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Urea for Dairy Cows

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Numerous questions regarding urea as a feed additive have been answered by research. These findings enable its successful use in many feeding programs when coupled with good management practices.

What is urea?

Feed-grade urea is a synthetic chemical compound rich in nitrogen drawn from the air. Chemically pure urea contains 46.65 percent nitrogen. Feed-grade urea contains less because certain additives are included to improve handling and feeding properties. It has normally been 42 percent, although a new process enables urea to contain 45 percent nitrogen. Fertilizer-grade urea normally contains 46 percent nitrogen but is not approved for use in livestock feeding.

What does "crude protein equivalent" mean?

Urea is not protein but can be called "non-protein nitrogen" when added to the ration. A term called "crude protein equivalent" is used to express its maximum value if its total nitrogen content is converted to protein in the paunch (rumen) of ruminant animals. This is possible only because certain bacteria in the rumen are able to combine the nitrogen from urea with the carbohydrates obtained from energy feeds to build their own protein. Then it is made available to the animal when these micro-organisms are digested in the true stomach. If energy isn't readily available for this conversion, the maximum crude protein equivalent of urea will not be attained.

The maximum crude protein equivalent of urea can be calculated by multiplying its nitrogen content by a factor of 6.25. This factor is used because most natural proteins contain about 16 percent nitrogen (or 1 part in 6.25 parts). Thus, the maximum crude protein equivalent of feed-grade urea (42 percent nitrogen) is 262.5 percent. Stated another way, 1 pound of 42 percent nitrogen urea is equal to 2.62 pounds of crude protein if converted completely into usable protein by the rumen bacteria. The crude protein equivalent of 45 percent nitrogen is 281.25 percent.

Comparison of urea and natural protein sources

Urea can be used to meet part of the protein requirement of dairy cows but it has no other nutritional value. Natural protein sources such as oil meals provide energy and some minerals in addition to protein. Consequently, comparative cost figures should include the contribution of both energy and protein provided by oil meals.

There is no advantage in feeding urea unless feed costs are reduced. The following thumb rules enable economic comparison when both energy and protein are considered.

13 pounds of 45 percent nitrogen urea plus 100 pounds shelled corn equals 100 pounds of 44 percent soybean meal

14 pounds of 42 percent nitrogen urea plus 100 pounds shelled corn equals 100 pounds of 44 percent soybean meal

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15 pounds of 45 percent nitrogen urea plus 100 pounds shelled corn equals 100 pounds of 50 percent soybean meal
16 pounds of 42 percent nitrogen urea plus 100 pounds shelled corn equals 100 pounds of 50 percent soybean meal

These thumb rules should not imply that a ration for dairy cattle be mixed in these proportions because of possible palatability or toxicity problems.

Determining the amount of urea in a commercial supplement.

Some dairymen may prefer to purchase a commercial supplement with urea rather than purchase feed-grade urea to mix with feeds. If urea is present in a supplement, a statement will be on the feed tag to indicate the amount of crude protein equivalent supplied by urea. This statement will be listed under the crude protein analysis and might read "This includes not more than 21 percent equivalent crude protein from non-protein nitrogen." In this example 100 pounds of this protein supplement could contain either 8.0 pounds of 42 percent nitrogen urea (14 ÷ 2.62) or 7.5 pounds of 45 percent nitrogen urea 14 ÷ 2.81).

If the above supplement containing 7.5 pounds of 45 percent nitrogen per hundred was mixed with grains at a rate of 400 pounds per ton, the urea content of the mix as fed would be about 1 percent. (4.00 x 7.5 = 30 pounds.30 ÷ 2000 = .015 or 1.5 percent)

Feeding recommendations

Too much urea, poor mixing and sudden introduction of urea can cause palatability or toxicity problems.

How much urea can be fed?

Research has shown that urea when properly fed can replace from one-fourth to one-third of the protein nitrogen in the total ration of dairy cows.

A common rule of thumb has been: Do not feed more than 3.0 percent of urea by weight in the grain mixture of dairy cows. This 3.0 percent level should never exceed one-third of the protein nitrogen in the total ration. However, certain feeding programs violate this rule. Such feeding programs include corn silage, limited hay, corn silage and limited hay, or poor quality hay when fed to cows receiving 15 to 20 pounds of grain daily. With these types of feeding programs it is advisable to limit urea to 2.0 percent by weight in the grain mixture. Excessive amounts of urea can result in kidney damage or/and sudden death of cattle.

Although the upper limit of effective and safe urea feeding has not been fully established, stay safe. Never exceed 2.0 percent urea in the grain mixture in some cases and never over 3.0 percent.

How to feed urea?

Never add urea into the ration suddenly. This practice usually results in reduced grain intake and thus less milk production. Research shows that a period of three weeks or more is necessary for rumen bacteria to completely adjust to a ration containing urea.

Chances of possible palatability or toxicity problems are reduced when urea is added to complete mixed ration (such as combined forage and grain) or when added to silage at the time of ensiling.

Caution should be used to avoid sifting out of urea in coarsely ground grain mixtures. Five percent liquid molasses tends to reduce this problem and also should improve the palatability of the mixture.

Poor mixing of supposedly safe amounts of urea can result in toxicity. Urea should not be added to the grain mixture if poor mixing facilities are used. Using urea-containing supplements with grains are safer in these cases.

Don't add urea to a poor quality mixture (one that is low in energy, high in fiber). Readily available carbohydrates from sources such as corn and molasses must be supplied to enable efficient conversion of urea nitrogen into bacterial protein.

If you are uncertain whether 42 percent or 45 percent nitrogen urea is included, ask the feed dealer. Most manufacturers use an anti-caking agent such as "kaolin" in making 45 percent nitrogen urea, but this agent normally isn't present in 42 percent nitrogen urea. If present, it will be listed in the ingredients.

Commercial supplements with urea must also bear a statement on the label that the supplement can't be fed free choice if it contains more than 3 percent by weight as urea or one-third of the crude protein. All labels should be read carefully for feeding instructions.

The addition of extra crude protein in the form of urea to rations already balanced does not increase milk production. This may also be true when large amounts of good quality forages are consumed since protein needs of most cows will be met by balancing these forages with relatively low-protein concentrate feeds.

Don't add urea to feeds containing raw soybeans. An enzyme present in raw soybeans, urease, breaks urea down into ammonia and carbon dioxide. This results in an ammonia odor and a feed of poor acceptance.

Other research has been concerned with the greater need of minerals such as zinc, cobalt, calcium, phosphorus, and sulfur when urea is used rather than natural protein. Most dairy rations will provide these minerals in adequate amounts, although they could become critical when poor quality forages and poor grain mixtures are fed.

Urea in growing rations?

It is not advisable to feed urea to calves less than four months of age. Findings indicate that urea may be inferior to natural protein supplements for growing cattle. This is most evident when poor quality roughages are fed.

Urea treated corn silage or high moisture corn?

Research on the addition of urea to corn silage is not conclusive. Some questions regarding the efficiency of urea conversion into protein and the economy of this practice still exists.

The addition of not more than 10 pounds of urea per ton of corn silage at the time of filling has been reported to produce an acceptable product. Greater amounts tend to reduce feed acceptance.

In theory, if converted completely, 10 pounds of urea will increase the protein content of corn silage from approximately 2.3 to 3.6 percent on an as-fed basis.

On a similar basis, 10 pounds of urea will increase the protein content of 26-28 percent moisture shelled corn from 6.4 to 7.7 percent protein.

Examples of Grain Mixtures

The following grain mixtures serve only as examples to show the substitution of urea for part of the crude protein content.

The crude protein content and estimated net energy values are also shown when molasses is deleted from the mixtures.

Table 1. Grain mixtures with 12-14% crude protein content (with and without UREA)

Ingredients	Unit	Grain Ration Number 1	2	3	4	5	6
Content of Ration							
Gd. shelled corn	lb	1650	1760	----	----	----	----
Corn & cob meal	lb	----	----	1550	1720	1200	1300
Gd. oats	lb	----	----	----	----	400	450
Soybean meal, 44%	lb	250	120	350	150	300	125
UREA, 42% N	lb	----	20	----	30	----	25
Molasses, blackstrap	lb	100	100	100	100	100	100
Steamed bonemeal a/	lb	20	20	20	20	20	20
Trace mineral salt	lb	20	20	20	20	20	20
TOTAL		2040	2040	2040	2040	2040	2040
Calculated Analysis							
Crude protein,	%	12.9	12.9	13.6	13.6	13.6	13.6
Estimated Net Energy	therms	78.0	77.3	71.9	70.1	71.8	70.2
UREA (by weight)	%	----	0.98	----	1.47	----	1.23
Above mixtures without 100# molasses:							
Crude protein	%	13.4	13.4	14.2	14.2	14.1	14.1
Estimated Net Energy	therms	78.4	77.6	72.0	70.1	71.8	70.2

a/ Dicalcium phosphate or defluorinated phosphate may be used.

Table 2. Grain mixtures with 14-16% crude protein content (with and without UREA)

Ingredient	Unit	Grain Ration Number 1	2	3	4	5	6
Content of Ration							
Gd. shelled corn	lb	1500	1735	----	----	----	----
Corn & cob meal	lb	----	----	1500	1725	1000	1160
Gd. oats	lb	----	----	----	----	500	575
Soybean meal, 44%	lb	400	125	400	135	400	125
UREA, 42% N	lb	----	40	----	40	----	40
Molasses, blackstrap	lb	100	100	100	100	100	100
Steamed bonemeal a/	lb	20	20	20	20	20	20
Trace mineral salt	lb	20	20	20	20	20	20
TOTAL		2040	2040	2040	2040	2040	2040
Calculated Analysis							
Crude protein	%	15.5	15.5	14.6	14.6	15.7	15.7
Estimated Net Energy	therms	78.0	76.5	72.1	69.7	72.1	69.7
UREA (by weight)	%	----	1.96	----	1.96	----	1.96
Above mixtures without 100# molasses:							
Crude protein	%	16.1	16.1	15.1	15.2	16.3	16.3
Estimated Net Energy	therms	78.3	76.8	72.2	69.7	72.2	69.6

a/ Dicalcium phosphate or defluorinated phosphate may be used.

Table 3. Grain mixtures with 16-18% crude protein content (with and without UREA)

Ingredient	Unit	Grain Ration Number 1	2	3	4	5	6
Content of Ration							
Gd. shelled corn	lb	1400	1635	----	----	----	----
Corn & cob meal	lb	----	----	1400	1625	900	1035
Gd. oats	lb	----	----	----	----	500	600
Soybean meal, 44%	lb	500	225	500	235	500	225
UREA, 42% N	lb	----	40	----	40	----	40
Molasses, blackstrap	lb	100	100	100	100	100	100
Steamed bonemeal a/	lb	20	20	20	20	20	20
Trace mineral salt	lb	20	20	20	20	20	20
TOTAL		2040	2040	2040	2040	2040	2040
Calculated Analysis							
Crude protein	%	17.3	17.3	16.4	16.4	17.6	17.6
Estimated Net Energy	therms	78.0	76.5	72.5	70.1	72.5	70.1
UREA, (by weight)	%	----	1.96	----	1.96	----	1.96
Above mixtures without 100# molasses:							
Crude protein	%	18.1	18.0	17.1	17.1	18.3	18.4
Estimated Net Energy	therms	78.3	76.7	72.5	70.0	72.5	70.0

a/ Dicalcium phosphate or defluorinated phosphate may be used.

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