Setting Yourself up for Success with Amino Acid Balancing

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Overview

- Calf
- Heifer
- Transition
- Lactation

AjiPro-L

CALF STAGE

Colostrum

- Quantity, Quality, Time
  - >50 g/L IgG
  - 6 Quarts (4 initial feeding, 2 second feeding)
  - Immediately?
- Impact of Amino Acids?
  - Reason for low colostrum quality includes dry cow nutrition
  - Deficiency in protein and energy
  - Diets very low in protein affect the ability of the calf to absorb IgG (Maunsell, 2014)

Milk Replacer

- Increased feeding amount in recent years
  - 4 quarts vs. 8+ quarts on farms
  - 3x feeding, automation
- Mono-gastric Animal
  - Not a functioning rumen/developing rumen
- Amino Acid Need
  - YES

Amino Acid Nutrition in Calves

- The newborn calf is the most efficient animal on the farm with respect to utilizing protein
- A high protein diet, without respect to amino acid balance can result in waste
- Calf must excrete the excess nitrogen
  - do not have a fully developed rumen to help recycle it.
- The gold standard of today is provide their young calves the precise nutrition they need
  - Amino acid balancing

Amino Acids in Milk Replacer

- **Amino acid supplementation of calf milk replacers containing plasma protein.**
  - University of Illinois
  - Published JDS June 2017
  - Results
    - Supplemented Isoluecine and Threonine
    - BW was less as plasma protein (PP) inclusion increased without AA supplementation
    - Chance of antibiotic treatment was greater for the higher inclusion of PP without supplemental AA than for other milk replacers with PP
- **Effects of preweaning nutrient intake in the developing mammary parenchymal tissue**
  - Cornell
  - JDS June 2017
    - Energy work not AA supplementation
    - Enhanced calves had 5.9 times greater mammary parenchymal mass
    - Enhanced calves had a larger total population of putative mammary stem cells present in the mammary gland

Field Application

- Commercial milk replacers with amino acids
  - Starting to come to market
  - Individual companies making private blends
- On farm performance
  - On farm work has shown gains up to 2.3 lbs of ADG for first 56 days
  - Taller calves, not fat, skeletal growth
  - Weaning chest circumference/height correlated to mature body size

Amino Acid Recommendations

- 3 Limiting Amino Acids- Lysine, Methionine, and Threonine
  - Milk Replacer only diet
    - Ratio: 100:29:70
  - Milk Replacer, starter, and hay
    - Ratio: 100:30:65
- Confirmed in research conducted in China, New Zealand, and USA

*NOTE- This is done with crystal form of amino acids they are not rumen protected

2-22 Months

HEIFER STAGE

Current heifer mindset

- Wind, Water, and Weeds
- Want heifers raised as cheaply as possible
- Represent a large expense for the dairy farm

- Do amino acids play a role here?

Calf Starters and Growers

- Calf starter should obtain the maximum growth possible
- Often purchased on price instead of quality
- Researchers at Cornell University are now recommending that the calf starter contain a 22.5 percent crude protein level on an as fed basis
- The quality of the protein is important and should contain the required amounts of essential amino acids

What next?

- 3-6 Months
  - Grower grain mix
  - High quality alfalfa hay
  - Not recommended to feed these young calves fermented forages
  - 20 to 22 percent crude protein

* Secret to success shared by a 2X farm with 114 pound tank average?

-24% CP Alfalfa hay, oat hay, and a little concentrate to growing animals

How can we enhance growth during this time?

- Rumen Fermentation Modifiers
  - Improve growth in heifers
  - Why does this happen?
- Improved rumen microbial production results in increased microbial flow to the intestine

	Arg	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
					(% of Total EAA)					
Animal Products										
Meat	16.8	6.3	7.1	17.0	16.3	5.1	8.9	9.9	2.5	10.1
Milk Protein	7.2	5.5	11.4	19.5	16.0	5.5	10.0	8.9	3.0	13.0
Rumen Microbes										
Bacteria	10.4	4.2	11.5	15.9	16.6	5.0	10.1	11.3	2.7	12.3
Protozoa	9.3	3.6	12.7	15.8	20.6	4.2	10.7	10.5	2.8	9.7

Field Observations

- Is the show industry ahead of us?
  - Constantly hear:
    - “I put rumen protected amino acids in the feed for a genetic/show farm”
    - “Rumen modifiers improve skeletal growth, it is in our show line of feed”
- Why do they do this diet changes?
  - Size, growth, larger heifer, awards
  - Isn’t this the same goal of all dairy farmers?

Achievable Guidelines

- 51 inches at the withers to begin breeding
  - Do not use weight we are not interested in short fat heifers
  - 10 Months 10% reach this goal
  - 11 Months 25% reach this goal
  - 12 Months 65% reach this goal

End of Heifer Program

- Make sure breeding is timely
- As heifers get older, the rate at which their frame size increases tends to slow down
- If not calving soon they will gain body condition

As a result….
Over weight heifers calve in with less production potential
Increased heifer raising cost
Trouble breeding back
Start the cycle again

TRANSITION COW

Non-Nutritional Factors

- Bunk Space
  - Stocking density of 80%
- Time
  - 3 weeks pre-calving
- Clean
- Air quality and flow
- Cooling
  - Increasing knowledge of future calf potential from cooling

Challenges in transition period

- Increased nutritional requirements
  - Rapid fetal growth during last several weeks of gestation
  - Mammary gland development
- Limited dry matter intake
  - Physical limitation (increased fetal mass)
  - Physiological limitation
    - Changes in hormone balances
    - ↑ fat mobilization → ↑ plasma NEFA → ↓ appetite

More important to precisely formulate the diet

MP-deficiency in transition

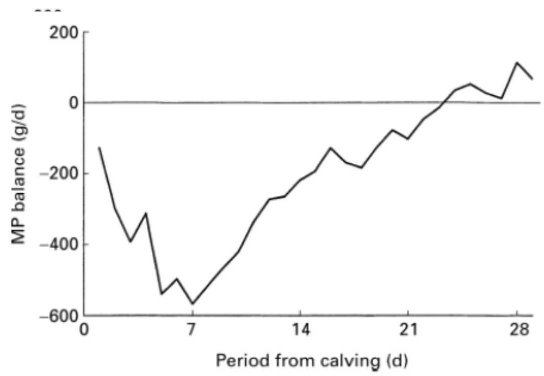


Fig. 1. Calculated metabolizable protein (MP) balance in post-parturient cows (*n* 80) fed on a ration containing (/kg DM) 178 g crude protein (nitrogen × 6·25) and 7·0 MJ net energy for lactation. Individual values were calculated from daily individual measurements of crude protein intake and milk yield, and weekly measurements of milk composition.

Bell et al., 2000

Pre-Fresh Amino Acid Needs

- Protein depletion-repletion studies indicated that skeletal muscles are by far the largest contributor to protein mobilization (Swick and Benevenga, 1977)
- Increasing abundance of mRNA coding for proteins in the ubiquitin-mediated proteolytic pathway in muscle biopsies from both postpartum transition cows and sows (Clowes et al., 2005; Chibisa et al., 2008) also indicate that milk protein secretion in the initial phase of the lactation is largely sustained
- **The RUP requirements of post-fresh transition cows are higher than at any other time within their lactation**

Pre-Fresh Amino Acid Needs

- AA released from mobilized protein appears to be important in supporting the AA requirements of the mammary gland at least in the earliest stages of lactation
- Mobilized AA are also used to fuel gluconeogenesis - whole-body glucose turnover is increased dramatically at initiation of lactation and propionate availability from rumen fermentation is not sufficient
- The ability of cows to up-regulate gluconeogenesis in early lactation is critical to avoiding metabolic problems (e.g., ketosis) and maximizing peak milk production
  - Methionine plays a huge role

Should you start balancing for AA Pre-Fresh?

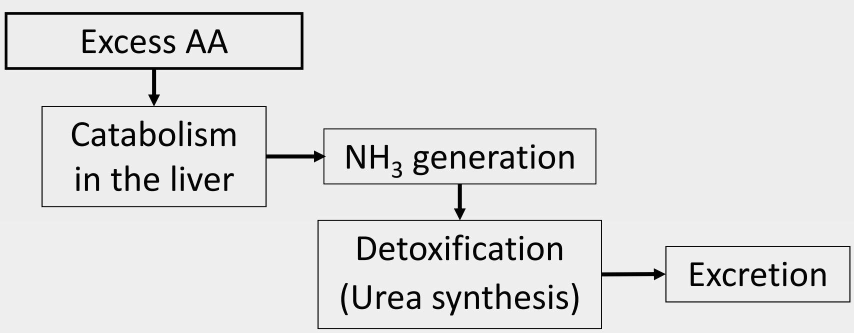
- Yes
- Relatively short time of the lactation cycle
  - Easy place to start off financially with amino acid balancing
- Help off set depressed intake when we know they will become limiting
- Precision nutrition

AA composition in various MP sources

	Arg	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
					(% of Total EAA)					
Animal Products										
Meat	16.8	6.3	7.1	17.0	16.3	5.1	8.9	9.9	2.5	10.1
Milk Protein	7.2	5.5	11.4	19.5	16.0	5.5	10.0	8.9	3.0	13.0
Rumen Microbes										
Bacteria	10.4	4.2	11.5	15.9	16.6	5.0	10.1	11.3	2.7	12.3
Protozoa	9.3	3.6	12.7	15.8	20.6	4.2	10.7	10.5	2.8	9.7
Vegetable Protein										
Brewer's grain	8.9	6.4	10.6	17.6	11.4	4.8	10.3	11.4	3.0	15.6
Corn gluten meal	6.9	4.7	9.3	36.4	3.8	5.5	13.8	7.5	1.5	10.7
DDGS	7.7	7.2	9.8	26.3	6.2	5.2	11.1	10.3	2.7	13.4
Whole cotton	25.4	6.0	7.7	13.9	9.6	3.8	12.2	7.7	2.9	10.8
Soybean meal	16.3	5.7	10.8	17.0	13.7	3.1	11.0	8.6	3.0	10.6
Corn meal	10.8	7.0	8.2	29.1	7.0	5.0	11.3	8.4	1.7	11.5
Animal Protein										
Blood meal	7.6	11.2	2.1	22.8	15.7	2.1	12.3	8.1	2.7	15.4
Feather meal	14.7	1.1	10.0	29.3	3.9	2.1	10.0	10.5	1.5	17.1
Fish meal	13.1	5.7	9.3	16.5	17.0	6.3	8.8	9.5	2.4	11.3
Meat&Bone meal	20.5	5.5	7.8	16.2	14.2	3.6	9.2	9.0	1.8	12.1

Tri-State Dairy Nutr. Conf., 1995 Proceedings

Fate of Excess Amino Acids



Urea synthesis in the liver is an ATP-consuming pathway.

→ Lys's effects might have been diminished by energy loss caused by feeding excess amount of non-limiting AAs.

→ This might be critical in early lactation when cows are suffering from negative energy balance.

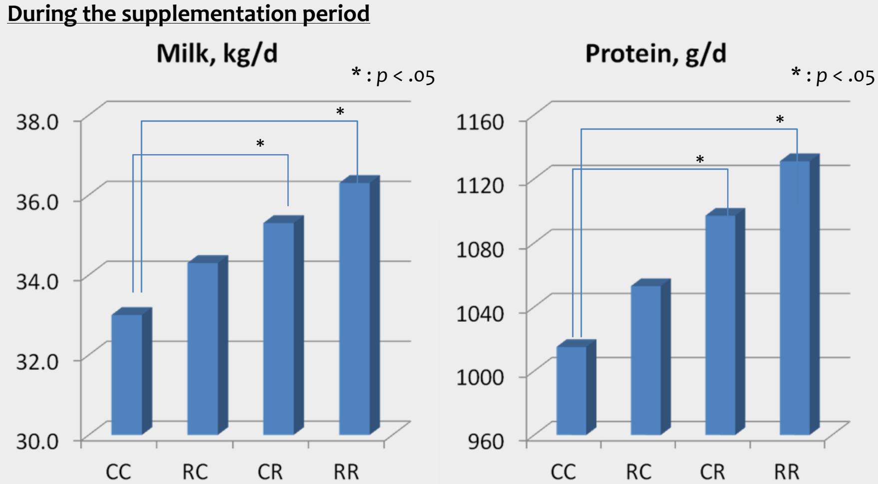
Chalupa et al., 1999

- Supplemental MP-Met (0.049% ration DM) and MP-Lys (0.157%) for pre-fresh and MP-Met (0.039%) and MP-Lys (0.126%) for post-fresh, respectively, in a form of RPAA
- 40 multiparous cows and 10 primiparous cows were assigned to the each of following treatments;
  - CC (No RPAA in pre- or post-fresh)
  - RC (RPAA in pre-fresh only)
  - CR (RPAA in post-fresh only)
  - RR (RPAA in both pre- and post-fresh)
- Supplementation: 3 wk prior to calving and 4 wk after calving

Journal of Dairy Science, Vol. 82, Suppl. 1, 1999

Chalupa et al., 1999 (cont.)

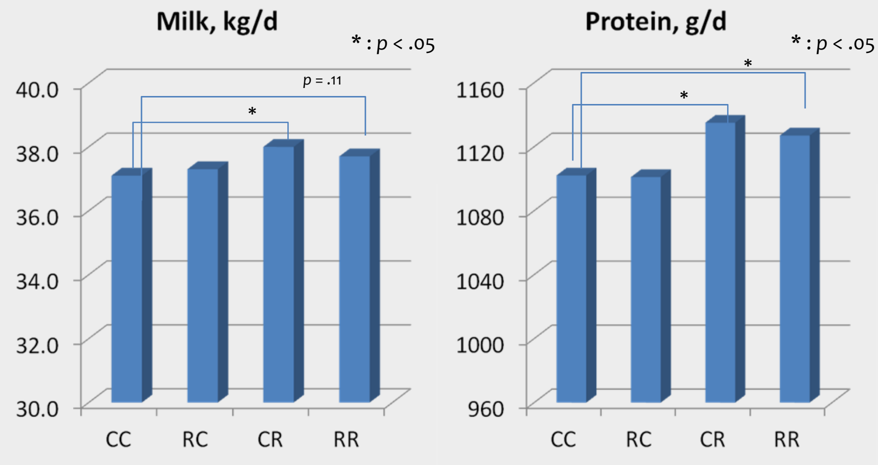
During the supplementation period



Journal of Dairy Science, Vol. 82, Suppl. 1, 1999

Chalupa et al., 1999 (cont.)

For the entire lactation (44 weeks)



Journal of Dairy Science, Vol. 82, Suppl. 1, 1999

Take Home Messages

- Importance of AA balancing is more eminent in early lactation than in the other stages of lactation
- Some data suggests the benefit of balancing AA in pre-fresh period on subsequent milk production, and additional information about immune status to occurring
- Effects of AA balancing during transition on milk production will likely improve overall performance for the lactation

LACTATING COW

Non-Nutritional Lactation Factors

- Over crowding
- Stall comfort
- Water space
- Time away from feed
- Hoof care
- Pregnancy Rate
  - This can be largely affected by nutrition

Nutritional Factors affecting Production

- Forage varieties
  - Corn- BMR, Enogen
  - Hay- Low Lignin
  - Grain- Grinding size (fecal starches)
- Silage management
  - Inoculant, packing density, bunker face management

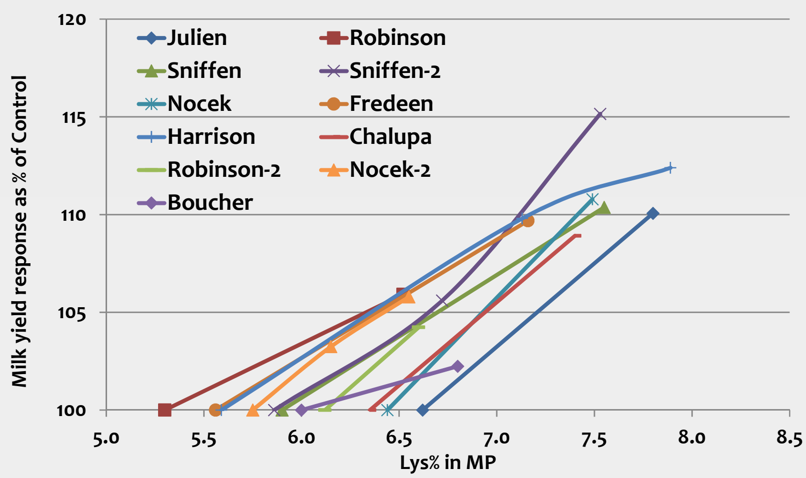
Amino Acids Balancing in Lactating Animals

- Important even in low milk price times
- Zantan et al.
  - Meta-analysis of 64 methionine papers
  - Always a positive response to AA supplementation
  - Didn't take into account the health benefits
    - Estimated $300 per health event

A list of Ajinomoto studies

Code	Location	Period	RPAA used*	Conducted by	Publication
ASH-2	NY	0 - 8wk	LM	Julien, WE et al.	JDS vol. 82, suppl. 1, 1999
FRS-3	NB, CA	0 - 6wk	LM	Robinson, PH et al.	JDS vol. 79, suppl. 1, 1996
KH-2	VT	0 - 4wk	LM	Sniffen, CJ et al.	JDS vol. 82, suppl. 1, 1999
KH-3	VT	0 - 6wk	L, LM	Sniffen, CJ et al.	JDS vol. 82, suppl. 1, 1999
MD	NY	0 - 6wk	L	Nocek, JE et al.	JDS vol. 82, suppl. 1, 1999
NSAC-3	NS, CA	6 - 12wk	LM	Fredeen, AH et al.	JDS vol. 82, suppl. 1, 1999
ROV-1	NY	0 - 4wk	LM	Chalupa, W et al.	JDS vol. 82, suppl. 1, 1999
WSU-1	WA	0 - 10wk	LM	Harrison, JH et al.	J Dairy Sci. Vol. 81(4):1062-77, 1998
CA	CA	11 - 18wk	L	Robinson, PH et al.	Anim. Feed Sci. Tech. 168: 30-41, 2011
SHRC-2	NY	5 - 8 wk	L	Nocek and Shinzato	JDS vol. 93, E-Suppl. 1: 235-236, 2010
WHM	NY	17 - 29 wk	L	Boucher, SE et al.	JDS vol. 93, E-Suppl. 1: 236-237, 2010

Response in each study



Early lactation (calving to peak)

- MP target: 98% of the req. model predicts
  - Adequate RDP to maximize microbial protein
  - Overfeeding of MP resulting in higher cost
- Metabolizable Lys target: 7.0 ~ 7.2% in MP
  - Add synthetic lysine to achieve the target
- Metabolizable Met target: 2.4 ~ 2.6% in MP
  - Add synthetic methionine to achieve the target

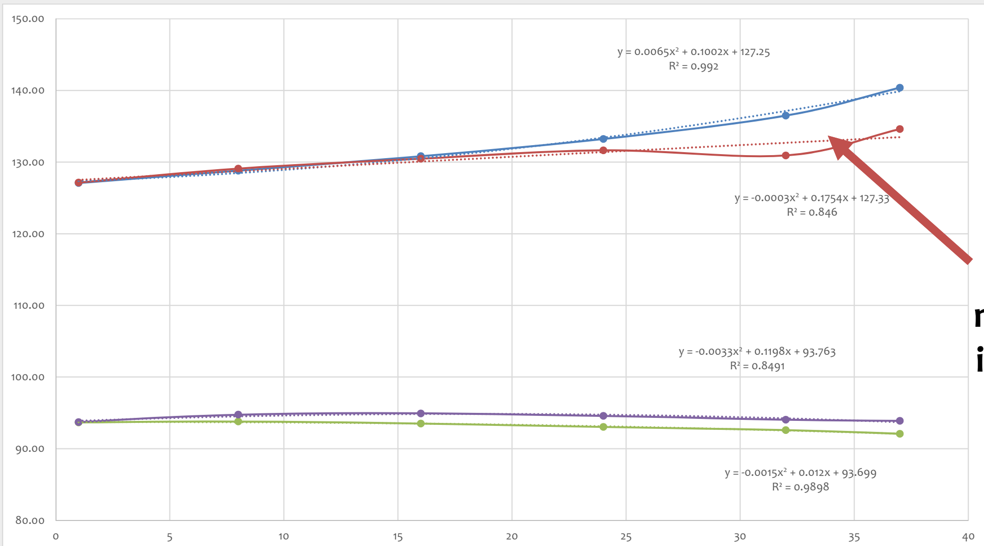
Income Over Feed Cost

Sources:	Blood Meal A	Blood Meal B	Blood Meal C	Blood Meal D	Blood Meal E
Manufacturer	NAME	NAME	NAME	NAME	NAME
Cost: Ton	$700	$800	$900	$1,000	$1,100
Kg	$0.77	$0.88	$0.99	$1.10	$1.21
Lysine, %	9.12	9.12	9.12	9.12	9.12
Methionine, %	1.18	1.18	1.18	1.18	1.18
Rumen Escape, %	77	77	77	77	77
Post-Ruminal Dig., %	67	67	67	67	67
Feeding Rate, g/d	227.00	227.00	227.00	227.00	227.00
mLys Supplied, g	10.68	10.68	10.68	10.68	10.68
mMet Supplied, g	1.38	1.38	1.38	1.38	1.38
Cost/Cow/Day	$0.1751	$0.2001	$0.2251	$0.2502	$0.2752

Protected AA Equiv.

Synthetic Lysine Source	Blood Meal A	Blood Meal B	Blood Meal C	Blood Meal D	Blood Meal E
Cost/Cow/Day	$0.1669	$0.1669	$0.1669	$0.1669	$0.1669
Grams/Cow/Cay	41.72	41.72	41.72	41.72	41.72
mLys Supplied, g	10.68	10.68	10.68	10.68	10.68

Preview…



What can cause this big of spread in production? Lysine nutrition more in depth at the break out.

Thank You!