VIGORTONE® AG PRODUCTS

Animal Nutrition *At Its Best*™

NITRATE

Nitrate poisoning occurs in ruminants grazing on pasture or ingesting hay, haylage, corn silage or other roughages that have accumulated elevated nitrate or nitrite levels.

Many factors have been associated with nitrate accumulation. Those important to livestock management are included here. Nitrate accumulates in plants during a period of rapid growth that follows a period of interrupted plant growth. Growth interruption may be the result of drought, hail damage or light frost. Nitrate accumulation will be greatest in the first 5 to 7 days following the resumption of growth. Nitrates will also be elevated as a result of excessive nitrogen fertilization of certain accumulator plants. Herbicides have been reported to modify the plant's metabolism resulting in nitrate accumulation three to five days after application of the herbicide.

An enzyme in the plant, nitrate reductase, is necessary to prevent the accumulation of nitrate. This enzyme is light and temperature dependent. Nitrate tends to accumulate in plant tissues at night, on cloudy days and when environmental temperatures are cool. Nitrate levels are highest in the roots and stems, lower in leaves, and almost no nitrate accumulates in the flower and seed.

Sources Of Nitrates

1. Accumulator plants: (Fresh Plant-Hay-Silage)

WEEDS:

Johnson Grass	Fireweed
Pig Weed	Cheeseweed
Lambs Quarter	Sweet Clover
Canada Thistle	Smartweed
Jimson Weed	Dock
Wild Sunflower	Russian Thistle
Nightshade	

CROP PLANTS:

Oats	Alfalfa
Beet	Rye
Rape	Sudangrass
Soybean	Wheat
Flax	Corn

2. Water Supply — Nitrate levels are additive with feed sources. Nitrate levels in water are increased by fertilizer runoff or manure contamination. Nitrates in water are more rapidly metabolized to nitrites and are more rapidly absorbed in cattle than feed sources.
3. Hay (cured) — Nitrate level remains constant during storage.
4. Silages — Nitrate level decreases by as much as 50% after ensiling.

Nitrate, when ingested by ruminants, is reduced by microorganisms in the rumen to nitrite which is absorbed. The nitrite interacts with the ferrous iron in the hemoglobin, oxidizing it to ferric iron. The resultant methemoglobin is unable to carry oxygen. Should nitrite be ingested the effect is the same, except microbial reduction is not required. As methemoglobin levels reach 30 to 40 percent of total hemoglobin, oxygen carrying capacity is reduced sufficiently for clinical signs to be seen. As the percentage of methemoglobin increases, the condition progresses from distress, to prostration and finally to coma. Death usually occurs when methemoglobin levels reach 80 to 90 percent.

Mechanism Of Nitrate Intoxication

1. Nitrate source is ingested.
2. Nitrate reduced to Nitrite by rumen microorganisms.
3. Nitrite is absorbed into the bloodstream.
4. Nitrite reacts with hemoglobin in red blood cells to produce Methemoglobin.
5. Methemoglobin is unable to carry oxygen to the tissues.
6. Anoxia (lack of oxygen) produces clinical signs.

Signs And Symptoms

Nitrate poisoning in ruminants is an acute or subacute condition. Clinical signs of acute toxicity generally are seen within six hours

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following ingestion of high nitrate forage, although as much as a week may pass before clinical signs are observed. Signs are usually related to lack of oxygen in the blood resulting from methemoglobinemia. Depression and a cyanotic or brown cast to mucous membranes along with a rapid, weak pulse are often seen. Animals occasionally show behavioral changes, muscular tremors, incoordination and weakness. Exercise may accentuate the clinical signs and often result in marked difficult breathing and/or collapse. If not treated, animals may die within several hours to a day after onset of clinical signs. Abortions can result within a few days after an episode of acute nitrate intoxication. Even animals that are not obviously affected may abort.

Chronic nitrate intoxication has been reported. Most often this is associated with decreased weight gains and milk production, poor reproductive performance and abnormal vitamin A and thyroid metabolism.

The following outlines the symptoms associated with acute and chronic nitrate toxicities. The levels of nitrates, expressed on a dry matter basis and associated with either acute or chronic toxicity, are guidelines only and include nitrates from both feeds and water.

Acute Clinical Signs
(Over 1.5% Nitrate-Dry Matter Basis)

1. Labored breathing.
2. Frothing at the mouth.
3. Rapid pulse.
4. Weakness.
5. Diarrhea.
6. Incoordination and convulsions.
7. Death.
8. Brown colored blood.

Marginal Clinical Signs
(.44% to 1.5% Nitrate-Dry Matter Basis)

1. Poor growth.
2. Abortion.
3. Infertility.
4. Vitamin A deficiency.
5. Interference with iodine metabolism (Hypothyroidism).
6. Decreased immune response.

The specific level of nitrate required to create a toxicity situation varies by individual animal but will be influenced by several factors. First, if a large amount of nitrate containing feed is ingested and absorbed in a short time, the effect is greater than if taken over a longer period. Second, feeding a grain supplement with high nitrate diets provides some protection from nitrate intoxication. Providing added energy increases the amount of nitrate that is converted to bacterial protein over a given time.

Finally, acclimation to progressively higher nitrate levels in feed and water is possible as the animals make physiological adjustments in red blood cell numbers and metabolic processes.

A safe level of nitrate/nitrite is virtually impossible to set because of all the variables, i.e. extremely wide ranges of individual animal tolerance, variability in conversion of nitrate to nitrite, dietary history, disease level and environmental conditions. When possible, nitrate in drinking water should be below 45 parts per million (ppm) and be free of nitrites. Total rations should contain less than 4400 PPM nitrate (DM basis) and be free of nitrites.

Nitrate Problem Prevention Tips

1. Have feed ingredients and water supply tested for nitrates.
2. Don't feed drought stricken fresh forages for three to five days after a recovery rain.
3. Cut suspected forages at higher than usual heights to avoid possible higher nitrate-containing portions of the stalks.
4. Ensiling removes about one-half of nitrate content.
5. Make feeding changes on a gradual basis.
6. Don't allow hungry animals free access to suspected forages.
7. Dilute high nitrate feed with low nitrate feeds.
8. Feed balanced rations.
9. Supply adequate vitamins, minerals and trace elements.

Vigortone Recommendations On Handling Nitrate Containing Feedstuffs

1. Whenever total dry matter intake of nitrates is 4400 PPM or above, inject vitamin A in each animal every 70 days or provide the suggested amount of Vigortone Dri-Ade supplementation daily in the diet.
2. Always attempt to blend down the level of nitrates being fed so that the maximum intake is less than 4400 PPM (DM).
3. Be sure animals forced to ingest nitrate contaminated feed are provided with an adequate amount of a Vigortone vitamin-mineral supplement.
4. If nitrate containing feedstuffs are fed, include two to four pounds of grain in the ration as carbohydrate supplementation decreases nitrate toxicity.

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GUIDELINES FOR FEEDS CONTAINING NITRATES:

Nitrate % (NO_3)	Nitrate-Nitrogen % (NO_3-N%)	Comments
Below .44% (4,400 PPM)	Below .1% (1,000 PPM)	Generally safe
.44 to .88% (4,400-8,800 PPM)	.1-.2% (1,000-2,000 PPM)	Usually safe when fed with balanced ration. For pregnant cows limit to 50% of total ration dry matter. Watch for Vitamin A deficiency.
.88 to 1.5% (8,800-15,000 PPM)	.2-.4% (2,000-4,000 PPM)	Limit to 25% of total dry matter intake. Lowered milk production and reproduction problems may occur. Balance ration for vitamins and minerals.
Over 1.5% (Over 15,000 PPM)	Over .4% (Over 4,000 PPM)	Do Not Feed. (May produce acute nitrate intoxication.)

CONVERSION FORMULAS:

$(NO_3) = \frac{(NO_3 - N\%)}{.23}$ OR $(NO_3 - N\%) = (NO_3\%) \times .23$

To change PPM to % — move decimal place four places to the left (divide by 10,000)
To change % to PPM — move decimal place four places to the right (multiply by 10,000) [3]