# First steps to amino acid balancing best practices

*There are steps nutritionists can take to help dairy herds better reach their full potential by balancing amino acids.*

By **JESSICA TEKIPPE***

AMINO acid balancing has become increasingly popular in dairy nutrition, yet nutritionists can sometimes find themselves being overwhelmed with the volume of information available.

The following article lays the foundation for steps nutritionists can take to help herds better reach their full potential.

## Essential amino acids

The first step is to emphasize essential amino acids (EAAs), not crude protein. Conventional but increasingly dated diet formulation is based on crude protein estimation with a safety premium to avoid amino acid malnutrition. Consequently, higher excretion of nitrogen-containing compounds results, because the protein supply is not matched as closely as possible to requirements.

What cows need is some combination of EAAs in both rumen-available and unavailable fractions. During the digestion process, proteins break down into amino acids that are absorbed into the bloodstream. These amino acids are then incorporated into new protein molecules.

Currently, dairy cows convert 35% of dietary nitrogen to milk nitrogen. Feeding practices for monogastric animals are seeing accumulation levels as high as 85%. The difference among species can be partially attributed to the current understanding and usage of amino acids.

Most efficiency issues with EAAs in dairy cows result from the inability of productive tissue to capture the EAA when it passes through mammary tissue. Mammary blood flow is a major part of the process, and research has found a connection between signaling and single-nutrient limitations, which leads to inefficiencies.

The rumen itself adds complexity, as the amino acids consumed in the diet may not be the same amino acids that reach the animal. In addition, rumen microbes have amino acid requirements. If the level of an amino acid is low, it will take longer for translation to occur and for the microbe to grow.

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## DMI

Another important step with amino acid balancing is measuring dry matter intake (DMI). Measuring DMI can be difficult with some herds and may require weighing back the refusal, yet knowing the actual DMI can affect the bottom line.

The DMI can vary from the ration as formulated to what is mixed to what cows eat after sorting. The Table illustrates the difference in grams of methionine and lysine supplied if the DMI is calculated incorrectly.

It is also recommended that the moisture content of forage be tested weekly to adjust the feeding rate in order to keep the actual pounds of dry matter consistent. It is recommended that forage rates be changed with any fluctuation in forage moisture greater than 2%.

**Variation in grams of methionine and lysine supplied at varying DMI levels**

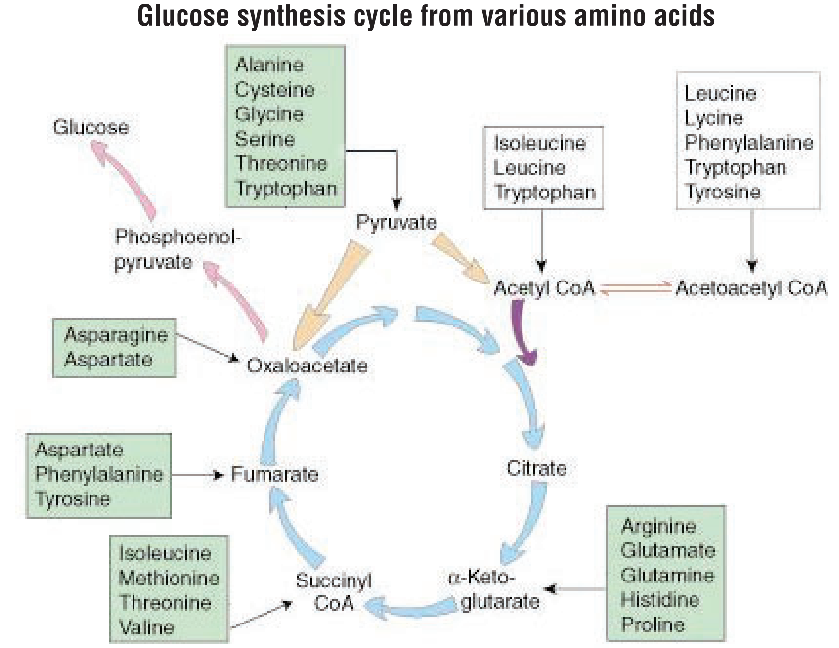
| DMI, lb. | Methionine | Lysine |
|---|---|---|
| 52 | 56 | 170 |
| 55 | 60 | 180 |
| 58 | 63 | 190 |

The feedstuffs' composition is also critical when balancing for amino acids. Many feedstuffs, especially byproducts, can vary in nutrient value and should be tested to make sure they deliver the grams of amino acids wanted.

## Other nutrients

Amino acids are important, but don't overlook other nutrient needs. If other nutrient

**Glucose synthesis cycle from various amino acids**



needs go unmet, the amino acids in the ration may be rendered useless.

In pigs, for example, lysine requirements are expressed with respect to net energy — the energy needed for the process of tissue protein synthesis.

In ruminant nutrition, the separation of energy and protein is impossible. The energy level of the diet has a large effect on feed intake. Differences in feed intake directly result in variations in milk yield potential, intake of protein and rate of digestion, which will affect rumen undegradable protein. Energy also affects microbial growth capacity and the ending fate of these amino acids. If energy is limiting, amino acids will be deaminated.

Amino acids are categorized as glucogenic or ketogenic amino acids based on whether or not their carbon skeleton can be converted to glucose (Figure).

Another important factor in nutrient availability is the carbohydrate source. Providing various carbohydrate sources maximizes the ability of rumen microbes to provide much of the cows' protein needs. Carbohydrate availability determines the rate of microbial growth in the rumen and the efficiency of utilization of ruminal ammonia.

Carbohydrate supplementation and source, starch degradability and synchronization of ruminal energy and nitrogen release may be key factors in improving the efficiency of nutrient utilization in ruminants.

## Amino acid ratios

Another key practice is controlling the ratios of amino acids to each other. Body cells use active transport mechanisms to take up amino acids. The three different types of transport for amino acids are neutral amino acids (threonine, leucine, valine, isoleucine, phenylalanine, methionine, cystine/cysteine and tryptophan), basic amino acids (histidine, arginine and lysine) and acidic amino acids.

Within an amino acid type, one amino acid can compete for and inhibit the transport of another. Because of the potential negative effects of amino acids on each other, the factorial method may overestimate production responses when one amino acid is in excess.

For example, in one study where lysine was the first-limiting amino acid, extra methionine was supplemented, and milk protein production decreased.

For this reason, monitoring key ratios is critical. The appropriate ratio for lysine to methionine is around 2.85-3.00:1. The ratio is important also because of intake control.

It has been proved that intake is controlled by oxidation of fuels in the liver. This can come from several sources, including excess amino acids. If there isn't enough methionine or lysine, the excess of either is oxidized, releasing non-esterified fatty acids that suppress intake and affect the liver's ability to produce glucose, the main precursor for milk production.

Finally, nutritionists must choose the most efficient way to provide amino acids to cows. The ruminant uniquely takes up amino acids through two forms: the feed itself and rumen microbes. The amino acid profiles of microbial protein and milk are very similar. This makes microbial protein a high-quality protein similar to the animal proteins used in feeds.

The National Research Council (2001) predicted microbial protein production from the amount of predicted digested organic matter in the rumen. If the diet is limiting in ruminally degraded feed protein, predicted microbial protein production is limited. The amount of microbial amino acids can then be predicted based on the assumed amino acid profile of the microbial protein.

Amino acid requirements can also be met using rumen-protected amino acids. For example, supplementation with a rumen-protected lysine may achieve a lysine concentration in metabolizable protein that comes as close as possible to meeting the optimal concentration without oversupplying amino acids.

Nutritionists can help ensure that dairy herds realize the greatest return on investment possible by balancing for amino acids and supplementing as needed. The key to any new nutritional program is to have an open dialogue among everyone involved. ■