Calf Supplements – Choose wisely!

- MOS - Biomos
- FOS – Fructo-oligo-sacharides
- Spray Dried Plasma
- Organic Acids: Sodium Butyrate
- Gammulin – Inner Shield
- Nucleotides
- Calcium Lactate
- Lactoferrin
- Electrolytes
- Essential Oil - Oleobiotec
- Regano
- Copper Sulfate – Zinc Oxide
- Betaine
- Acidifiers
- Essential Oil - XTRACT
- FOS – Fructo-oligo-sacharides
- TGF-Beta 1 from Colostrum
- Gammmulin – Inner Shield
- Organic Acids: Sodium Butyrate
- Egg Antibodies
- Neo-Terra
- B-vitamins
- Charcoal
- NeoTec4
- Acidifiers
- Essential Oil - APEX
- Yeast
- Betaglaucan
- Bovatec
- Spray Dried Colostrum
- Chinese Mushrooms
- Organic Minerals – Cu, Zn, Mn, Fe
- Neo-Terra
- B-vitamins
- DeccoX
- Butyric Acid
- Bacillus Probiotic (DFM)
- Vitamin E, C – antioxidants
- Micro-Aid
- Yucca Extract
- Selenium Yeast
Criterion to Judge

- $$$$$$ ROI
  - MOST IMPORTANT!
  - Cash Outlay
- Proof
  - Research
  - Field Experience
- Ease of Use

Risk to Scarce Capital

Supplements?
Vaccines?
Injectable Antibiotics?

Management interventions
Today, we’ll evaluate

- Functional Proteins – blood & colostrum-based
- Neomycin, Bovatec and Deccox
- Vitamin & Trace Mineral supplements
- MOS
- Direct-Fed Microbials (a.k.a. Probiotics)
- Miscellaneous (Essential Oils, Butyrate/NT4)

Plasma’s Physical properties

Will make the change in CMRs nearly undetectable

+Will not change CMR color
+Will not change aroma of CMR
+Will not change solubility of CMR

- It is important to note that CMRs containing plasma should not be mixed with water that is 150+°F (65°C). Higher temperatures will denature proteins and reduce solubility.
- 78% C.P., 0.3% fat, 0.5% fiber, 7% moisture, 8.5% ash
Nutrapro B (APC) spray dried plasma

78% C.P.

Judging Spray Dried Plasma

- Research shows
  - Fewer loose stools
  - Improved livability
- Proof
  - 11 published calf trials
  - 19 non-published calf trials
  - Well proven in the field
- Reduced CMR costs
  - Saves $1 - $2 / bag of CMR
A third to 40% of the milk replacers made in America contain plasma. Nation-wide use is heavily skewed in western markets where large calf ranches can clearly see the health benefits and significant savings.

Broad scale use of plasma protein in early-life veal formulas (first 6 – 8 weeks)
Published Calf Trials

- Morril, J. Dairy Sci. (JDS), K-State, 1995
- Quigley, JDS, Univ. of Tenn, 1996
- Quigley/Drew, Fd & Ag Immunology, 2000. E coli
- Arthington, JDS, Iowa State, 2002. Coronavirus challenge
- Quigley/Kost, JDS, APC, 2002
- Quigley/Wolf, JDS, APC, 2003
- Jones/Quigley, JDS, VA Tech/APC, 2004
- Quigley/Wolfe, JDS, APC, 2006

11 calf trials in 10 published papers (one had two trials)

19 Non-published calf trials

- Sowinski, MSC, JDS Abst, 1990
- Doppenburg, Vitek, veal, 1992
- Doppenburg, Vitek, veal, 1993
- Doppenburg, Vitek, veal, 1993
- Doppenburg, Vitek, veal
- Johnson, CSU, CMR, 1997
- Quigley 1999
- Catherman, Strauss Feeds, 2001
- Quigley, APC, Gammulin, 2001
- Wawrzyniak (Kehoe), ISU, coronavirus, 2004
- Wood, Animix, JDS Abst., 2009
- Lopes, UC-Davis, JDS Ab. 2009
- Carlson, Waseca, JDS Ab. 2009
- Hayes, Waseca, JDS Abs. 2009
- Kehoe, U-W-R.F., JDS A. 2010
- Pineda, U of Ill., JDS A., 2010
- Wood, Animix, JDS A. 2013
- Wood, Animix, veal, 2013
- Wood, Animix, veal, 2014
30 Total Plasma Studies

21 plasma, 7 serum, 2 combination

Criterion to Judge – compared to an “all Milk”

• **Gain** – 4 superior (p<0.05), 1 trend superior (p<0.10), 21 equal, 1 poorer (p<0.05).

• **Scours** – 20 measured fecal score or scour days. 8 reported less (p<0.05), 1 trended less (p<0.10), 11 reported the same. 1 reported less week 2 and more week 3 (p<0.05).

• **Starter intake** – 16 reported. 3 increased (p<0.05), 12 same. 1 poorer (p<0.05).

• **Antibiotics** – 5 superior (fewer treatments) (p<0.05), 2 show + interaction w/NT, 6 the same

Bottom line: performs at least as well as “all milk” and often better!

**Mortality**

<table>
<thead>
<tr>
<th>Author, Pub./Company, Use rate</th>
<th>Plasma <em>All-Milk</em> No. Calves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nollet, J. Vet. Med. 1999. plasma 35 or 75 gd</td>
<td>22% 100% 24</td>
</tr>
<tr>
<td>Quigley, APC 1999 (NT group 25% mortality)</td>
<td>50% 50% 80</td>
</tr>
<tr>
<td>Doppenburg, Vitek 1993. Veal d 3 - 48 (8.3% plas)</td>
<td>24% 26% 92</td>
</tr>
<tr>
<td>Quigley, JDS* 2003 (5% plasma)</td>
<td>6.3% 25% 120</td>
</tr>
<tr>
<td>Quigley, JDS 2006 (Gammulin in Acc. Nut)</td>
<td>12.6% 22% 79</td>
</tr>
<tr>
<td>Quigley, JDS 2002 (4% plasma, +/- Gamm.)</td>
<td>4% 20% 120</td>
</tr>
<tr>
<td>Drew, J Immunology, 2000 (3.5% plasma)</td>
<td>0% 16.7% 36</td>
</tr>
<tr>
<td>Pineda, U of Ill, 2010. Abstract. Gammulin 14 day</td>
<td>2.5% 16% 93</td>
</tr>
<tr>
<td>Wood, Animix 2013. Abstract. plasma</td>
<td>4.8% 13.2% 86</td>
</tr>
<tr>
<td>Doppenburg, Vitek 1993. Veal d 3 - 45 (8.3% plas)</td>
<td>13% 10.3% 91</td>
</tr>
<tr>
<td>Wood, Animix 2009 (5% plasma, 6% wheat)</td>
<td>8% 5% 120</td>
</tr>
<tr>
<td>Doppenburg, Vitek 1992. Veal, d 0-43, plasma</td>
<td>3.9% 7.8% 102</td>
</tr>
<tr>
<td>James/Quig. VA Tech, 2004 JDS, plasma</td>
<td>7.8% 2.5% 78</td>
</tr>
<tr>
<td>Quigley, JDS 1996 (7.5% plasma)</td>
<td>6% 0% 68</td>
</tr>
<tr>
<td>Lopez, U-C, Davis 2008. Gammulin d 1 - 23</td>
<td>5.2% 5.2% 518</td>
</tr>
<tr>
<td>Morrill, JDS, 1995 (7% plasma)</td>
<td>6.7% 6.6% 120</td>
</tr>
<tr>
<td>Quigley, APC 2001, Gammulin d 1 - 15</td>
<td>3% 5% 120</td>
</tr>
<tr>
<td>Quigley, JDS 2002 (5% plasma)</td>
<td>0% 3.3% 120</td>
</tr>
<tr>
<td>Wood Animix 2013. extra plasma over 5.2%</td>
<td>2.4% 0% 128</td>
</tr>
<tr>
<td>Hayes. APC 2009 (8% &amp; 4% plasma)</td>
<td>0% 0% 120</td>
</tr>
<tr>
<td>Arrington, JDS 2002. Coronavirus, 160 g/d serum</td>
<td>0% 0% 12</td>
</tr>
<tr>
<td>Hunt, J Peds. 2002. Crypto, serum 57g/d</td>
<td>0% 0% 24</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td><strong>8% 15% 2,351</strong></td>
</tr>
</tbody>
</table>

* denotes Journal of Dairy Science. Red denotes statistical significance (P<0.05).
Disease Challenge Studies - Plasma
Published Calf trials on plasma
Crypto – 57 g / day serum
  33% ↓ in scours, 30% ↑ gut repair
E Coli – 75 g / day plasma.
  ↓ mortality
E Coli – 3.5% inclusion rate, plasma
  Improved ADG
Coronavirus – 160 g / day serum
  Improved feed intake & hydration
Not Published: Kehoe (ISU/APC) coronavirus, No effect

Functional proteins are in colostrum, fresh suckled milk and serum and plasma

Which functional proteins?

- Globulin proteins (16 – 22%)
- Growth Factors
- Hormones
- Immune Cells

Serum and plasma are more like colostrum than milk

Plasma helps you mimic the real deal . . . Mama’s milk!
Individually bucket-fed, every-third pair in stall-barn, fed either whole colostrum (~20\% IgG, 44\% CP: 18\% CF), or plasma/dry fat blend (~13\% IgG, 52:18), WPC/dry fat (44:18). Step down fashion, 2 lbs in starter phase (wk 1 – 7), 1 lb finisher (wk 8 – 20). 77\% FPT

Individually bucket-fed, every third pair in stall-barn, fed either whole colostrum (13\% IgG, 44\%CP:18\% Fat, or plasma/fat blend (~13\% IgG, 52:18), WPC/fat (44:18). Step down fashion, 2 lbs in starter phase (wk 1 – 7), 1 lb finisher (wk 8 – 20). 77\% FPT

**Neomycin/Oxytetracycline**

- **Current option:** 100 lb. calf 1,000 mg Neomycin & 1,000 mg OTC for 7 – 14 days. Cost: $1.96 - $3.92

**Calf Med Pack**

**Medicated**

For use in calves, beef cattle and non-lactating dairy cattle.

*Indications for use: For treatment of bacterial enteritis caused by E. coli and bacterial pneumonia (diaphragm fever complex) caused by Pasteurella multocida susceptible to oxytetracycline, treatment and control of colibacillosis (shipping fever complex) caused by E. coli susceptible to neomycin.*

**Active Drug Ingredient**

- Neomycin Sulfate ................................................................. 10 grams/lb.
- Oxytetracycline hydrochloride ................................................................. 10 grams/lb.

**Guaranteed Analysis**

- Protein, Min. .......................... 22.68 \% .......................... 22.68 \%
- Fat, Max. .......................... 0.1 \% .......................... 0.1 \%
- Crude Fiber, Max. .......................... 0.2 \% .......................... 0.2 \%
- Calcium, Min. .......................... 0.05 \% .......................... 0.05 \%
- Phosphorus, Min. .......................... 0.1 \% .......................... 0.1 \%

**Ingredient Statement:** Maltodextrin, Dextrose, Dried Whey, Kaolin.

This is not a complete feed and must be mixed as indicated under the following directions:

**Mixing Directions:**

Treatment: Mix 45.4 grams of Calf Med Pack with non-medicated milk replacer per calf per day. This will provide a 100 pound calf 30 mg of Neomycin and 30 mg Oxytetracycline per pound of body weight. Feed continuously for 7-14 days. If symptoms persist after using for 5 or 3 days, consult a veterinarian. Treatment should continue 24 to 48 hours beyond remission of disease symptoms.

**Residue Warning:** A withdrawal period has not been established for use in pre-ruminating calves. Do not use in calves to be processed for veal. A milk discard time has not been established for use in lactating dairy cattle. Do not use in female dairy cattle 20 months of age or older. Withdraw 5 days before slaughter. Use of more than one product containing neomycin or failure to follow withdrawal times may result in illegal drug residue.

Net Weight 50 lb. (22.68 kg)

Manufactured by:
NT Published Calf Trials

  - 54 mg Neomycin & 108 mg OTC for 2 weeks;
- Berge, JDS, UC-Davis, 2005
  - 480 mg Neomycin & 684 mg OTC daily for 28 days
- Heinrichs, JDS, Penn State 2003. NT vs. Biomos
  - 400 mg Neomycin & 200 mg OTC daily for 42 days
- Quigley/Drew, Fd & Ag Immunology, 2000. E coli challenge
  - 800 mg Neomycin & 400 mg OTC daily for 21 days
- Donovan, JDS, SDSU, 2002
  - 125 mg Neomycin & 64 mg OTC for 35 days
- Quigley, JDS, U of TN, 1997
  - 131 mg Neomycin & 66 mg OTC for 28 days

6 published calf trials on Neomycin/OTC

13 Non-published NT calf trials

Journal of Dairy Sci. Abstracts:
- Katzman, UW-RF, JDS Abst, 2011
- Shields, Merricks, JDS Abst, 2013
- Fowler, LOL, JDS Abstract. 1992
- Dvorak, Alltech, JDS Abst, 1997
- Quigley, APC, 1999
- Sowinski, MSC, 1993
- Sowinski, MSC, 1992
- Sowinski, MSC, 1991
- Sowinski, MSC, 1991
- Sowinski, MSC, 1991
- Sowinski, MSC, 1991

Veal research:
- Doppenburg, Vitek, veal, 1992
- Doppenburg, Vitek, veal, 1993

Research on Neomycin/OTC
| Study                                      | Year | NT  | Improvement
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Berge, JDS 2009.</td>
<td>54:108</td>
<td>↑</td>
<td>morbidity</td>
</tr>
<tr>
<td>Berge, JDS 2005.</td>
<td>480:684</td>
<td>↑</td>
<td>ADG (+258%), ↓</td>
</tr>
<tr>
<td>Heinrichs, JDS 2003.</td>
<td>340:170</td>
<td>↓</td>
<td>scours</td>
</tr>
<tr>
<td>Drew, Food &amp; Ag Imm. 2000. E coli.</td>
<td>800:400</td>
<td>↑</td>
<td>ADG (+25%)</td>
</tr>
<tr>
<td>Donovan, JDS 2002.</td>
<td>125:64</td>
<td>No significant diff.</td>
<td></td>
</tr>
<tr>
<td>Quigley, JDS 1997.</td>
<td>131:66</td>
<td>↑</td>
<td>ADG (+42%)</td>
</tr>
<tr>
<td>Katzman, JDS Abst. 2011.</td>
<td>400:200</td>
<td>↑</td>
<td>gut morphology</td>
</tr>
<tr>
<td>Shields, JDS Abst. 2010.</td>
<td>1000:1000</td>
<td>↓</td>
<td>scours &amp; morbidity, ↓</td>
</tr>
<tr>
<td>Quigley, APC, 1999.</td>
<td>400:200</td>
<td>↓</td>
<td>mortality, ↓</td>
</tr>
<tr>
<td>Doppenburg, Veal, 1992.</td>
<td>1,000:500</td>
<td>↑</td>
<td>ADG (+27%), ↓</td>
</tr>
<tr>
<td>Doppenburg, Veal, 1993.</td>
<td>500:250</td>
<td>↓</td>
<td>morbidity</td>
</tr>
</tbody>
</table>

Red denotes P<0.05 NT improvement; Blue P<0.10 NT trend improvement, Yellow, detriment due to NT P<0.05. NT denotes Neomycin:OTC

| Study                                      | Year | NT  | Improvement
<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alltech, JDS Abst. 1997.</td>
<td>200:100</td>
<td>↑</td>
<td>ADG (+14%), ↑ Starter</td>
</tr>
<tr>
<td>MSC, JDS Abst. 1993.</td>
<td>800:400</td>
<td>↑</td>
<td>14 d ADG (+19%), ↑ 28 d ADG (+3%)</td>
</tr>
<tr>
<td>LOL, JDS Abst. 1992.</td>
<td>250:10 0</td>
<td>↓</td>
<td>scours</td>
</tr>
<tr>
<td>MSC, 1991.</td>
<td>400:200</td>
<td>↑</td>
<td>14 d ADG (+418%), ↑ 49 d ADG (+60%)</td>
</tr>
<tr>
<td>No stats provided</td>
<td>800:400</td>
<td>↑</td>
<td>14 d ADG (+372%), ↑ 49 d ADG (+55%)</td>
</tr>
<tr>
<td>MSC, 1992.</td>
<td>400:200</td>
<td>↑</td>
<td>ADG vs. non med &amp; NT 200:100</td>
</tr>
<tr>
<td>MSC, 1991.</td>
<td>400:200</td>
<td>↑</td>
<td>14 d ADG (+200%), ↑ 49 d ADG (+9%)</td>
</tr>
<tr>
<td>MSC, 1991.</td>
<td>400:200</td>
<td>↑</td>
<td>14 d ADG (+445%), ↑ 49 d ADG (+60%)</td>
</tr>
<tr>
<td>No stats provided</td>
<td>800:400</td>
<td>↑</td>
<td>14 d ADG (+372%), ↑ 49 d ADG (+241%)</td>
</tr>
<tr>
<td>MSC, 1991.</td>
<td>400:200</td>
<td>↑</td>
<td>35 d ADG (+16%)</td>
</tr>
</tbody>
</table>

Red denotes P<0.05 NT improvement; Blue P<0.10 NT trend improvement, Black denotes no stats provided. NT denotes Neomycin:OTC
28 CTC/OTC calf trials in whole milk or CMR

- Morrill, JDS. 1977. 83 mg CTC/d. No significant difference
- Swanson, JDS. 1963. Day 1 – 63: 50 mg CTC ↑ 63 d ADG (+25%), 50 mg milk + 25 mg CTC in starter ↑ ADG (+33%). Both P<0.01. CTC ↑ starter & hay intake.
- Murdock, JDS. 1961. 50 mg CTC ramped up to 275 mg CTC ↑ 49 d ADG in males (+18%) and in females (+4.3%). CTC-fed calves ↑ ADG P<0.01.
- Brown, JDS. 1960. 50 mg CTC milk, 15 mg CTC/lb. starter. ADG ↑ (P<0.01). CTC did not spare protein, but did enable very low CP starter to gain well.
- Rusoft, JDS. 1959. Holsteins: 50 mg CTC d 1 – 112, ↑ ADG (+22%), Jerseys ↑ ADG (+14%), both P<0.05. 250, 500 or 1,000 mg for days 1 – 3 ↓ mortality P<0.05
- Bush, JDS. 1959. 80 mg CTC d 1 – 112, ↑ ADG +13% P<0.05. CTC had no effect on digestibility of any nutrient as measured week 5, 8 or 11. Feed intake ↑.
- Everett, JDS. 1958. 50 mg CTC d 1 – 49, then 15 mg CTC to d 86. ADG ↑ (+18%) P<0.01. CTC-fed calves grew taller and had more heart girth

Red denotes P<0.05 NT improvement; Blue P<0.10 NT trend improvement. Black denotes No Significant Difference (NSD). JDS, Journal of Dairy Science.

1950's & 1960's calf production?
- Colostrum 3 days
- Whole milk 10% of BW for 4 weeks.
- Weaned at 350 lbs. whole fluid milk total intake
- 18 – 22% CP calf starter introduced week one
- High quality alfalfa hay free choice starting 7 days
- Cap starter intake at 5 lbs. / d for Holsteins
- 8 week weight 155 lbs. in Holsteins
- 12 week weight 210 lbs.

Recent U of Illinois study comparing conventional to full potential milk feeding strategies:
- 7 – 8 weeks: 150 to 172 lbs.
- 12 – 13 weeks: 207 to 255 lbs.

Not that different

Pictures to the right: Iowa State Dairy Farm. Old one erected 1916. Replaced with state of the art 450 cow dairy.

ISU An. Sci. bursting at seams: 1400 enrolled!
28 CTC/OTC calf trials in whole milk or CMR

- Swanson, JDS. 1963. Day 1 – 63: 50 mg CTC/d ↑ 63 d ADG (+25%), 50 mg milk + 25 mg CTC in starter ↑ ADG (+33%). Both P<.01. CTC ↑ starter & hay intake.
- Bartley, JDS. 1957. 45 mg CTC/d ↑ 56 d ADG (+5.2%) P<.05.
- Landaora, JDS. 1957. Holsteins: 50 mg CTC/d in “old” barn 28 d ↑ ADG (+57%) and for “new” barn 28 d ↑ ADG (+31%), both P<.001. 400 mg CTC/1x/week injected, in “old” barn 28 d ↑ ADG (+37%) and in “new” barn ↑ ADG (+66%), P<.001. Jerseys: “old” barn +100% for 50 mg and +40% for “new.”
- Radison, JDS. 1956. Coliforms and salmonella from calf feces more susceptible to phagocytosis if blood came from calf fed 45 mg CTC/d.
- Hogue, JDS. 1956. 40 mg CTC/d ↑ 42 d ADG 12%. Nitrogen retention ↑ 36%
- Jones, JDS. 1956. 50 mg CTC/d ↑ 56 d ADG 32%, P<.05
- Lassiter. JAS (J. Animal Sci.). 1955. 75 mg CTC/d NSD
- Gaunya. JDS. 1955. 4.5 or 9.0 CTC/lb. starter. NSD.

Red denotes P<.05 NT improvement; Blue P<.10 NT trend improvement.

28 CTC/OTC calf trials in whole milk or CMR

- Swanson, JDS. 1955. Holsteins: 50 mg CTC ↑ 29 d ADG (+11%), ↑ 120 d ADG (+13%). Jerseys: 30 mg CTC/d ↑ 29 d ADG (+25.7%) and 120 d ADG (+10%).
- Bartley, JDS. 1955. 30 mg CTC/d ↑ 1 - 112 d ADG (+60%) P<.05
- Rusoff, JDS. 1954. Jerseys injected 400 mg CTC/1x/week ↑ 1 – 112 ADG (+37%). Jerseys fed 50 mg CTC/d ↑ 1 – 112 ADG (+20.5%). Rumen function, b-vitamin generation and diversity of flora the same. No effect on GI tract bacteria. Injected excreted in urine, oral excreted in feces. CTC ↑ carcass weight, quantity of bone and marbling.
- Smith, JDS. 40 mg CTC/d 1 – 49, 80 mg to d84. ↑ ADG P<.05. CTC had no effect on thiamine, riboflavin, niacin, pantothentic acid or B12.
- Bartley, JDS. 1954. 15 mg CTC/100 lbs. BW d 1 – 175 ↑ ADG (+7.6%). 45 mg CTC/100 lbs BW d 1 – 175 ↑ ADG (+17.8%).
- Bartley, JDS. 1954. 15 mg CTC/100 lbs. BW d 1 – 175 ↑ ADG (+7.9%). 45 mg CTC/100 lbs. BW d 1 – 175 ↑ ADG (+19.9%)

Red denotes P<.05 NT improvement; Blue P<.10 NT trend improvement.
### 28 CTC/OTC calf trials in whole milk or CMR

- **Owen, JDS. 1954.** 40 mg CTC ↑ 56 d ADG (+55%), 40 mg OTC ↑ 56 d ADG (+55%). ADG stats reported only on 88 d weight, P<0.01 for both OTC & CTC.

- **Bartley, JDS. 1955.** 45 mg CTC/d ↑ 1 - 84 d ADG (+56%) P<0.05. 45 mg CTC/d ↑ 1 - 84 d ADG (+42%). 90 mg CTC/d ↑ 1- 84 d ADG (+32%).

- **Bartley, JDS. 1953.** 15 mg CTC/d ↑ 1 – 49 d ADG (+30.7% for one group and +61.6% for another). Had to keep feeding CTC to 12 weeks to maintain ADG.

- **MacKay, JDS. 1953.** 30 mg CTC/d 1 – 49, 80 mg to d84. ↑ ADG (+5.8%) 30 mg CTC/d 1 – 49, 80 mg to d84. ↑ ADG (+5.8%)

- **Knodt, JDS. 1953.** 0.5 gram CTC d 1 – 49 ↑ ADG (+20%), 1 gram CTC/d d 1- 49 ↑ ADG (+29%). 2 gram CTC/d day 1 – 49 ↑ ADG 7%. All P<0.05.

- **Bloom, JDS. 1952.** 0.5 g CTC ↑ ADG (+6%), 1 g ↑ ADG (+29%), 2 g ↑ +7%

- **Kesler, JAS. 1952.** 20 mg CTC d 1 – 56 ↑ ADG (+22.7%)

- **Murley. JDS. 1952.** 80 mg CTC d – 116 ↑ ADG Holsteins (+12%); Jersey, Ayreshire or Guernsey ↑ ADG (+41%). Both P<0.01.

---

### Coccidiostats

- **Deccox. Compendium 0.5 mg/kg body weight/day (22.7 mg / 100 lbs. of BW). Cost: +$1.79/bag CMR. Deccox M additive costs $0.06/day, 56 d = $3.36.**

- **Bovatec. Compendium 1.0 mg/kg body weight/day (45.4 mg/100 lbs. of body weight). Cost: $0.27/bag CMR. Bovatec costs 15% as much as Deccox**
4 Published Deccox calf trials

- Lallemand. Vet. Rec. 2006. 2.5 mg/kg. No effect on crypto.
- Moore. JAVMA. 2003. 2 mg/kg. No effect on crypto.
- Fitzgerald. Am J Vet Res. 1989. continuous 0.5 mg/kg/day necessary to best control cocci. Intermittent feeding lesser control.
- Miner, Am. J. Vet. Res. 1976. 0.5, 0.7 & 0.8 mg/kg BW suppressed oocyst shedding and prevented bloody diarrhea. Lesser doses gave only partial suppression.

- Abstract: U of Ill. JDS 1992. Deccox ↓ cocci shedding, ↑ day 1 – 126 ADG 14% and ↑ height, length and heart girth (P<0.05).

Red denotes P<0.05 Deccox improvement; Black denotes no effect.

7 Published Bovatec calf trials

- Quigley. JDS. 1997. 1 – 42 d ADG ↑ 68% (P<0.05) with Bovatec in CMR. Starter grain intake & F/G improve P<0.03. No effect Bovatec in grain at 42 d.
- Sinks. JAVMA.1992. 18 mg/lb. Starter. ↑ ADG in cocci inoculated calves 50%. ↑ ADG in noninoculated calves 8%.
- Heinrichs, JDS. 1990. ↑ 1 – 168 d ADG (+7.4%), P<0.05
- Anderson. JAS. 1988. No cocci present. 1 – 56 d ADG ↑ 6.6% . 1 – 84 d ADG ↑ 9.6%. Dry feed intake ↑ 10.8%. All P<0.10. Cannulated week of age & Bovatec improved rumen function.

Red denotes P<0.05 Bovatec improvement; Blue P<0.10 Bovatec trend improvement, Yellow, Bovatec detriment P<0.05.
4 Published Deccox vs. Bovatec calf trials

- Heinrichs. JDS. 1991. Deccox 0.5 mg/kg of BW or Bovatec 1.0 mg/kg of BW, both in starter grain. Bovatec decreased early starter grain intake. Deccox ↓ coccidiosis shedding wk 4 – 8. Both ↓ coccidiosis shedding weeks 12 – 16. 112 day body weight: Control 206.4 lbs. (a); Deccox 244 lbs. (+18%) (b); Bovatec 227 lbs. (+10%) (c). Subscripts different P<0.05

- Conloque. Am J. Vet Res. 1984. Both drugs prevented scours and ↓ shedding (P<0.01) when used in starter grain.


- Foreyt. Am J. Vet. Res. 1986. Bovatec, Deccox or Rumensin in grain ↓ shedding (P<0.05).

Bovatec costs 15% as much as Deccox

Red denotes P<0.05 improvement; Blue P<0.10 trend
A gallon of whole milk fails to meet the calf’s **trace mineral** requirements . . .

- Manganese – NRC requirement 18.1 mg. Provides 0.13 mg,^ 0.7% of NRC
- Zinc – NRC is 18.1 mg. Provides 12 mg,^ 66%.
- Copper – NRC is 4.53 mg. Provides 0.27 mg,^ 6%
- Iron – NRC 45.4 mg. Provides 1.2 mg,^ 2.6%
- Cobalt – NRC 0.05 mg. Provides 0.002 mg,^ 4%
- Selenium – NRC 0.13 mg. Provides 0.14 mg,^ 107%
- Iodine – NRC 0.23 mg. Provides 0.07 mg,^ 30%

^ = NRC 2001. NRC reports no b-vitamin levels for whole milk
* = USDA SR-21 for 3.25% fat milk (vitamin D used whole milk)

A gallon of whole milk fails to meet the calf’s **vitamin** requirements . . .

- Vitamin A – NRC requirement 5,218 IU. Provides 5216 IU,^ 100% of NRC
- Vitamin E – NRC is 23 IU. Provides 3.6 IU,^* 16% of NRC
- Vitamin D3 – NRC is 272 IU. Provides 139 IU^ or zero,^ 0% to 51%
- B1, Thiamin – NRC is 2.95 mg. Provides 1.6 mg,^ 54%
- B3, Niacin – NRC 4.54 mg. Provides 4 mg,^ 88%
- B6, Pyridoxine – NRC 2.95 mg. Provides 1.6 mg,^ 54%
- B12 – NRC 31.8 mcg. Provides 17.2 mcg,^ 54%
- B9, Folic Acid – NRC 0.23 mg. Provides 0.2 mg,^ 87%

^ = NRC 2001. NRC reports no b-vitamin levels for whole milk
* = USDA SR-21 for 3.25% fat milk (vitamin D used whole milk)
Ways to bridge this micro-nutrient gap

- Fetal reserves
- Colostrum
- Early starter grain intake
- Supplementation

Vita Plus “Calf Milk Supplement” costs $1.68/calf for a routine 56 day milk feeding period.

Maternal & Fetal Blood Mineral Concentration (ppm)

Penn State study examining liver samples from 181 pairs of pregnant cows and their fetuses over 13 months.
Fetal Reserves: Iron Concentration

Anemic: blood hemoglobin less than 7.0 g/100 ml of blood
Marginally Anemic: blood hemoglobin between 7.0 and 7.9 g/100 ml

➢ Beltsville, Maryland research center, 1953. Whole milk, grain (no TM) and alfalfa hay. Hemoglobin measured every 14 days. Nadir.

<table>
<thead>
<tr>
<th></th>
<th>Hemoglobin grams/100 ml of blood</th>
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<tbody>
<tr>
<td></td>
<td>5.0 - 6.0</td>
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<tr>
<td>Beltsville, 1947</td>
<td>37</td>
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<tr>
<td>Beltsville, 1952</td>
<td>49</td>
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<td>Beltsville, 1946</td>
<td>31</td>
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<tr>
<td>PSU, Veal, 1999</td>
<td>757</td>
</tr>
<tr>
<td>UC-Davis, Veal, 1994</td>
<td>290</td>
</tr>
</tbody>
</table>

Likely 5 – 8% of calves are born anemic. Another 20% are borderline anemic.

Fetal Tissue Vitamin Reserves?

➢ Plasma vitamin D concentrations (Nonnecke, Reinhardt; USDA-ARS)
  ➢ Newborn: 20 – 25 ng / ml
  ➢ Target range: 30 – 60 ng / ml
➢ Calves are born Vitamin A deficient (Puvogel; Swiss & Penn State)
➢ Calf has two to seven days reserve of Vitamin C (Toutain; J of Physiology / Hidiroglou)
Colostrum VTM Concentration

One gallon of colostrum is... (Kehoe; Penn State 55 samples / Foley, older JDS)
- Deficient in two essential B-vitamins
- Deficient in four essential trace minerals, including iron
- Barely adequate to meet one day’s NRC requirement of vitamins D, E, thiamine, panthothenic acid and biotin
- Highly variable in E (low of 9 IU, high of 67 IU)
- Highly variable in Fe (deficient to 1.5x NRC)
- Rich in Vitamin A, but highly variable (3x to 46x NRC)

VTM from grain? Intake inadequate

VTM in starter grain formulated for one pound per day intake. Typically no b-vitamins.
Supplementing Vitamin E

- **Calf** research shows, supplementing E causes:
  - ↑ white blood cell production, ↓ eye and nasal discharge
    (Eicher, JDS. 1994. 25 – 40 IU per day for eight weeks)
  - ↑ feed conversion (Eicher, JDS. 1992)
  - ↑ white blood cell & IgM production (2800 IU injection, weekly, Reddy, JDS, 1986)
  - ↑ weight gain, ↓ scours (Luhman, J. Dairy Science 76:220; Also BASF unpublished)
  - ↑ growth rate (2.5 lbs./day, 7 weeks) linked with ↑ E depletion (Nonnecke, USDA/ARS)
  - ↑ growth rate linked with ↑ E depletion rate (Kruenger, ISU, 2013)
  - ↓ vitamin E status at birth linked with ↑ mortality (Torsein, 2011)

Supplementing Vitamin A

- **Calf** research shows, supplementing A causes:
  - ↑ stool consistency (Swanson JDS. ~20,000 IU), ↓ early scours (Eicher JDS. ~20,000 IU)
  - Too little (zero) or too much (68,000 IU) vitamin A ↓ innate immune function (Rajaraman, JDS)
  - No health effect from vitamin A addition (1,500 or 30,000 IU), also less E absorbed with addition of A. If electrolyte with A was fed too +30,000 IU more Al↓ more scours (Franklin, JDS).
  - Serum retinol (Vit A) levels not effected by enhanced growth (Nonnecke, USDA/ARS)

Be careful with excessive vitamin A feeding! Ties up E. Ideally, stay around 20,000 – 40,000 IU
Supplementing Vitamin D

- Regulates calcium homeostasis:

  1950's, JDS calf research, D void diets, no sunshine: “arched back, big knees and sore joints.” Colévos also reported poorer protein digestion and poorer nitrogen retention.

- Improved immune function from vitamin D supplementation
  (Sacco, USDA/AMS, 2012)

Research shows even low levels (27 ng/ml) in blood maintain calcium homeostasis. Higher levels may improve health.

Supplementing B vitamins: Muscle Accretion

**Effect of Added Folic Acid (B-Vitamin) on Growth of Veal Calves**

- Girard et al., 1993. Livestock Production Sciences 34: 71-82.

**Added Folic Acid saved 20kg (44 lbs) powder per calf!**
B-Vitamins: Support Immunity

• Incoming Feedlot Cattle infected with bovine herpesvirus type 1 (BHV-1, i.e. shipping fever complex)
• Plasma concentrations of Pantothenic acid, B6 (pyridoxine) and B12 were significantly (p<0.001) reduced with disease challenge
• Folic acid levels were not effected

Dubeski et. al., J. Animal Science. 1996. 74:1358 – 1366

Enhanced B-Vitamin Supplementation – Veal

• 112 Calf Study – every-other-calf in barn study design
• Fed from day 11 to finish
• Control diet had typical industry levels of B-vitamins
• Test Diets had:
  • 9X thiamine, 9X riboflavin, 9X pyridoxine, 8X pant. acid, 6X B12, 7X biotin, 3X folic acid, 2X choline, 4X niacin
• Measured Individual treatments, 11 day weight, 62 day weight, hanging carcass weight & carcass quality
Animix B-Vitamin Veal calf study: Results

• Increasing B-vitamin supplementation —
  Day 11 through day 62:
  • ↓ calf treatment $ (p<0.12, $2.01 vs. $0.85 / calf)
  • ↓ incidence of re-treatments (p<0.035) 29% vs. 12.7%
  • ↓ antibiotic injections (p<0.10) 1.52 / calf vs. 0.63 / calf
  • ↓ feed refusals (28% reduction, NSD p<0.35)
  • + 1.48 lbs at 62 days (NSD, p<0.50)
  • Economics through 9 weeks - $0.93 / calf
  • Economics to 143 days - $7.50 / calf

Supplementing Vitamin C for calves

• Published calf research proves Vitamin C —
  • ↓ ocular and nasal discharge (Eicher, Morrill, JDS 75:1635)
  • ↑ IgG production in stressed calves (Cummins, JDS 74:5)
  • ↓ scours (Sahinduran, ACTA Vet Brno 73; Seife, J Vet ed 843; Nockels, Agri-Pract 9:10)
  • ↓ naval infections (Nockels, Agri-Pract 9:10)
  • Assists in respiratory challenge (Nockels, Agri-Pract 9:10)
  • Has vitamin E sparing effect (Eicher, Morrill, JDS 75:1635)

8 published calf studies reported ↑ health. One had no effect.

Very Economical – 200 mg for 4 weeks, ~10 cents / calf
Importance of **Iron Supplementation**

Negative effects of iron deficiency –
- Rough haircoat, poor health, excessive licking
- Reduced feed intake, poor feed conversion
- Pale nose and/or gums
- Chalky colored manure with thick consistency
- Higher incidence of sudden death

*Source: Dr. Drew Vermeire, Nouriche. The Producer’s Connection*

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**Selenium Supplementation**

**Dairy calf trials:**
- Selenium yeast improved thermo-regulation in cold weather (Ebrahimi, 2009)
- Selenium can improve immune function (Reffett, 1988)

**Beef cow/calf pair trials:**
- Selenium can improve ADG (Castellan, 1999) and livability (Spears, 1986)
- Selenium improved immune function (Gunter, 2003)

Whole milk is highly variable in selenium content: meta-analysis of 42 studies in 33 references shows variation from a low of 0.03 mg to a high of 0.5 mg Se/gallon. Only 28.6% of these studies showed Se meeting NRC requirement of 0.13 mg Se per gallon of whole milk.
Organic Trace Mineral Supplementation

Calves fed either

- 28:20 at 1.8 lbs./d week 1; 2.5 lbs. week 2 – 6; 1.25 lbs. week 7, or
- 22:20 at 1.25 lbs. / day week 1 – 4; 0.625 / d week 5.
- 2 x 2 using either trace minerals 100% from sulfates, or 100% from Zinpro (Zn, Cu, Mn & Fe)

+16.4 lbs 63 day gain if feeding 100% Zinpro minerals vs. sulfates in the intensified program

MOS in Calves

Published calf research

- Trend to ↑ starter intake & gain (Quigley, JDS, 1996)
- Many published pig, poultry, cow & human trials on MOS.

Non-published calf data:

- ↑ starter intake 22%, 19% and 33%
- Gain on-par with NT, (both superior to negative control)
- ↓ fecal coliforms & crypto
- ↓ respiratory disease
- 14 calf trials, 900 calves, 17% ↑ gain

$0.54 to $1.08/50# bag CMR depending on use rate
Probiotics in Calves

• 3 Billion cfu lactic acid producing bacteria + 12 lbs gain (Abe, 1995. J of Dairy Science)
• Low level of probiotics ↑ gain (Cruywagen, 1996. J of Dairy S)
• Probiotics had no impact in 6 older studies
  Jenny 1990 JDS (Journal of Dairy Science); Ellinger 1978 JDS; Vazquez 1997 JDS; Morrill 1995 JDS

Probiotics – Product Selection

• High bacteria count: 1 Billion cfu / day
• Durable bacteria
• Resistant to commonly used antibiotics
• Broad spectrum of bacteria
• Reputable Product & calf focused supplier
• Need not be excessively expensive
• Use to re-establish gut microflora
Electrolytes: The Proven Need

- Scouring Calf –
  - Quick Dehydration
  - Lose 6 – 12% of body fluids in 1 day
  - Lots of sodium and chloride lost
  - Total body water loss can be 17.3%
  - Water is 75% of body weight


Hydrate, Hydrate, Hydrate

- Keep calves hydrated!
- VitaLyte Electrolyte - $0.56 / 2 oz.
- Lactated Ringer’s Solution – Use liberally!
My suggestions?

- Plasma in CMR. *Save $1 – 2 / calf*, or more
- Neomycin/OTC for 14 days. + $2 - $4/calf
- Bovatec in CMR. + $0.27 - $0.54 / calf (+ starter grain too)
- Vitamins & TM in whole milk. + $1.68
- Electrolytes & Ringer’s as an intervention. +$0.56
- MOS as intervention, maybe in CMR. + $0.56 - $1.12
- Direct fed microbial (Probiotic) strategically

Honorable mention: FOS, NeoTec4, Sodium butyrate, Apex (Ess. oils)

NeoTec4

- Composed of:
  - Essential omega 3 fatty acids (C18:3)
  - Medium chain fatty acids (coconut/palm kernel)
  - Butyrate (short chain fatty acid)

- Average of 5 studies
  - Scours ↓ - 23%
  - ADG ↑ 12%
  - Frame ↑ 15%
  - G/F ↑ 8%

Costs?
- App. $0.70/bag of CMR

PAS 2007
JDS 2009
FOS in Calves

- Sugar that’s not broken down until hind gut
- Proven to enhance beneficial bacteria
- ↓ E coli & clostridia in calves (Bunce, J of An. Sci, 1995)
- ↑ gain & energy metabolism in veal (Bouhnik J of Nutrition, 1999)
- Widely used in calf supplements

Essential Oils (Botanicals)

- Components of herbs & spices
- Significant use in E.U. veal formulas (Natural Oregano)
- Leading U.S. brand is Apex
  - 13 non-published trials in grain-fed calves
  - Responses include: consistent improvements in starter feed intake & gain; Some trials note reduced scours & treatments, improved uniformity & improved F:G
  - 5 non-published veal trials: improvements in gain from 1 – 3.4%
  - $0.30/bag CMR
  - Small market share