

# FACT SHEET

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## NITRATE POISONING

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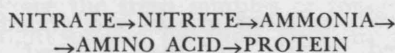
Nitrate poisoning is a noninfectious-disease condition which may affect cattle consuming certain forages either in the fresh or dry state. Nitrate poisoning is often confused with wheat pasture poisoning (grass tetany) and acute bloat. The

symptoms for the three conditions are similar, and each can result in sudden death. Differentiation between or among them is most important since cause and prevention is different for each condition.

### CAUSES OF NITRATE POISONING

Nitrate poisoning is caused by ingesting an excessive amount of nitrate; wheat pasture poisoning is caused by a low magnesium level in the blood; and bloat is due to distention of the rumen by gas.

Under normal conditions, nitrate ingested by cattle is converted to ammonia in the rumen by bacteria. The steps of conversion of this process may be depicted as follows:



The rate at which nitrate is converted to nitrite exceeds the rate of conversion of nitrite to ammonia. Consequently, when higher than normal

amounts of nitrate are consumed, an accumulation of nitrite may occur in the rumen. Nitrite will then be absorbed into the bloodstream and will cause hemoglobin to be converted to methemoglobin, which is unable to transport oxygen. Thus, when an animal dies from nitrate poisoning, it is due to asphyxiation.

The occurrence of nitrate poisoning is difficult to predict because the development of this is influenced by various circumstances. These include the rapid change of nitrate levels in plants and the wide range in the quantity of nitrate which cattle can tolerate under various conditions.

### NITRATE LEVELS IN PLANTS

The growth of a plant is dependent upon several factors. These include available nitrate in the soil and the plant's genetic ability to grow. The faster a particular type of plant can absorb nitrate, the greater is its potential for growth. In the process of breeding and selecting plants for increased production, an automatic selection occurs toward the ability to accumulate large amounts of nitrate.

#### Plants Most Often Involved

A wide variety of plants can be affected by nitrate accumulation. These plants may be cate-

gorized as field crops, weeds and vegetables. Texas field crops capable of high levels of nitrate accumulation under adverse conditions include corn, small grains, sudan and fescue.

Weeds and some wild grasses that are capable of nitrate accumulation include carelessnessweed, lambsquarter, sunflower, bindweed and many others.

Often the most advantageous method of harvesting vegetables grown in some areas of Texas is by grazing. Vegetables most frequently grazed that are capable of accumulating large amounts of nitrate include sugar beets, lettuce, cabbage, potatoes and carrots.

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## Nitrate Accumulation

Under normal growth conditions there is little nitrate buildup in the plant even though the plant's roots are absorbing large amounts of nitrate. This occurs because the stem and leaves normally convert nitrate to protein about as fast as it is absorbed by the roots. Tests have shown, however, that this process fluctuates continuously. Plants tested at 3-hour intervals have shown a variation in nitrate levels of as much as 0.6% in a 24-hour period. Under normal conditions, even with these variations, the nitrate levels will remain below the toxic level. However, under certain conditions this balance can be disrupted so that the roots will

accumulate nitrate faster than the plant can convert the nitrate to protein.

The nitrate-to-protein cycle in a plant is dependent on three factors:

- Adequate water
- Energy from sunlight
- A temperature conducive to rapid chemical reactions

If any one of these factors is inadequate, the root continues to absorb nitrate at the same rate while storing it unchanged in the stalk and lower parts of the leaves. When this situation develops, the trouble starts.

## TOXICITY VARIATION

Cattle can tolerate a wide range of nitrate, depending on several factors. Factors making nitrate less toxic include:

- The animal can become conditioned to eat larger amounts of feed with a high nitrate content if the increase is gradual.
- Healthy animals are less likely to be adversely affected than animals in poor health.
- Adequate amounts of available carbohydrates are present. (This allows the animal to consume more nitrate because it speeds up the conversion process from nitrate to protein.)

Factors making nitrate more toxic:

- Rapid change in the diet can trigger nitrate poisoning.
- Parasitism or other conditions causing anemia will increase susceptibility.
- Supplemental feeding of urea or natural protein may increase toxicity under certain conditions.
- Nitrogen may be consumed as nitrite instead of nitrate.

## CASE HISTORY

The usual story behind cases of nitrate poisoning fits into one of the following categories:

1. Cattle in some way were able to get access to sacks of fertilizer. They chewed the sack and ate concentrated fertilizer in the process.
2. Plants growing rapidly on rich land ceased growing during a period of cloudy, cold weather. The soil temperature remained relatively warm, and the roots of the plants continued to absorb nitrates from the soil which then accumulated in the plants.
3. Improved irrigated grasses are grazed down, fertilized heavily and then watered. If the animals are not removed from the pasture during this time, or are turned back on the pasture before the grass can regain a rapid growth (indicated by regaining a dark green color), grazing cattle may pick up a dangerous level of nitrate from the plants.
4. Hybrid sudan pasture has ceased rapid growth because of hot, dry summer weather. This condition could also cause prussic acid poisoning.

## SYMPTOMS AND TREATMENT

### Symptoms of Chronic Nitrate Poisoning

The following symptoms of chronic nitrate poisoning are listed in many publications. The importance of chronic nitrate poisoning is doubtful. In fact, many authorities contend that it does not occur.

- Lower milk production
- Lower weight gains
- Vitamin A deficiency (this could occur if the only source of Vitamin A was from the conversion of carotene to Vitamin A. Vitamin A injected or fed as Vitamin A will not be affected.)

### Symptoms of Acute Nitrate Poisoning

- Staggering gait
- Muscular tremors
- Rapid pulse
- Cyanosis
- Abortion (This may occur when acute nitrate poisoning does not kill the cow but asphyxiates the fetus.)
- The most noticeable symptom of acute nitrate poisoning will be associated with lack of oxygen. The animal actually smothers to death.

### Postmortem Lesions

- Blood is chocolate brown in color if a blood sample is obtained from the animal within

a couple of hours after death. (This blood changes back to a dark red within a few hours after death.)

- Hemorrhages in the lungs and on the heart
- Irritation of the stomach and intestines (if the source of nitrate is from eating fertilizer)

### Treatment

It is most advisable to call your local veterinarian immediately. If he is not available, the following steps should be taken:

- Handle animal very carefully.
- Inject methylene blue intravenously—1 gram per 250 lb. body weight.
- Administer also vasoconstrictor drugs such as epinephrine.

### METHOD OF PREPARING LABORATORY SAMPLES

If a nitrate buildup is suspected, the plant material should be sent to a laboratory equipped to do quantitative nitrate analysis.

#### Preparation of Forage Samples

- Clip grass down to about the same level it would ordinarily be grazed. Do not pull it up by the roots.
- Take four to five samples from different areas of the field.
- Place the fresh samples of forage in an airtight plastic bag and pack in a container with a bag of ice. (An alternative method is to air dry the samples in the shade for three to four days and then ship without refrigeration.)

#### Preparation of Animal Samples

- The most useful animal sample which may be sent to confirm suspected nitrate poison-

ing is blood from a live animal (and urine if it can be collected).

- Samples from a dead animal would be any clear body fluid. The last body fluid to discolor after death is the fluid in the eye. Remove the entire eyeball and send it refrigerated intact.
- DO NOT SEND STOMACH CONTENTS. The bacteria in the stomach contents will break the nitrate down to ammonia long before the sample is received by the laboratory. Also, if the contents are mixed with another tissue sample the nitrate in this sample will be destroyed.

It is best to package each sample separately, refrigerate with wet ice and send by the quickest carrier to the laboratory (this is generally by bus).

### TOXIC LEVELS

Toxic levels of nitrate may be found in fresh forage, dry forage or contaminated water. Most laboratories in Texas report the forage samples in percent of dried weight of samples and the water samples in parts per million (PPM).

While most laboratories report the findings as nitrate ( $\text{NO}_3$ ), some report findings as potassium nitrate ( $\text{KNO}_3$ ). The following formulas will enable an individual to convert laboratory findings

to the standard measure with which he is most familiar.

- Potassium Nitrate ( $\text{KNO}_3$ ) = Nitrate  $\times$  1.6
- Potassium Nitrate = Nitrate Nitrogen  $\times$  7.0
- Nitrate ( $\text{NO}_3$ ) = Potassium Nitrate  $\times$  0.6
- Nitrate = Nitrate Nitrogen  $\times$  4.4
- Nitrate Nitrogen ( $\text{NO}_3\text{N}$ ) = Potassium Nitrate  $\times$  0.14
- Nitrate Nitrogen = Nitrate  $\times$  0.23

- Parts Per Million (PPM) = Percent (%)  
× 10,000
- Percent (%) = PPM ÷ 10,000

In water, nitrate in a concentration of 500 parts per million (NO<sub>3</sub>) is reaching toxic levels.

Toxic levels of nitrate in forage may occur when the amount of nitrate reaches 1 percent (NO<sub>3</sub>) of the total ration. There are reports of chronic nitrate poisoning being caused by 0.3 percent (NO<sub>3</sub>) of the ration over an extended period of time. (As mentioned previously, there is some doubt that chronic nitrate poisoning occurs.)

### PREVENTATIVE MANAGEMENT

Understanding the essential elements necessary to produce a potentially dangerous situation is the first step in preventing a problem. Remember, conditions capable of nitrate buildup are:

- Long period of cloudy weather
- Cold temperatures
- Plants growing in shade
- Restricted water
- Damage to plants (e.g. trampled, blown down in storm, hail)

Nitrate is broken down from nitrate to nitrite and ammonia. Nitrite is the form which is most readily absorbed into the circulatory system. The quicker the breakdown to ammonia, the smaller the amount of nitrite absorbed. Energy is neces-

sary for this process. Feeding a grain supplement is a good way to supply the energy necessary for a more rapid breakdown and conversion to protein. The grain would also dilute the amount of nitrate in the total ration.

If there is a problem or the potential of a problem:

- Check feed, hay and water for nitrate concentration.
- Feed a ration high in carbohydrate.
- Remember that urea and natural protein have the potential of aggravating the condition.
- Remember that high-nitrate feeds can be diluted with low-nitrate feeds.

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