



Guidelines for Nitrates in Feed and Water

C. C. Stallings, Extension Dairy Scientist, Nutrition
G. M. Jones, Extension Dairy Scientist, Management
Virginia Tech

Summary

It is best to ensile a forage containing high levels of nitrates because reductions of over 50% are common during fermentation. If you suspect high nitrate levels due to stress conditions (drought), sample and have analyzed the ensiled forage before feeding. If appreciable levels are present, limit the forage in the ration by using other forages. Forages containing high nitrate levels should be introduced slowly to non-adapted animals. Rations should be balanced for all nutrients, especially vitamin A. Research indicates some vitamin A is destroyed when nitrates are present in the ration. Care should be exercised when feeding high nitrate feeds to growing animals and pregnant cows because they are most susceptible to nitrate toxicity.

Nitrates tend to accumulate in plants (especially the stem, but very little in the kernel) when growth is slowed. This can result from a lack of water or other stress conditions. Generally, nitrates from inorganic and organic fertilizers are taken up from the soil and converted to protein by the plant. If the plant is not growing, this transformation from nitrate to protein does not occur and nitrate accumulates. High fertilization rates tend to magnify this problem. Also certain species tend to accumulate nitrates. An example would be plants of the sorghum family.

Effect of Ensiling

Ensiling a forage will reduce the level of nitrates. Estimates are that over 50% of the nitrates will be lost during fermentation. As a result it is best to wait until after ensiling before sampling for nitrate analysis. If green-chopping, it might be advisable to check nitrate levels before feeding. If there is not adequate time to do this, feed the forage to a test animal such as your poorest heifer or steer. Introduce feed slowly over several days and observe for signs of labored breathing, staggering, or panting. If no problems develop, the feed should be safe for more mature animals.

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The Virginia Tech Forage Testing Lab will measure nitrates in forages. Results may be delayed if large numbers of samples are received. Request nitrates only on those forages critical to you. The regular forage analysis for dry matter, crude protein, acid detergent fiber, and energy will take priority and nitrate results may not be received until after the other results are received.

Levels in Feed and Water

Table 1 contains ranges in nitrate and nitrate-nitrogen concentrations for feeds. Results from the Virginia Tech Forage Testing Lab are expressed as percent nitrate on a dry basis. Some other labs will express results as nitrate-nitrogen. One percent nitrate-nitrogen is equal to 4.4% nitrate. Forages containing 0 to .44% nitrate on a dry basis or 0 to .1% nitrate-nitrogen are generally regarded as safe for feeding to all animals. Forages containing levels of .45 to .88% nitrate (.1 to .2% nitrate-nitrogen) are considered safe if fed in blended, balanced rations. If fed to pregnant cows the forage containing nitrates should be limited to one-half of the ration dry matter. Forages containing .89 to 1.5% nitrate (.2-.4% nitrate-nitrogen) should be limited to 25% of the ration dry matter and be fed with care. Forages containing greater than 1.5% nitrate (.4% nitrate-nitrogen) are considered toxic and should only be used with great care.

Table 1. Nitrate (NO₃) and nitrate-nitrogen (NO₃-N) levels in feedstuffs

| Nitrate -----% of dry matter----- | Nitrate-nitrogen ----- | Comments |
|--------------------------------------|---------------------------|---|
| 0 - .44 | 0 - .1 | Considered safe |
| .45- .88 | .1-.2 | Generally safe when fed in balanced rations. Limit to one-half of ration dry matter for pregnant animals. |
| .89-1.50 | .2-.4 | If used, should be limited to 25% of ration dry matter. Feed with care. |
| Greater than 1.5 | Greater than .4 | Potentially toxic, exercise caution. |

Another source of nitrates can be water. Ranges are in Table 2. Water containing 0 to 44 parts per million (ppm) nitrate or 0 to 10 ppm nitrate-nitrogen is considered safe and should cause no problems. From 45 to 132 ppm nitrate (10 to 30 ppm nitrate-nitrogen) water is safe if the ration is relatively low in nitrates and nutritionally balanced. Water containing 133 to 220 ppm nitrate (30 to 50 ppm nitrate-nitrogen) can be harmful if used over a long period of time, especially if feed is high in nitrate. Water containing greater than 220 ppm nitrate or 50 ppm nitrate-nitrogen is dangerous and should not be used. Chlorination will not remove nitrates.

Table 2. Nitrate (NO_3) and nitrate-nitrogen ($\text{NO}_3\text{-N}$) levels in water

| Nitrate -----parts per million----- | Nitrate-nitrogen -----parts per million----- | Comments |
|--|---|--|
| 0- 44 | 0-10 | Considered safe |
| 45-132 | 10-30 | Safe if ration is low in nitrates and nutritionally balanced. |
| 133-220 | 30-50 | Could be harmful over a period of time especially if feed is high in nitrates. |
| Greater than 220 | Greater than 50 | Dangerous |

Quick Test

There is a test that allows checking for nitrates on the farm. Test kits are available but the following method can also be used.

1. Put 62.5 milligrams diphenylamine in a container
2. Add enough 80% sulfuric acid to bring solution up to a total of 100 milliliters
3. Add solution directly to chopped plant material. A dark blue color will develop within seconds if nitrates are present.

Considerations When Using Feeds Containing Nitrates

1. Ensilage forage if possible to reduce the nitrate level. It is best to ensilage for at least 3 weeks before feeding, but any amount of fermentation will reduce the nitrate level some.
2. The majority of plant nitrates are in the stalk, especially the lower part. Raising the cutter bar during chopping will reduce silage nitrate levels.
3. Introduce feeds containing nitrates into rations slowly over a period of several weeks. Feeding several times per day will tend to prevent overconsumption at any one time.
4. Dilute forages containing high nitrates with "clean" feeds. Use another forage and/or high fiber by-product feeds.
5. Feed a balanced ration containing adequate levels of protein, fiber, energy, minerals, and vitamins, especially vitamin A (supplement with 64,000 I.U. per cow per day).
6. Young, growing, and pregnant animals are the most susceptible to nitrate poisoning. Look for signs of labored breathing, staggering, and panting. An animal in this category can be used as a test animal to check for detrimental effects of a forage.

7. If feeds are high in nitrates, avoid other potential sources such as runoff from cattle lots and fertilized fields.
8. There are no magic feed additives to counteract the influence of nitrates. Properly balanced rations with limited nitrate containing forage is the best way to prevent problems from developing.