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Urea toxicity in ruminants: from feed to fatality

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Introduction

Urea is a colourless, crystalline, and hygroscopic chemical compound that is commonly used as a source of non-protein nitrogen (NPN) in ruminants due to its low cost and availability. Urea itself is not a source of amino acids; however, urea is digested in the rumen through the action of urease-producing bacteria and converted to ammonia. Ammonia is then utilized by rumen microbes, which use energy from carbohydrate digestion to produce microbial protein, which becomes an important source of amino acids.

Urea can be a good and cheap ingredient of feed in certain proportions, but too much of it can lead to fatal urea poisoning due to fast accumulation of ammonia in the body.

Common Feed Forms of Urea

Urea can be supplied to ruminants in various forms depending on the type of feeding being done. Examples of forms include urea treated straw or crop residues, urea-molasses solution, and urea-molasses mineral block (UMMB). These forms are used as non-protein nitrogen sources for



Figure 1. Cattle consuming urea containing feed supplements.

the rumen microorganisms and are especially important where the ration consists of low-quality crop residues.

Why does urea poisoning occur?

Urea poisoning occurs mainly when ruminants consume excessive amounts of urea within a short period, particularly when they have not been properly adapted to urea-containing feed. Improper mixing of urea in the ration, accidental ingestion of urea fertilizer, sudden introduction of urea-containing feed, and inadequate readily fermentable carbohydrates can increase the likelihood of poisoning. The ingestion of 0.3-0.5g of urea per 1kg body weight in unaccustomed animals leads to pathological effects, while the dose of 1-1.5g per kg leads to death.

Mechanism of Urea Poisoning

Following ingestion, urea is rapidly hydrolysed by urease-producing microorganisms in the rumen, resulting in the production of ammonia (NH_3). Under normal conditions, rumen microorganisms utilize ammonia, along with available energy, for microbial protein synthesis. However, when urea is consumed in excessive amounts, ammonia is produced faster than it can be utilized by the rumen microorganisms. As a result, excess ammonia accumulates in the rumen and is rapidly absorbed through the rumen wall into the bloodstream, leading to hyperammonemia. When the liver's capacity to detoxify ammonia is overwhelmed, the elevated blood ammonia concentration can affect the central nervous system and result in ammonia toxicity.

Signs of poisoning

Clinical signs usually develop rapidly after ingestion of a toxic amount of urea. Affected animals may initially show restlessness, excessive salivation, muscle tremors, abdominal discomfort, incoordination, and difficulty breathing. As toxicity progresses, animals may develop severe muscle tremors, staggering, convulsions, recumbency, and respiratory failure. In severe cases, death may occur within a short period.

Treatment

1. The animals affected with non-protein nitrogen toxicosis can be managed by rumen infusion with 5% acetic acid solution (vinegar) up to 0.5 - 2L/animal in case of sheep and goats and 2 – 8L/animal in case of cattle when the chances arise. The acetic acid will decrease the pH of rumen content and prevent absorption of ammonia by making the uncharged ammonia convert to the ammonium ion.
2. Rumen infusion of icy water up to 40L/animal in adult cattle and less volume in sheep and goats is also advisable. Cold water will cool down the temperature of the rumen and will dilute the reacting rumen content.

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Prevention

Most cases can be avoided by managing the feeds appropriately:

1. The urea fertilizer and feeds containing urea are adequately separated from the livestock.
2. In the process of introducing urea to the ration, measure the needed amount of the fertilizer, but never estimate.
3. Ensure that the fertilizer is mixed uniformly in the feed.
4. If the ration is to contain urea, introduce it gradually in accordance with your local veterinarian or animal nutritionist's recommendations.
5. Never let the animals consume urea in the form of concentrated supplements.
6. Ensure that all feeds that contain urea are labelled correctly.

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