by Chuck G. Schwab, Darin R. Bremmer, and Eric C. Schwab

Why balance diets for these amino acids?

FOR about 90 percent of you with dairy herds, higher milk component levels mean bigger milk checks. Of today's 10 federal milk marketing orders (FMMOs), six pay for protein and fat using a multiple component pricing (MCP) system. These FMMOs — Northeast, Upper Midwest, Central, Mideast, Pacific Northwest, and Southwest — account for more than 80 percent of the FMMO milk receipts. California has used multiple-component pricing since 1962.

If you are paid for components, then your goal should be to feed for components. Our experience is that producers cannot realize maximum component yields, particularly milk protein, without balancing for lysine and methionine.

Lysine and methionine usually are the first two limiting amino acids for lactating cows. They are provided to the cow in shorter supply, relative to body need, than other amino acids. Because amino acids are the building blocks for protein, the quantity of protein the cow can synthesize depends on her supplies of lysine and methionine, not on the supply of other amino acids. Not until diets are balanced for lysine and methionine can you make maximal use of the other amino acids.

Why it matters

First, protein generally is the most valued milk component. Except for a few months, protein prices always have been higher than butterfat prices, sometimes much higher. During the last 11 years, annual butterfat prices have varied between $1.19 and $2.05 per pound, and protein prices have varied between $1.69 and $3.89 per pound.

Second, milk protein concentrations are affected by diet more than some people think. Notable feed factors are fat levels and carbohydrate balance. Too much fat lowers milk protein whereas an improved balance of fiber, starch, and sugars raises milk protein. Milk protein also improves with amino acid balancing. Research dating to the 1970s shows that the "more balanced" the amino acids, the higher the milk protein. Diet effects are independent of factors such as breed, genetic merit, stage of lactation, parity, and season.

A third point is that several computer models can predict concentrations of amino acids in digestible protein, or what is more commonly called metabolizable protein.

And, finally, for several of the models, we now have lysine and methionine dose-response plots that show how changes in concentrations of these amino acids in metabolizable protein affect content and yield of milk protein.

Our experiences confirm that there is an optimal ratio of lysine and methionine in metabolizable protein. Concentrations of lysine and methionine in metabolizable protein have a big effect on milk protein percentages. And it usually is impossible to achieve the levels of lysine and methionine in metabolizable protein that are needed to maximize income-over-feed costs without the use of a rumen-protected methionine supplement. Finally, balancing for lysine and methionine reduces the amount of rumen-undegradable protein to be purchased.

What can happen

The most obvious response to amino acid balancing is a boost in milk protein percentage. Improvements of 0.2 percentage units are common. A 0.1 percentage unit rise in butterfat usually accompanies the rise in milk protein.

Gains in milk protein of 0.30 percentage units have been seen, as well. But jumps this great usually are associated with diets that were very high in lysine and low in methionine before amino acid balancing.

Documenting accurate on-farm milk yield responses from amino acid balancing often is difficult due to the number of factors affecting milk yield and daily measurements. However, many research studies show milk responses. As expected, early-lactation cows are more responsive than later-lactation cows. A summary of 13 experiments showed an average of more than 6 pounds of milk during the first 4 to 15 weeks of lactation. After peak lactation, a smaller percentage of cows respond with more milk, but most still respond with higher milk protein.

Calculating effects on herd profitability from balancing for lysine and methionine is difficult due to the number of benefits realized. To see how modest effects on production and components impact herd profitability, see the table.

The top portion shows the value of components and total milk for cows averaging 80 pounds of milk with milk containing average Upper Midwest FMMO component levels. Pricing was done for years when milk prices were low (2009), average (2004), and high (2008).

The middle part of the table assumes that the ration was balanced for a moderate response to amino acid balancing. Why a modest response? A skeptical producer or consultant may be conservative in their approach. They may have the lysine to methionine ratio right, but they may not believe it is necessary to push the levels higher. Maybe everything is "fully dialed in," but the methionine supplement fed is not as "protected" as thought and so actually is underfed. Or, the high-lysine protein supplement fed is overprocessed (overheated) and does not contain the expected level of digestible lysine. In this case, you may see a "moderate" herd response of an additional 0.1 percent unit of protein. Our best guess is that the cows also produced an extra 1 pound of milk.

The bottom of the table shows the value of components and total milk for a "fully dialed in" approach to achieve above-average responses. That might be 0.2 percent units more protein, 0.1 percent units more fat, and 2 pounds more milk (82 instead of 80). This approach can maximize income-over-feed costs.

Of course, income benefits are better when milk prices are higher. However, you should note that a 70 cents advantage existed even in the worst year. In the best year (2008), there was a $1.12 advantage. Another point is that these responses are gross increases in income as they do not consider likely savings in reduced protein purchases.

Daily income (dollars) per cow for protein, fat, and milk without and with amino acid balancing in years with low, normal, and high milk prices*

	2009 (Lower milk prices)	2004 (Normal milk prices)	2008 (Higher milk prices)
		No amino acid balancing (80 pounds milk)	
Protein	$5.34	$6.01	$9.39
Fat	$3.72	$5.79	$4.66
Total milk	$9.71	$12.13	$14.31
		"Moderate" responses to amino acid balancing (+1 lb. milk, +0.1% protein)	
Protein	$5.59	$6.28	$9.82
Fat	$3.77	$5.86	$4.72
Total milk	$10.01 (+.30)	$12.48 (+.35)	$14.80 (+.49)
		"Above average" responses to amino acid balancing (+2 lbs. milk, +0.2% protein, +0.1% fat)	
Protein	$5.84	$6.57	$10.26
Fat	$3.92	$6.10	$4.91
Total milk	$10.42 (+.71)	$13.00 (+.87)	$15.43 (+1.12)

*Assumes an average milk yield of 80 pounds without amino acid balancing.

What it means

We have seen responses at 65 pounds and more than 100 pounds of milk. Confirmation of its benefit on margins occurred in 2009 when clients insisted on continuing amino acid balancing. They had seen firsthand the benefits of long-term amino acid balancing on milk yield, component levels, income-over-feed costs, and cow health.

Research studies typically show more milk in early lactation with smaller effects on milk protein concentrations. After peak, the effects on milk protein percentage are more pronounced. However, we have a well-documented situation where protein concentrations went up more than 0.20 percent units in cows in the first two to three weeks of lactation.

High milk yields do not mean you cannot also have high components. Milk yields for Holsteins of 95 pounds or higher with butterfat of at least 3.8 percent and protein of 3.25 or higher are attainable. You do need above-average management skills for this to happen, but correctly balancing for lysine and methionine is clearly part of the solution.

Chuck Schwab is the principal at Schwab Consulting, LLC, Boscobel, Wis., and professor emeritus, animal sciences, University of New Hampshire; Bremmer and Eric Schwab provide dairy nutritionist and technical services at Vita Plus Corporation, Madison, Wis.

Used by permission from the May 25, 2011, issue of Hoard's Dairyman.
Copyright 2011 by W.D. Hoard & Sons Company, Fort Atkinson, Wisconsin.