Conclusion:

Precision feeding of dairy cows makes it possible to optimize the production of metabolizable protein from the diet. The benefits of optimizing the production of metabolizable protein are more efficient milk production which will lead to lower feed costs. You will also be able to optimize the production of milk components which will add value to milk in those markets that pay producers for milk protein and milk fat. Maximizing the yield of metabolizable protein from the diet requires the proper balance of sugars, starches and fermentable fiber in the diet to drive microbial protein production in the rumen. The second step in maximizing metabolizable protein production is to provide the proper balance of amino acids in the dietary RUP. Evaluation of dose response trials with dairy cows, would suggest that to optimize milk protein yield in cows producing greater than 75 pounds of milk will require greater than 185 grams of metabolizable lysine and greater than 58 grams of metabolizable methionine.

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PRECISION FEEDING OF DAIRY COWS: MAXIMIZING METABOLIZABLE PROTEIN AND REDUCING FEED COSTS

Precision feeding of dairy cows requires two steps. First, you must provide the proper mix of sugars, starches, fermentable fiber, NPN and amino acids to the rumen bacteria to maximize microbial protein production. Second, you must provide the proper mix of amino acids in the rumen undegradable protein supplied by the diet. Metabolizable protein comes from microbial protein and rumen undegradable protein. Microbial protein is high quality metabolizable protein and provides the correct mix of amino acids to optimize milk component production. The quality of the metabolizable protein from the diet will be variable and dependent on the quality and sources of rumen undegradable protein in the diet. The benefit of maximizing metabolizable protein production is being able to feed lower crude protein diets without decreasing milk or milk component yield.

Many dairy producers would like to increase milk and protein. Milk yield and milk protein yield are increased by formulating dairy diets to supply optimal amounts of lysine and methionine as part of the metabolizable protein (NRC 2001). There is a common misconception among nutritionists that we can not effectively formulate dairy cattle diets to supply lysine and methionine because we can not confidently predict the supply of amino acids in the metabolizable protein reaching the duodenum. Use of dairy formulation software such as CNCPS, CPM, Dalex and NRC makes it possible to predict the supply of lysine and methionine in the metabolizable protein reaching the duodenum for absorption.

What can be achieved by maximizing metabolizable protein and balancing lysine and methionine in the diet at appropriate levels?

- ***A more precise feeding program***
- ***Efficiency through increased performance and/or lowering feed cost***

Guidelines to maximize metabolizable protein production

1. Sugar content of the diet should be between 5 -7% of diet dry matter and should supply 0.75-1.2 lb supplemental sugar from a molasses-based liquid supplement.
2. Sugar plus starch content of the diet should not exceed 31% of diet dry matter. For example if the diet contains 6% sugar, the maximum starch content should be 25%.
3. Forage NDF as a percent of total NDF in the diet should be between 70% and 80%
4. If you feed a diet containing less than 23% starch make sure that you have plenty of fermentable fiber in the diet. High quality alfalfa hay is an excellent source of soluble and insoluble fermentable fiber.
5. Total NFC in the diet should fall between 38 – 42% of diet dry matter.
6. Estimated microbial protein production from the rumen should be 1400 – 1600 grams per day and microbial protein should supply 50 – 60% of the metabolizable protein in the diet.

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7. RDP as a percent of diet DM should be between 10.5% and 11.5%. The amount of RDP required in the diet will be a function of the amount of rumen fermentable carbohydrate in the diet.
8. Peptide balance should be between 100 – 110%
9. Set the lysine content of the diet to a minimum of 6.8% of the metabolizable protein. This will provide a minimum of 180 – 190 grams of metabolizable lysine in the diet.
10. Set the methionine content of the diet to a minimum of 2.3% of the metabolizable protein. This will provide a minimum of 60 – 65 grams of metabolizable methionine.

Guidelines for Lowering Feed Costs without a Loss in Milk or Milk Components

1. When soybean meal price exceeds $300 per ton, the cost per pound of protein will exceed $0.3125 per pound. Replace some of the soybean meal in the diet with protein from forage, QLF liquid supplement and distiller's grains.
2. Use rumen protected amino acids to supply part of the lysine and methionine needed in the diet. Use of rumen protected amino acids makes it possible to optimize milk protein production without having to feed high protein diets.
3. Do not over feed protein. When formulating diets to optimize metabolizable protein production, you can formulate diets at 16.5% crude protein.
4. Use products which have been shown to stimulate dry matter intake during the transition period. When cows have higher dry matter intake pre-calving, they have higher dry matter intake post-calving and this will lead to a smoother transition and greater milk yield in the first 50 DIM. Higher milk yield during the first 50 DIM will lead to higher milk yield during the entire lactation when persistency of lactation is normal. Use of QLF liquid supplement during the transition period will boost dry matter intake.
5. Use QLF liquid supplement to provide uniform delivery of ionophores to the TMR which will increase feed efficiency.
6. Monitor milk production efficiency for the herd. Your goal should be greater than 1.6. If a herd is producing 80 pounds of 3.5% fat-corrected-milk and the average dry matter intake for the herd is 52 pounds, then milk production efficiency is 1.54. Efficiency values less than 1.6 may indicate that fermentation in the rumen is not optimized.

Use of QLF TMR 40 to Lower Feed Costs
1.2 pounds of QLF TMR 40 can replace 1 pound of soybean meal

Table 1. Cost Comparison of Soybean meal and QLF TMR 40

Soybean Meal (48% CP) $/Ton	Cost per Pound $	Cost for 1.2 pounds of TMR 40 $	Savings from replacing 2 pounds of soybean meal with TMR 40 $
330	0.165	0.168	0
350	0.175	0.168	0.014
400	0.200	0.168	0.064
450	0.225	0.168	0.114
475	0.237	0.168	0.138

Example in table does not include the effect of sugar from TMR 40 on rumen fermentation or forage digestion.

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Step 2 of Precision Feeding is to make sure the diet supplies enough lysine and methionine to optimize the yield of milk components

We can use animal performance in dose response trials to estimate the lysine and methionine requirement. The values listed in table 2 represent the amount of absorbable lysine required to maximize milk protein yield as reported in the cited trials. High producing cows (>75 lbs/day) appear to require between 185 and 221 grams of absorbable lysine to optimize milk protein yield. To supply greater than 185 grams of metabolizable lysine, the diet should contain 6.8% - 7.2% lysine as a percent of the metabolizable protein. For example, if a diet supplies 2800 grams of metabolizable protein with a lysine content of 6.8%, then the diet would supply 190 grams of metabolizable lysine. The values listed in table 3 represent the amount of absorbable methionine to optimize milk protein yield as reported in the cited trials. To maximize milk protein yield, it appears to require a minimum of 2.4% methionine as a percent of the MP. It appears that cows producing greater than 75 lb of milk will require 58 -65 grams of metabolizable methionine to optimize the yield of milk protein.

Table 2. Lysine required for maximum yield of milk protein based on milk yield and composition.

Milk Yield lb/d	Milk Protein Content, %	Lysine supplied as a % of total essential amino acids (%EAA)	Absorbable Lysine Supplied g/d	Reference
77	3.20	14.8	221	Rulquin et al. 1990
77	3.05	15.2	204	Schwab 2006
73	2.99	13.9	197	Schwab 2006
68	3.16	14.5	195	Schwab 2006
81	2.97	14.5	242	Pisulewski et al. 1996
101	2.94	NR[1]	185[2]	Socha et al. 2005

[1]Not Reported [2]As reported in the cited reference

Table 3. Methionine required for maximum yield of milk protein based on milk yield and composition.

Milk Yield lb/d	Milk Protein Content, %	Methionine supplied as a % of total (EAA) or (TAA) or (MP).	Absorbable Methionine Supplied g/d	Reference
77	3.02	5.1 (%EAA)	52	Rulquin et al. 1993
77	3.0	5.0 (%EAA) (2.4% MP)	58	NRC 2001
77	3.26	2.2 (%TAA)	74	Socha et al. 2008
81	2.94	>5.0 (%EAA)	77	Pisulewski et al. 1996
84	3.15	2.4 (%TAA)	77	Socha et al. 2008
90	3.02	2.7 (%TAA)	62	Socha et al. 2008

The most efficient way to supply lysine and methionine to the cow is to maximize microbial protein production in the rumen and you can accomplish this by feeding supplemental sugar in the diet from QLF liquid feed. As stated previously diets should contain 5 – 7% sugar and this usually requires the feeding of 0.75 to 1.2 pounds of supplemental sugar in the diet.

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