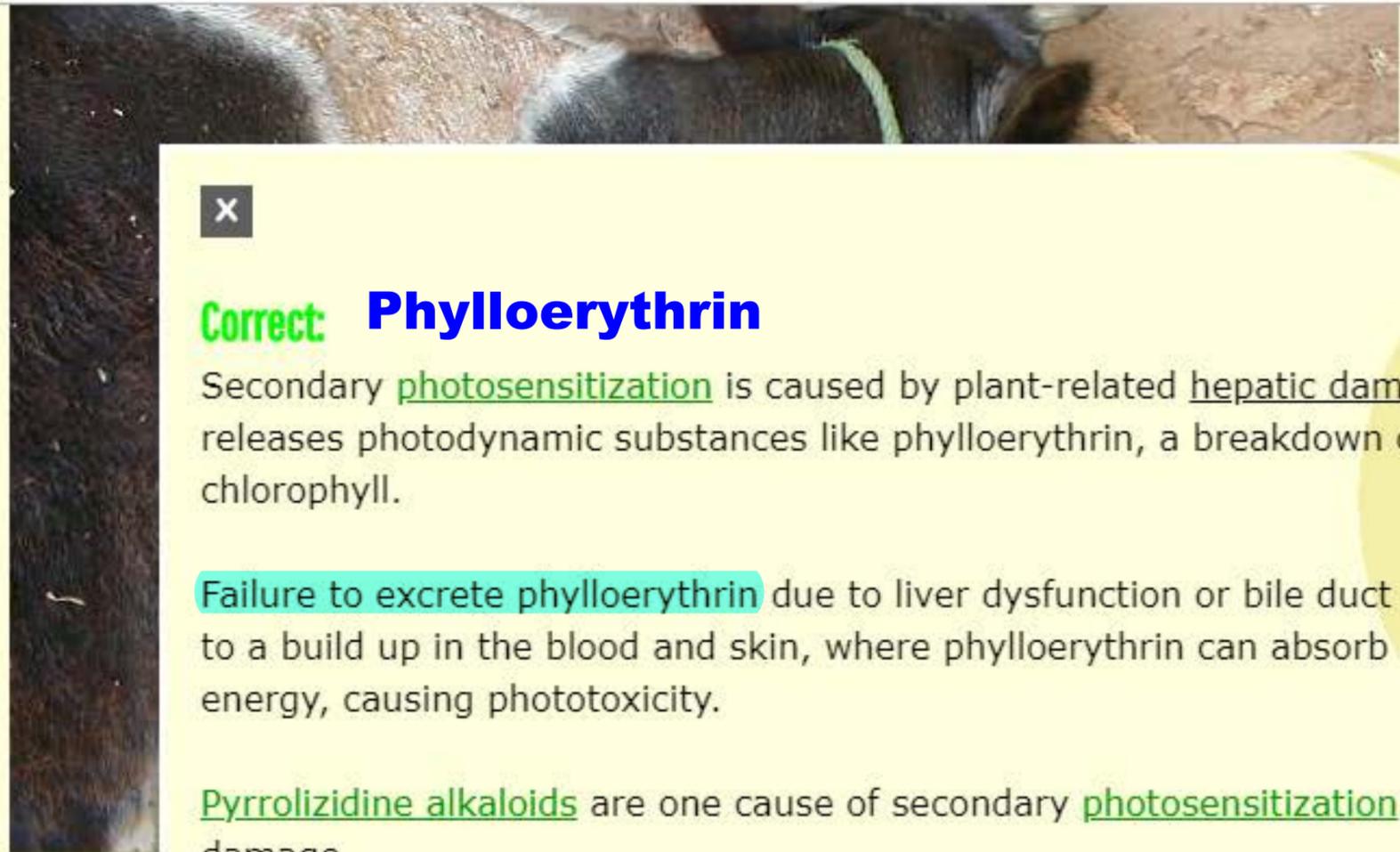
This cow is off-feed, icteric and has raw irritated skin over the back, suggesting secondary photosensitization.

What is the underlying toxic agent that typically causes secondary photosensitization?





Unconjugated bile acid	HIDE
Gossypol	HIDE
Ptaquiloside	HIDE
Phylloerythrin	HIDE
Aflatoxin	HIDE



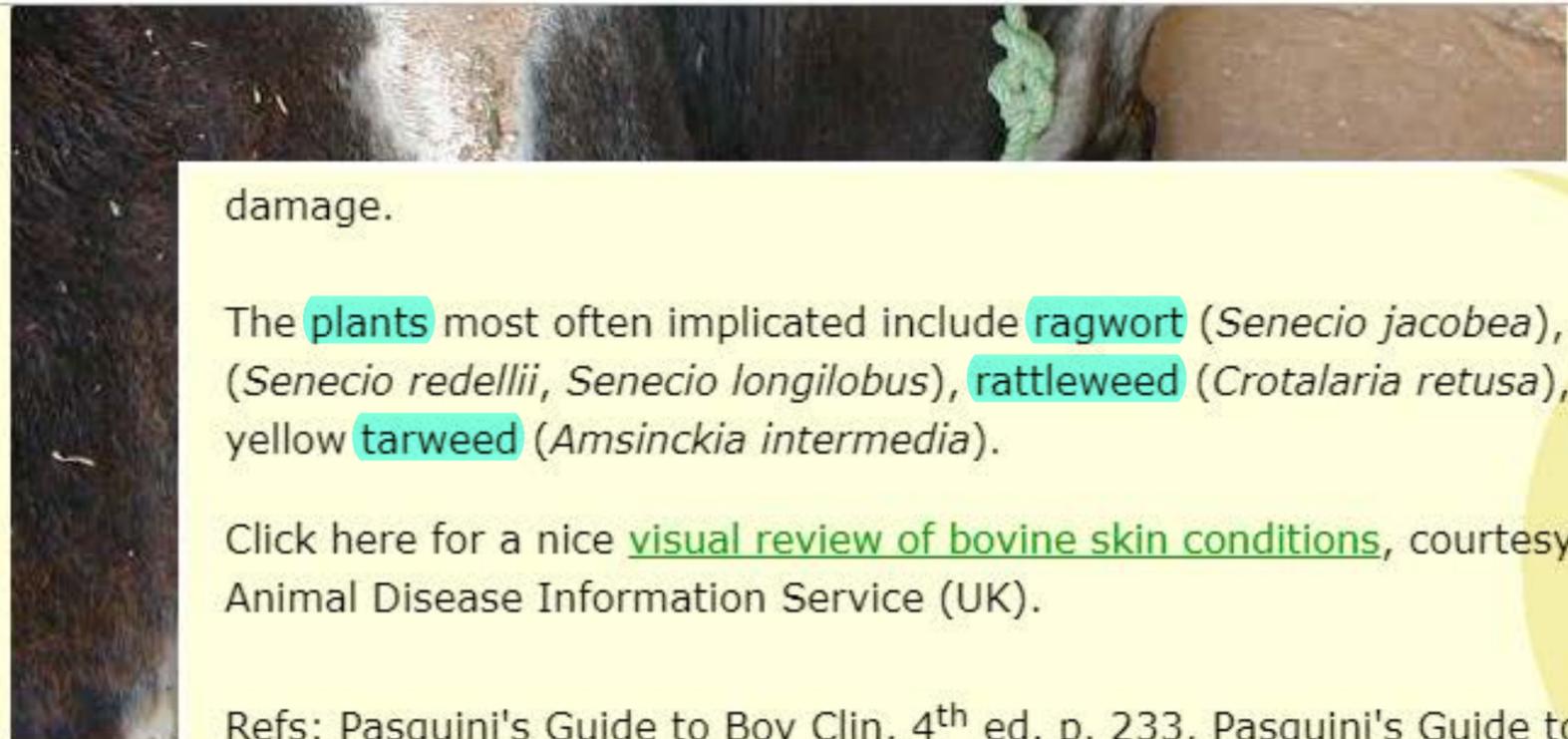
**Correct: Phylloerythrin**

Secondary photosensitization is caused by plant-related hepatic damage, which releases photodynamic substances like phylloerythrin, a breakdown of product chlorophyll.

Failure to excrete phylloerythrin due to liver dysfunction or bile duct lesions can lead to a build up in the blood and skin, where phylloerythrin can absorb and release light energy, causing phototoxicity.

Pyrrolizidine alkaloids are one cause of secondary photosensitization due to liver damage.

Unconjugated bilirubin	HIDE
Gossypol	HIDE
Ptaquiloside	HIDE
<b>Phylloerythrin</b>	<b>HIDE</b>
Aflatoxin	HIDE



damage.

The **plants** most often implicated include **ragwort** (*Senecio jacobea*), woolly groundsel (*Senecio redellii*, *Senecio longilobus*), **rattleweed** (*Crotalaria retusa*), and seeds of yellow **tarweed** (*Amsinckia intermedia*).

Click here for a nice [visual review of bovine skin conditions](#), courtesy of the Natl. Animal Disease Information Service (UK).

Refs: Pasquini's Guide to Bov Clin, 4<sup>th</sup> ed. p. 233, Pasquini's Guide to Eq Clin, 3<sup>rd</sup> ed. p. 323 and the Merck Veterinary Manual online edition. Image courtesy of [Lucien Mahin](#) and Wikipedia

Unconju  
Gossypc  
Ptaquilo

Phylloerythrin	HIDE
Aflatoxin	HIDE

BACK NEXT





PREV

NEXT

51 ✓	52 ✓	53	54	55	56	57	58	59	60
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Which toxic agent may have caused the problem seen in this horse?

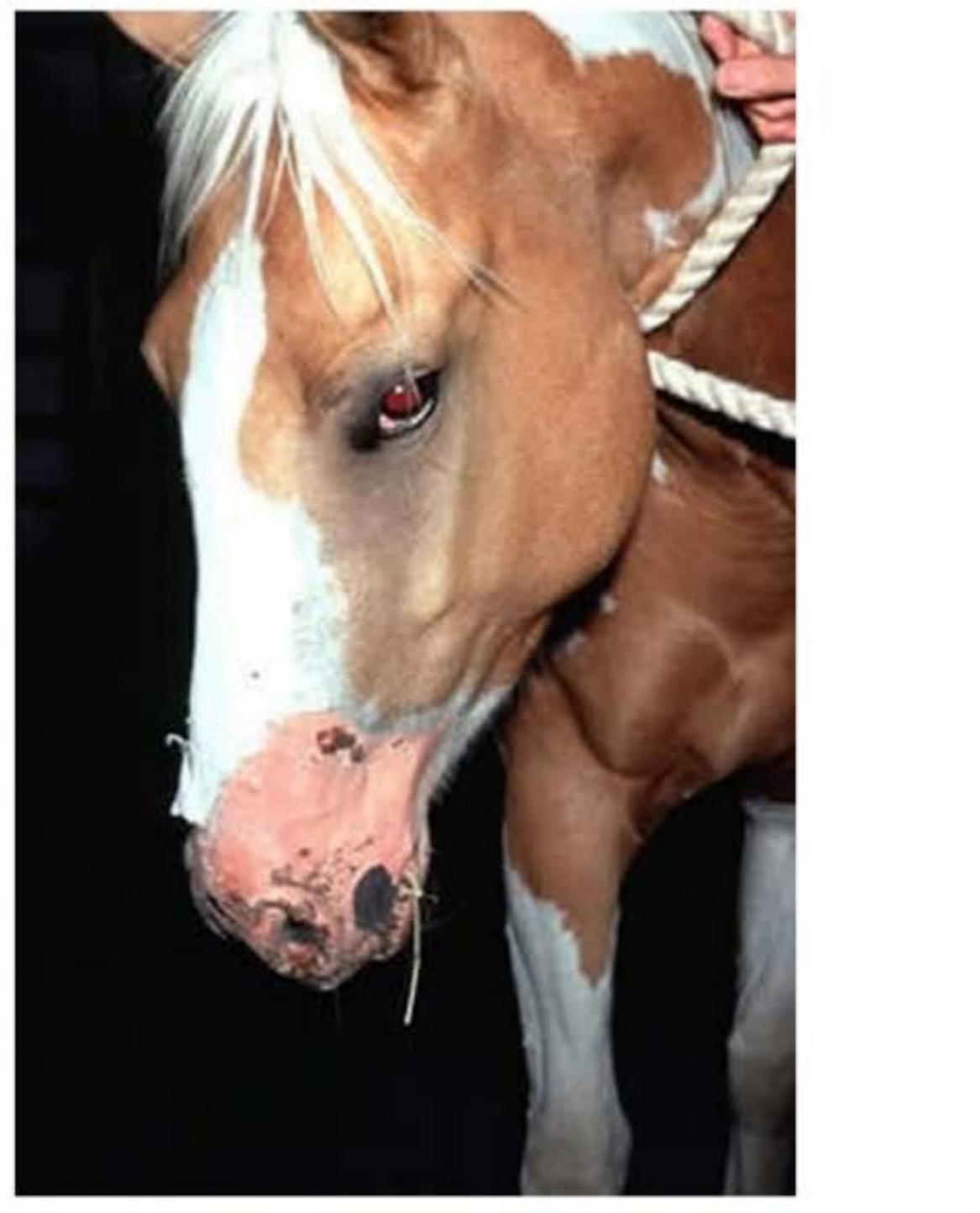
[Click here to see image](#)

Cantharidin	HIDE
Moldy winter wheat	HIDE
<b>Pyrrolizidine alkaloids</b>	HIDE
Metalddehyde	HIDE
Gossypol	HIDE

BACK NEXT LEAVE BLANK

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

THE MERCK VETERINARY MANUAL Multimedia



Courtesy of Dr. Stephen White



PREV

51

Which to  
[Click here](#)

Canthar

Moldy w

Pyrrolizi

Metalden

Gossypol

**Correct:**  
 Pyrrolizidine alkaloids are one cause of secondary photosensitization due to liver damage. Note how the skin of the white muzzle has sloughed off.

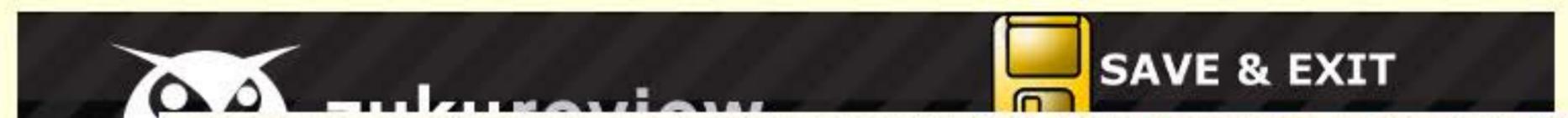
The plants most often implicated in pyrrolizidine alkaloid hepatotoxicity include ragwort (*Senecio jacobea*), woolly groundsel (*Senecio redellii*, *Senecio longilobus*), rattleweed (*Crotalaria retusa*), and seeds of yellow tarweed (*Amsinckia intermedia*).

Primary photosensitization is caused by photodynamic substances in the plant itself.

Examples of primary photosensitizers are hypericin from *Hypericum perforatum* (St. John's wort) and fagopyrin from *Fagopyrum esculentum* (buckwheat).

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



Examples of primary photosensitizers are hypericin from *Hypericum perforatum* (St. John's wort) and fagopyrin from *Fagopyrum esculentum* (buckwheat).

Secondary photosensitization is caused by plant-related hepatic damage, which releases photodynamic substances like phylloerythrin, a breakdown of product chlorophyll. **Secondary photosensitization is much more common than primary.**

Which to  
[Click here](#)  
**Canthar**  
 Moldy w  
 Pyrrolizi  
 Metalde

**Causes of secondary photosensitization** include **common bile duct occlusion**, **facial eczema** (pithomycotoxicosis) and **mycotoxic lupinosis**.

Refs: Pasquini's Guide to Eq Clin, 3<sup>rd</sup> ed. p. 323 and the Merck Veterinary Manual online edition.

Gossypol	HIDE
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BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

PREV NEXT

51 ✓	52 ✓	53 M ✓	54	55	56	57	58	59	60
------	------	--------	----	----	----	----	----	----	----

A 9-year-old neutered male Labrador retriever mix with a 2-day history of vomiting, salivation and acting drunk is presented.

The dog had several urinary accidents in the house yesterday and seemed to be drinking more, but hasn't urinated today, and is not eating and drinking today.

During the day, the dog is free to roam outside; he is up to date on vaccines.

The dog is lethargic and very depressed. Upon physical exam moderate to severe dehydration is noted.

A brief neurological exam reveals ataxia, knuckling, and a slight head tremor.

Which one of the following findings would you expect on testing if your top differential diagnosis is correct?

Value	Normal
T=99.5 F (37.5 C)	99.5-102.5 F, 37.2-39.2 C
HR=84 bpm	60-120
RR=48 brpm	15-34

The dog is lethargic and very depressed. Upon physical exam moderate to severe dehydration is noted.

A brief neurological exam reveals ataxia, knuckling, and a slight head tremor.

Which one of the following findings would you expect on testing if your top differential diagnosis is correct?

Value	Normal
T=99.5 F (37.5 C)	99.5-102.5 F, 37.2-39.2 C
HR=84 bpm	60-120
RR=48 brpm	15-34

Hypophosphatemia	HIDE
Osmole gap below 5 mOsm/kg	HIDE
Hyperglobulinemia	HIDE
Sodium urate crystalluria and isosthenuria	HIDE
Anion gap more than 25 mg/dl	HIDE

BACK NEXT LEAVE BLANK

The dog is lethargic and very depressed. Upon physical exam moderate to severe dehydration is noted.

A brief n

**Correct:** Anion gap more than 25 mg/dl

Which or diagnosis

Ethylene glycol intoxication causes severe **metabolic acidosis** - anion gap will be increased. Ethylene glycol toxicity should be at the top of the differential diagnosis list in a dog with these signs and findings.

**Value**

T=99.5

C)

HR=84 l

RR=48 l

If urine is obtained, one would expect to see **calcium oxalate crystalluria**.

The **osmole gap** = measured osmolality - calculated osmolality. Ethylene glycol **toxicity** is suggested by >20 mOsm/kg osmole gap.

**Dogs** with **ethylene glycol** toxicity would be more likely to have **hyperphosphatemia** than hypophosphatemia.

**Hypoph**

**Hyperglobulinemia** is not a feature of ethylene glycol toxicity.

**Osmole**

Hyperglobulinemia	HIDE
Sodium urate crystalluria and isosthenuria	HIDE
Anion gap more than 25 mg/dl	HIDE

BACK

NEXT



PREV

NEXT

51 ✓	52 ✓	53 M ✓	54 M ✗	55	56	57	58	59	60
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What is the treatment plan for a cow that is exhibiting poor weight gain, mild lameness, rough and light colored hair coat with depigmented hair around her eyes.

The owner also says that she has had dark diarrhea that appears to be full of froth or bubbles.

Copper/Molybdenum/Selenium dietary supplement	HIDE
IM injectable copper/iron dextran	HIDE
Thiamine injectable, Selenium/vitamin B complex	HIDE
Thiamine injectable, FeSO4 dietary supplement	HIDE
Injectable copper, CuSO4 dietary supplement	HIDE

BACK NEXT LEAVE BLANK



51 ✓	52 ✓	53 M ✓	54 M ✗	55 ✓	56	57	58	59	60
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What is t  
rough ar  
  
The own  
bubbles.  
  
Copper/  
IM injec  
Thiamin  
Thiamin  
Injectab

**Correct:**

**Injectable copper and CuSO4 dietary supplement.**

This is copper deficiency, which presents with ADR ("Ain't Doin' Right") signs :  
ACHROMOTRICHIA (depigmented hair, especially around eyes= "SPECTACLES"),  
rough coat, decreased milk yield, lameness and decreased fertility, libido and "Peat  
Scours" also called "Teart" (severe scours with gas bubbles).

Molybdenum toxicosis causes a secondary DEFICIENCY in Copper.

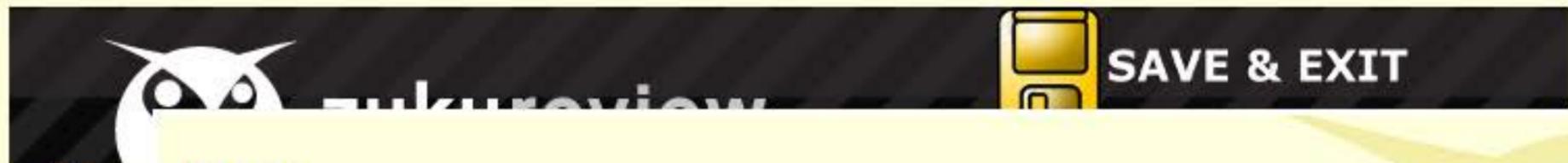
Rx both with Cu injections and supplement diet. If molybdenum content of feed is  
more than 5 mg/kg, you can supplement with 1% copper sulfate (CuSO4-5H2O) in  
salt to control development of secondary copper deficiency.

Follow this link to the [Zuku Review Top 20 Tox](#) notes.

BACK NEXT







Correct: **Heart**

51 ✓

Heart. [Ionophores](#) are used as feed additives to increase feed efficiency and as coccidiostats.

Which or

Overdosages lead to abnormal transport of specific ions across cell membranes leading to **damage to the myocardium and fibrosis**. These changes in turn cause decreased performance or **congestive heart failure**.

- Skeletal
- Liver
- Kidneys
- Lungs
- Heart**

Other acute clinical signs include colic and myoglobinuria.

Refs: Pugh, Sheep and Goat Medicine 2<sup>nd</sup> ed. pp. 511-2 and Merck Veterinary Manual [Toxic myopathies in horses](#).

BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem

 **zukureview**  **SAVE & EXIT**

[< PREV](#) [NEXT >](#)

51 ✓	52 ✓	53 M ✓	54 M ✗	55 ✓	56 ✓	57	58	59	60
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Which one of the following items may **cause zinc toxicity**?

Excess dietary selenium	HIDE
Crude oil or gasoline	HIDE
Anthelmintic drench	HIDE
Fertilizer-contaminated water	HIDE
U.S. Lincoln penny	HIDE

[BACK](#) [NEXT](#) [LEAVE BLANK](#)

 Overview  Mark this Question  Lab Values  Definitions  Report a Problem



- 51 ✓
- Which or
- Excess c
- Crude o
- Anthelm
- Fertilize

Correct:

Think of zinc toxicosis associated with ingestion of U.S. Lincoln pennies. All pennies minted since 1984 (and a few in 1983) are **97.5% zinc by weight**.

Other sources of zinc include batteries, car parts, paint, zinc-oxide sunscreen creams, zippers, board-game pieces, screws and nuts on pet carriers, and the coating on galvanized metals like plumbing pipes and some cookware.

Click here to see a radiograph of a dog who ate a penny.

Iron poisoning is a sporadic problem of newborn piglets overdosed by iron injection.

Refs: Osweiler's Toxicology, NVMS, pp. 204-5 (Zn) and the Merck Veterinary Manual online edition.

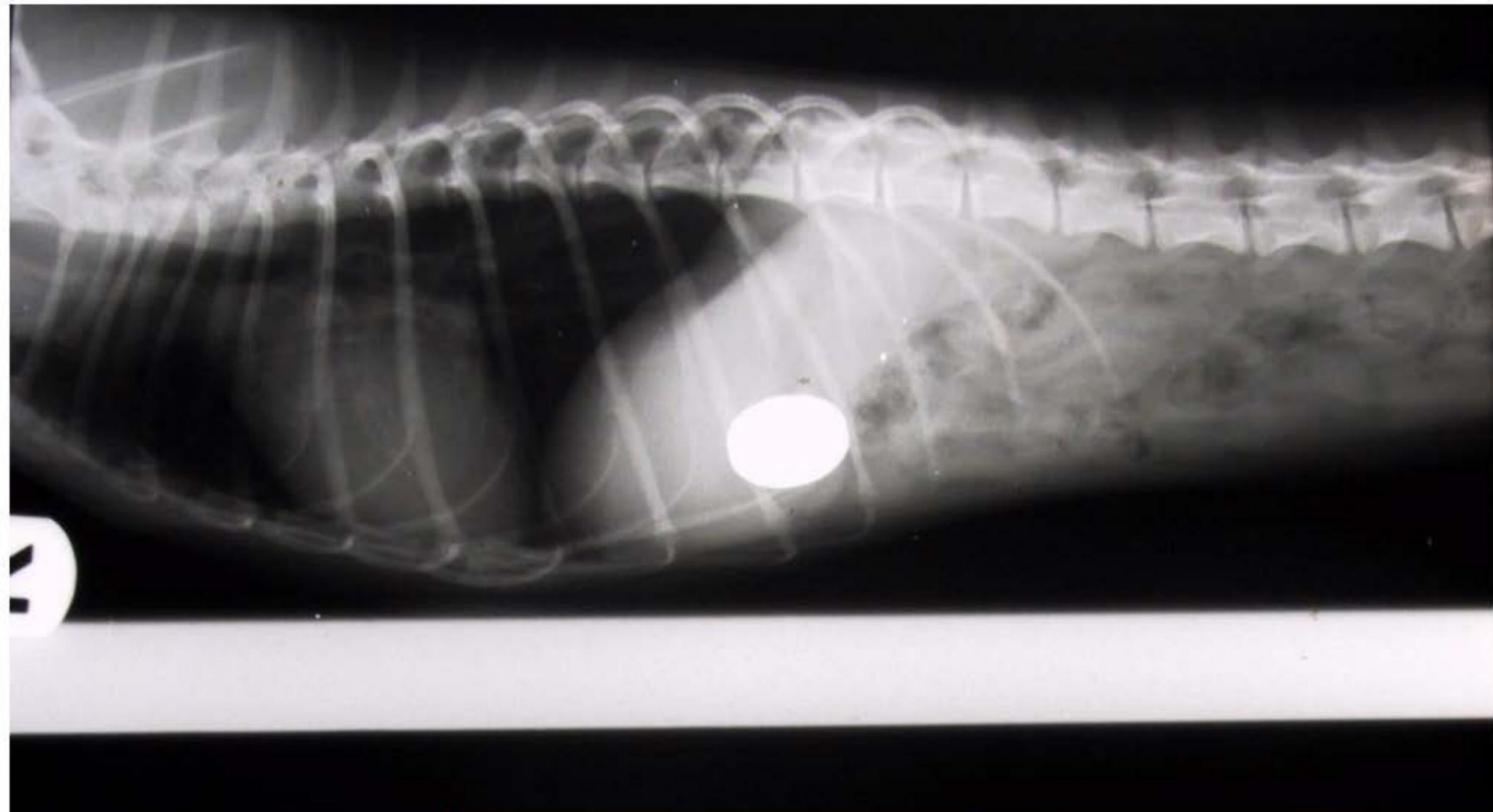
U.S. Lincoln penny

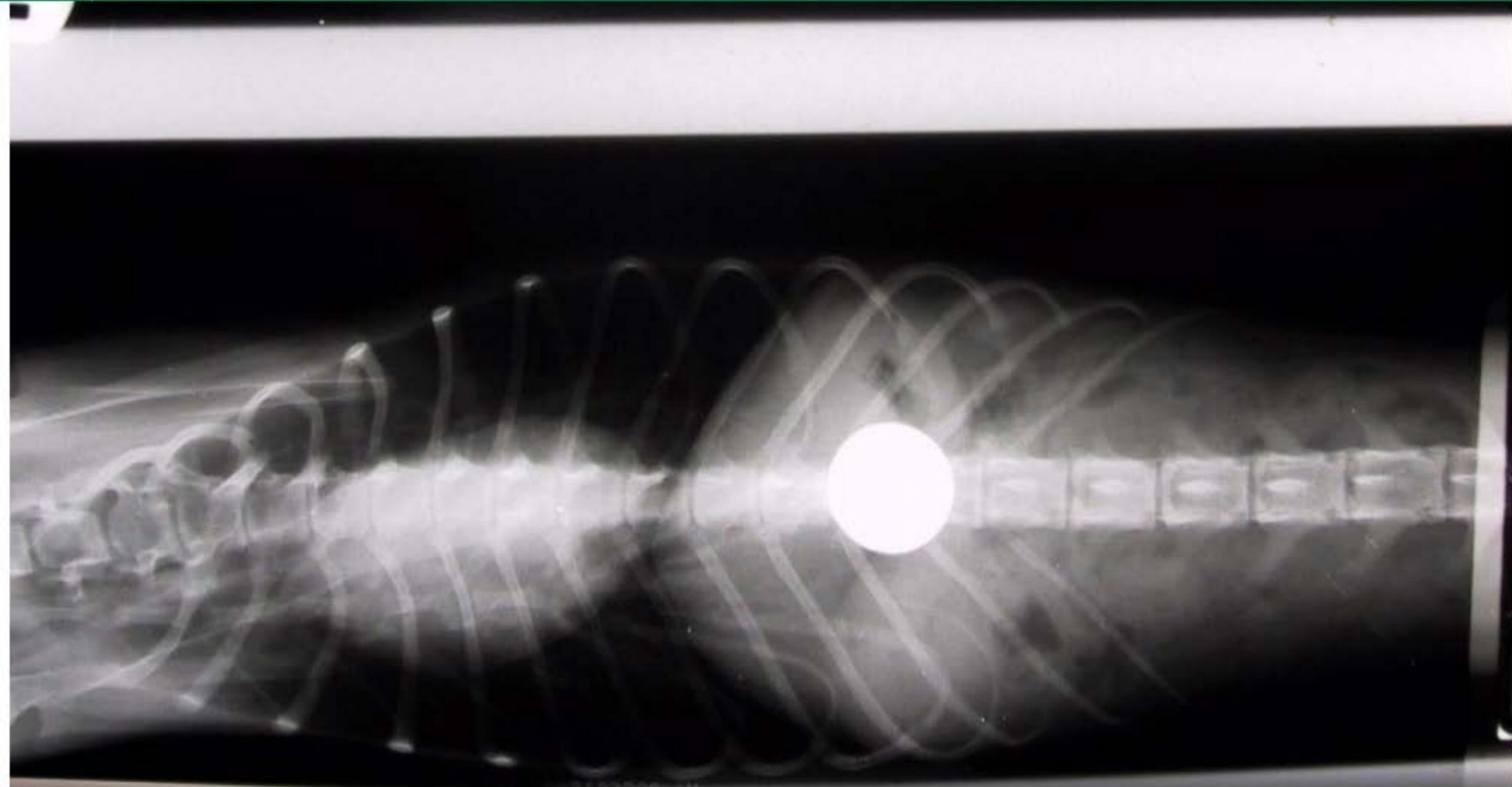
BACK NEXT

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



Gastric foreign body, USA penny



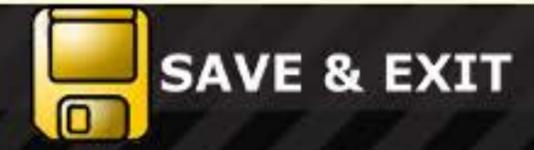


Courtesy of Dr. Raymond Cahill-Morasco.

Lateral and ventral-dorsal radiographs of a young, small breed dog with a USA penny foreign body in the stomach.



**zukureview**



PREV

NEXT

51 ✓	52 ✓	53 M ✓	54 M ✗	55 ✓	56 ✓	57 ✓	58	59	60
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Vasoconstriction, necrosis of extremities, gangrene, and pituitary effects are primarily associated with which toxic agent?

Slaframine	HIDE
Endophyte-infected ryegrass	HIDE
Macrocyclic trichothecenes	HIDE
Fumonisin	HIDE
Ergot alkaloids	HIDE

BACK    NEXT    LEAVE BLANK

- Overview
- Mark this Question
- Lab Values
- Definitions
- Report a Problem



PREV

51

### Correct: Ergot alkaloids

Ergotism is caused by ingestion of alkaloids in a parasitic fungus, *Claviceps purpurea*, that infects small grains (rye, wheat) and forage plants like bromes, bluegrass, and ryegrass.

Vasoconstriction associated

Look for vasoconstriction with terminal necrosis of the extremities due to thrombosis - affected animals are predisposed to frostbite and gangrene.

Slaframine

May have CNS effects, potent oxytocic action, or pituitary effects (decreased prolactin leading to agalactia).

Endophthalmitis

Click here to see a table of [Mycotoxicoeses in Domestic Animals](#).

Macrocytosis

Refs: The Merck Veterinary Manual online edition.

Fumonisin

Ergot alkaloids HIDE

BACK

NEXT





**zukureview**



**SAVE & EXIT**

PREV

NEXT

51 ✓	52 ✓	53 M ✓	54 M ✗	55 ✓	56 ✓	57 ✓	58 ✓	59	60
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Which one of the following choices is the **best treatment for acetaminophen** toxicosis in a **cat**?

Phytonadione	HIDE
Atropine	HIDE
Ethanol	HIDE
N-acetylcysteine	HIDE
Hypertonic saline	HIDE

BACK    NEXT    LEAVE BLANK

-  Overview
-  Mark this Question
-  Lab Values
-  Definitions
-  Report a Problem



PREV

51

Correct:

Acetaminophen toxicosis is treated with N-acetylcysteine, which provides a sulfhydryl source to hepatocytes and erythrocytes, thus decreasing oxidative damage from the acetaminophen.

Refs: Cote, Clinical Veterinary Advisor-Dogs and Cats, 3rd ed. pp. 12-3 and the Merck Veterinary Manual online edition.

Which or cat?

- Hyperto
- N-acety
- Phytona
- Atropine
- Ethanol

HIDE

BACK NEXT

- Overview
- Lab Values
- Definitions
- Report a Problem



**zukureview**



**SAVE & EXIT**

PREV

NEXT

51 ✓	52 ✓	53 M ✓	54 M ✗	55 ✓	56 ✓	57 ✓	58 ✓	59 M ✓	60
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Which **mycotoxin** is associated with **moldy red clover** due to the fungus **Rhizoctonia leguminicola** (black patch disease)?

Macrocyclic trichothecenes	HIDE
Fumonisin	HIDE
Slaframine	HIDE
Ergot alkaloids	HIDE
Aflatoxins	HIDE

BACK

*This is the last question. Click Save and Exit after you finish it.*

FINISH

LEAVE BLANK AND FINISH



51 ✓

Which m  
leguminc

Macrocy

Fumonis

Slafram

Ergot al

Aflatoxins

HIDE

BACK

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FINISH

**Correct:**

**Slaframine toxicosis** is due to the fungus *Rhizoctonia leguminicola* (black patch disease) on red clover (*Trifolium pratense*) especially in wet, cool years. See profuse salivation, oral irritation, retching and sometimes vomiting, primarily in horses and occasionally in cattle.

**Aflatoxicosis** is caused by toxigenic strains of *Aspergillus* (*A. flavus*, *A. parasiticus*) on peanuts, soybeans, corn (maize) and other cereal grains. The liver is the major target organ, with widespread hemorrhages, icterus and death in acute cases. Subacute outbreaks are more common, with nonspecific signs of anorexia, weakness, unthriftiness and sudden death.

Click here to see a table of [Mycotoxicoeses in Domestic Animals](#).