# Nitrate and Oxalate Poisoning

Plants absorb nitrates from the soil and metabolize them to form plant proteins. If plants absorb excess nitrates and are consumed by livestock before they are converted to proteins, nitrate poisoning can occur. Forage crops that are over fertilized before being harvested or grazed can be a common cause of nitrate poisoning. However, excess nitrate accumulation also occurs readily in some common pasture weeds. Nitrate concentration can vary widely among plants and growing conditions. Nitrates are highest in plants in mornings and evenings, and on cool, cloudy days (when plant metabolism is slower). Drought, fertilization and nutrient deficiency can result in nitrate accumulation in plant tissues. Highest concentrations occur generally in stems, rather than leaves, flowers or fruit/seed.

Animal metabolism converts nitrate ($NO_3$) to nitrite ($NO_2$), which is toxic. This occurs less frequently for horses which do not readily convert nitrate to nitrite. In small quantities, nitrates are reduced by beneficial bacteria in the rumen to microbial proteins. It is the rapid absorption of large quantities of nitrates that can lead to poisoning, overwhelming the rumen's ability to convert nitrates into proteins. Increasing the carbohydrates (energy content) in an animal's diet can prevent poisoning as it allows the conversion of nitrates to proteins to occur more quickly, thus reducing the likelihood of nitrate poisoning.

Symptoms of nitrate poisoning include drowsiness and weakness followed by muscular tremors, increased heart and respiratory rates, staggering gait and recumbency (inability to stand upright without support). Sub-lethal doses can cause abortion and reduced milk production. Animals suspected of having nitrate poisoning should be kept stress free and the suspect food source removed. Forages assumed of being high in nitrates, especially if they have been heavily fertilized with N-fertilizer or experienced drought, should be tested.

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Rather then absorbing excess nitrates, some plants store high quantities of potassium and sodium oxalates (salts). If large quantities of oxalate accumulating plants are eaten, the rumen is overwhelmed and unable to metabolize the salts and they are absorbed into the bloodstream. In the bloodstream they form insoluble salts that precipitate in the kidney, causing kidney failure.

Sheep are most susceptible, then cattle. Cattle are able to detoxify large quantities of oxalates in their rumen, reducing chances of poisoning. Animals can develop a tolerance for oxalate accumulating plants by building up the concentration of oxalate-degrading bacteria in the rumen. If eaten in small amounts over time, with other feed to dilute the concentrations in the rumen, oxalate accumulating plants cease to be a problem.

Within a few hours of poisoning, animals develop muscle tremors, tetany (calcium deficiency), weakness and recumbency (inability to stand upright without support). Coma and death can follow within 12 hours of consumption.

Livestock should be adapted to oxalate plants over four days, incrementally increasing the time allowed to graze the plants, before being left in pastures containing high concentrations of oxalate-accumulating plants.

| Common Pasture Plants Causing Nitrate and Oxalate Poisoning | |
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| *Amaranthus retroflexus* | Redroot pigweed |
| *Chenopodium album* | Lambsquarter |
| *Malva neglecta* | Common mallow |
| *Rumex* spp. | Dock |

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