Are Your Dairy Cows Getting the Protein They Need?

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Balanced rations provide dairy cows with the nutrients they need to produce milk at an optimum financial return. These rations may not always be least cost, but are designed to generate the most return per cow. As we have learned more about the nutritional needs of cows and the role of rumen bacteria and other microbes in supplying these needs, ration balancing programs have become much more complex to account for all of these factors. Irrespective of these increases in complexity and the plethora of terms on balanced ration printouts, the bottom line is the cow still needs rather large amounts of protein and energy to support herself and milk production.

Energy is still the hardest nutrient group to supply in adequate amounts to high-producing and early lactation cows to support performance. Thus, the constant message from nutritionists on the importance of harvesting high quality forages to supply needed energy precursors. My colleague, Dr. Larry Chase, from Cornell University said it best, "Your nutritionist is only as good as your forage". In years in which forage quality has been suboptimum or when corn silage lacks the grain fill, rations contain more concentrates and usually are more costly as we attempt, but often do not succeed, to provide the needed amount of energy. Consequently, dairy cows often do not milk as well as expected.

Much has been written about supplying the energy needs of dairy cows, but what about supplying adequate amounts of "protein" to support milk production? Do dairy nutritionists still balance rations for crude protein, an analysis commonly found on forage reports and often a value quoted by farmers related to the quality of forages? The answer is "not exactly". Crude protein is calculated from the measured amount of nitrogen in a forage or grain sample and then the amount of nitrogen is multiplied by a factor of 6.25. By itself, crude protein does not explain what happens when this feedstuff is digested in the cow's rumen. Different proteins and sources of nitrogen are digested at different rates in the rumen. Therefore, nutritionists have expanded the terms used to describe the "protein fraction" in feedstuffs. To better understand the importance of each step when implementing feeding programs on-farm, a rudimentary understanding of the terminology on a ration printout and how nutritionists provide adequate amounts of "protein" in dairy diets is needed.

Rumen Bugs Make Protein

The microbes or bugs in the cow's rumen supply 60 to 75% of the protein needs of the cow. These microbes include bacteria that digest either fiber or starches, protozoa, and fungi. They use nitrogen (some comes from dietary protein sources) and energy (carbohydrates- starches and sugars) supplied in the diet to make proteins within themselves, known as microbial protein. Both a nitrogen and carbohydrate source needs to be present at the same time for this process to occur. Computer ration balancing programs allow the user to estimate how much microbial protein could be made by the rumen bacteria. These programs use the crude protein and other nutrient values from a forage analysis, along with standard parameters about each feedstuff in the diet and what occurs in the rumen, to calculate microbial protein yields. Nutritionist recognize that microbial protein has the best combination of amino acids needed for milk production and milk protein synthesis. Feeding programs and practices on-farm can negatively or positively impact rumen fermentation, efficiency and products of the rumen microbes, and ultimately, milk production and reproductive performance.

Microbial protein, along with protein not degraded in the rumen, flows to the small intestine. (Protein not digested in the rumen are known as ruminally undegraded protein or RUP, also formally known as bypass protein.) In the small intestine, both sources of protein are broken down to amino acids and absorbed by the cells lining the small intestine and is called metabolizable protein or MP on many ration printouts. Most computer, ration-balancing programs calculate the amount of metabolizable protein a diet will likely "make". They also calculate, based on the amount of metabolizable protein, the amount of milk this diet will support at the estimated intake. If intake is lower than estimated by the computer program, less metabolizable protein will be available and milk production will be lower than calculated. As these computer ration balancing programs have added additional parameters and data, they have improved estimating the amount of milk these rations can support from a "protein" standpoint. One must realize that these programs model nutrient needs of the cow along with the rumen environment and microbes that in turn feed the cow. Thus, providing the rumen bacteria a consistent supply of nutrients is needed and this is where sound feeding management practices are important. Cows need to eat numerous meals throughout the day that are as consistent in composition as possible.

Cows Need Amino Acids Not Protein

Dairy cows, like all mammals, require amino acids, not proteins per se, which cells use as building blocks to form proteins needed for body functions, growth, reproduction, and milk production. Thus, diets are formulated to supply these needed amino acids. Of the 20 amino acids found in proteins in an animal's body, 10 are considered essential; in other words the body cannot make these 10 amino acids from others and they must be absorbed as such by cells in the small intestine from either dietary or microbial protein. Among these 10 essential amino acids, lysine, methionine, and, under certain conditions, tryptophan are known as limiting amino acids because they may not be supplied naturally in adequate amounts and must be supplemented as a feed additive to correct deficiencies. Corn-based ingredients, such as corn grain, are deficient in lysine and soybean-based products are deficient in methionine. Ration balancing programs calculate the amount of lysine and methionine supplied and allow the user to determine if additional lysine and/or methionine may need to be added to support milk production of a particular group of cows. As we learn more about the role and supply of each essential amino acid, additional amounts of these amino acids and others may need to be added to balanced diets to support an improved performance.

Feeds Short Protein- What Can I Do?

When deficiencies are found, alternative feedstuffs and/or feed additives can be added to correct the problem and allow for the synthesis of more metabolizable protein to support milk production. By understanding which protein-related fraction is deficient, one can target the use of specific ingredients and feed additives. For example, if a rapidly-degraded nitrogen source is needed, urea could be a cost effective means of providing the needed nitrogen for the rumen bacteria.

Correcting deficiencies in protein-related fractions is often possible in contrast to deficiencies in energy. Farmers may not like the additional cost of protein, but changes can be made to allow optimum performance and the greatest return above feed costs. Accurate and current feed samples are needed so that the most accurate and up-to-date data are used in ration balancing software. One thing to remember, a nitrogen and carbohydrate source needs to be present at the same time to maximize microbial protein, the most cost-effective protein source and thus, amino acid source for a cow. The take home message here is carbohydrates, which supply energy, may be the limiting nutrient for the rumen bacteria and not protein or nitrogen. A carbohydrate deficiency for the rumen bacteria can occur when lower quality forages or the incorrect type and amount of concentrates are fed. Limitations in a carbohydrate source for the rumen bacteria can create a protein deficiency for the cow even though adequate nitrogen may be present for the bacteria. Thus, returning to my opening statement from Dr. Chase, "Your nutritionist is only as good as your forage".