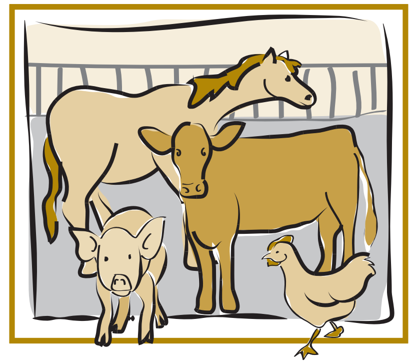
Colorado State University
Extension

Urea and NPN for Cattle and Sheep

Fact Sheet No. **1.608** Livestock Series | **Management**



by T.L. Stanton and J. Whittier*

Quick Facts

- Urea can be fed to ruminants as an economical replacement for a part of the protein in a ration.
- The amount of urea a ruminant animal can use depends on the digestible energy or total digestible nutrients (TDN) content of the ration.
- No more than 0.1 to 0.25 pound urea per head per day should be fed to feedlot cattle consuming a high concentrate ration.
- Toxicity should not be a problem if urea is fed according to recommendations.
- Vinegar is a helpful emergency treatment for urea poisoning if the animal is treated before tetany develops.

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Many years ago, researchers recognized that nonprotein nitrogen (NPN) compounds are used by bacteria in the rumen of cattle and sheep. Since that time, studies show that these compounds are broken down to ammonia during the normal fermentation process in the rumen. Microorganisms in the rumen combine the ammonia with products of carbohydrate metabolism to form amino acids and hence, proteins. The proteins formed in this manner (from NPN compounds) are similar in amino acid content to the proteins available to the animal when the principal source of dietary nitrogen is intact protein.

The bacteria and protozoa, and the protein they contain, are digested by the animal farther on in the digestive tract. In this manner, the ruminant animal makes use of certain NPN compounds even though it does not possess enzymes of its own for their breakdown. Animals with simple stomachs (pigs and chickens) cannot make use of large concentrations of NPN compounds because of a lack of enzymes and bacteria to break down the NPN to ammonia and synthesize it into protein.

Many common feedstuffs fed to livestock contain some NPN. Forages generally are higher in NPN than are concentrates. Corn silage may contain as much as 50 percent of its total nitrogen as NPN. Alfalfa hay may contain 10 to 20 percent of the nitrogen in this form. Since many feeds contain some NPN, it is not a foreign substance in ruminant rations.

Commercial Sources of NPN

The most common NPN source used in ruminant feeding is urea. Many other products have been used experimentally and commercially, but most of them do not compare favorably to urea, because of greater toxicity, higher cost or lower palatability.

Ammoniated products. Many low-protein feeds and by-products of the milling industry have been ammoniated and fed as sources of nitrogen for ruminants. Examples are ammoniated molasses, ammoniated condensed distillers' molasses solubles, ammoniated citrus pulp, ammoniated beet pulp and ammoniated furfural residue. These products generally have been found to be less satisfactory than urea as a protein substitute. In some instances they have been more toxic and less palatable than urea. They cannot be stored for a great length of time, especially under moist conditions, because much of the ammonia will be lost as a gas.

Ammonium salts. Diammonium phosphate (DAP) and monoammonium phosphate (MAP) are two ammonium salts that show promise as sources of NPN and phosphorus. Research conducted at the Oklahoma Agricultural Experiment Station indicated that DAP was a satisfactory source of phosphorus, but its nitrogen was not retained as well by sheep as that supplied by urea. Rations containing DAP also were less palatable than those containing urea because of ammonia losses when the feed came in contact with water or saliva. Monoammonium phosphate is more stable and palatable than DAP and is a good source of both nitrogen and phosphorus.

Urea. Urea is a simple compound that contains 46.7 percent nitrogen. It is found in many plants and is a normal end product of protein metabolism in mammals. A part of the urea produced in the animal's body is returned to the digestive tract in the saliva. The remainder of the urea is passed off in the urine as waste.

One pound of pure urea furnishes as much nitrogen as 2.92 pounds of protein (protein equivalent of 292 percent). The feed grade of urea has other ingredients, such as kaolin, wheat middlings, rice hulls or

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Urea Is a Protein Replacement

Urea is not necessary in the diet of ruminant animals; it is fed as a replacement for a part of the protein in a ration. Whether it is used is a matter of the cost of urea in relation to high protein feeds. When plant protein feeds, such as soybean meal, are high priced, it is economical to use urea as a protein supplement in ruminant rations. If sufficient protein is furnished by homegrown feeds, feed costs will not be lowered if urea is added.

Using the protein equivalent of 281 percent, 13.5 pounds of urea and 86.5 pounds of corn or similar grain are equal in protein and energy value to 100 pounds of 44-percent protein soybean meal or similar protein supplement for ruminant animals. The cost of the urea-corn mixture normally would be less than the cost of soybean meal, and the use of urea obviously would reduce protein supplement costs.

limestone, added to it to prevent caking and lumping. This material lowers the protein equivalent to 281, 283, 287 or 262 percent, depending on the amount added. The 281 urea is the most common.

Factors Influencing Urea Utilization

Source of readily available carbohydrates. The single most important factor influencing the amount of urea a ruminant animal can use is the digestible energy or total digestible nutrients (TDN) content of the ration. Rations high in digestible energy (high grain) result in good urea utilization; those that are low in digestible energy (high forage) result in a lowered utilization of urea. The addition to a high forage ration of any feed that will increase TDN will improve urea utilization. Utilization of urea by animals fed high forage rations will be improved by the addition of grain or molasses. Molasses will not improve the utilization of urea when high grain rations are fed, however.

Frequency of feeding urea. Feed urea containing supplements at least daily. A constant or continuous intake of urea will improve its utilization over abrupt or periodic intake.

Level of urea fed. Low levels of urea are utilized more efficiently and with less problems than high levels.

Thorough mixing of urea-containing supplements into the daily feed. If urea-containing supplements are mixed with the entire daily ration, the intake of urea at any one time likely will not be great, and the ability of the microbes to synthesize protein likely will not be exceeded.

Adequate supply of phosphorus, sulfur and trace minerals. Substitution of urea for natural protein sharply changes the quality and quantity of minerals available for ruminal bacteria and cattle. Although needed only in small quantities, these elements are necessary building blocks for microbial protein synthesis. Feeding dehydrated alfalfa meal, which is high in trace minerals and sulfur, aids urea utilization. These often are found in many urea-containing supplements.

Solubility of proteins. Natural proteins such as soybean meal and cottonseed meal have different solubilities or rates of hydrolysis in the rumen. The more soluble the protein, the more rapidly it is hydrolyzed to ammonia in the rumen. For this reason, some natural proteins may be more competitive with urea.

Recommendations for Urea Feeding

Feedlot Rations

Feed no more than:

- Up to 15 to 25 percent of total crude protein (CP) in cattle and sheep fattening rations.
- 0.1 to 0.25 pound urea per head per day to cattle.
- 0.28 to 0.70 pound CP per head per day to cattle.
- Up to 0.5 to 1.0 percent urea in total air dry beef ration (90 percent dry matter). Current recommendation is 0.7 percent urea. Feeding higher levels of urea will cause lower feed intakes, lower daily gains, poorer feed conversions, longer feeding period and less profit.

Dry Cows

Feed no more than:

- 0.05 pound actual urea per cow per day.
- 0.14 pound protein equivalent from urea per cow per day.

Supply no more than 20 to 33 percent of total nitrogen in supplement from urea when: 1) feeding harvested roughages and 2) feeding low protein supplements to cows grazing dry winter range. It is best not to feed urea in high protein supplements (40 percent CP) to cows on winter range. If this is the practice, be sure that urea contributes less than 10 percent CP equivalent.

Lactating Cows

Feed no more than:

- 0.05 to 0.10 pound actual urea.
- 0.14 to 0.28 pound protein equivalent from urea.

Calves

Do not feed urea to 300- to 450-pound calves.

Urea Toxicity

Urea toxicity (poisoning) may be a problem if urea is fed at high levels. Most cases of urea poisoning are due to poor mixing of feed or to errors in calculating the amount of urea to add to the ration. Accidental overconsumption of urea-containing supplements also has resulted in some cases of urea toxicity. If the proper level of urea is added to the ration and it is mixed uniformly, no problem should arise.

Urea toxicity is characterized by uneasiness, tremors, excessive salivation, rapid breathing, incoordination, bloat and tetany. These symptoms usually occur in about the order listed. Tetany is the last symptom before death occurs. Laboratory findings of urea toxicity include a sharp rise in blood ammonia levels and a rise in

Table 1: Maximum amounts of urea that should be fed to yearlings and calves.

Concentrate content of the ration, %	Lbs urea per day Yearlings	Calves
81-100	0.25	0.20
61-80	0.20	0.17
40-60	0.15	0.14
Less than 40	0.12	0.10

Yearlings: 650 pounds and heavier
Calves: 450-650 pounds

rumen pH. Animals usually die when their blood ammonia level reaches 5 milligrams per 100 milliliters of blood. Rumen pH will rise to about 8, and the normal function of the rumen will cease.

When low carbohydrate rations are fed, clinical signs of toxicity can be seen from as little as 0.3 grams urea per kilogram of body weight (.14 grams urea/lb of body weight) of animals that have not been fed urea previously. Feeding a 1,000-pound cow 7 to 8 pounds of 30 percent crude protein cube containing 10 percent crude protein from urea would give 0.3 grams urea per kilogram of body weight.

When adequate carbohydrate rations are fed, as much as 1 to 2 grams of urea per kilogram of body weight may not cause toxicity if animals previously have been fed urea. For instance, feeding 35 to 50 pounds of a 30 percent crude protein cube (10 percent CP from urea) to a 1,000-pound cow provides this level of urea.

Call a veterinarian to treat cases of urea toxicity. As an emergency measure, 1 gallon of vinegar may be administered to cattle as a drench. Acetic acid furnished by the vinegar lowers rumen pH and neutralizes ammonia, thus preventing further absorption of ammonia into the bloodstream.