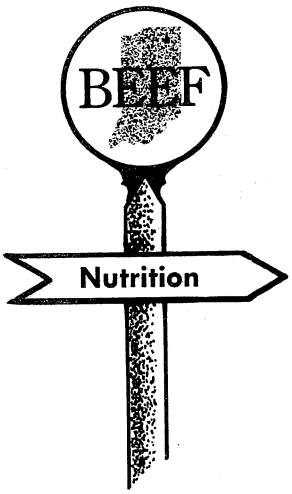
6-1-1966

Urea for Beef Cattle

L. L. Wilson

W. M. Beeson

AS-344
June, 1966



Urea for Beef Cattle

L. L. Wilson and W. M. Beeson, Animal Sciences Department

Each year more cattle feeders are relying on urea as the main protein supplement (or nitrogen source) in feedlot rations. Most combinations of farm-grown feeds for cattle are deficient in protein and must be supplemented. This additional protein is needed to balance a ration for maximum growth and performance. Bacteria in parts of a ruminant's stomach can utilize non-protein nitrogen if enough other nutrients (energy, vitamins, minerals) are available. Urea is usually a more economical source of nitrogen than natural sources of protein. However, feeding urea requires some special considerations in order to be an effective and economical supplement. These considerations are outlined in this publication.

What is Urea?

Urea is not a protein and contains no vitamins, minerals or energy. It is a synthetic chemical compound manufactured by heating carbon dioxide, anhydrous ammonia and water under pressure. Urea also occurs naturally in the urine of most animals.

Most feed-grade urea has a crude protein equivalent of 262 percent. The crude protein equivalent is the percent of nitrogen in urea times 6.25. To find the amount of protein in a feedstuff, the percent of nitrogen in the feed is multiplied by 6.25. For example, 44% soybean oil meal usually contains 7.04% nitrogen. Multiplying 7.04 by 6.25 gives 44%, the percent of total protein in the soybean oil meal. One hundred pounds of urea contains 42 pounds of nitrogen (42% nitrogen). Multiplying 42% by 6.25 equals 262% protein. Urea supplements containing 45% nitrogen (45% nitrogen x 6.25 = 281% protein equivalent) are now being marketed and will soon replace the 42% product.

CO_2 Carbon dioxide + NH_3 Anhydrous ammonia + H_2O Water + Heat → UREA

UREA + Energy + Rumen Bacteria + Other Nutrients → Body Proteins

1/ Energy is provided from carbohydrates which are sugars and starches contained in grains and molasses.

Ruminants Can Use Urea

Urea nitrogen cannot be used directly by ruminants, but microorganisms in the rumen can use it directly to build bacterial protein. Non-ruminants (swine and poultry) cannot use urea even indirectly.

Billions of bacteria exist in the rumen, the first and largest compartment of the ruminant's stomach. If acceptable amounts of other nutrients are available, rumen bacteria can produce protein by combining urea nitrogen with carbon, hydrogen and oxygen from starchy, high-energy feeds. The newly-formed protein then exists as part of the bacterial bodies.

Eventually, these bacteria pass into the fourth compartment of the ruminant stomach (abomasum). In the abomasum and intestines, the bacteria are digested and absorbed in the same manner as other protein.

As long as the rumen bacteria properly change urea nitrogen into bacterial protein, urea can be used efficiently as a protein supplement. If the bacteria cannot use the urea because of some limiting nutrient or because of an excess of urea, urea may then be detrimental to growth, performance and overall health and may even cause death.

Essential Factors for Best Use of Urea

(a) Sources of starches and sugars such as grains or molasses must be available in the ration.

(b) All major and trace minerals must be available at required levels. Special attention should be given to calcium, phosphorus, cobalt, magnesium, zinc, sulfur and iodine.

(c) High-urea supplement should contain about 3.5% salt to improve palatability.

(d) Dehydrated alfalfa meal should be used as a source of unidentified growth factors. If 90 percent or more of the protein in a supplement is supplied by urea, a good practice is to include at least 36 percent dehydrated alfalfa meal in the supplement.

(e) Use high-quality ingredients in high-urea supplements. Don't use fillers such as corn cobs, oat hulls, screenings, etc.

(f) Add vitamin A and feed additives (stilbestrol and antibiotics) to meet the daily requirements. One ton of a 64 percent urea supplement to be fed at the rate of 1 pound per head daily should contain twice the total amount of additives as 1 ton of a 32 percent supplement to be fed at 2 pounds per head daily.

(g) Urea should be free-flowing and thoroughly premixed in the supplement.

(h) Feeding instructions should be clearly understood by the feeder. The supplement should be thoroughly mixed with the grain, silage, or total ration so that each animal obtains the required amount. Do not feed high-urea supplements as top-dressing in feed bunks.

(i) Animals should be well-started on feed before urea is added to the ration. Cattle to be self-fed should be eating a maximum amount of the concentrate-urea mixture before self-feeding.

(j) Don't add urea supplements to rations already adequate in protein.

How Much Urea is Safe for Cattle?

(a) Urea is most efficient and safest when it supplies not more than 33 percent of the total protein in the entire ration.

(b) For fattening cattle, a maximum of about 0.58 pound of protein equivalent from urea should be fed per head daily. This means not more than about 0.22 pound of actual urea (262 percent protein) per head daily.

(c) For cattle on growing, moderate-energy rations, feed not more than 0.15 pound

of actual urea (262 percent protein) per head daily.

(d) Table 1 is a thumb rule for the maximum amount of urea that should be fed with different levels of concentrate mixtures.

Table 1. Approximate maximum percent of grain-concentrate to feed as urea (262 percent protein equivalent)

Total grain daily	Concentrate as urea	Actual urea daily
lb.	%	lb.
5	2.0	0.10
7	2.0	0.14
9	2.0	0.18
12	1.8	0.22
14	1.6	0.22
18	1.2	0.22
20	1.1	0.22

Replacement Value of Urea

Urea can usually reduce feed costs. However, before using urea, the feeder should figure and compare the exact costs of different protein supplements.

One pound of 262 percent urea has the same crude protein equivalent as 6.0 pounds of 44 percent soybean meal. However, since oil meals contain energy as well as protein and since urea needs an additional energy source, direct price comparisons cannot be made.

In terms of energy and protein content, 1721 pounds of ground shelled corn (8.7 percent protein) plus 279 pounds of urea (262 percent protein) equals 2000 pounds of soybean meal (44 percent protein). Table 2 illustrates a price comparison which assumes that ground shelled corn costs $2.20 per hundredweight, urea $5.00, and soybean meal $4.00.

Table 2. Price comparison of urea (262 percent protein) plus corn with soybean meal as energy and protein sources

Corn plus Urea	
1721 lb. corn X $2.20/cwt. =	$37.86
279 lb. urea X $5.00/cwt. =	13.95
Total cost	$51.81
Soybean Meal	
2000 lb. meal X $4.00/cwt. =	$80.00
Total cost	$80.00

Difference in cost = $28.19 per ton of supplement

In comparisons of this type, remember that prices of feedstuffs usually vary according to supply and demand. Price comparisons should be made in your own locality several times during the year. The above example might seem to suggest that urea can be used to replace all the oil meal in a supplement. Under many practical feeding situations this is not recommended.

Urea in Commercial Supplements

Many commercial protein supplements contain urea. If urea is included in the supplement, a statement giving the amount of total protein equivalent supplied from urea will be listed under the crude protein analysis such as "This includes not more than 13 percent equivalent crude protein from non-protein nitrogen." This indicates that there are 260 pounds of urea protein equivalent (13% x 2000 pounds) in a ton of supplement. The 260 pounds of urea protein equivalent would represent a total of about 100 pounds of actual urea (260 pounds divided by 262 percent) in a ton of supplement. Table 3 gives the pounds of actual urea per ton for supplements containing different percents of non-protein nitrogen.

Table 3. Urea content of commercial supplements (262 percent protein equivalent)

Crude protein from non-protein nitrogen (from feed tags)	Urea per ton
%	lb.
2	15
6	46
10	76
16	122
20	153
26	198

Before buying a commercial supplement, the feeder should know the amount of non-protein nitrogen in the supplement and make sure it fits his feeding program.

Feeds containing different amounts of urea and natural protein should be compared in price according to the cost per unit of protein. It pays to shop and compare analyses and costs of different supplements.

Sample Urea Supplements

The total protein in supplements may vary according to the amount of urea. Here are some supplements and recommended conditions for their use.

Table 4. 32% Supplement a/

Ingredient	Percent
Urea (262% protein equiv.)	3.5
Soybean meal (44%)	42.5
Ground shelled corn	20.0
Cane molasses	12.0
Dehy. Alfalfa meal (17%)	15.0
Bonemeal or dical. phosphate	5.2
Iodized salt	1.8
Total	100.0%
Micronutrients Per 1000 Pounds	
Cobalt carbonate	2 gm.
Zinc oxide (80% zinc)	625 gm.
Vitamin A	10 mil.IU

a/ Plus feed additives in sufficient quantities to meet recommended daily amounts.

This ration is similar to Purdue Supplement "A" but contains 3.5% urea and may be fed at the rate of 1.0 to 2.0 pounds per day with moderate- to high-energy rations. If urea containing 45 percent nitrogen is used, the percent of urea in the ration would be reduced to 3.3 percent.

Two separate mineral boxes which contain (a) a mixture of 2 parts bonemeal or dicalcium phosphate and 1 part iodized salt and (b) trace-mineralized salt should be available for the cattle.

Table 5. Missouri 40% supplement a/

Ingredient	Percent
Urea (262% protein equiv.)	10
Alfalfa meal	20
Ground shelled corn	60
Soybean oil meal	10
Total	100%
Vitamin A per pound	20,000 IU

a/ Plus feed additives in sufficient quantities to meet recommended daily amounts.

The Missouri Station recommends feeding the following mineral mixture free choice: 40% iodized salt, 40% bonemeal, 20% limestone, plus 1 ounce of cobalt chloride and 0.5 pound of zinc oxide per 100 pounds of mineral mix. Trace-mineralized salt should also be offered in a separate box. If urea containing 45 percent nitrogen is used, the percent of urea in the ration would be reduced to 9.3 percent.

The Missouri supplement can be fed at the rate of 0.75 to 1.5 pounds per head daily with a moderate- to high-energy ration.

Purdue 64% supplement (Table 6) may be fed as a meal or hard pellet. If the 14% molasses content does not allow a pellet hard enough for bulk handling, the molasses content may be reduced to 10 or 12 percent. If a 45 percent nitrogen urea is used, the amount of urea in the ration would be reduced to 19.7 percent. A 28% molasses "64" supplement may be made in a soft pellet by using 28% molasses, 36% dehydrated alfalfa meal, and 22.1% urea. Purdue "64" supplements are

Table 6. Purdue 64% supplement [a/]

Ingredient	Percent
Urea (262% protein equiv.)	21.1
Dehy. alfalfa meal	51.0
Cane molasses	14.0
Bonemeal or dical. phosphate	10.4
Iodized salt	3.5
	100.0%
Micronutrients Per 1000 Pounds	
Cobalt carbonate	4 gm.
Zinc oxide (80% zinc)	1250 gm.
Vitamin A	20 mil. IU

a/ Plus feed additives in sufficient quantities to meet recommended daily amounts.

recommended for use with high-grain fattening rations and not for wintering or growing rations. Purdue "64" should be fed at the rate of 1.0 pound per head daily.

The Iowa 80% supplement (Table 7) should be used only on high-grain rations and fed at the rate of 0.5 pound per head daily. It is critical to include this recommended trace mineral premix. Iowa 80% was

Table 7. Iowa 80% supplement

Ingredient	Percent
Urea (262% protein equiv.)	30.0
Ground corn or molasses	33.0
Dical. phosphate	20.0
Limestone	12.0
Trace mineral [a/]	1.0
Stilbestrol premix (1 gm./lb)	2.0
Vitamin A (2 mil. IU/lb)	2.0
Total	100.0%

a/ 4.4% manganese, 6.6% iron, 0.3% iodine, 1.3% copper, 0.2% cobalt, 12.0% zinc and 20.0% magnesium.

designed for on-farm mechanical mixing and should not be used as a top-dressing. If 45 percent nitrogen urea is used, the amount of urea in the ration would be reduced to 28.0 percent.

Cattle Performance on Urea Versus Natural Protein

If all of the above conditions and recommendations are satisfied, cattle should gain as rapidly and efficiently on rations with urea as with natural protein supplements. There is no significant evidence that any differences result in carcass cutability or quality or dressing percent.

Cooperative Extension Work in Agriculture and Home Economics, State of Indiana, Purdue University and U. S. Department of Agriculture Cooperating. H. G. Diesslin, Director, Lafayette, Ind. Issued in furtherance of the Acts of May 8 and June 30, 1914.