by Glen Broderick

We're learning more about protein quality

UNTIL recently, dairy nutritionists worried little about the quality of rumen undegraded protein (RUP), or bypass protein, in the diet. But, with cows milking more these days, the source and quality of RUP is becoming as important as the amount being fed. Here's why.

For years, we've known that all animals require 10 different amino acids in their diets — known as essential amino acids — to serve as building blocks for protein. (There also are nonessential amino acids which need not be fed because they are formed in the body before being used to make proteins.)

Importance of amino acids . . .

Protein quality (the essential amino acid composition of feed protein) has been considered much less important to ruminants because rumen microbes synthesize high-quality protein out of the lower-quality protein and the nonprotein nitrogen in the diet. And microbial protein is "high" quality because the essential amino acids are present in proportions very close to those required by the cow.

So what has happened to change this view? Research has shown that, even for ruminants such as dairy cows, not all RUP (bypass protein) is created equal. The differences have to do with essential amino acids.

Going back 30 years or more, research showed small milk responses when two amino acids, methionine and lysine, were infused into the abomasum (to avoid breakdown in the rumen). However, there were large gains in milk yield when a mixture of all essential amino acids was infused. So it was thought that dairy cows would not respond to a single essential amino acid.

Our thinking started changing about 15 years ago with the availability of rumen-protected methionine (RP-Met) and rumen-protected lysine (RP-Lys). Early trials in North America indicated that small milk protein responses occurred when feeding RP-Met alone. And further small increases occurred when feeding RP-Lys with RP-Met.

RUP and milk protein levels . . .

By that time, there also was a large volume of research showing variable effects on milk yield and milk components when feeding various RUP supplements. Our own studies compared solvent soybean meal with expeller soybean meal and roasted soybeans, both of which have more bypass protein due to heat treatment. The expeller soybean meal had 91 percent more RUP than the solvent soybean meal.

In three separate trials, when these three soybean products were fed to supply equal amounts of crude protein in the ration, the boost in milk protein for expeller soybean meal averaged only 54 percent — a substantial improvement but far from the 91 percent increase in RUP. Why wasn't more of the bypass protein finding its way into milk?

Later, we ran similar trials with fishmeal. The low-soluble, ruminant-grade fishmeal had double the RUP of solvent soybean meal. And, when cows were fed this, their milk protein also doubled (compared to cows fed solvent soybean meal). Protein utilization was better with fishmeal because of differences in the protein quality of fishmeal compared to soybean meal. What causes this difference? Fishmeal is much higher in methionine . . . one of the essential amino acids. We concluded that utilization of soybean RUP is limited when there is not enough methionine.

Consider the source . . .

Ruminant-grade fishmeal often is quite expensive. Often, the cost was not covered by the value of its greater protein quality. However, there are higher quality plant proteins that could be used.

In a recent study at the U.S. Dairy Forage Research Center, we compared four diets based on typical Midwest feeds. The diets all contained about 16.5 percent crude protein, but the supplemental protein came from four different sources: urea, solvent soybean meal, cottonseed meal, or canola meal. Yields for total milk, 3.5 percent fat-corrected milk (FCM), milk protein, and milk fat were all greatest for cows fed canola meal.

	Urea	SBM[1]	CSM[2]	CM[3]
	lbs./day			
Milk	72.5	88.2	89.3	90.6
3.5% FCM	67.5	81.8	80.9	85.5
Milk protein	2.03	2.71	2.60	2.80
Milkfat	2.23	2.69	2.60	2.84

[1]Solvent soybean meal
[2]Cottonseed meal
[3]Canola meal

These results cannot be explained by rumen protein outflow . . . the protein that is available for milk production. The cows receiving cottonseed meal had the most rumen protein outflow, but they didn't make as much protein (or fat) as the cows fed canola meal. The reason might be because canola meal has substantially more methionine or better amino acid quality than either soybean meal or cottonseed meal.

Another approach to improving protein quality in a ration (and actual use by the cow) is to feed supplemental methionine. In another recent feeding trial, we fed cows diets based on alfalfa and corn silages plus high-moisture corn. In these four diets, we reduced crude protein in steps of about 1.3 percentage points and raised the amount of RP-Met (Mepron) by about 8 grams per day with each drop in crude protein.

It was possible to reduce the diet from 18.6 percent crude protein to 16.1 percent (plus 17 g/day of RP-Met) without reducing yield of milk or milk components. Indeed, there was an indication that milk and component yield and feed efficiency actually were improved by reducing crude protein when adding RP-Met. MUN (milk urea nitrogen) levels dropped and protein utilization improved, with each step down in crude protein. However, milk production clearly was suffering at 14.8 percent crude protein.

CP[1], % of DM	18.6	17.3	16.1	14.8
RP-Met, grams/day	0	8	17	25
	Production, lbs./day			
Milk	87.6	91.7	91.9	87.4
3.5% FCM	85.7	92.7	90.8	85.0
Milk protein	2.54	2.71	2.71	2.66
Milkfat	3.01	3.28	3.15	2.90

[1]Crude protein

Conclusion: Supplementation with RP-Met will allow cows to be fed perhaps 2 percent less crude protein (dry matter basis) without reducing milk and milk protein yield.

This strategy brings about a positive environmental effect, as well. By improving protein (nitrogen) utilization, it also reduces amount of nitrogen excreted from the cow . . . especially urine nitrogen. Plus, there's a reduction in urine nitrogen that translates into less ammonia being volatilized to the atmosphere.

In related research currently being conducted at the Dairy Forage Research Center, we are trying to determine how changes in dietary crude protein affect nitrogen excretion and utilization of manure nitrogen by plants. We also are trying to determine how rumen synthesis of high-quality microbial protein can be maximized, and we're developing approaches to improve the nutritional value of high protein forages such as alfalfa.

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