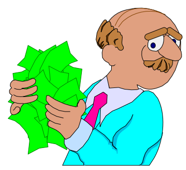
Calf Supplements – *Choose wi$ely!*



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

Criterion to Judge

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

Supplements?

Risk

Vaccines?

to

Injectible Antibiotics?

Scarce Capital

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

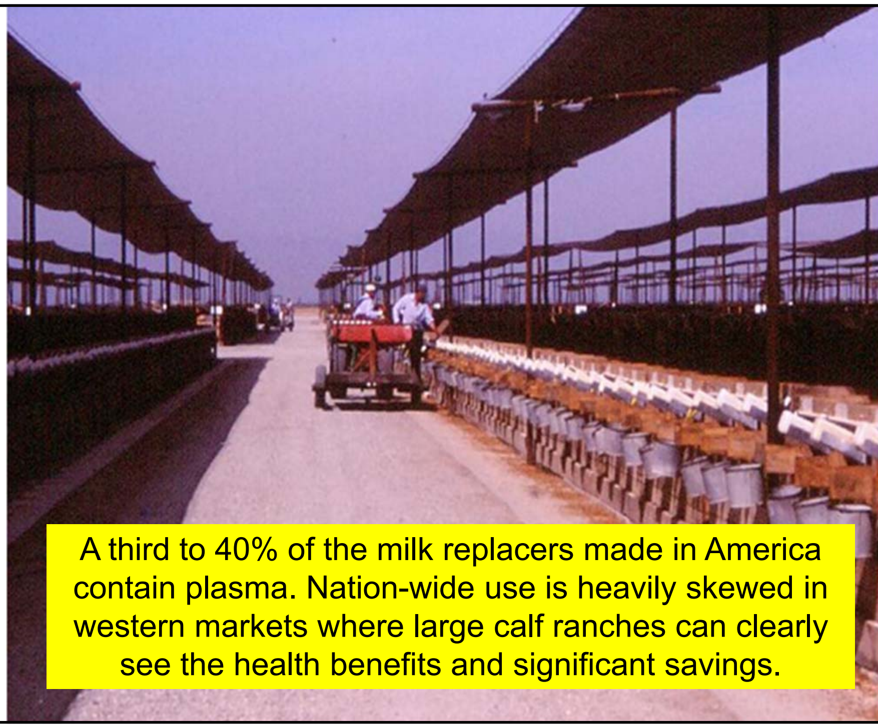
Will make the change in CMRs nearly undetectable

+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

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

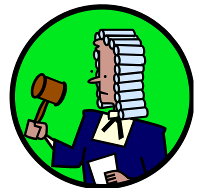
- Morrill, J. Dairy Sci. (JDS), K-State,1995
- Quigley, JDS, Univ. of Tenn, 1996
- Nollet, J Vet Med, 1999, Gent U, Bel. E Coli challenge
- Quigley/Drew, Fd & Ag Immunology, 2000. E coli
- Arthington, JDS, Iowa State, 2002. Coronavirus challenge
- Hunt, Pediatric Res., NC State, 2002. Crypto challenge
- 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

30Total 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

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

* 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

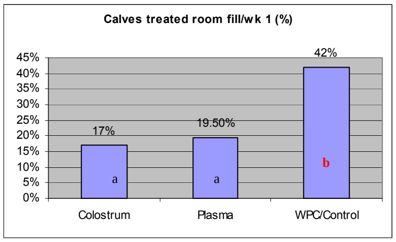
Functional proteins are in colostrum, fresh suckled milk *and* serum and plasma

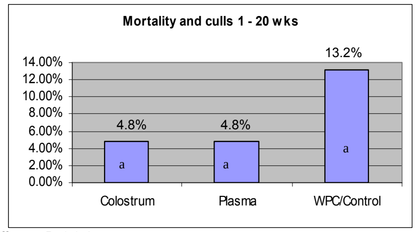
Which functional proteins?

- 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!

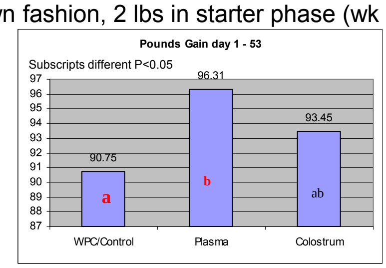




Subscripts different, P<0.05)

Individually bucket-fed, every-third pair in stall-barn, fed either whole colostrum (~20% IgG, 44% CP: 18% CF), or plasma/dry fat blend (~11% IgG, 44:18) or WPC/dry fat (44:18), 12.5 lbs/calf step-down fashion, first 13 weeks. 120 calves. Veal. 84% 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 (shipping fever complex) caused by Pasteurella multocida susceptible to oxytetracycline; treatment and control of colibacillosis (bacterial enteritis) caused by E. coli susceptible to neomycin.

Active Drug Ingredient

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

Guaranteed Analysis

Protein, Min.	1.2 %
Fat, Min.	0.1 %
Crude Fiber, Max.	0.2 %
Calcium, Min.	0.05%
Calcium, Max.	0.55%
Phosphorus, Min.	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 10 mg of Neomycin and 10 mg Oxytetracycline per pound of body weight. Feed continuously for 7-14 days. If symptoms persist after using for 2 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 preruminating 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

- Berge, J. Dairy Sci. (JDS), Wash. State, 2009
  - 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

19 Neomycin/OTC (NT) calf trials

- Berge, JDS 2009. NT 54:108 ↑ morbidity
- Berge, JDS 2005. NT 480:684 ↑ ADG **(+258%),** ↓ morbidity
- Heinrichs, JDS 2003. NT 340:170 ↓ scours
- Drew, Food & Ag Imm. 2000. E coli. NT 800:400 ↑ ADG **(+25%)**
- Donovan, JDS 2002. NT 125:64 No significant diff.
- Quigley, JDS 1997. NT 131:66 ↑ ADG **(+42%)**
- Katzman, JDS Abst. 2011. NT 400:200 ↑ gut morphology
- Shields, JDS Abst. 2010. NT 1000:1000 ↓ scours & morbidity, ↓ ADG - 3%
- Quigley, APC, 1999. NT400:200 ↓ mortality, ↓ morbidity
- Doppenburg, Veal, 1992. NT1,000:500 ↑ ADG **(+27%)**, ↓ scours
- Doppenburg, Veal, 1993. NT 500:250 ↓ morbidity

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

19 Neomycin/OTC (NT) calf trials

- Alltech, JDS Abst. 1997. NT 200:100 ↑ **ADG (+14%),** ↑ **Starter**
- MSC, JDS Abst. 1993. NT 800:400 ↑ 14 d ADG **(+19%),** ↑ 28 d ADG **(+3%)**
- LOL, JDS Abst. 1992. NT 250:10 0 ↓ scours
- MSC, 1991. NT 400:200 ↑ 14 d ADG **(+418%),** ↑ 49 d ADG **(+60%)**

No stats provided NT 800:400 ↑ 14 d ADG **(+372%),** ↑ 49 d ADG **(+55%)**

- MSC, 1992. NT 400:200 ↑ ADG vs. non med & NT 200:100
- MSC, 1991. NT 400:200 ↑ 14 d ADG **(+200%),** ↑ 49 d ADG **(+9%)**
- MSC, 1991. NT 400:200 ↑ 14 d ADG **(+445%),** ↑ 49 d ADG **(+60%)**

No stats provided NT 800:400 ↑ 14 d ADG **(+372%),** ↑ 49 d ADG **(+241%)**

- MSC, 1991. NT 400:200 ↑ 35 d ADG **(+16%)**

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<0.01. CTC ↑ starter & hay intake.
- Bartley, JDS. 1957. 45 mg CTC/d ↑ 56 d ADG **(+5.2%)** P<0.05.
- 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<0.001. 400 mg CTC/1x/week injected, in "old" barn 28 d ↑ ADG **(+37%)** and in "new" barn ↑ ADG **(+66%),** P<0.001. 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<0.05
- 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<0.05 NT improvement; Blue P<0.10 NT trend improvement.
Black denotes No Significant Difference (NSD). JDS, Journal of Dairy Science.

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<0.05
- 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<0.05. CTC had no effect on thiamine, riboflavin, niacin, pantothenic 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<0.05 NT improvement; Blue P<0.10 NT trend improvement.
Black denotes No Significant Difference (NSD). JDS, Journal of Dairy Science.

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%)**
- 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 $P<0.01$.

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.

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.
- Eicher. JDS. 1992. Starter intake ↓ with Bovatec. Bovatec in CMR had no effect on starter intake. No cocci symptoms. Also no ADG response.
- Sinks. JAVMA.1992. 18 mg/lb. Starter. ↑ ADG in cocci inoculated calves 50%. ↑ ADG in noninoculated calves 8%.
- McMeniman. Aust. Vet. J. 1995. Cocci controlled in CMR. Not Starter
- 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.
- Foreyt. Am J. Vet. Res. 1986. Bovatec in grain ↓ shedding ($P<0.05$). Bovatec prevented cocci despite induced infection.

Red denotes $P<0.05$ Bovatec improvement; Blue $P<0.10$ Bovatec trend improvement, Yellow, Bovatec detriment $P<0.05$.

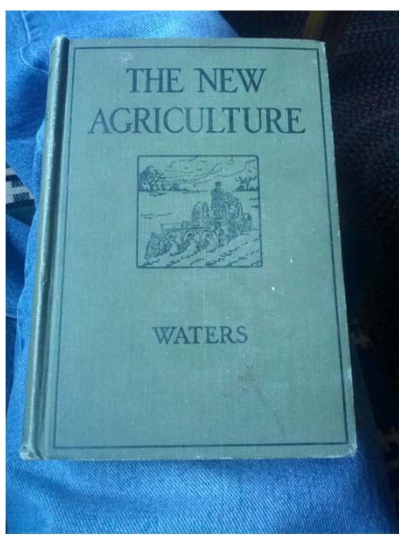
4 Published Deccox vs. Bovatec calf trials

- 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 ↓ cocci shedding wk 4 – 8. Both ↓ cocci 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.
- Hoblet. Am J. Vet Res. 1989. Oocyst shedding ↓ eightfold with Deccox, and ↓ fourfold with Bovatec.
- 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

1928



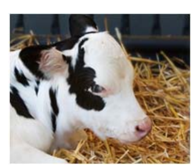
A gallon of whole milk fails to meet the calf's trace mineral requirements . . .

- 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)

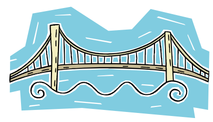
A gallon of whole milk fails to meet the calf's vitamin requirements . . .

- 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%



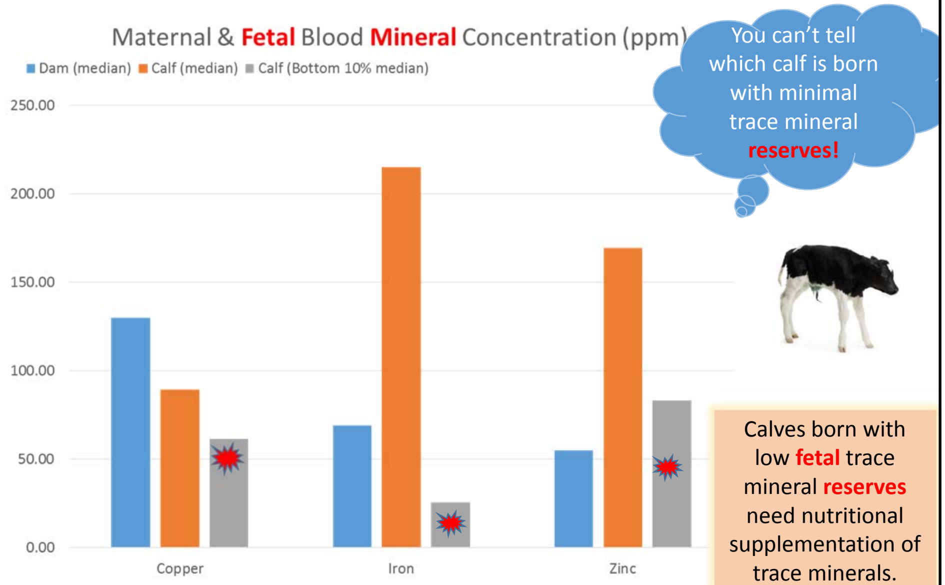
^ = NRC 2001. NRC reports no b-vitamin levels for whole milk
* = USDA SR-21 for 3.25% fat milk (vitamin D used whole milk)

Ways to bridge this micro-nutrient gap



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

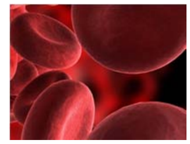
Vita Plus "Calf Milk Supplement" costs $1.68/calf for a routine 56 day milk feeding period.



Calves born with low fetal trace mineral reserves need nutritional supplementation of trace minerals.

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

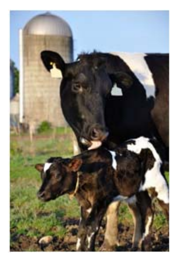
Marginally Anemic: blood hemoglobin between 7.0 and 7.9 g/100 ml

- Beltsville, Maryland research center, 1953. Whole milk, grain (no TM) and alfalfa hay. Hemoglobin measured every 14 days. Nadir.
- Penn State, 1999. Veal field analysis. Blood hemoglobin at arrival.
- UC-Davis, 1994. Veal field analysis. Blood hemoglobin upon arrival

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

	Hemoglobin grams/100 ml of blood			
	n	5.0 - 6.0	6.0 - 7.0	7.0 - 8.9
Beltsville, 1947	57	10.4%	8.6%	-
Beltsville, 1952	49	6.1%	20.4%	-
Beltsvillle, 1946	31	15.2%	21.2%	-
PSU, Veal, 1999	757	-	4.8%	23.0%
UC-Davis, Veal, 1994	290	-	-	8.0%

Fetal Tissue Vitamin Reserves?



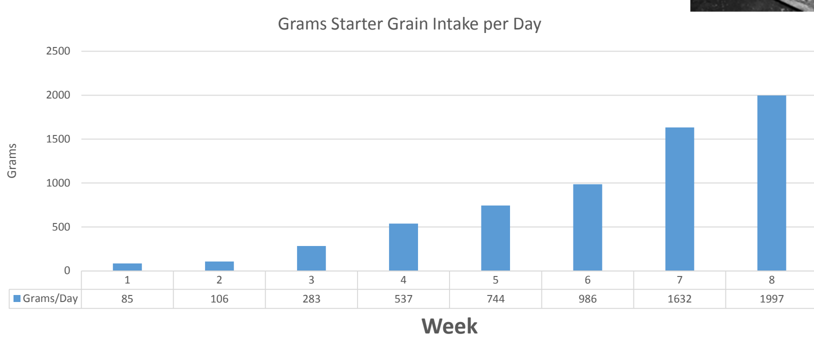
- Plasma vitamin D concentrations (Nonnecke, Reinhardt; USDA-ARS)
  - Newborn: 20 – 25 ng / ml
  - Target range: 30 – 60 ng / ml
- Calves are born Vitamin A deficient (Puvogel; Swiss & Penn State)
- Calf has two to seven days reserve of Vitamin C (Toutain; J of Physiology / Hidiroglou)

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

- **<u>Calf</u>** 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 (Krueger, ISU. 2013)
- ⇩ vitamin E status at birth linked with ⇧mortality (Torsein, 2011)

Supplementing Vitamin A

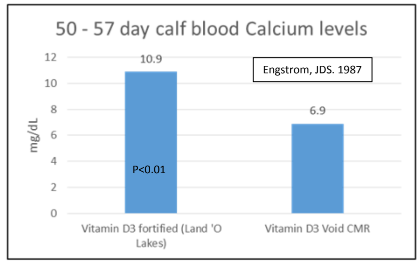
Be careful with excessive vitamin A feeding! Ties up E. Ideally, stay around 20,000 – 40,000 IU

- **<u>Calf</u>** 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 (15,000 or 30,000 IU), also less E absorbed with addition of A. If electrolyte with A was fed too (+30,000 IU more A), *more* scours (Franklin, JDS).
  - Serum retinol (Vit A) levels not effected by enhanced growth (Nonnecke, USDA/ARS)

Supplementing Vitamin D

- Regulates calcium homeostasis:

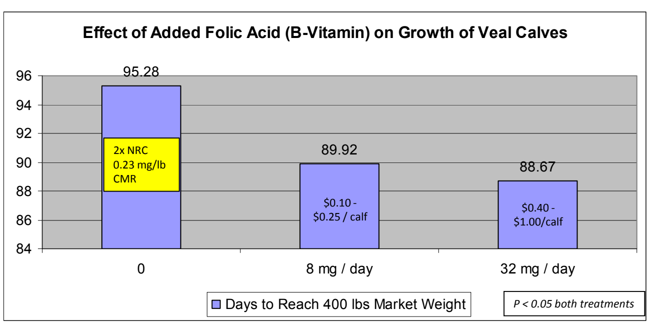
1950's, JDS calf research, D void diets, no sunshine: "arched back, big knees and sore joints." Colovos also reported poorer protein digestion and poorer nitrogen retention.



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

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

Supplementing B vitamins: Muscle Accretion



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

Very Significant respiratory disease outbreak in this room. Mycoplasma pneumonia.

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 B43; 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

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:

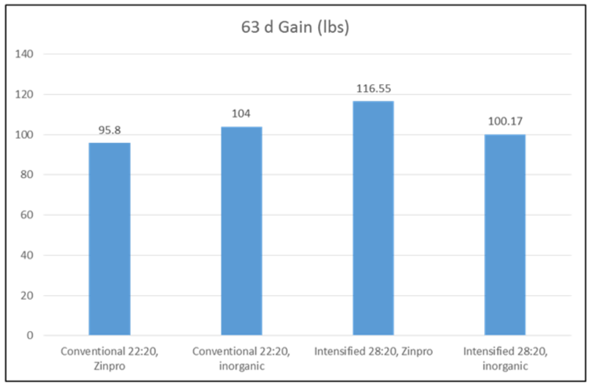
- Selenium can improve ADG (Castellan, 1999) and livability (Spears, 1986)
- Selenium improved immune function (Gunter, 2003)

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

- ⇩ scours (Heinrichs, J Dairy Sci. 2000)
- 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

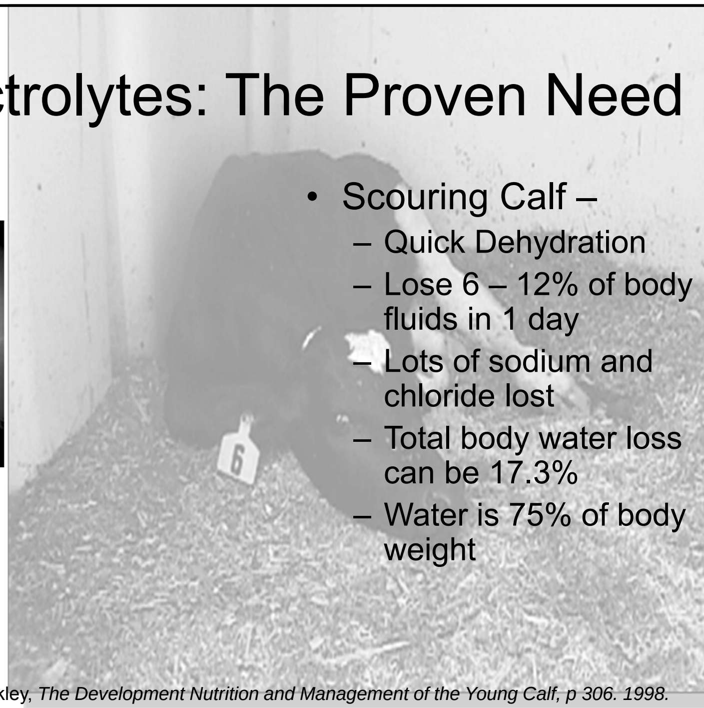
Probiotics in Calves

- 3 Billion cfu lactic acid producing bacteria + 12 lbs gain (Abe, 1995. J of Dairy Science)
- ⇧ ADG, F/G, ⇩mortality (Timmerman, 2005. J of Dairy Science)
- Low level of probiotics ⇧ gain (Cruywagen, 1996. J of Dairy S)
- ⇧ Intake & Gain (Christen, 1995. J of An. Sci; Ruppert 1994. J of Dairy Science)
- 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

Source: Davis & Drackley, *The Development Nutrition and Management of the Young Calf, p 306. 1998.*

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

P.A.S. (Prof. An. Sci) 2007
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