Calves: Birth to Weaning

Scott E. Pooch, DVM, DABVP and Stacey Hamilton, PhD
University of Missouri
The 5 C’s*

- Colostrum
  - 1st day of life protocols
- Calories
  - Maintenance growth performance immunity
- Comfort
  - Bedding ventilation
- Cleanliness
  - Equipment housing
- Consistency
  - Creatures of habit

*Dr. Sheila McGuirk
University of Wisconsin-School of Veterinary Medicine
Calf Rearing (Farming) is a Fine-Tuned Balancing Act

Lance Fox, DVM Diamond V
What To Do With a Newborn Calf?

56% removed ASAP, 36% allowed calf to nurse (2007 NAHMS)
Calf Hauling (Animal Welfare)

Entry to barn/pen

* Transport humanely – careful lifting and shifting onto trailer and pens
The Newborn Calf

Temperature regulation

Often overlooked **Jersey!!!!!**

* Poor ability to control body temperature for the first 24 hours of life
* Hypothermia can be rapid
  * Drops blood sugar levels and increases time to first suck
* Dry calves, avoid wind and cold concrete
Types of Warming Units
Colostrum

The first feeding of colostrum is the **MOST** important meal of a calf’s life!
University of AZ Colostrum Study

<table>
<thead>
<tr>
<th></th>
<th>2 Liters</th>
<th>vs.</th>
<th>4 Liters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinary cost per calf</td>
<td>$24.51</td>
<td></td>
<td>$14.77</td>
</tr>
<tr>
<td>ADG</td>
<td>1.76# (0.8 kg)</td>
<td></td>
<td>2.27# (1.03 kg)</td>
</tr>
<tr>
<td>First-lactation yield</td>
<td>19,739# (8972 kg)</td>
<td></td>
<td>21,845# (9930 kg)</td>
</tr>
<tr>
<td>Second-lactation yield</td>
<td>21,261# (9664 kg)</td>
<td></td>
<td>24,903# (11,320 kg)</td>
</tr>
</tbody>
</table>


Lance Fox, DVM Diamond V
Colostrum vs. Milk

* Colostrum
  * Total solids 23.9%
  * Fat 6.7%
  * Protein 4.8%
  * Calcium 0.26%
  * Vitamin A 295
  * Vitamin E 84
  * IgG 48mg/ml
  * Immunological active cells
  * Lactoferrin

* Milk
  * Total solids 12.5%
  * Fat 3.6%
  * Protein 3.2%
  * Calcium 0.13%
  * Vitamin A 34
  * Vitamin E 15
  * IgG 0.6mg/ml
Colostrum

- Timing of collection
- Cleanliness
- Timing of feeding
- Volume
- Method
- IgG concentration (IgG)
Cleanliness

Culture of Colostrum
* <100,000 cfu/mL total bacteria
* <10,000 cfu/mL fecal coliforms
* Heat treatment of colostrum
Colostrum should be fed within ___ hours after birth? (*Quick*)
ASAP (within 3 hours of birth)

How much should be feed? (*Quantity*)
10% of BW

# of IgG’s needed for passive transfer? (*Quality*)
- 200 grams of IgG
IgG Concentration: Colostrum Quality Assessment

* Colostrometer (Green)
* Brix Refractometer ($\geq 22\%$)
# Colostrum Absorption Assessment

<table>
<thead>
<tr>
<th>Total Protein</th>
<th>Deaths</th>
<th>Total</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 5.5</td>
<td>36</td>
<td>714</td>
<td>1.81</td>
</tr>
<tr>
<td>5-5.49</td>
<td>89</td>
<td>1350</td>
<td>1.31</td>
</tr>
<tr>
<td>&lt; 5.0</td>
<td>78</td>
<td>857</td>
<td>1</td>
</tr>
</tbody>
</table>

Goal > 80%

P=0.002

Dr. Dale Moore, Washington State University
<table>
<thead>
<tr>
<th>Southwest Center</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>77.8%</td>
<td>Overall</td>
</tr>
<tr>
<td>63.6%</td>
<td>1st calf Heifers</td>
</tr>
<tr>
<td>84.0%</td>
<td>Mature cows</td>
</tr>
</tbody>
</table>

When a calf nurses from a cow, it consumes an unknown quantity of an unknown quality of colostrum!
Colostrum Collecting, Storing (if not feeding)

Goal: <45°F (<7.2°C) ASAP

Refrigerated--- 7 days

Frozen--- 12 months
Calories
Sources of Milk

* Colostrum
  * Essential for first day of life
  * Preferable for first 3 days
  * Rich in nutrients, good for gut bacteria
* Whole milk
  * Perfect food for calves
  * Calves less prone to scours, but don’t feed milk from mastitis cows
* Pasteurizer
* Calf milk replacer
  * Usually consistent quality
  * Can move rearing away from the parlor
Calf Requirements

Major Inputs Used to Compute Young Calf Requirements

- Calf Body Weight: 90 (lbs)
- Temperature: 75.0 deg. F
- Dist ME: 2.10 (Mcal/lbs)
- Dist NEm: 1.81 (Mcal/lbs)
- Dist NEg: 1.45 (Mcal/lbs)

Calculation of Young Calf Requirements

Allowable Gain
- Energy Allowable ADG: 0.86 (lbs/day)
- ADP Allowable Gain: 0.74 (lbs/day)

Maintenance Requirement Calculations

- Total Milk Dry Matter Intake: 1.25 (lbs/day)
- Total Starter Dry Matter Intake: 0.00 (lbs/day)
- Net Energy Basal Maintenance Requirement: 0.86 (Mcal/day/BW^0.75)
- Temperature Multiplier: 1.00
- Net Energy Required for Maintenance: 1.39 (Mcal/day)
- Dry Matter Intake Required for Maintenance: 0.77 (lbs/day)

Efficiency of use of ME for NEm: 0.86
- Metabolizable Energy Required for Maintenance: 1.62 (Mcal/day)

Apparent Digestible Protein Required for Maintenance: 27 (g/day)
- Crude Protein Required for Maintenance: 29 (g/day)

Growth Requirement Calculations

- Intake Available for Growth: 0.48 (lbs/day)
- Net Energy Available for Growth: 0.70 (Mcal/day)
- Efficiency of use of ME for NEg: 0.69
Calf Requirements

Major Inputs Used to Compute Young Calf Requirements

- Calf Body Weight: 90 (lbs)
- Temperature: 32.0 deg. F
- Dist ME: 2.10 (Mcal/lbs)
- Dist NEm: 1.81 (Mcal/lbs)
- Dist NEd: 1.45 (Mcal/lbs)

Calculation of Young Calf Requirements

- Allowable Gain: 0.16 (lbs/day)
- ADG Allowable Gain: 0.74 (lbs/day)

Maintenance Requirement Calculations

- Total Milk Dry Matter Intake: 1.25 (lbs/day)
- Total Starter Dry Matter Intake: 0.00 (lbs/day)

- Net Energy for Basal Maintenance Requirement: 0.086 (Mcal/day/BW^0.75)
- Temperature Multiplier: 1.54
- Net Energy Required for Maintenance: 2.14 (Mcal/day)
- Dry Matter Intake Required for Maintenance: 1.18 (lbs/day)

- Efficiency of use of ME for NEm: 0.86
- Metabolizable Energy Required for Maintenance: 2.46 (Mcal/day)

- Apparently Digested Protein Required for Maintenance: 27 (g/day)
- Crude Protein Required for Maintenance: 29 (g/day)

Growth Requirement Calculations

- Intake Available for Growth: 0.07 (lbs/day)
- Net Energy Available for Growth: 0.09 (Mcal/day)
- Efficiency of use of ME for NEd: 0.69

0.16 #/day
Calf Requirements

Major Inputs Used to Compute Young Calf Requirements

- Calf Body Weight: 80 (lbs)
- Temperature: 55.0 deg. F
- DMI (Mcal/kg)
  - Dist ME: 2.20
  - Dist NE: 1.89
  - Dist Nf: 1.52

Calculation of Young Calf Requirements

- Allowable Gain: 1.84 (#/day)
- Energy Allowable ADG: 1.26 (#/day)
- ADP Allowable Gain: 1.84 (#/day)

Maintenance Requirement Calculations

- Total Milk Dry Matter Intake: 1.88 (#/day)
- Total Starch Dry Matter Intake: 0.90 (#/day)
- Net Energy Basal Maintenance Requirement: 0.086 (Mcal/day * BW^0.75)
- Temperature Multiplier: 1.13
- Net Energy Required for Maintenance: 1.44 (Mcal/day)
- Dry Matter Intake Required for Maintenance: 0.76 (#/day)
- Efficiency of use of ME for NEm: 0.86
- Metabolizable Energy Required for Maintenance: 1.67 (Mcal/day)
- Apparent Digestible Protein Required for Maintenance: 26 (g/day)
- Crude Protein Required for Maintenance: 28 (g/day)

Growth Requirement Calculations

- Intake Available for Growth: 1.12 (#/day)
- Net Energy Available for Growth: 1.69 (Mcal/day)
- Efficiency Use of ME for NEm: 0.86

1.84 #/day
What Are the Advantages of Accelerated Growth?

* Increased Average Daily Gain (ADG) pre-weaning

* Mixed results in yearling and calving weights

* Majority of studies indicate decreased breeding and calving age

* Majority of studies cite significant or tendency to have an increased first lactation milk yield
What Defines an Accelerated Milk Replacer

* High protein (26-28% crude protein)
* Moderate fat (15-20% crude fat)
* Increased amounts of milk replacer and water with weaning at a “younger” age (~6-7 weeks of age)
MU Southwest Center Study: Objectives

* Determine if intensified milk feeding in small framed dairy heifers will result in:
  * Younger weaned calves at similar weights as traditionally fed calves
  * Decreased breeding and calving age
  * Increased milk production in first lactation
### Active Drug Ingredient

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neomycin Sulfate</td>
<td>1300 grams/ton</td>
</tr>
<tr>
<td>Oxytetracycline (from oxytetracycline dihydrate base)</td>
<td>1300 grams/ton</td>
</tr>
</tbody>
</table>

### Guaranteed Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein</td>
<td>28.50%</td>
<td></td>
</tr>
<tr>
<td>Crude Fat</td>
<td>15.00%</td>
<td></td>
</tr>
<tr>
<td>Crude Fiber</td>
<td>0.15%</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>0.75%</td>
<td>1.25%</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.60%</td>
<td></td>
</tr>
</tbody>
</table>

### Active Drug Ingredient

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neomycin Sulfate</td>
<td>1600 grams/ton</td>
</tr>
<tr>
<td>Oxytetracycline (from oxytetracycline dihydrate base)</td>
<td>1600 grams/ton</td>
</tr>
</tbody>
</table>

### Guaranteed Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein</td>
<td>20.0%</td>
<td></td>
</tr>
<tr>
<td>Crude Fat</td>
<td>20.0%</td>
<td></td>
</tr>
<tr>
<td>Crude Fiber</td>
<td>0.15%</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>0.75%</td>
<td>1.25%</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.7%</td>
<td></td>
</tr>
</tbody>
</table>
Parameters

* 16 Holstein, Jersey or Crossbred heifers assigned to Milk Formula 1 as the traditional milk replacer program
* 21 Holstein, Jersey or Crossbred heifers assigned to Velocity as the accelerated feeding program
* Calves were assigned as groups of 8 and “mob-fed” using 10 nipple feeders
* Birth weight:
  * MF1 = 70.6 #
  * Velocity = 69.0 #
* Average age at start of treatment
  * MF1 = 9.7 days
  * Velocity = 7.0 days
# Protocol for Feeding Traditional vs. Accelerated Milk Replacers

## Milk Formula 1-traditional MR

<table>
<thead>
<tr>
<th>Week</th>
<th>Oz powder/feeding</th>
<th>Warm water (Pints)/feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>7.5</td>
<td>3</td>
</tr>
<tr>
<td>Week 2</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Week 3</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Week 4</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Week 5</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Week 6</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Week 7</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Week 8</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

Milk Formula 1-traditional milk replacer – 68#

## Velocity-accelerated MR

<table>
<thead>
<tr>
<th>Week</th>
<th>Oz powder/feeding</th>
<th>Warm water (Pints)/feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>7.5</td>
<td>3</td>
</tr>
<tr>
<td>Week 2</td>
<td>12.5</td>
<td>5</td>
</tr>
<tr>
<td>Week 3</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Week 4</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Week 5</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Week 6</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Week 7</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

Velocity-accelerated milk replacer – 66#
## Approximate Cost of Each Program

<table>
<thead>
<tr>
<th></th>
<th>Velocity (Accelerated)</th>
<th>MFI</th>
<th>Difference</th>
<th>Period Fed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost/Unit</td>
<td>Total Cost</td>
<td>Cost/Unit</td>
<td>Total Cost</td>
</tr>
<tr>
<td>Milk</td>
<td>66</td>
<td>$1.90</td>
<td>68</td>
<td>$1.43</td>
</tr>
<tr>
<td>Starter</td>
<td>315</td>
<td>$0.28</td>
<td>292.5</td>
<td>$0.28</td>
</tr>
<tr>
<td>Grower</td>
<td>450</td>
<td>$0.27</td>
<td>450</td>
<td>$0.27</td>
</tr>
<tr>
<td>Developer</td>
<td>675</td>
<td>$0.25</td>
<td>675</td>
<td>$0.25</td>
</tr>
<tr>
<td>Total Per Calf</td>
<td>$502.05</td>
<td></td>
<td>$467.59</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- Average Daily Gain increased in heifers fed Velocity
- Weaning weight same at 6 weeks vs. 8 weeks
- Numerical advantage in weights throughout
- Intangibles
  - Calf health
  - Labor and time
- Stay tuned for:
  - Breeding/calving age (95.2% vs 87.5% PR, and 2/8/14 vs 2/11/14 calving date)
  - Milk yield

Project sponsored by Hartville Feed and Milk Specialties Global Animal Nutrition
Comfort and Cleanliness

Dip Navels
7% Iodine
Cleanliness
(Soaking ≠ Drying)
Cleanliness
(DRY)
Bloat

* Feed milk at what temperature? (~105°F/40°C)
* Bottle Fed Operations: Out with the old, in with the new
* Thoroughly mix milk replacer
* History of Pneumonia?

Lance Fox, DVM Diamond V
Individual or Group
Calves and Mob Feeders
What else?

* Water
* Grain
* Forage?
Free Choice vs. No Water

<table>
<thead>
<tr>
<th></th>
<th>Free Choice</th>
<th>No Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG Increase</td>
<td>0.678# (0.31 kg)</td>
<td>0.399# (0.18 kg)</td>
</tr>
<tr>
<td>Starter Increase</td>
<td>0.927# (0.42 kg)</td>
<td>0.643# (0.29 kg)</td>
</tr>
<tr>
<td>Scour Days</td>
<td>4.5 days</td>
<td>5.4 days</td>
</tr>
</tbody>
</table>

(Kertz, et al 1984)
Impacting Rumen Development: Hay vs Grain

A.J. Heinrichs, The Pennsylvania State University

Lance Fox, DVM Diamond V
Ideal Criteria for Weaning?

* Age
* Space Availability
* Daily Grain Intake

A calf that is eating ~2 lbs (0.9 kg) of starter/day for several consecutive days is ready for the weaning process.

Lance Fox, DVM Diamond V
Thermo Neutral Zone is ~50-75°F (10-24°C) (calves < 1 month old)

* Good Rule of Thumb:
  * For every 1°F drop in ambient temperature below the TNZ, maintenance energy increases by 1%
  * 25°F (-3.8°C) 25% increase
  * 0°F (-17°C) 50% increase
Dairy Calf and Heifer Association

* Gold Standards for raising heifers
## Deaths

### Mortality

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-60 days of age</td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>61-120 days of age</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>121-180 days of age</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>6-12 months</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>12 months to calving</td>
<td>&lt; 0.5%</td>
</tr>
</tbody>
</table>
## Disease Incidence

<table>
<thead>
<tr>
<th>Scours</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 60 days of age</td>
<td>&lt; 25%</td>
</tr>
<tr>
<td>61-120 days of age</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>121-180 days of age</td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pneumonia</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 60 days of age</td>
<td>&lt; 10%</td>
</tr>
<tr>
<td>61-120 days of age</td>
<td>&lt; 15%</td>
</tr>
<tr>
<td>121-180 days of age</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>6-12 months</td>
<td>&lt; 3%</td>
</tr>
<tr>
<td>12 months to calving</td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other diseases</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 months</td>
<td>&lt; 4%</td>
</tr>
<tr>
<td>12 months to calving</td>
<td>&lt; 2%</td>
</tr>
</tbody>
</table>
Pieces of the Disease Management Pie

Energy Needed for Immune Function:
* 25-30%


Lance Fox, DVM Diamond V
When problems persist, don’t get caught chasing zebras.
Now What?