



## Incorporating High Nitrate Feeds Into Feeding Programs

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When drought hits and feed is short, producers wonder if they can provide high nitrate feeds to their cattle. The answer is “Yes, if you know what you’re doing.”

Nitrates can be very dangerous to cattle, causing reduced performance, abortions, and death. Know the toxicity symptoms and toxic levels of nitrates before using high nitrate feedstuffs in your feeding program. Refer to SDSU Extension Extra 4015 (Nitrate Poisoning of Livestock) for specifics regarding nitrate poisoning and guidelines for safe nitrate levels in animal diets.

While nitrates feeds are dangerous to cattle, they can be fed if properly managed. Toxic effects of nitrates are related to amount and rate of ingestion of the nitrate ion.

Rumen microorganisms can incorporate nitrates into microbial protein by converting the nitrates to ammonia, but only so much can be converted in short periods of time. If large amount of nitrates are ingested in a feeding, complete conversion to ammonia does not occur and toxic levels of nitrite (an intermediate) are absorbed.

The key to using high nitrate feedstuffs is to dilute them so that the rate and amount of intake are slow enough that the conversion of nitrate to ammonia can take place. Providing readily fermentable energy in the diets, such as that contained in cereal grains, also speeds the conversion of nitrates to ammonia.

The first step in dealing with high nitrate feeds is to get a representative sample of the **baled** forage. Samples of standing forage are not adequate. Second, make sure the

units from the feed analysis are on the same scale as the nitrate guidelines. Nitrates are 22.6% nitrogen, and nitrate levels are often reported as nitrates (ion), nitrate nitrogen (nitrate-N), or potassium nitrate. Multiply nitrate-N by 4.4 and potassium nitrate by .61 to convert each to nitrates (ion).

Nitrates are usually reported as a percentage of diet dry matter, whereas nitrate-N is reported as a percentage or in parts per million (ppm). Divide a number expressed as ppm by 10,000 to convert to percentage (1000 ppm is 0.10%).

Finally, nitrate guidelines are usually given on a dry matter basis, so it is important to make sure feedstuff concentrations are on a dry basis as well. Following are five guidelines to use when feeding high nitrate feeds.

### 1. When formulating diets with high nitrate feeds, pay attention to total dietary nitrate concentration.

Nitrate content of all feedstuffs and water should be taken into consideration when planning the nutrition program. Dietary nitrate-N should be below 0.1% for pregnant cows and 0.15% for non-pregnant cows. If feeds are available that contain higher nitrate-N levels than this, they must be diluted with feedstuffs that are lower in nitrates.

The maximum amount of a high nitrate feedstuff can be determined algebraically. If pregnant cows were to consume a mixture of two hays, the calculations would be:

- 1) Hay 1: 0.20% nitrate-N
- Hay 2: 0.05% nitrate-N
- 2) Maximum safe level for pregnant cows: 0.10%

3)  $0.10 = .002(x) + .0005(100-x)$

where  $x$  = the maximum amount of high nitrate in Hay 1;  
 $100 - x$  = minimum amount of Hay 2,  
 0.10 is the maximum safe level of nitrate-N in the diet,  
 .002 is percentage of nitrate-N in Hay 1 divided by 100,  
 and .05 is the % of nitrate-N in Hay 2 divided by 100.

4)  $0.10 = .002x + .05 - .0005x$

5)  $0.05 = (.002 - .0005)x$

6)  $0.05 = .0015x$

7)  $33.3 = x$  (Hay 1);  $66.6 = 100 - x$  (Hay 2)

8) With only these two hays in the diet, a maximum of 33.3% of Hay 1 could be included in the ration. If more than two ingredients were in the ration, the same approach could be used using the high nitrate feed and the nitrate content of the rest of the diet.

9) Balance the ration for protein, energy, vitamins, and minerals. If animal requirements cannot be met without feeding more than 33.3% of Hay 1, additional ingredients (to substitute for Hay 1) or supplements will be necessary.

**2. Rations are not balanced for nitrates, as this is simply a way to determine maximum safe levels of high nitrate feedstuffs that can be included.**

Make sure animal requirements are met and that annual feed allocation is taken into consideration. Assume a ration was formulated for pregnant cows that contained two hays such as the those given in the above example: 15% corn, 7% supplement, 39% high nitrate hay, and 39% low nitrate hay. If calculations revealed that a maximum of 30% of the high nitrate feed could be included in the ration, the formulated ration would be unsafe for the cattle. Therefore the level of the high nitrate feed would need to be locked in at a maximum of 30% of the diet.

If the high nitrate hay were considerably higher in protein and energy than the low nitrate hay, reducing the high nitrate hay to 30% of the ration would result in nutrient deficiencies. The ration would need to be reformulated to contain more corn and supplement.

Following is an example of how to calculate the proportion of high nitrate hay in a mixture of hay. Assume you have two hays with similar energy and protein values, corn, and supplement:

Hay A: 0.38% nitrate-N

Hay B: No nitrates

Assume the ration needed is 35% corn, 5% supplement, and 60% hay to growing heifers. **What proportion of the hay mixture can hay A be used?**

1) The maximum tolerable nitrate-N level for this class of cattle is 0.15%. Since the hay is the only feedstuff with

nitrate, the hay mixture can contain .25% nitrates (0.15/0.60; safe level of nitrate in ration/(percentage of mixture in diet/100).

2)  $0.25 = .0038(x) + 0(100-x)$ .

3)  $65.7 = x$

4) The mixture can contain as much as 65% of Hay A and 35% Hay B. The total ration could contain as much as 39% Hay A (65% of mixture \* 60% of diet).

5) The actual decision of how much of each hay to use depends on a diet that meets animal requirements and the amount of each ingredient available.

**3. When diluting high nitrate feeds, make sure the cattle consume a combination of the low and high nitrate feeds.**

The ideal way to feed high nitrate forages is to grind the hay and mix it in a total mixed ration.

Hays can be fed with bale processors or rolled on the ground. This can be a problem if the hays differ in palatability. For example, if low nitrate straw is rolled out at the same time as high nitrate oat or sorghum hay, boss cows will likely consume the majority of the high nitrate hay and leave the straw for more timid animals. Animals need equal access to both the low and high nitrate feeds.

If the hay is fed through a bale process, two hays can be fed on top of each other, which forces some mixing. If bales are rolled on the ground or if inadequate mixing is noticed from hay fed from the processor, it is best to feed the low nitrate hay first. When cows have had a chance to consume this hay, follow by feeding the high nitrate hay.

It is important that cows are not hungry when fed the high nitrate hay. For example, do not feed low nitrate hay in the morning and high nitrate hay in the afternoon. Likewise, it is not advisable to feed low and high nitrate feeds on alternate days, especially to pregnant cattle. It is the amount of nitrate in the rumen at one time that causes nitrite accumulation, nitrite absorption, and thus the transformation of hemoglobin to methemoglobin.

Increasing the feeding frequency (such as feeding three times/daily) and including grain are both ways to reduce the toxic effects of nitrates. These might be viable tools with moderate nitrate levels (0.075-0.10% for pregnant cows) to make the ration safe without diluting.

Feeding high nitrate hay in bale feeders (free-choice) is dangerous.

When management issues do not allow you to accurately allocate the right amount of feed to each animal (such as

rolling bales on the ground, etc.), it is beneficial to formulate diets to have lower nitrates than the recommended maximum tolerable level.

**4. Gradually increase the amount of a high nitrate feed into the diet so that adaptation can take place.**

For example, if you are feeding a high nitrate feedstuff at 50% of the diet DM, work the cattle up to this level over a period of time:

- 1) 25% high nitrate hay; 0.05% nitrate-N : 5 days
- 2) 35%: 0.06% nitrate-N: 5 days
- 3) 45%: 0.07% nitrate-N: 5 days
- 4) 50%: 0.075% nitrate-N: Final ration

The number of steps and the increments depend on the level of nitrate in the feed and the ultimate level of the high nitrate feedstuff in the ration. Animals should be gradually adapted to dietary nitrate levels, not just to percentages of dietary ingredients.

**5. Pregnant cows can be very sensitive to nitrates. If possible, save low nitrate feeds for cows in late gestation, feeding the high nitrate feeds to nonpregnant cattle or during early pregnancy.**

Remember that there is always variation around a sample mean. This means that some of the hay will have more

nitrates than the number given in the analysis. In addition, some cattle consume more feed than others. For these reasons, it is advisable to build safety margins into dietary nitrate concentrations, especially for pregnant cattle. **An upper limit of .075% nitrate-N for cows in late pregnancy is reasonable.**

**In summary**

Feeds with high nitrates can be fed to cows if diluted and managed appropriately. Look at total dietary nitrate levels when formulating diets, and slowly adapt animal to nitrate feeds.

Use caution when feeding high nitrate feeds to pregnant cattle. **It is best to avoid feeds with over 0.20 nitrate-N for pregnant cattle.**

Remember to closely observe animals consuming high nitrate feeds and make sure hungry cattle never have access to feeds high in nitrates. Take the time to double check your calculations so that nitrates are not over-fed.

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