Increasing nutrition precision by focusing on amino acids

Jessica Tekippe for *Progressive Dairyman*

The dairy industry has become increasingly precise in identifying and meeting the protein requirements of dairy cattle. Most notably, the industry has moved from focusing on the diet's content of crude protein to metabolizable protein and now to individual amino acids. Cows require amino acids, not protein, and we are answering that requirement with greater precision than ever before.

At the dawn of the 20th century, Henry Armsby published *The Nutrition of Farm Animals*. In this 1917 book, Armsby says lactating dairy cows require 0.6 pounds of protein for every 1,000 pounds of bodyweight.

A century later, seven versions of Nutrient Requirements of Dairy Cattle have been published by the National Research Council (NRC), with an eighth on its way. As expected, the industry has made numerous improvements over time in identifying and meeting the protein requirements of dairy cattle.

For nutritionists, however, the challenge remains: Understanding current concepts in protein and amino acid nutrition and converting them into more cost-efficiently-filled bulk tanks for clients. Variations in ration formulation software models suggest the challenge this poses, as well as the determination to achieve success.

Crude protein

Traditionally, the optimal protein requirements for the highest level of production were determined through dose-response measurements. Performance was measured for groups of cows fed a single diet. The only variation among diets was the level of supplemental protein fed.

If milk production increased, the diet with the lower protein concentration was considered to be inadequate. Conversely, when the removal of protein from a diet failed to reduce animal productivity, the supply of protein was considered to be above the protein requirement.

Various mathematical and statistical models were used to determine the break point, i.e., the protein requirement. Initially, the approach was to determine the percent or amount of dietary crude protein cows needed for milk production.

The 2001 NRC, for instance, estimated that 23 percent dietary crude protein was required for maximum milk yield. Today, producers and nutritionist alike know these levels are too high and are way above the levels fed to modern dairy herds. In addition, any crude protein consumed by cows in excess of their requirement is excreted via urine.

Since the adoption of the 2001 NRC, many progressive nutritionists realized that balancing for crude protein wasn't adequate for dairy diets. The major weakness of formulating diets on a crude protein basis is that it doesn't take into account the type of crude protein consumed.

One classic example of this is the form of nitrogen. In the crude protein model, the nitrogen from urea and soybean meal are treated the same. Yet they could hardly be more different.

Metabolizable protein

This led to the development of the Burroughs metabolizable protein system. It recognizes that not all the crude protein in the ration is available for absorption as amino acids. With the Burroughs system, the amount of dietary nitrogen solubilized in the rumen and available for microbial protein synthesis was characterized as such.

With the Burroughs system, calculations include the amount of total digestible nutrients available to support microbial growth. To determine this, the calculated microbial protein was added to the amount of dietary protein that escaped ruminal degradation. The calculation requires knowing three things: the amount of protein in feeds converted to ammonia in the rumen, the amount of feed protein that escaped ruminal breakdown and the total digestible nutrient value for the feeds.

The Burroughs system also introduced many new terms, which are now routinely used to describe the protein requirements of ruminants.

- Rumen-degradable protein (RDP) – the feed protein degraded in the rumen by the ruminal microbial population.

- Rumen-undegraded protein (RUP) – the feed protein that remains undegraded in the rumen and passes to the small intestine for digestion and absorption.

- Metabolizable protein (MP) – the total sum of absorbable amino acids provided from ruminal microbial protein and RUP digested in the small intestine.

Metabolizable protein models allowed us to more accurately meet animal requirements. By fractionating crude protein into RDP and RUP, and formulating to meet the MP requirements of the animal, we recognized the potential to lower the total amount of crude protein fed without sacrificing milk and milk component production. The goal, therefore, was not to simply lower ration crude protein but to meet the MP requirements of the animal while lowering purchased feed costs. Bottom line: This helped improve income over feed costs.

Amino acids

Of the nitrogen fed to dairy cows, only 21 to 38 percent actually is exported as milk or meat. Consequently, 62 to 79 percent of the nitrogen fed is excreted in urine and feces.

Can we increase the efficiency of nitrogen utilization? Yes, we can via amino acid balancing. What started as a catchy phrase has become a best practice when formulating dairy rations.

Our counterparts in the swine and poultry industries, in monogastric livestock production, have long realized and capitalized on the production and efficiencies that occur when balancing for an animal's specific amino acid requirements.

In our defense, the ruminant animal is much more complex. With ruminants, amino acids need to be protected enough to get past the rumen, so they can be available for digestion and absorption in the small intestine. The "crude" protein we originally balanced for was actually a composite of different amino acids.

As an industry, we want to move the dairy business forward. Amino acid balancing provides additional opportunities for the dairy to profit, i.e., higher milk and component production or reduced protein needs.

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Ideally, each amino acid's supply and requirements would be identical matches. However, the amino acid composition of milk protein differs from the amino acid composition of feed ingredient protein. This mismatch often results in deficiencies of amino acids in dairy rations. These deficiencies, in turn, result in production or profit inefficiencies.

When amino acids are supplied at levels below cow requirements, milk production is limited. Two amino acids are typically first limiting, methionine and lysine. It is absolutely necessary that these two amino acids make up a certain portion of the dietary protein content. Without them, dairy cows simply cannot produce at peak potential.

Today's leading dairy nutritionists use amino acid balancing to improve milk component and milk production levels, improve protein utilization and lessen dairy's environmental impact. ***PD***

PROGRESSIVE DAIRYMAN

Reprinted from May 7, 2015