Your cows need soluble protein

Our goal is to provide the right mix of protein, nitrogen, and carbohydrates. Urea can be a good fit.

By Mary Beth de Ondarza

A number of years ago nutritionists began to understand that protein is not just protein. It can be soluble protein (SIP), degradable protein (DIP), undegradable protein (UIP), or unavailable protein.

Now, everybody is talking about the amino acids that make up protein. A protein is a chain of 50 or more amino acids. Amino acid nutrition definitely is important. But, remember that the microbes supply most of the amino acids needed by the cow. So, it is important to give the rumen the proper protein and nitrogen supply that it needs for most efficient milk production.

Soluble protein (SIP) is made up of ammonia (NH_3), nitrates (NO_3), amino acids, peptides (chains of less than 50 amino acids), and some true proteins. Soluble protein is almost instantly available to the rumen microbes and is present in large amounts in hay crop silage. Urea is 100 percent SIP

Degradable protein (DIP) contains true proteins that are digested more slowly in the rumen. Soluble protein also is included in the DIP fraction.

Undegradable protein (UIP, bypass protein, rumen escape protein) is protein that isn't rumen degradable. UIP contains protein that is available for absorption at the small intestine as well as protein that will show up in the manure.

Unavailable protein (ADF-N, ADIN, ADF-CP, bound protein) is of no use to the cow. It goes through her and shows up in the manure. It often is the result of extensive heating of feed protein.

Our goal is …

The goal when feeding dairy cows always should be to maximize microbial protein production as much as possible. Then you supplement with additional protein which is expected to escape rumen fermentation.

Rumen microbial protein contributes between 50 and 75 percent of the lactating cow's total protein supply. We need to provide nitrogen and amino acids to the microbes so that they can make as much microbial protein as possible. The microbes use nitrogen, amino acids, and carbohydrates to produce their own body protein. The microbes end up being washed down from the rumen to the cow's intestine. They then are absorbed from the intestine and used as a source of amino acids for the cow to make milk protein and body protein.

For efficient growth, the rumen microbes require sources of protein, nitrogen, and carbohydrates that are available at the same time. As carbohydrate availability increases, more dietary protein and nitrogen can be incorporated into the microbes. Soluble protein (SIP) provides immediate (with-in one hour after ingestion) protein and nitrogen for the microbes to use. Degradable protein (DIP), since it includes SIP, provides the immediate protein and nitrogen for the microbes to use plus the long-term (within 16 hours after ingestion) protein for the microbes to use. You need the right amounts of both SIP and DIP to complement the rapidly and slowly digestible carbohydrate in the cow's diet.

If you feed to little SIP or DIP, there will be less microbial protein produced and less total carbohydrate fermented in the rumen. Milk production actually could decrease if a ration with sufficient available carbohydrate for the rumen was fed with just a slowly degradable protein such as corn gluten meal or distillers' grain.

IF more SIP or DIP is fed than the cow needs, the cow will waste that extra nitrogen. It will be excreted in the cow's urine, and there will be higher levels of urea nitrogen in the blood and in the milk. Generally, it is recommended that rations designed for high production contain about 28 to 32 percent SIP 9 percent of CP) and 60 to 65 percent DIP (percent of CP).

What about NPN?

Nonprotein nitrogen (NPN) is nitrogen that is not incorporated into amino acids and protein. Much of the soluble protein in forages like hay crop silage is nonprotein nitrogen. Urea is one the most common forms of nonprotein nitrogen used in commercial feeds.

Urea is a synthetic, white, crystalline product that is soluble in the rumen. Its chemical formula is $CO(NH_2)_2$. Urea often is seen as a cheap ingredient to use in rations. For this reason, it sometimes has been overused to the cow's detriment. Many dairy producers have heard of problems with feeding urea. Unfortunately, they may have decided they never want to feed it. However, in many rations,

especially those containing little hay crop silage, urea is the chemical reaction that the rumen microbes use to convert urea into usable protein for the cow.

CO $(NH_2)_2$(Urea)+H_2O(water)→NH_3(Ammonia)+CO_2(Carbon Dioxide)

NH_3(Ammonia)+Ration Carbohydrate→Microbial Protein (-CH_2-CH_2-CO-NH-CH_2-)

When too much excess ammonia is absorbed out of the rumen, blood urea nitrogen(BUN)levels and milk urea nitrogen (MUN) levels rise. High BUN or MUN levels have been associated with poor fertilization and reduced embryo quality. Because embryos often survive for only a few days when BUNs and MUNs are high, cows show irregular heat cycles.

It is recommended that, especially during the breeding period, BUN levels not exceed 20 milligrams per deciliter(mg/dL) and MUN levels not exceed 16 to 18 mg/dL. High BUN and MUN levels often result from excessive dietary SIP, but they also can be high from overfeeding DIP or from not feeding enough rumen fermentable carbohydrate.

BUN levels fluctuate during the day. You need a representative sampling from several cows taken throughout the day to evaluate BUN status. For this reason, some people prefer to use MUN to assess nitrogen status because it represents a 12-or 8-hour period of time.

Urea toxicity…

If too much urea is fed, a toxic level of ammonia can be absorbed through the rumen wall into the cow's bloodstream. Usually, large amounts of circulating ammonia will cause cows to eat less before you notice acute signs of toxicity. The urea itself is not toxic. The ammonia produced from it is what is responsible for cell death.

Since the efficient use of urea depends upon the level of rumen available carbohydrate in the ration to convert urea into microbial protein, there really is not an absolute level of dietary urea that will cause toxicity. Use urea to meet soluble protein requirements, but do not exceed the requirement.

Regardless of soluble protein and available carbohydrate levels in rations, generally limit urea in rations to no more than 0.33 pound per cow per day in milking rations. Use less in heifer diets (less than 0.25 pound per heifer per day).

Be sure to adapt the rumen microbes and cows to urea over a period of two to three weeks, and make sure urea is mixed into the ration well. Don't feed urea to calves less than 3 months of age because their rumens are not fully functioning. They are able to use the urea as well to form microbial protein.

Remember that feed grade urea is 45 percent nitrogen, unlike amino acids and protein that contain 16 percent nitrogen. Urea has a crude protein equivalent (CPE) of 281 percent (45 percent times 6.25). The term crude protein equivalent is used to describe the maximum amount of protein which could be made if all of the nitrogen in the urea is converted to microbial protein. Therefore, 1 pound of urea is equal to 2.81 pounds of crude protein equivalent.

Many of the rumen microbes require specific sources of amino acids. Isoacids basically are amino acid backbones with no nitrogen. They are obtained from the breakdown of dietary amino acids and are required for growth of fiber digesting bacteria. Amino acids are preferred over ammonia by many starch-digesting bacteria. A study was conducted where rumen microbes were grown in a laboratory with a set amount of carbohydrate available to them.

There was a significant gain in microbial protein synthesis when casein was added as a food source. Casein is milk protein that is a good source of isoacids and amino acids. This increase in microbial protein production was observed even though ammonia (or free nitrogen) levels were more than adequate. Based on this work, it is commonly recommended that 2 pounds of soybean meal, canola meal, or equivalent source of degradabole amino acids be included in rations for high-producing cows.

So, as you strive for better milk production efficiency, don't overlook the basics of protein nutrition. Work with your nutritionist to fine-tune rations and meet the needs of the rumen microbes.