

Calf Nutrition – What’s New?

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Milk Products
June 2012

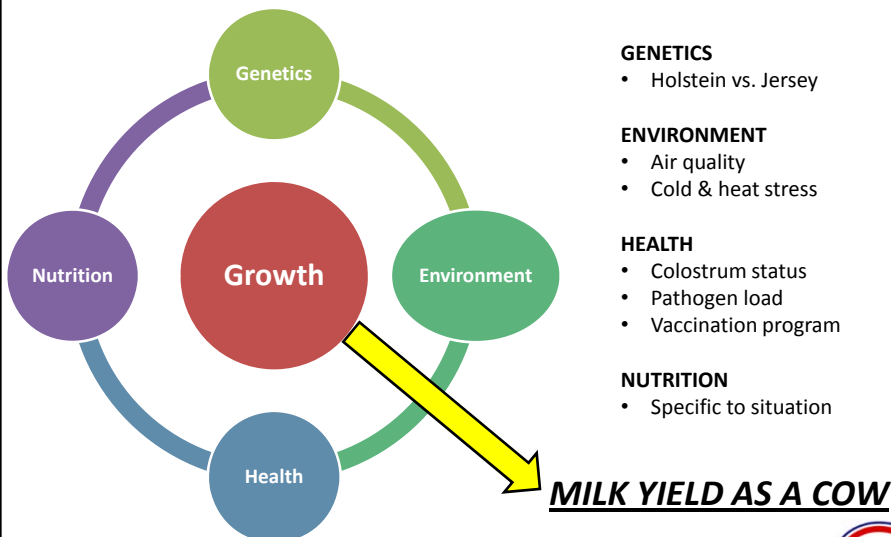


Heifer Growth Benchmarks

- **Birth to 60 days = 2X birth weight**
 - 90 lbs → 180 lbs = 1.5 lbs/day
 - 60 lbs → 120 lbs = 1.0 lbs/day
- **61 to 120 days = 2.2 lbs/day**
- **121 to 180 days = 2.0 lbs/day**



What Influences Calf Growth?



Cornell Trial

- **Study design**
 - Determine preweaning factors that affect lactation performance
 - Fed an intensified milk replacer program
 - 1244 calves with completed 1st lactation records
- **Parameters analyzed**
 - Preweaning ADG
 - Birth & weaning weight
 - Age at 1st calving
 - Birth month, year, & season



Soberon et al., 2012, J. Dairy Sci. 95:783



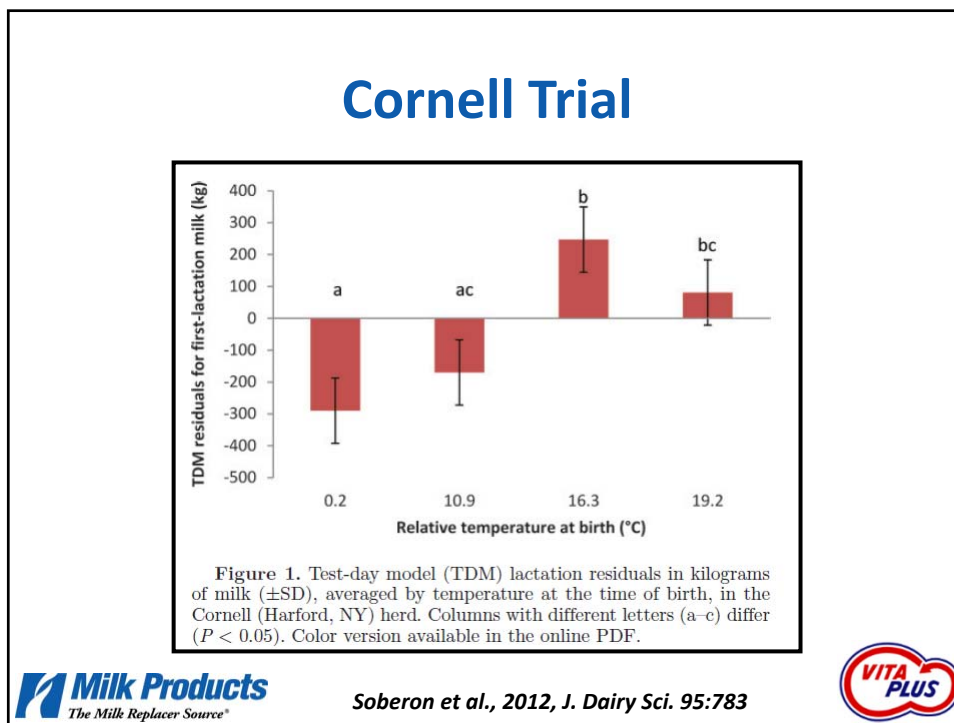
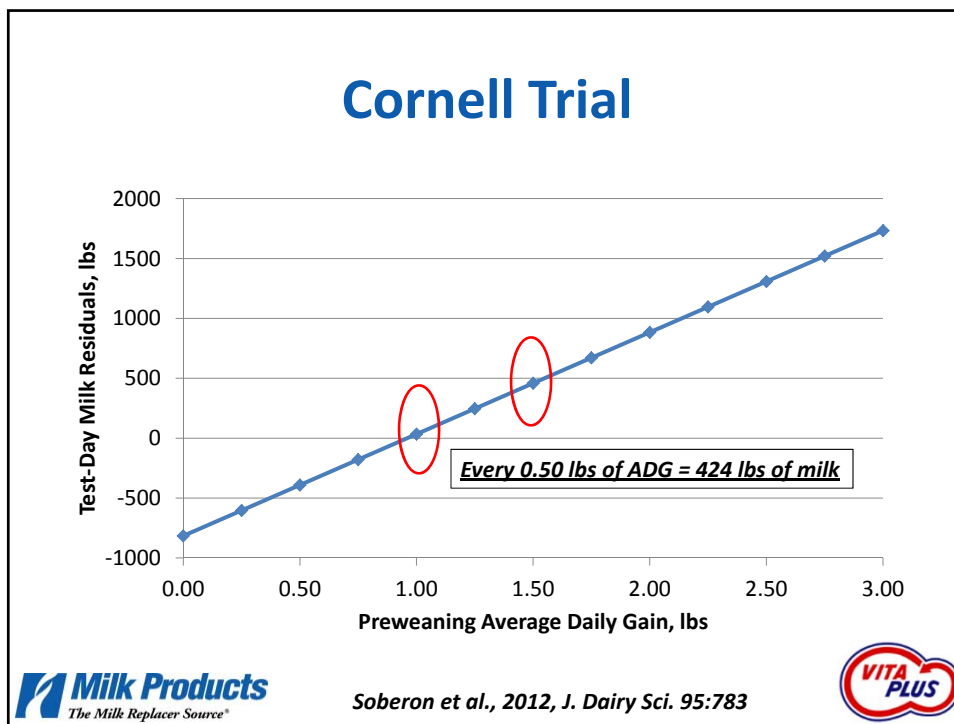
Cornell Trial

- **Preweaning ADG**
 - Positively correlated with 1st lactation milk yield
 - Average ADG = 1.80 lbs/day
- **Temperature at birth**
 - Colder temperatures at birth negatively correlated with milk production



Soberon et al., 2012, J. Dairy Sci. 95:783





Outline

- Colostrum Management
- Liquid Feeding Programs
- Evaluating and selecting the right program for to achieve the goals of your operation



Disease on the Calf Operation

IMMUNITY

(Calf's ability to fight off disease)

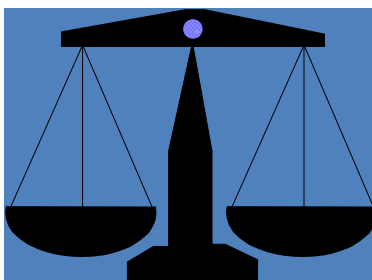
**COLOSTRUM
VACCINATIONS
NUTRITION**

vs.

PATHOGEN LOAD

(Number of disease-causing bacteria and viruses presented to the calf)

**BIOSECURITY
SANITATION
HOUSING**



Colostrum Program Monitoring

- **Passive Transfer of Immunity**
 - Serum IgG \geq 10 mg/mL
- **Prevalence of FPT among healthy heifer calves**
 - 19.2% *(Beam et al., 2009)*




Why is Successful Passive Transfer Important?

- **Reduced treatment and mortality rates**
 - NAHMS, Wells, 1996
- **Improved growth rates and feed efficiency**
 - Fowler, 1999; Faber et al., 2005; Nocek et al., 1984; Robison et al., 1988; Faber, 2005
- **Decreased age at 1st calving**
 - Faber et al., 2005
- **Increased 1st and 2nd lactation milk production**
 - DeNise, 1989; Faber, 2005

Slide recreated from Godden, 2011, AABP Pre-Conference





Recent results: University of Illinois

- Purchased male calves were fed either intensified early nutrition (28-20) or conventional (22-20) milk replacer.
- Average daily gain (ADG) through 5 wk compared in calves with adequate (**Good**; >10.0 mg/mL) vs. inadequate (**Poor**; <10.0 mg/mL) blood IgG concentration


Variable	Control		Intensified	
	Poor	Good	Poor	Good
n	21	20	17	25
IgG, mg/mL	5.58	17.93	6.09	20.36
ADG, lb/d	1.17	1.09	1.39 ^a	1.63 ^b

^{a,b} $P < 0.05$. Interaction, $P < 0.07$ Osorio and Drackley, 2009 (unpublished)


Colostrum Intake and Growth

	Low Colostrum Intake		High Colostrum Intake	
	Low Nutrition	High Nutrition	Low Nutrition	High Nutrition
Study design				
Colostrum fed within 1 hr, L	2	2	4	4
Colostrum fed at 12 hr, L	--	--	2	2
Milk replacer ¹ fed, L/d	4	Up to 12	4	Up to 12
Results				
ADG (d 1-52), lbs/d ²	0.78 ^a	1.21 ^b	0.78 ^a	1.72 ^c
Post-weaning DMI, lbs/d	4.85 ^a		6.17 ^b	

¹28% CP, 15% fat, all-milk protein
²Values with unlike superscripts are significantly different ($P < 0.05$)



Soberon et al., 2011, J. Dairy Sci. 94:E-Suppl. 1. Abstr M180



Colostrum Management Goals

- **Quality (IgG concentration)**
 - Immunoglobulin concentration – 50 g/L IgG is “good”



Measuring Colostrum Quality

- **Colostrometer**
 - Measures specific gravity
 - Not durable
 - Temperature sensitive
- **Brix Refractometer**
 - Durable
 - Not temperature dependent
 - Brix% ≥ 22

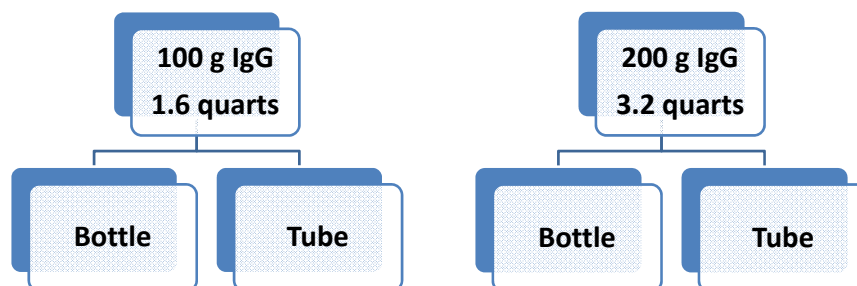


Colostrum Management Goals

- **Quality (IgG concentration)**
 - Immunoglobulin concentration – 50 g/L IgG is “good”
- **Quantity (amount fed)**
 - 10% of birthweight
 - 3 quarts if fed by bottle (if good quality ~150 g IgG intake)
 - 4 quarts if fed by tube (if good quality ~200 g IgG intake)



Colostrum Feeding Method



Godden et al., 2009. J. Dairy Sci. 92:1758-1764.



Colostrum Feeding Method

Parameter	1.6 quarts Bottle	1.6 quarts Tube	3.2 quarts Bottle	3.2 quarts Tube
Calves, n	24	24	24	25
IgG fed, g	100	100	200	200
24-hr serum IgG, mg/mL	12.50 ^a	9.85 ^b	19.65 ^c	18.65 ^c
Failure of passive transfer, %	0^a	58.3^b	0^a	0^a

Godden et al., 2009. *J. Dairy Sci.* 92:1758-1764.

- **Guidelines for Colostrum Feeding**

- If feeding 3 quarts or less – Attempt to bottle feed 1st
- If feeding 4 quarts at once – Ok to tube feed
- Bottle feeding critical if feeding colostrum replacer



Colostrum Management Goals

- **Quality (IgG concentration)**
 - Immunoglobulin concentration – 50 g/L IgG is “good”
- **Quantity (amount fed)**
 - 10% of birthweight
 - 3 quarts if fed by bottle (if good quality ~150 g IgG intake)
 - 4 quarts if fed by tube (if good quality ~200 g IgG intake)
- **Quickness (of milking and feeding)**
 - Milk cow & feed colostrum ASAP, but within 6 hours of birth



Cows Milked \geq 6 hrs Post-calving

- **IgG concentration**
 - Goes down due to IgG reabsorption or dilution
 - 20-40% decrease in 6 hours
- **Goal = Milk within 4 hours**

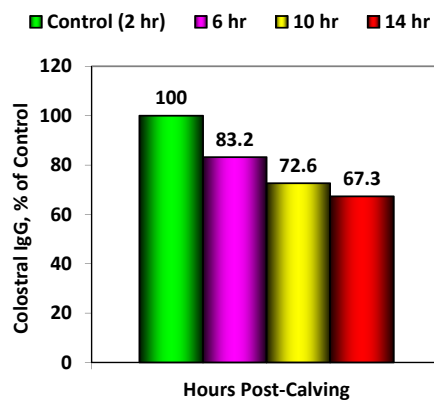
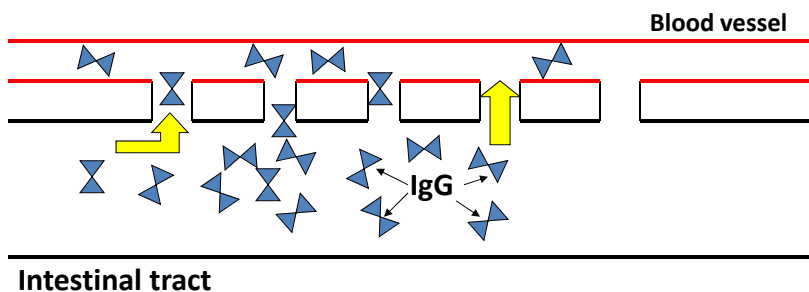


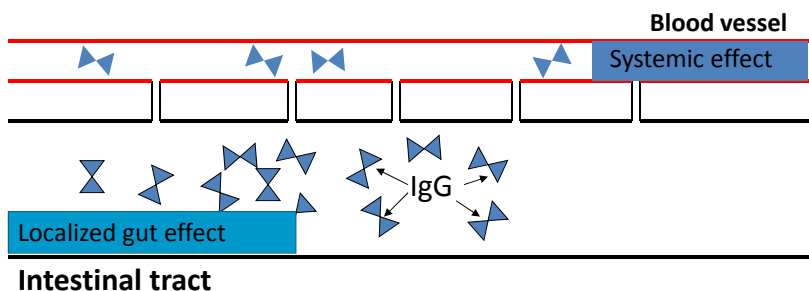
Figure 1. Effect of delayed colostrum collection relative to calving on colostral IgG concentration (% of control) in Holstein cows (Moore et al., 2005).



Colostrum Absorption (before gut closure)



Colostrum Absorption (after gut closure)



Colostrum Management Goals

- **Quality (IgG concentration)**
 - Immunoglobulin concentration – 50 g/L IgG is “good”
- **Quantity (amount fed)**
 - 10% of birthweight
 - 3 quarts if fed by bottle (if good quality ~150 g IgG intake)
 - 4 quarts if fed by tube (if good quality ~200 g IgG intake)
- **Quickness (of milking and feeding)**
 - Milk cow & feed colostrum ASAP, but within 6 hours of birth
- **Cleanliness (bacteria counts of colostrum fed)**
 - Standard plate count = <100,000 CFU/mL



Colostrum Cleanliness

- **High Bacterial Load in Colostrum**
 - Can introduce disease to the calves
 - Source of *E. coli*, Rotavirus, Coronavirus, *Salmonella*, *Mycoplasma*, etc.
 - Can interfere with IgG absorption
 - Block absorption sites
 - Secrete enzymes that destroy IgG
- **Goals**
 - Total Plate Count < 100,000 CFU/mL



Colostrum Cleanliness

Item	Iowa State Study ¹	Cal State-Fresno Study ²
No. of samples collected	892	546
Avg. total plate count (TPC), CFU/mL	550,000	--
Minimum TPC, CFU/mL	--	13,420
Maximum TPC, CFU/mL	--	2,171,835
Percent of samples with TPC > 100,000 CFU/mL	45.9%	40.29%
Percent of samples with TPC > 500,000 CFU/mL	27.2%	--
Percent of samples with TPC > 1,000,000 CFU/mL	16.6%	--
Avg. time elapsed – harvest to feeding or storage	48 minutes	--
Percent of samples let sit for > 60 min	54.3%	--

¹Conrad et al. 2011. J. Dairy Sci. 94(E-Suppl. 1):Abstract T260.

²Zhelev et al. 2011. J. Dairy Sci. 94(E-Suppl. 1):Abstract T254.



Colostrum Cleanliness



Colostrum Cleanliness



Colostrum Cleanliness



 **Milk Products**
The Milk Replacer Source®



Take-Home Messages - Colostrum

- **Colostrum intake/IgG status**
 - Increases response to high plane of nutrition
- **Management is critical!**
 - Quality
 - Quantity
 - Quickness
 - Cleanliness

 **Milk Products**
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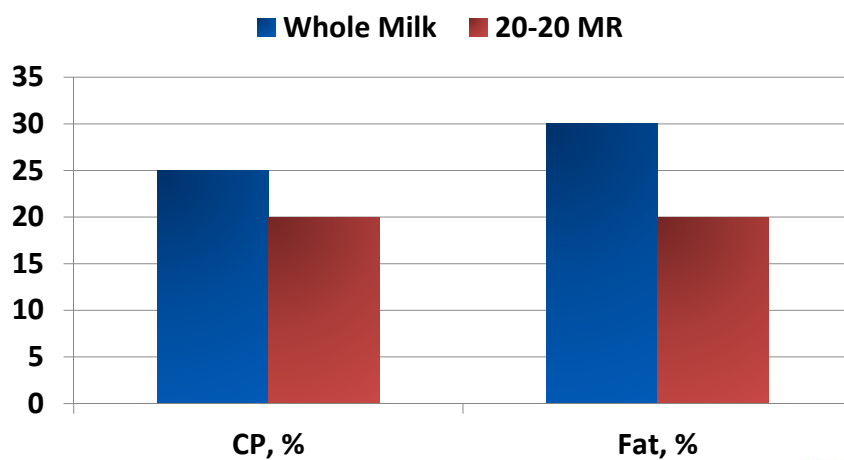


Calf Nutrition Program

- **Liquid feed**
 - Milk or milk replacer
 - Major source of nutrition for first 3 weeks of life
- **Calf starter**
 - Stimulates rumen growth and development
- **WATER!!!**
 - Promotes calf starter intake and rumen development



Whole Milk vs. Milk Replacer



Milk Replacer Selection

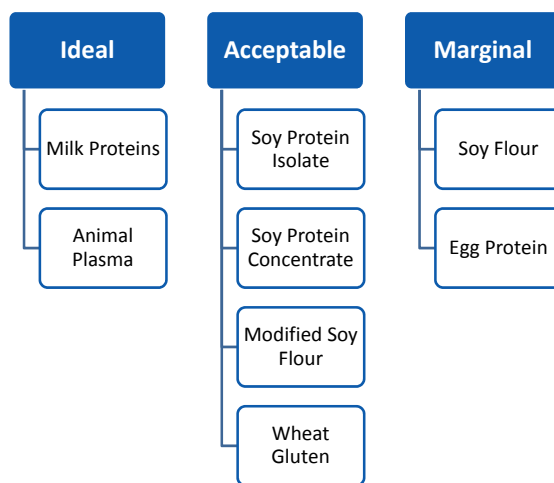
- **Protein source**
 - Milk proteins
 - Animal plasma
 - Plant proteins
- **Protein & Fat → feeding rate**
- **Medication**
 - Antibiotics
 - Coccidiostats
- **Additives**



Milk Products
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Milk Replacer Protein Sources



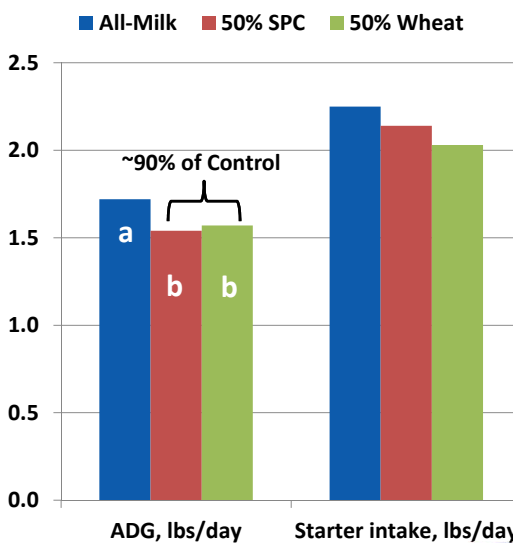
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UMN Waseca Research Study

- Trt #1**
20-20 all-milk
- Trt #2**
20-20 soy protein concentrate (SPC)
- Trt #3**
20-20 wheat gluten

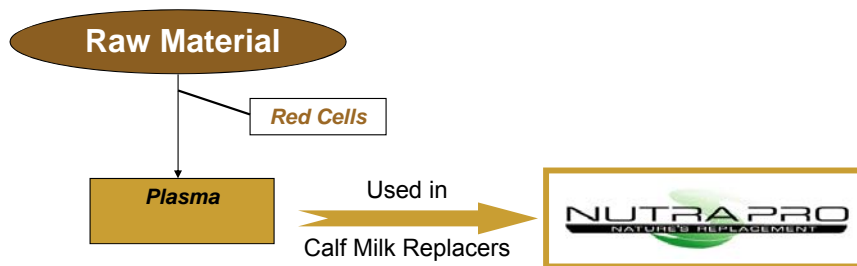
Calf Performance, d 1-56



Hayes et al., 2007, J. Dairy Sci. 90 (Suppl. 1):114. Abstr M348



APC - Functional Protein Fractionation



- **Highly-digestible protein source**
 - Supports equivalent growth performance versus all-milk milk replacers
- **Considered a “functional protein”**
 - Proteins resist digestion, can serve other functions
 - Approx. 15% immunoglobulin G (IgG)
 - Also contains growth factors



E. coli Challenge Study

- **36 Holstein bull calves**
 - Purchased at sale barn

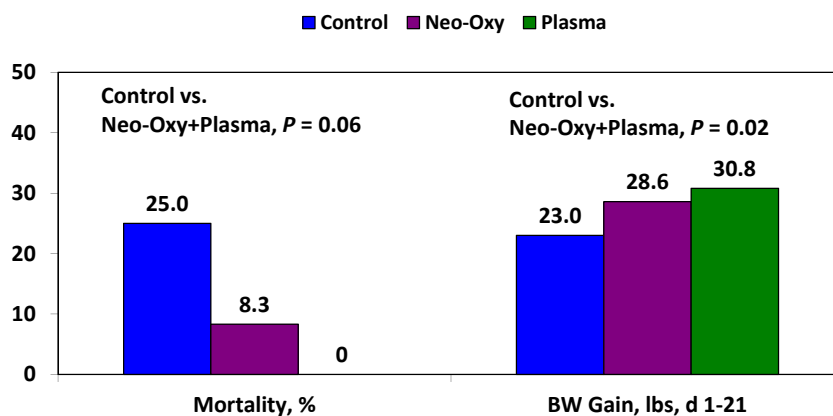
 - **Treatments**
 - Control – 20-20; nonmedicated
 - NT – 20-20; 1600/800 g/ton NT
 - Plasma – 20-20; 3.3% plasma
- } Day 3: All calves challenged with 1×10^8 CFU of enterotoxigenic *E. coli*



Quigley and Drew, 2000, Food and Agric. Immun. 12:311



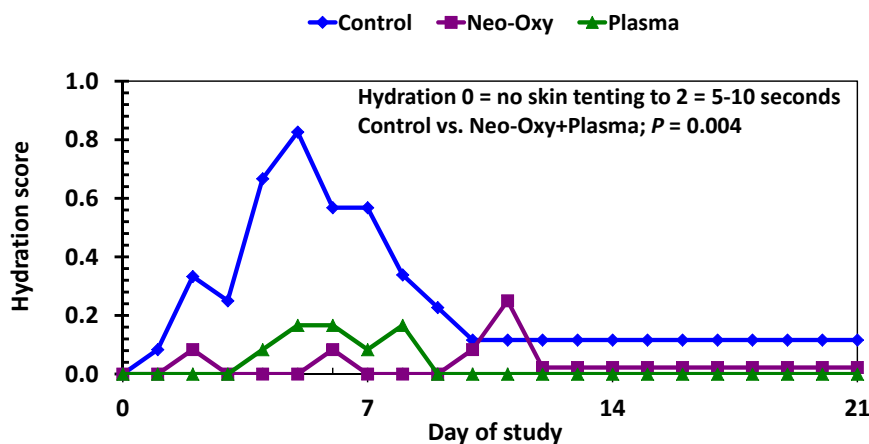
E. coli Challenge Results



Quigley and Drew, 2000, Food and Agric. Immun. 12:311



E. coli Challenge Results



Quigley and Drew, 2000, Food and Agric. Immun. 12:311



Take-Home Messages – Protein Source in Milk Replacer

- **Milk & plasma protein**
 - Support at least equivalent performance
 - Plasma can improve performance in stressed calves
 - Milk & plasma protein quality can vary by manufacturer
- **Modified soy protein & wheat gluten**
 - Typically deliver about 85-90% performance
 - Can have a place, economics must dictate



Milk Replacer Feeding Programs

- **Conventional**

- 20-22% CP, 18-20% fat
- 1.0-1.50 lbs/calf/day



Minimal milk replacer
Maximize starter intake

- **Moderate**

- 22-26% CP, 16-20% fat
- 1.5-2.0 lbs/calf/day



Moderate milk replacer
Moderate starter intake

- **Intensive**

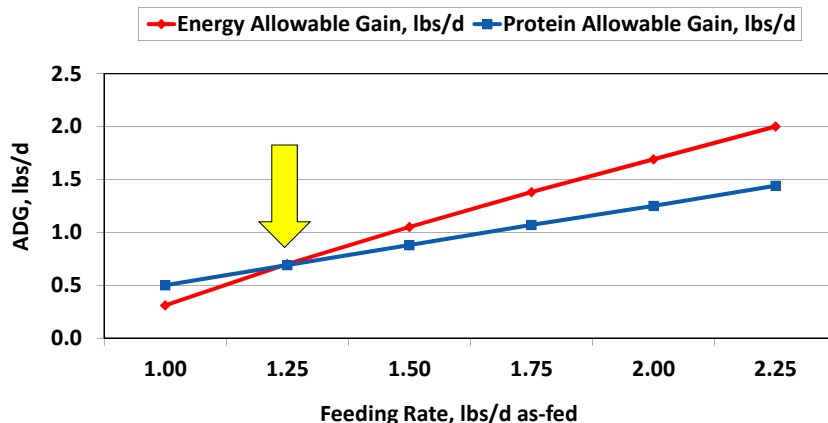
- 26-30% CP, 16-20% fat
- 2.0-3.0 lbs/calf/day



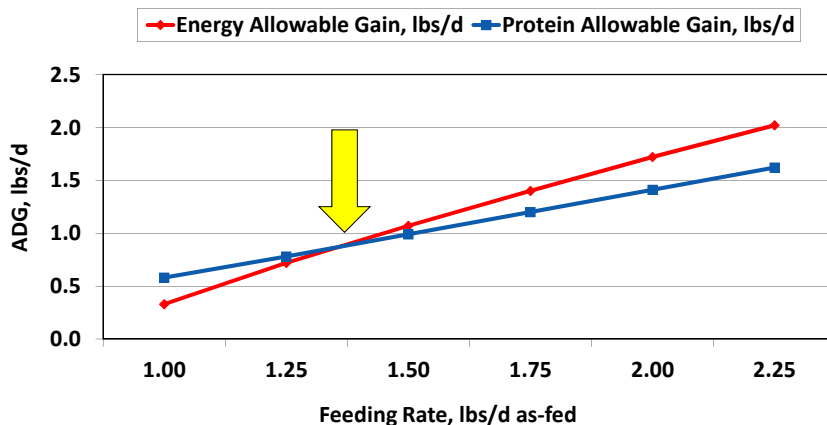
Maximize milk replacer
Minimal starter intake



MR Feeding Rate and Predicted Gain 20-20 MR, 100 lb calf, 68°F

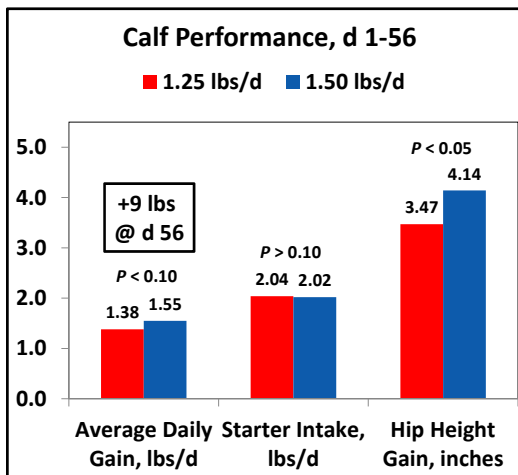


MR Feeding Rate and Predicted Gain 22-20 MR, 100 lb calf, 68°F



Feeding More Powder – 20-20

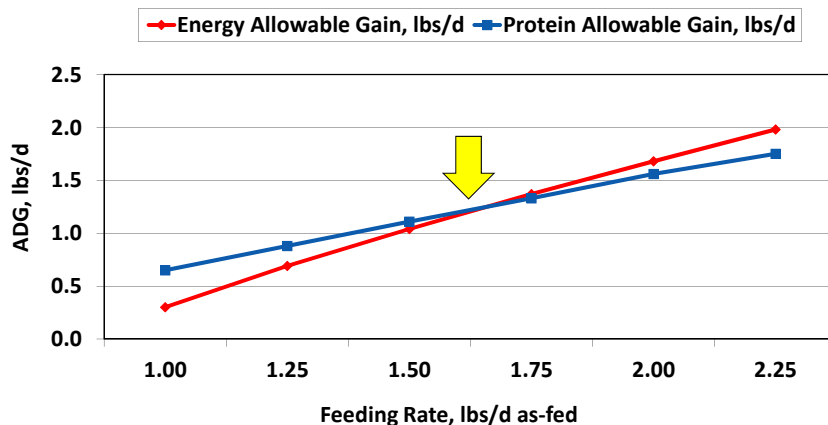
- **Treatments**
 - 20-20 @ 1.25 lbs/day
 - 20-20 @ 1.50 lbs/day
 - Each group fed 1X for d 36-42, then weaned at d 42
- **Conclusions**
 - Feeding 1.5 lbs/calf/d increases ADG but doesn't decrease starter intake



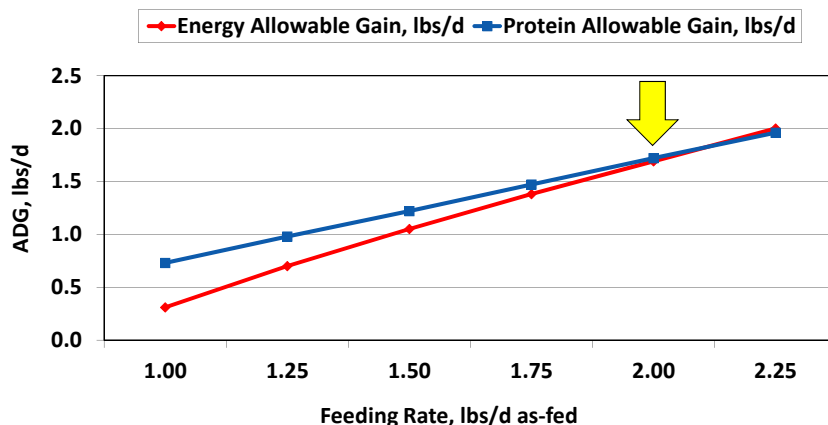
Carlson et al., 2011, J. Dairy Sci. 94 (Suppl. 1):Abstr. M334



MR Feeding Rate and Predicted Gain 24-18 MR, 100 lb calf, 68°F

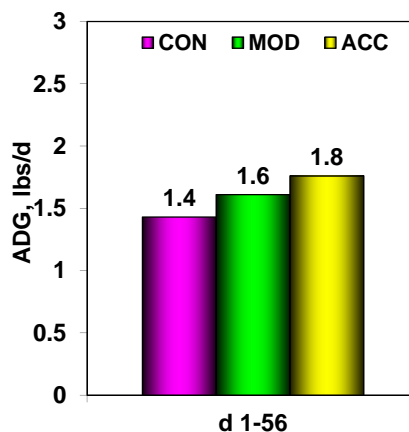


MR Feeding Rate and Predicted Gain 26-18 MR, 100 lb calf, 68°F



Calf ADG – Nursery Period

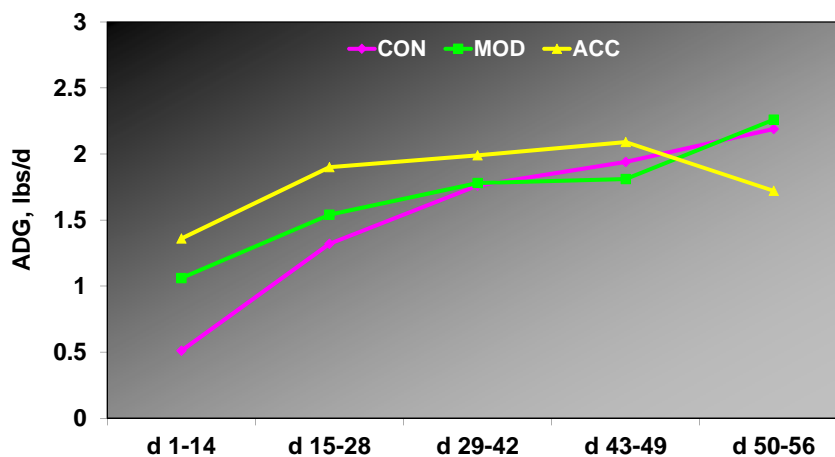
- **CON**
– 20-20, 1.25 lbs/day
- **MOD**
– 28-16, 1.50 lbs/day
- **ACC**
– 28-16, 1.50 → 2.25 lbs/day



Raeth-Knight et al., 2009, JDS 92:799



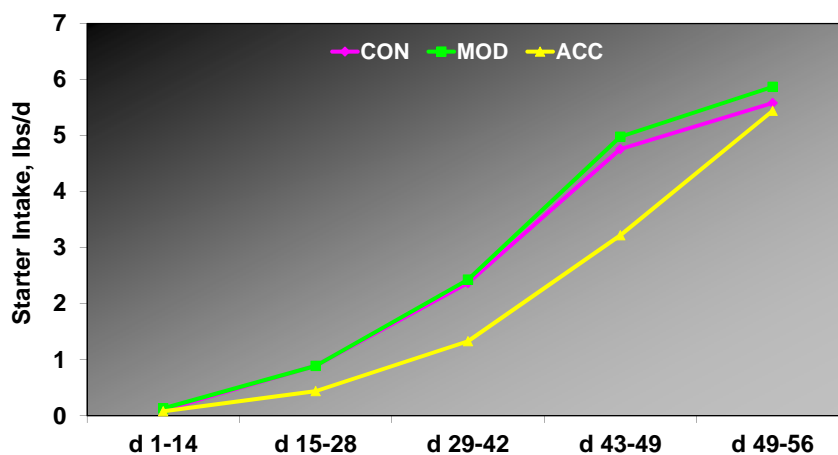
Calf ADG – Nursery Period



Raeth-Knight et al., 2009, JDS 92:799



Calf Starter Intake – Nursery Period



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Raeth-Knight et al., 2009, JDS 92:799



Starter Intake Required to Maintain BW Gain (NRC, 2001)

BW, lbs	Desired Gain, lbs/d	Starter Intake, lbs/d
132	1.32	3.37
132	1.76	4.19
176	1.32	3.97
176	1.76	4.81

Drackley, ADSA, 2009; Used 1.41 Mcal/lb ME for calf starter

Milk Products
The Milk Replacer Source®



Take-Home Messages: Milk Replacer CP/Fat & Feeding Rate

- **Feeding rate will dictate:**
 - Expected gain
 - Desired crude protein in order to optimize lean gain
 - Starter intake patterns, especially near weaning



Effect of Organic Trace Minerals on Calf Average Daily Gain

Treatments

1. Conventional MR program w/ inorganic trace minerals (CI)
2. Conventional MR program w/ organic trace minerals (CZPM)
3. Accelerated MR program w/ inorganic trace minerals (AI)
4. Accelerated MR program w/ organic trace minerals (AZPM)

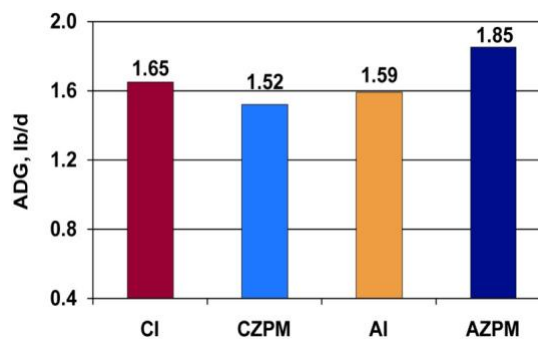


Figure 1. Effect of plane of nutrition and trace mineral source on week 1-9 average daily gain (Osorio et al., 2008).
²Plane of nutrition × trace mineral source interaction, $P \leq 0.05$



Osorio et al. 2008. *J. Dairy Sci.* 91(Suppl. 1):562. Abstr. 667.
 Figure supplied by Zinpro Corporation, Eden Prairie, MN



Effect of Organic Trace Minerals on Calf Frame Growth

Treatments

1. Conventional MR program w/ inorganic trace minerals (**CI**)
2. Conventional MR program w/ organic trace minerals (**CZPM**)
3. Accelerated MR program w/ inorganic trace minerals (**AI**)
4. Accelerated MR program w/ organic trace minerals (**AZPM**)

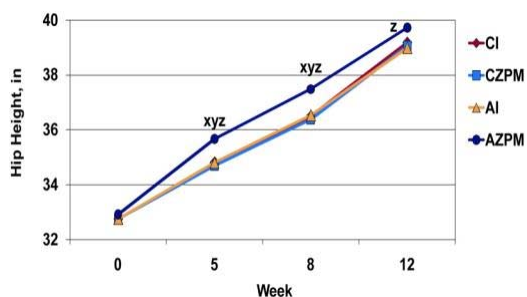


Figure 2. Effect of plane of nutrition and trace mineral source on hip height (Osorio et al., 2008).
 x ZPM vs. inorganic; $P \leq 0.05$, wk 5; $P = 0.063$, wk 8
 y Plane of nutrition, $P \leq 0.05$
 z Plane of nutrition \times trace mineral source interaction; $P < 0.05$, wk 5 and 8; $P = 0.078$, wk 12



Osorio et al. 2008. J. Dairy Sci. 91(Suppl. 1):562. Abstr. 667.
 Figure supplied by Zinpro Corporation, Eden Prairie, MN

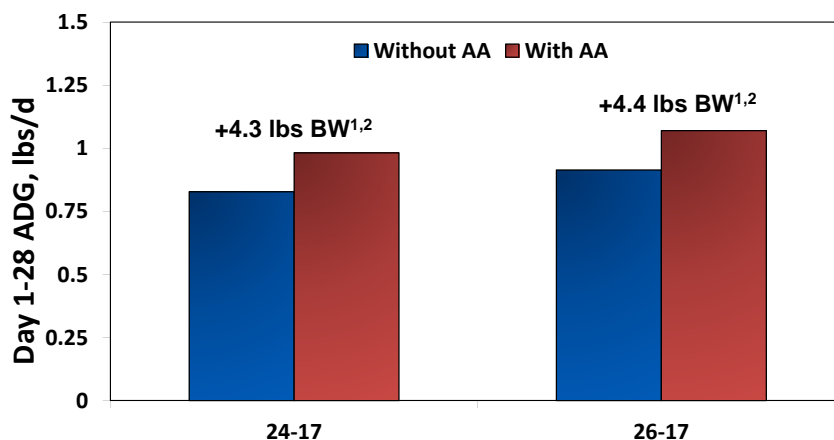


Amino Acids in Milk Replacers

- Amino acids = building blocks of protein
- Some manufacturers add amino acids, some don't
- Requirements not well defined for replacements
- Recent research has further defined guidelines
 - Lysine
 - Methionine



Effect of Lysine & Methionine



¹Linear effect of CP: $P < 0.05$

²CP \times AA: $P < 0.05$



Hill et al. 2008, J. Dairy Sci. 91:2433



Amino Acid Guidelines

- **Formulation guidelines**
 - CP:Lys – 11.1
 - Met:Lys – 0.31
- **Economics**
 - \$1.50/bag for each % CP increase
 - Additional Lys & Met = cost savings



Hill et al. 2008, J. Dairy Sci. 91:2433



Take-Home Messages: Trace Minerals & Amino Acids

- **Trace minerals**
 - Organic trace minerals should be considered if feeding an intensified growth program
- **Amino acids**
 - Should be balanced in milk replacer
 - Very inexpensive way to improve gain



Medications in Milk Replacers

- **Neomycin & Oxytetracycline**
 - Treatment of bacterial scours and bacterial pneumonia
 - Fed for 7-14 continuous days only
- **Deccox (decoquinate)**
 - Prevention of coccidiosis
 - Fed continuously
- **Bovatec (lasalocid)**
 - Control of coccidiosis
 - Fed continuously

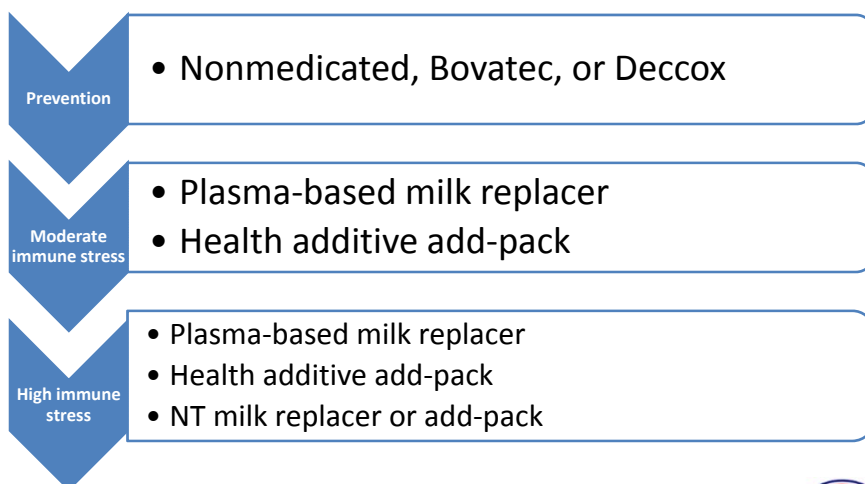


Common Milk Replacer Additives

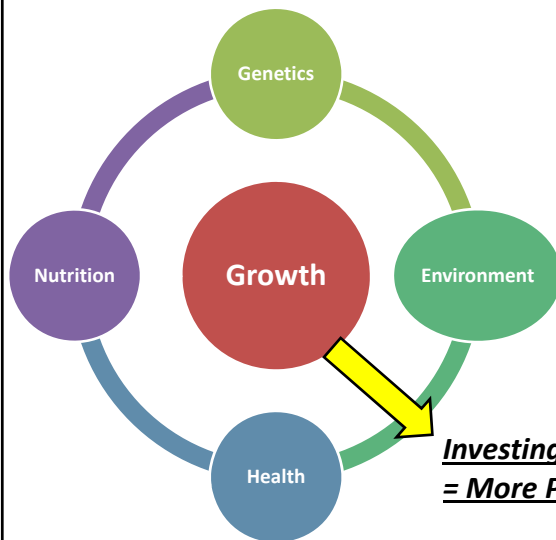
- **Yeast cell wall extracts (MOS, B-glucan)**
 - Binds to pathogenic bacteria, reducing colonization in gut
 - May enhance gut immune function
- **Direct-fed microbials (probiotics)**
 - Beneficial bacteria that help populate the gut
 - Compete/inhibit pathogenic bacteria
- **Essential oils/botanical extracts**
 - Natural additives with antimicrobial properties
 - Active against pathogenic bacteria



Positioning Medications/Additives



What Influences Calf Growth?



GENETICS

- Holstein vs. Jersey

ENVIRONMENT

- Air quality
- Cold & heat stress

HEALTH

- Colostrum status
- Pathogen load
- Vaccination program

NUTRITION

- Specific to situation

Investing in Calf Nutrition & Health
= More Productive Cows



Thank You!

