Amino Acid Balancing

An Opportunity to Lower Feed Costs - and - Maximize Revenue

By

Brian Sloan, Ph.D.

Version 2.0

About the Author

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Dr. Sloan has spent most of his professional life researching and developing practical methods for applying amino acid formulation in dairy cows. He was born in Scotland where he received his professional education. He worked in France for 10 years in research and development of amino acid products for dairy cows. He is fluent in French and English and has published numerous papers on amino acid balancing.

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Table of Contents

Reducing Ration Costs **3**
Can I really reduce ration cost through amino acid balancing and still maintain my present level of milk production, while potentially increasing milk components?

Are the Savings Worth the Effort? **13**
Are the savings I can make through amino acid balancing worth the effort?

Practical Feeding Conditions **15**
In what practical feeding conditions have you demonstrated both a decrease in ration cost and an improvement in milk performance?

Removing Protected Methionine **23**
If I remove the protected methionine from my formulation, what will I lose in terms of volume and components?

Impact of Milk Protein Prices **25**
At what price of milk protein does it become uneconomical to feed a protected methionine product?

Component loses when Protected Methionine is Removed **30**
How quickly will milk protein and fat decrease, once MetaSmart® is removed from the ration?

Decreasing Crude Protein **33**
Can I decrease my ration crude protein levels to 16%?

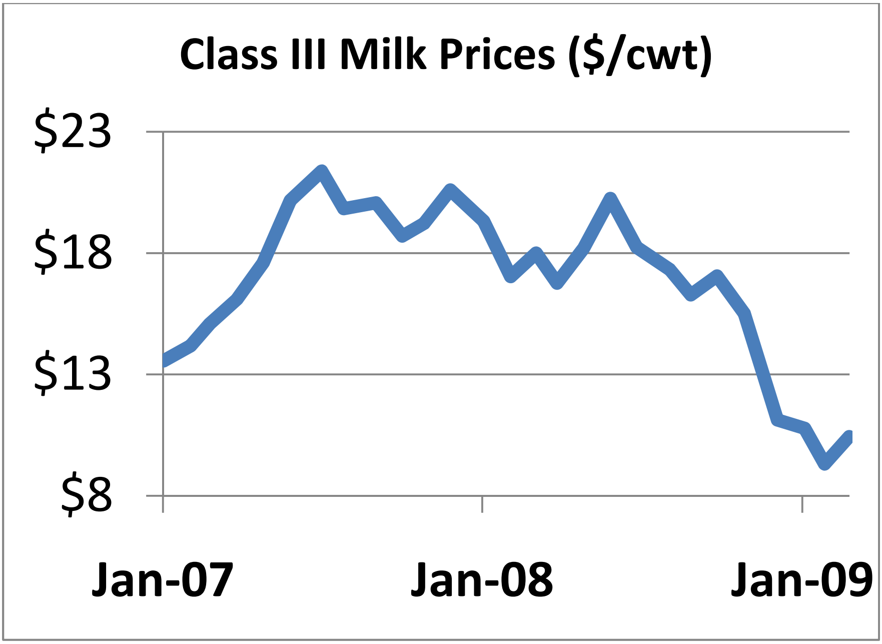
Preface

In the current milk market environment, amino acid balancing is more important than ever.

The current - very low - milk pricing is leading to unprecedented pressure on producers to reduce feed costs dramatically in order to remain in business. What can be done to help the producer through this crisis without compromising component production and milk revenue?

The pie chart below is based on March, 2009 Federal Milk Marketing Order component pricing. Protein has consistently made up more than half the milk check revenue. This revenue cannot be sacrificed.

However, because total milk revenue has significantly decreased from the 2007/8 highs, feed costs must be minimized to maintain operations.



This pamphlet is based on questions that I have received specifically addressing the role of amino acid balancing in the current environment.

Each question is followed by a short answer as to how amino acid formulation can be used to address the specific issue in the question. In most cases, I've followed the answer with an example, based on controlled studies, to substantiate and illustrate the solution.

Q. Can I really reduce ration cost through amino acid balancing and still maintain my present level of milk production, while potentially increasing milk components?

A. The fortunate aspect of employing amino acid balancing is that, as in monogastric nutrition, you can supply the required quantities of the essential amino acids (Lysine and Methionine) within a smaller amount of protein. In a dairy formulation, you can thus reduce the level of MP and RUP in the ration. The space created in the formulation can be used to supply more of another critical nutrient (NFC, NDF, etc.) utilizing less expensive ingredients, thus lowering the cost of the ration. All solutions still enable metabolizable methionine levels to be increased, resulting in milk production being maintained and components improved.

Reduce Ration Cost by Balancing Amino Acids

An Example of a Reformulated "Western" Dairy Ration

Brian Sloan, Ph.D.

To illustrate how to reduce the cost of a ration and still improve performance, a typical ration was formulated through CPM to meet the requirements of a cow producing 100 lbs. of milk - 3.50% fat and 3.30% Crude Protein (CP) - eating 54.1 lbs. of Dry Matter (DM) daily. Ingredient costs were California spot prices for the second week of November 2008.

The ration contains typical forages - corn as the principal grain, canola and distillers as the principal protein sources with one pound of an animal protein blend to provide additional Rumen Undegradable Protein (RUP) to meet metabolizable protein (MP) requirements.

“Conventional Western” Dairy Ration for High Producing Dairy Cow

Ration Formulated to Meet Nutrient Requirements of 2^{nd} Lactation Cows Producing 100 lbs. with 3.50% Fat and 3.30% CP

Ingredients	Lbs. as Fed	Ingredient Cost per Ton ($)
Alfalfa Hay	13.00	220
Corn Silage	47.00	50
Cane Molasses	1.00	160
Flaked Corn	14.50	186
Canola Meal	4.00	250
Whole Cottonseed	3.50	320
DDGS	3.00	195
Animal Protein Blend	1.00	865
Soybean Hulls	4.00	202
Tallow	0.20	420
Basemix - Premix	1.00	550
	Total DMI = 54.1 lbs	Cost per cow per day = $6.54

This ration was slightly positive in Metabolizable Energy (ME) balance (balanced for MP) and had a reasonable metabolizable lysine (LYS) level of 6.48% of MP.

However, the lysine (LYS) to metabolizable methionine (MET) ratio was 3.33 to 1 compared to the optimum 2.89 to 1 determined recently by Whitehouse et al. This indicates that MET levels need to be improved to exploit efficiently the LYS in the ration and all the other amino acids (AA).

Conventional Dairy Ration for High Producing Dairy Cows

Nutrient Balance Evaluated by CPM Version 3.0.10

ME Balance (mcal)	**3.00**
MP Balance (g)	-7.20
LYS (% of MP)	6.48
LYS (g)	193.60
MET (% of MP)	1.95
MET (g)	58.20
LYS:MET Ratio	3.33
CP %	17.70

Amino Acid Balancing Leads to Better Rations – Lower Cost

In the reformulated ration example, it was assumed that by bringing the ration into balance to achieve a LYS to MET ratio (2.89 to 1) while still maintaining the same level of LYS as a % of MP, the lactation protein efficiency would improve by 2.5 points from 0.65 to 0.675. This is a scenario where targeting higher LYS and MET as a % of MP, may not be financially justified due to the minimal milk protein premium being paid. The ration was reformulated and an amino acid balanced ration was achieved at a **savings of 16 cents per cow per day.**

The major changes were that the % of forage in the ration increased from 47.6% to 49%, whole cottonseed dropped from 3.50 lbs. to 2.5 lbs., and the inclusion of soybean hulls increased from 4 to just over 5.5 lbs.

The animal protein blend dropped out of the ration in preference for protected soybean meal. Liquid MetaSmart was formulated in to supply the extra MET needed to bring the ration into balance.

Amino Acid Balancing Leads to Better Rations – Lower Cost

Ration Formulated to Meet Nutrient Requirements of
2nd Lactation Cows Producing 100 lbs. with 3.50% Fat and 3.30% CP

Ingredients	Conventional	Amino Acid Balanced
	(lbs. as Fed)	
Alfalfa Hay	13.00	13.50
Corn Silage	47.00	48.00
Cane Molasses	1.00	1.00
Flaked Corn	14.50	13.50
Canola Meal	4.00	4.00
Whole Cottonseed	3.50	2.00
DDGS	3.00	3.00
Animal Protein Blend / Protein SBM	1.00	1.00
Soybean Hulls	4.00	5.65
Tallow	0.20	0.20
Basemix - Premix	1.00	1.00
Liquid MetaSmart®		0.05
Cost per cow per day	$6.54	$6.38

Not only was the amino acid balanced ration less expensive than the conventional ration, it also had a better nutrient profile. MP balance is still close to zero when the 2.5% point improvement in MP utilization (lactation protein efficiency) is taken into consideration. This allows a savings of over 70 g in MP supply, as you need less MP to meet amino acid requirements when the MP has an improved amino acid balance.

The LYS to MET ratio is improved to meet the target ratio of 2.89 / 1. The lysine supply was decreased slightly, but this has no negative consequence as LYS was in excess in the conventional ration and could not be fully exploited because of the deficit in MET.

The CP content of the amino acid balanced ration could be decreased by over half a point of protein because of the need for less MP supply. What stands out, however, is that the amino acid balanced ration will supply 7.5 g more MET. This extra MET will give enhanced performance at a lower cost.

Nutrient Balance Evaluated by Version 3.0.10

	Conventional	Amino Acid Balanced*	
ME Balance (mcal)	3.00	2.20	
MP Balance (g)	-7.20	6.40	
LYS (% of MP)	6.48	6.53	
LYS (g)	193.60	191.00	
MET (% of MP)	1.95	2.25	
MET (g)	58.20	65.70	+7.50
LYS:MET Ratio	3.33	2.91	
CP %	17.70	17.10	-0.60

*Assumes a 2.5% point improvement in MP utilization

It is important to note that when balancing rations for amino acids, we should always be striving to maximize the microbial protein contribution, first and foremost. In this example, there was actually a small numeric increase in microbial protein supply; therefore, the reduction in MP supply was all in terms of economizing on the level of supplemental RUP needed.

Nutrient Balance Evaluated by CPM Version 3.0.10

	Conventional	Amino Acid Balanced*	
Forage %	47.60	49.00	**+1.40**
Crude Protein %	17.70	17.10	**-0.60**
Microbial Protein (g)	1584	1610	**+26**
LYS (% of MP)	6.48	6.53	
LYS (g)	193.60	191.00	
MET (% of MP)	1.95	2.25	
MET (g)	58.20	65.70	**+7.50**
LYS:MET ratio	3.33	2.91	
	***Assumes a 2.5% point improvement in MP utilization**		

It is important to recognize the benefits of a lower CP package that is better amino acid balanced…

The ration was formulated for 100 lbs. of milk which would equate to the production level of the high producing group. Assuming this was a one group total mixed ration (TMR) and the herd average was 85 lbs. of milk, how will the supply of an extra 7.5 g of MET, as part of an amino acid balanced ration impact milk composition?

As a rule of thumb, for every one gram of supplementary MET the estimated response should be 7 g of milk protein. In this example, we could thus expect an extra 52.5 g (0.115 lbs.) of milk protein. If we assume that milk yield will not change, then an increase in milk protein % of between +0.12% to 0.15% should be observed.

Increasing MET by at least 5 g also shows, on average, an increase of +0.1% points in milk fat. Because we used MetaSmart as the supplementary source of MET in this example, we can also anticipate a further response in milk fat due to MetaSmart's contribution to the rumen pool of HMB, for a total increase of +0.15% in milk fat.

Performance Benefits to Amino Acid Balancing

The + 7.5 g of extra metabolizable methionine will give

1) **At least the same lbs. of milk (85lbs.)**
2) **An increase in milk protein (~+0.12% to 0.15%)**
3) **An increase in milk fat (~ +0.15%)**

➡ And still a lower feed cost of 16 cents per cow per day

Q. Are the savings I can make through amino acid balancing worth the effort?

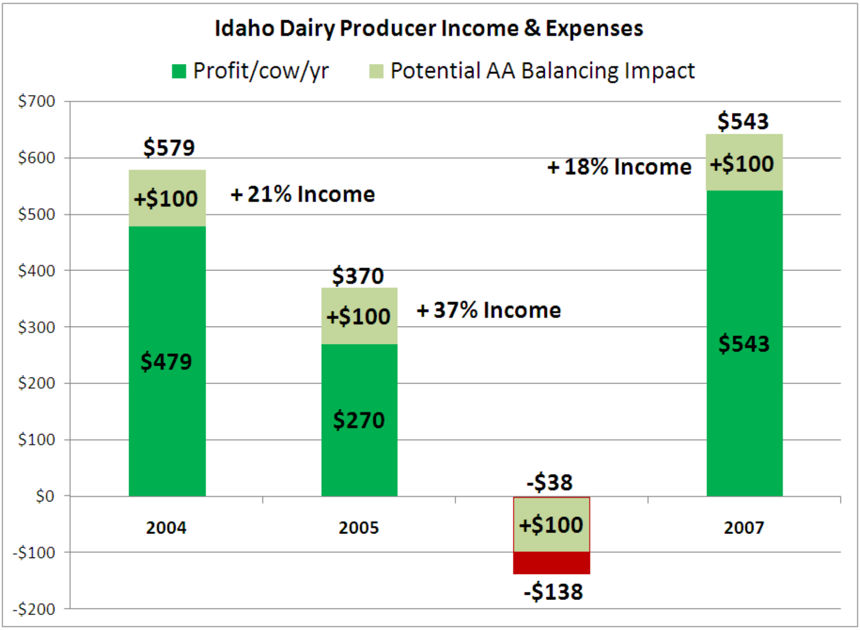
A. Typically a savings of 10 cents per cow per day is feasible. For a one thousand cow dairy, this corresponds to $365,000 per year. The accompanying improvement in milk components will be an increase in milk value of at least 20 cents per cow per day - a net benefit of 30 cents per cow per day or $100 per cow per year. Looking at typical profitability over the last five years, this can easily contribute 20% of the profit in a good year, and the difference of making a profit or not in a bad year.

Impact of Amino Acid Balancing on Producer Income

For the years 2004 through 2007, dairy producers in Idaho recorded annual income/losses per cow as follows.

2004	**2005**	**2006**	**2007**
$479	$270	($138)	$543

Saving 10¢ per cow per day in feed while increasing 20¢ per cow per day additional revenue, annual income per cow could be increased by $100. On a daily basis, this may not seem like much, but when compared with profitability on an annual basis, the improvement in income is very significant.



Participating dairies consisted of ~ 2000 cows with daily milk production of 68 lbs per day, butterfat of 3.7%, and protein of 3.1%. Herd turnover of was 30%.

Q. In what practical feeding conditions have you demonstrated both a decrease in ration cost and an improvement in milk performance?

A. In October 2008, the ration for a 2500-cow dairy in the Southwest was reformulated according to amino acid balancing principles. Ration cost was reduced by six cents per cow per day, milk volume was maintained, and both fat and protein % were each improved by approximately +0.1% points.

Case Study:
2500 Cow Herd in Southwest

By

Brian Sloan, Ph.D.

In October 2008, the ration on a 2500 cow dairy in the Southwest was reformulated according to amino acid balancing principles - the primary objective was to lower ration cost while maintaining milk production and eventually enhancing milk components.

The ration was reformulated using the existing ingredients already being used on farm. The major forage change was a reduction in the alfalfa hay inclusion while increasing the corn silage. This was accomplished with a savings in ration cost of six cents per cow per day.

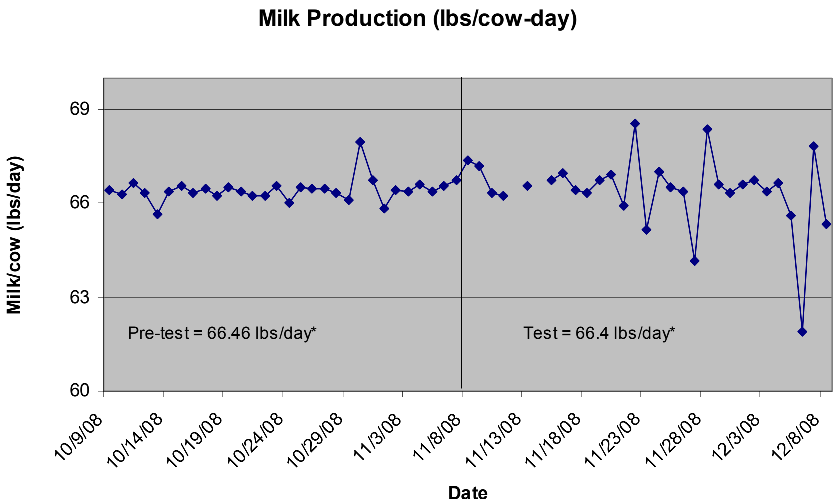
Ingredient (lb/day)	Initial Diet	AA Balanced Diet
Alfalfa Hay	14.8	11.0
Corn Silage	12.7	30.0
Wheat Silage	6.4	6.0
Alfalfa Silage	10.6	10.0
Canola Meal	4.8	*4.0*
Min-Vit	1.5	1.5
Corn Grain	7.4	6.5
Flaked Corn	5.8	5.5
Wheat Hay	1.6	1.5
Mix 30*	3.2	3.0
Canola Meal (high fat)	3.2	3.0
Ext. Whole Soybeans	2.1	2.0
MetaSmart Dry	-	0.1
Cost - $/cow/day	**6.09**	**6.03**

These ration changes permitted the crude protein (CP) content of the ration to be lowered by one and a half percentage points by reducing metabolizable protein (MP) supply by 130g, mainly through lowering the digestible rumen undegradable protein (DRUP) contribution.

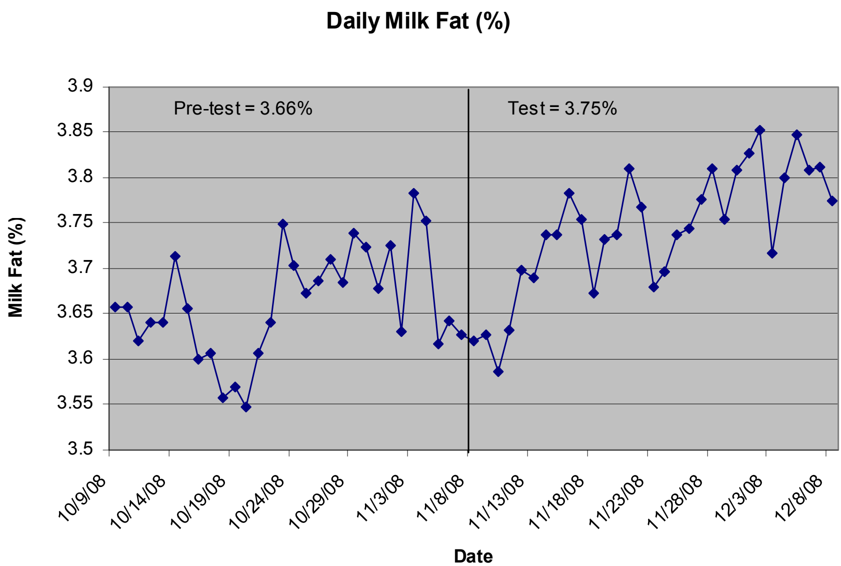
	Initial Diet	AA Balanced Diet
NDF (% DM)	27.90	29.20
peNDF (% DM)	21.50	22.60
Sugar (% DM)	6.20	5.30
Starch (% DM)	25.30	27.60
EE (% DM)	4.70	4.60
CP (% DM)	19.00	17.40
MP (g)	2714	2583
MP-Bact (g)	1425	1404
MP-RUP (g)	1288	1179
LYS (g)	185	174
MET (g)	52	60
LYS (% MP)	6.80	6.76
MET (% MP)	1.92	2.34
LYS:MET	**3.53:1**	**2.89:1**

The inclusion of MetaSmart allowed the metabolizable lysine (LYS) to methionine (MET) ratio to be brought into balance (2.89 to 1), while importantly achieving a high concentration of both LYS (6.76) and MET (2.34) in MP. The amino acid balanced ration supplied 8g extra metabolizable methionine which was anticipated to positively influence both milk fat and protein concentrations.

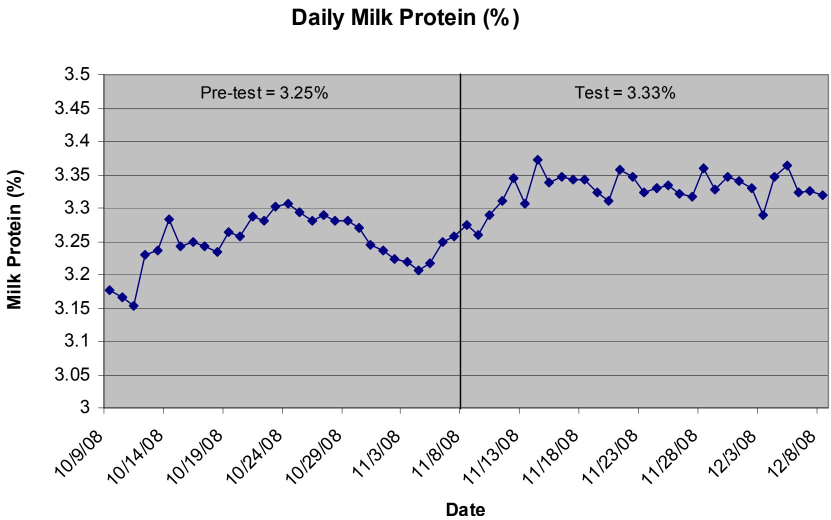
As was expected, milk yield was not influenced by the ration changes.



After the ration change, milk fat percent increased by an estimated +0.09% points.



Likewise milk protein concentrations also improved after the ration change, increasing by an estimated +0.08% points.



Even using the very low milk prices for March 2009, the change to an amino acid balanced ration not only decreased the ration cost by 6 cents per cow per day, but increased milk revenue by 17 cents per cow per day, a net benefit of 23 cents per cow per day.

On this 2500 cow herd, the effect of adopting an amino acid balanced ration would be a positive contribution of over $200,000 dollars to the bottom line on an annual basis.

Herd Data

Number of Cows: 1

		Adjustments:
Milk (lbs/cow):	64.46	±-0.04
Milk Fat (%):	3.66%	±0.09%
Milk Protein (%):	3.25%	±0.08%
Other Solids (%):	5.9%	
SCC (e.g. 350,000):	350000	
Cost Adjustment (Per Cow Per Day):		±$-0.06

	Current FMMO Pricing:
SCC:	$0.00063
Fat:	$1.159
Protein:	$2.197
Other Solids:	$-0.034

SCC Adjust/$cwt/1000:	$0.00063
Fat $/lb:	$1.159
Protein $/lb:	$2.197
Other solids $/lb:	$-0.034
PPD/cwt (Northeast #1):	$2.00
SCC Premium/cwt:	$0
Quality Premium/cwt:	$0
Other Premiums/cwt:	$0

Income Data	Current |	Adjusted
Fat ($/cwt):	$4.242 |	$4.346
Protein ($/cwt):	$7.14 |	$7.316
Other Solids ($/cwt):	$-0.201 |	
PPD ($/cwt):	$2 |	
Premiums ($/cwt):	$0 |	
Milk Price/cwt:	$13.18 |	$13.46
Milk Income/cow/day:	$8.50 |	$8.67
Milk Income/herd/day:	$8 |	$9
Milk Income/herd/month:	$258 |	$264
Milk Income/herd/year:	**$3,101** |	**$3,165**

Economic Impact	Per Cow/Day |	Per Herd/Year
Adjusted Income Impact:	**$0.17**	**$64**
Adjusted Feed Cost:	**$-0.06**	**$-22**
Income Over Feed Cost (IOFC):	**$0.23**	**$86**

Value	Per Cow/Day |	Per Herd/Year
1 lb of milk:	**$0.132**	**$48**
0.1point of milk fat:	**$0.075**	**$27**
0.1 point of milk protein:	**$0.142**	**$52**

Q. If I remove the protected methionine from my formulation, what will I lose in terms of volume and components?

A. MetaSmart® is an important ingredient in the formulation. Firstly, MetaSmart® provides the needed additional metabolizable methionine to balance a ration correctly. Secondly, MetaSmart® will provide some HMB to the rumen which will help maximize milk fat %. Removing MetaSmart® without making any other ration adjustments will decrease milk protein output. This can be estimated as follows: For every one gram of metabolizable methionine removed from the ration, milk protein will fall by 7g. Thus typically, if you remove 20g of liquid MetaSmart® from a ration, milk protein will decrease by at least 50 grams. The decrease in milk fat can be quite variable but could easily exceed 0.2%.

Q. At what price of milk protein does it become uneconomical to feed a protected methionine product?

A. The premium for milk protein pricing could fall to zero and there would still be reason to feed a protected methionine product. Rations should always be balanced for MET and LYS to optimize efficient use of protein in the diet, without adding unnecessary cost.

University of New Hampshire Field Trial 2001

by

C.G. Schwab Ph.D. & N.L. Whitehouse / University of New Hampshire -

Brian Sloan, Ph.D. / Adisseo - D. Stucker / Venture Milling

After the publication of the last NRC recommendations in 2001, the rations at the University of New Hampshire (UNH) experimental farm were reformulated to be balanced for metabolizable lysine (LYS) and methionine (MET).

This was done without increasing ration cost. Ration CP levels were decreased by one point, and milk proteins increased by +0.26%, and milk fat increased by +0.46%.

Even if the milk protein advantage was not considered this ration change was more profitable for the producer.

Ingredient Composition of the Control and Reformulated NRC diets (% of DM)

Ingredients	Control	Reformulated
Corn silage	29.81	30.76
Grass silage	9.62	13.46
Alfalfa hay	9.62	5.00
Corn grain, ground	15.38	19.22
Barley grain, ground	7.40	9.00
Soybean hulls	4.81	3.46
Soybean meal, 48%	11.63	7.52
Canola meal		3.86
Urea		0.12
SoyPlus	6.35	---
Selected Blood* + Smartamine® M	---	2.19
Protected Fat	1.92	1.92
Minerals and Vitamins	3.46	3.46
Cost $ cow/day	**5.19**	**5.19**

* ProvAAl

The changes in formulation constraints resulted in some blood meal being incorporated at the expense of the protected soybean meal.

Smartamine M inclusion ensured a LYS:MET ratio of 3:1. Rhodimet AT88 was also included to maximize rumen digestive processes.

After the eight week observational period, following the ration formulation changes, the below changes in milk performance were observed.

Changes in Milk Production, Milk Composition, and MUN Levels Following Amino acid Balancing of the Ration

	Control	Reformulated
Milk (kg/day)	41.2	41.1
True Protein %	2.87	3.13
Protein (kg/day)	1.16	1.27
Fat %	3.32	3.78
Fat (kg/day)	1.37	1.48
Milk Urea N	14.7	11.40

Rations -The Control NRC ration was fed beginning May 2000 to the University of New Hampshire Experimental herd. The ration was reformulated in February 2001 according to the new NRC recommendations.

Looking at these rations through the eyes of CPM, shows clearly that in the control ration, MP was being overfed, resulting in poor apparent lactation protein efficiency.

By balancing for MET and LYS in addition to the expected improvements in milk composition and yields, the MP balance appears negative, indicating the apparent lactation protein efficiency had been improved to 0.672, which is greater than the default value of 0.65.

Chemical Composition and CPM Version 3.0.10 Evaluation of PRE and POST UNH diets (% of DM)		
	Control	**Reformulated**
NDF	30.6	31.4
CP	18.1	17.2
RDP	11.1	10.5
RUP	7.0	6.7
MP balance, g/d	213	-64
Lys, % MP	6.78	7.07
Met, % MP	1.97	2.34
Apparent lactation Protein Efficiency	58.2	67.2

Using January 2009 feed costs and Federal Order pricing for the North East, the additional income over feed cost (IOFC) generated by making these changes in formulation to balance the rations for LYS and MET was $1.00 per cow per day.

Milk protein pricing amounted to 57 cents of this advantage. Therefore, even if this additional protein was not remunerated in any way the ration change gave a net benefit of 43 cents without needing to increase ration cost.

Bottom Line - employing amino acid balancing profitably does not need to depend on milk protein pricing.

Herd Data

Number of Cows:	1	
		Adjustments:
Milk (lbs/cow):	90.8	± -0.06
Milk Fat (%):	3.32%	± 0.46%
Milk Protein (%):	2.87%	± 0.26%
Other Solids (%):	5.9%	
SCC (e.g. 350,000):	350000	
Cost Adjustment (Per Cow Per Day):		± $0.00

Current FMMO Pricing:

SCC:	$0.00063
Fat:	$1.159
Protein:	$2.197
Other Solids:	$-0.034

SCC Adjust/$cwt/1000:	$0.00063
Fat $/lb:	$1.159
Protein $/lb:	$2.197
Other solids $/lb:	$-0.034
PPD/cwt (Northeast #1):	$2.44
SCC Premium/cwt:	$0
Quality Premium/cwt:	$0
Other Premiums/cwt:	$0

Income Data	Current	Adjusted
Fat ($/cwt):	$3.848	$4.381
Protein ($/cwt):	$6.305	$6.877
Other Solids ($/cwt):	$-0.201	
PPD ($/cwt):	$2.44	
Premiums ($/cwt):	$0	
Milk Price/cwt:	$12.39	$13.5
Milk Income/cow/day:	$11.25	$12.25
Milk Income/herd/day:	$11	$12
Milk Income/herd/month:	$342	$373
Milk Income/herd/year:	**$4,107**	**$4,470**

Economic Impact	Per Cow/Day	Per Herd/Year
Adjusted Income Impact:	$**1.00**	$**363**
Adjusted Feed Cost:	$**0.00**	$**0**
Income Over Feed Cost (IOFC):	$**1.00**	$**363**

Value	Per Cow/Day	Per Herd/Year
1 lb of milk:	$**0.124**	$**45**
0.1point of milk fat:	$**0.105**	$**38**
0.1 point of milk protein:	$**0.199**	$**73**

Q. How quickly will milk protein and fat decrease, once MetaSmart® is removed from the ration?

A. Milk protein % will decrease very quickly once the protected methionine is removed. The mammary gland relies almost entirely on a dietary supply of metabolizable methionine. When this supply is reduced, the mammary gland has to adjust to a level of milk protein synthesis in line with this new supply. So, in a matter of days, a reduction in milk protein % will be evident. The repercussions on milk fat will be more variable and take longer for the full negative impact to be realized.

Q. Can I decrease my ration crude protein levels to 16%?

A. In well controlled feeding situations where the nutritive contribution of each ingredient is well documented, and the ration fed is a true reflection of the ration formulated, the level of protein needed in the diet could become as low as 15% if the ration is balanced for LYS and MET. In practice, 16% is a more prudent target to allow for uncontrolled variation in feed nutritive value and feeding practices. Where forages containing high levels of soluble N are fed, it may not be possible to formulate a ration below 17% CP.

Increased Components with a Lower Crude Protein Ration

A Trial with a Reformulated Midwestern Ration

by

J. Chen, G. Broderick, Ph.D., D. Luchini, Ph.D., B. Sloan, Ph.D. and E. Devillard, Ph.D.

As part of a larger trial design, a Midwest ration containing over 7.5% distillers grains was compared to a ration formulated to be lower in crude protein (CP) and metabolizable protein (MP) concentration and balanced for lysine (LYS) and methionine (MET) where MetaSmart was included as the supplementary metabolizable methionine source.

There were 15 lactating cows per treatment. Average Days in Milk (DIM) was 95 at the beginning of the trial. The different diets were fed for 12 weeks. The full results will be presented and published in Montreal in July, 2009 at the ADSA conference. The authors are J. Chen, G. Broderick, Ph.D., D. Luchini, Ph.D., B. Sloan, Ph.D., and E. Devillard, Ph.D.

The Control ration was a typical Midwest ration with a high proportion of corn and alfalfa silage complemented with high moisture corn with a significant amount of corn distillers being fed. It was decided to feed a high protein low fat distillers product rather than the conventionally available product to avoid any pre-disposition to milk fat depression.

In the reformulated ration, in order to achieve higher levels of LYS as a % of MP, the distillers were dropped from the ration and replaced principally by more high moisture corn and soybean meal.

The rebalancing of the ration for LYS and MET also resulted in 44 grams of dry MetaSmart® being fed

Ingredient Composition of the Diets (% of DM)		
Ingredients	**Control**	**Reformulated**
Legume Silage	25.0	25.0
Corn Silage	35.0	35.0
High Moisture Corn	14.9	21.5
Corn Grain, Ground	4.3	4.2
Molasses	2.1	2.2
Soybean meal, 48%	3.7	8.4
SoyPlus	3.9	---
Corn Distiller Grains	7.6	---
Energy Booster	2.0	2.0
Dry MetaSmart	---	0.16
Minerals and Vitamins	1.45	1.45

The original intention was for the Control ration to have a CP concentration of ~ 17% and the reformulated ration to have a CP concentration of ~ 15.5% However, the ingredients used tested lower than anticipated such that the Control ration fed had a CP concentration of 15.8% and the reformulated ration a CP concentration of only 15.0%.

The intention was for the reduction in MP supply with the reformulated ration to be due entirely to a reduction in the rumen undegradable protein (RUP) contribution. This was achieved although both rations would be considered to be at the lower limit for rumen degradable protein (RDP) concentration. This, however, does not appear to have had any adverse effect on intake or performance.

The calculated MP balance for the reformulated ration is ~ -350g, 270g less than for the Control ration. This is a reflection of the excellent performance of the cows on this treatment and not a sign of underfeeding of MP.

LYS and MET was increased to 6.57% and 2.28% as a % of MP with the reformulated ration.

Chemical Composition and NRC 2001 Evaluation of Diets (% of DM)		
Item	**Control**	**Reformulated**
NDF	27.5	25.7
CP	15.8	15.0
RDP	9.8	10.1
RUP	6.1	5.0
MP balance, g/d	-80	-348
LYS, % MP	6.17	6.57
MET, % MP	1.80	2.28

Milk performance was excellent on both rations. There was a numerical increase in dry matter intake, milk yield, and milk fat % with the reformulated ration; but none of these differences were significant.

With the reformulated ration, however, milk protein content was improved by 1.4 percentage points and MUN's were decreased by 3 points.

This reflects the excellent use of dietary protein with the ration balanced for LYS and MET as a % of MP. In fact, the NRC 2001 would only predict an MP allowable milk of 34.8 kgs for the reformulated ration, whereas actual production was over 42 kgs.

This is further evidence that amino acid balancing of rations allows CP and MP levels in rations to be reduced and still improve milk components, due to the more efficient use of MP when its amino acid profile more closely matches the needs for milk protein synthesis by the mammary gland.

Effects of Reformulating the Ration on Milk Performance

	Control	Reformulated
Intake (kg DM/day)	24.7	25.7
Milk (kg/day)	41.2	42.1
MP allowable milk	39.4	34.8
True Protein %	3.05	3.19
Fat %	3.85	3.93
Milk Urea N (mg/dl)	13.2	10.2

Using March 2009 feed costs and Federal order pricing for the Midwest the additional income over feed cost (IOFC) generated by making these changes in formulation to balance the rations for LYS and MET was 33 cents per cow per day.

The cost of the control ration was $4.59 per cow per day compared to $4.86 for the reformulated ration. However, this takes into account the 1 kg greater intake on the reformulated ration which accounts for 19¢ of the increased cost. In practical feeding formulation the cost would be reduced further because there would be more ingredient flexibility to reformulate the ration.

Herd Data

Number of Cows: 1

		Adjustments:
Milk (lbs/cow):	90.8	± 2
Milk Fat (%):	3.85%	± 0.08%
Milk Protein (%):	3.05%	± 0.14%
Other Solids (%):	5.9%	
SCC (e.g. 350,000):	350000	
Cost Adjustment (Per Cow Per Day):		± $0.27

Current FMMO Pricing:

SCC:	$0.00063
Fat:	$1.159
Protein:	$2.197
Other Solids:	$-0.034

SCC Adjust/$cwt/1000:	$0.00063
Fat $/lb:	$1.159
Protein $/lb:	$2.197
Other solids $/lb:	$-0.034
PPD/cwt (Northeast #1):	$0.51
SCC Premium/cwt:	$0
Quality Premium/cwt:	$0
Other Premiums/cwt:	$0

Income Data	Current |	Adjusted
Fat ($/cwt):	$4.462 |	$4.555
Protein ($/cwt):	$6.701 |	$7.008
Other Solids ($/cwt):	$-0.201 |	
PPD ($/cwt):	$0.51 |	
Premiums ($/cwt):	$0 |	
Milk Price/cwt:	$11.47 |	$11.87
Milk Income/cow/day:	$10.42 |	$11.02
Milk Income/herd/day:	$10 |	$11
Milk Income/herd/month:	$317 |	$335
Milk Income/herd/year:	**$3,802** |	**$4,022**

Economic Impact	Per Cow/Day |	Per Herd/Year
Adjusted Income Impact:	$**0.60**	$**220**
Adjusted Feed Cost:	$**0.27**	$**99**
Income Over Feed Cost (IOFC):	$**0.33**	$**121**
	2.2 / 1 ROI	

Value	Per Cow/Day |	Per Herd/Year
1 lb of milk:	$**0.115**	$**42**
0.1point of milk fat:	$**0.105**	$**38**
0.1 point of milk protein:	$**0.199**	$**73**