An Update on Neonatal Calf Research

G. C. Duff

Montana State University

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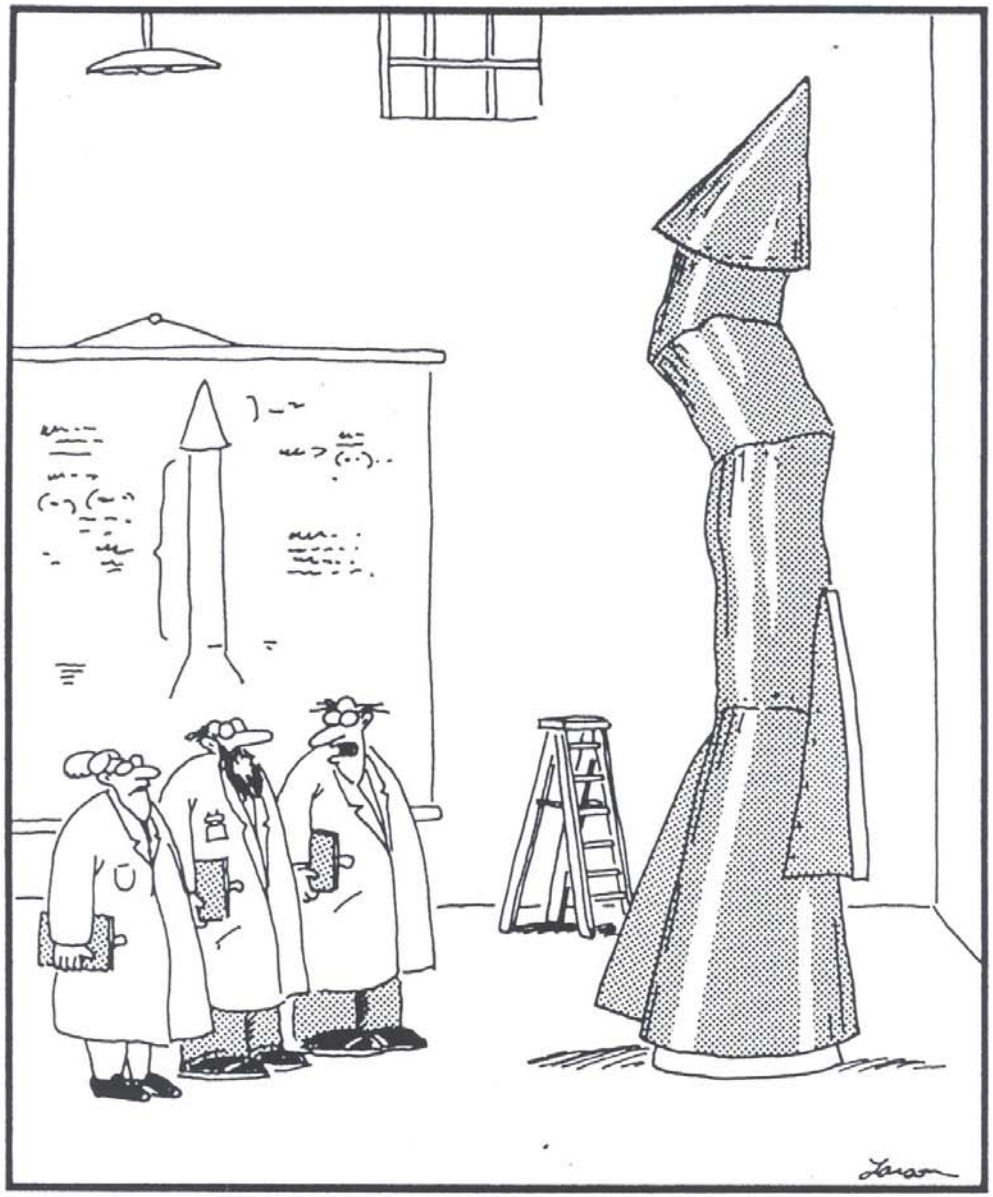


"It's time we face reality, my friend. ... We're not exactly rocket scientists."

Calf Scours:

- How big of a problem is it?
- What is it and how it “works”
- Recommendations:
  - Treat a calf with the problem
  - Prevent the problem from occurring again

Calf Scour Prequiz

- 5 short answers:
  - 1. What % of pre-weaning calf deaths are due to calf scours?
  - 2. What “bug” is the most important cause of calf scours?
  - 3. Where do the “bugs” come from?
  - 4. What is the most important treatment?
  - 5. What is a common but least important treatment?

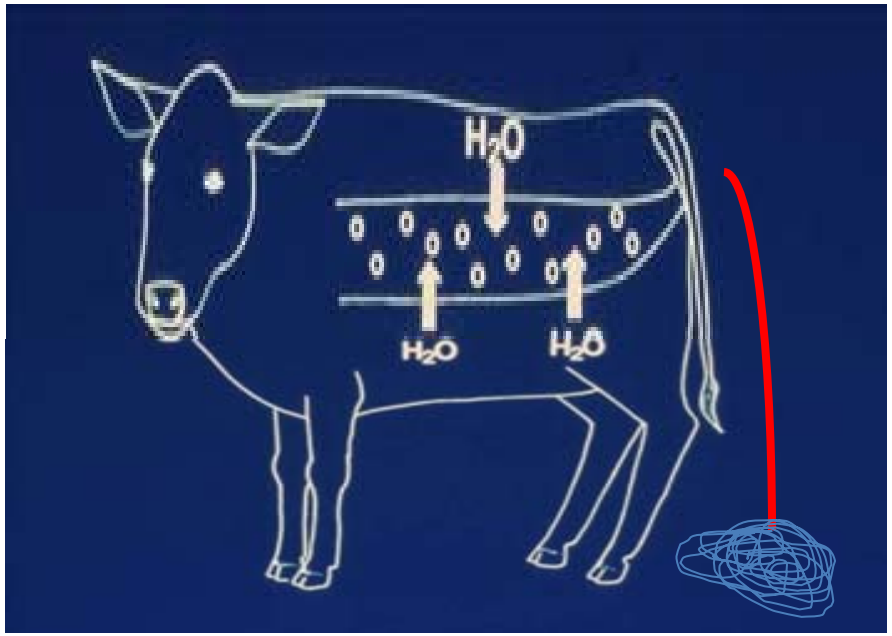
Calf Mortality - Beef and Dairy Herd NAHMS Studies

- Total Calf Mortality (death) prior to weaning
  - 6% Beef
  - 11% Dairy
- Scours as reason for Mortality:
  - 18% Beef
  - **60%** Dairy

Funston et al. (2010) Calves with scours are 24 lbs lighter at weaning

Calf Scours is a Big Deal!! $$$$$$

What is it? (the really simple version)



Diarrhea: Loss of body water & salts (electrolytes)

Diarrhea is the disruption of normal gut physiology

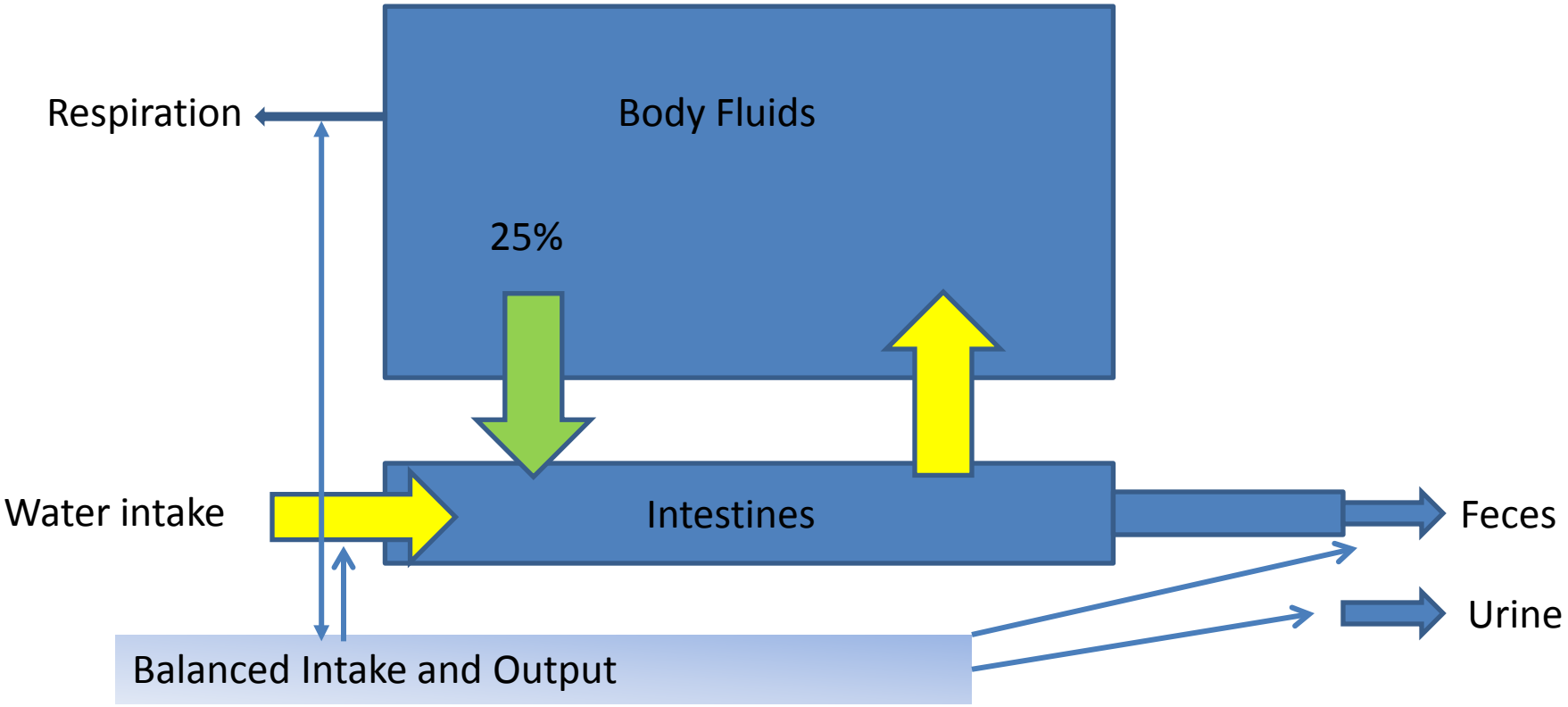
• Body water cycles in and out of intestinal tract as part of digestion
– **25%** of body water cycles thru intestinal tract daily

• Two forms of disruption:
– Normal secretion into intestine, reduced (**malabsorption**) back out

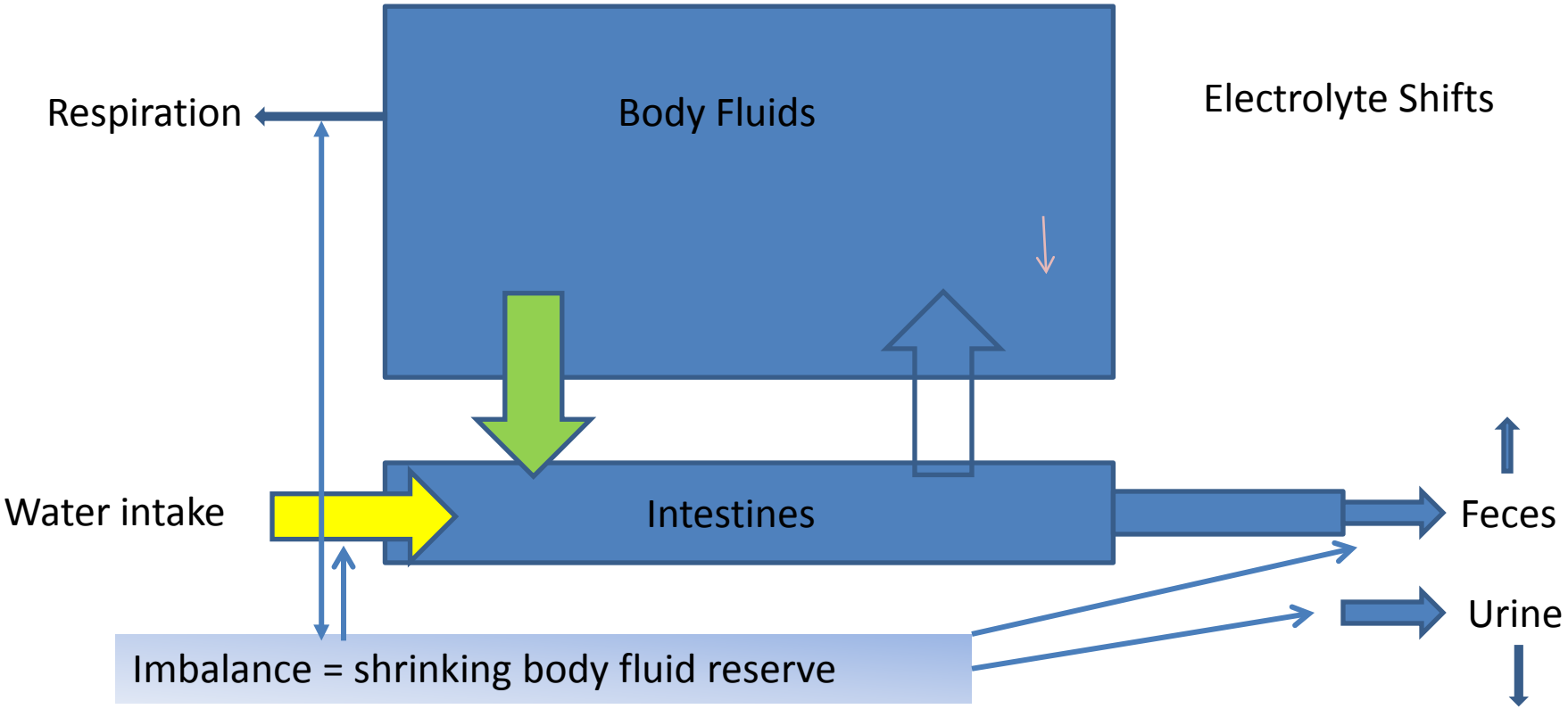
• Most infectious diarrheal agents
– Excess secretion (**hypersecretion**) into intestine, overloaded reabsorption back out

• *E. coli* K99, cholera

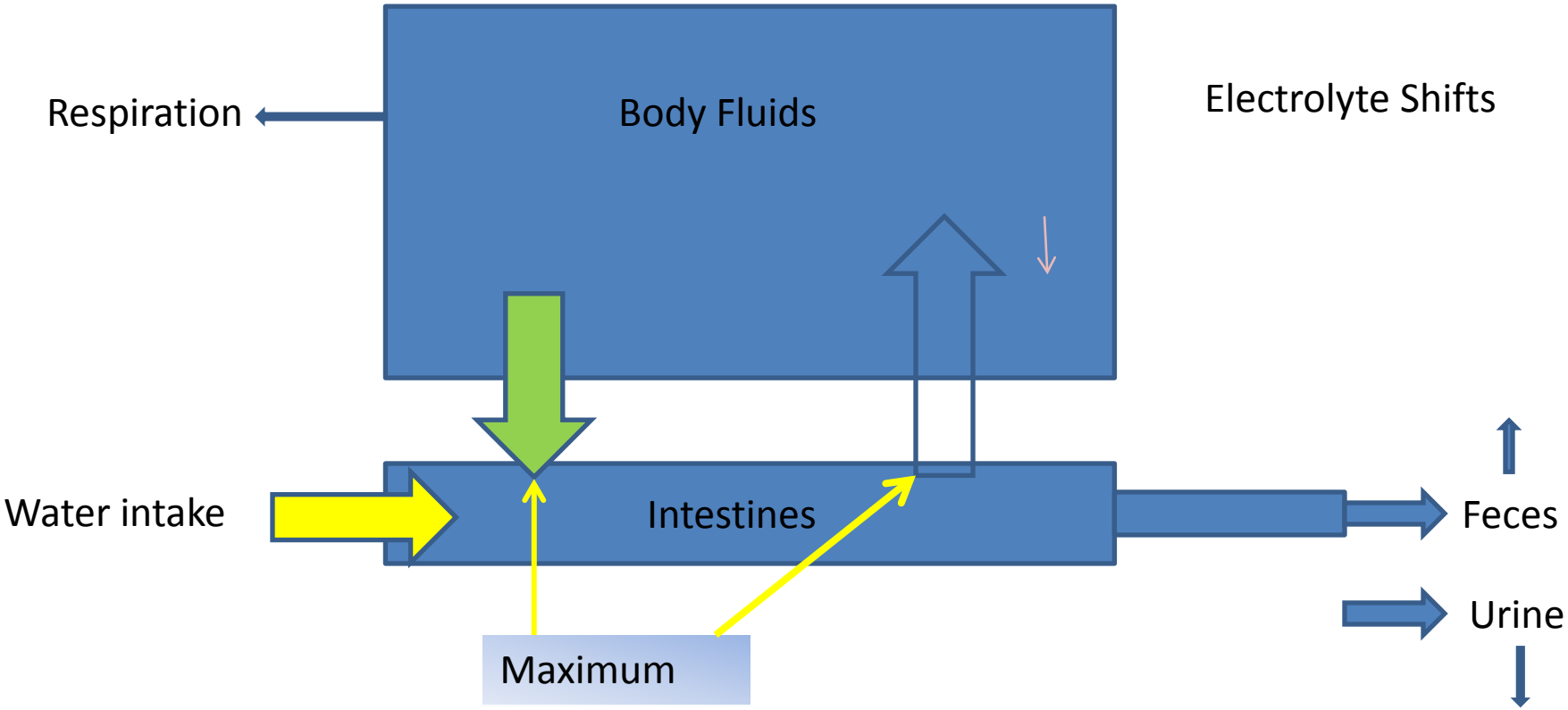
Balanced intake and output are essential to normal fluid balance



Malabsorption causes diarrheal imbalance



Hypersecretion causes diarrheal imbalance



The most important treatment is replacement fluid

- Detect scouring calf before fluid loss becomes profound so oral replacement works

- Replace both lost body fluid (water) and electrolytes (salts) in large enough quantity often enough that lose does not become profound

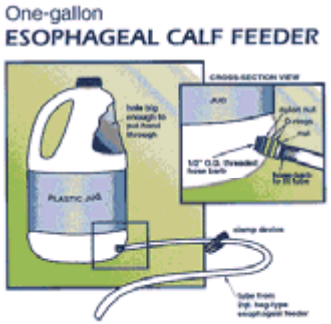
Oral rehydration solutions (ORS) have 4 key ingredients

- Dextose (glucose) – for energy
- Glycine – for absorption
- Salts – potassium chloride, salt, dicalcium phosphate, magnesium sulfate
- Sodium bicarbonate –buffer

2.3% glycine and 44 grams dextose (glucose)
high energy label – required for fuel absorption

CAUTION: Still only ½ the energy in milk

Must be inserted carefully and sanitized between calves



Least important (but all too common) Treatment?

For several reasons, the least important treatment is an antibiotic

Agents that cause scours are

- Viruses or protozoa that antibiotics have no effect upon
- Bacteria that are usually resistant to the OTC antibiotics

Antibiotics, particularly OTC (over the counter) oral antibiotics, are usually ineffective

CHECK WITH YOUR VETERINARIAN

To be successful, treatment must be early

Determine how to treat a scouring calf by classifying into one of three categories

- Degree of hydration
  - Early < 5% BW - supplemental oral fluids
  - Moderate 7% BW - high energy oral fluids
  - Severe > 9% BW - Emergency IV fluids

5 classification components

- Body position
- Skin
- Eyes
- Oral membranes
- Limbs

Early fluid loss

- Calf is:
  - Body position - bright, standing
  - Skin – tents for < 4 seconds
  - Eyes – bright
  - Oral membranes – moist
  - Limbs – warm

  - Calf will suckle electrolyte solution from bottle
  - Keep calf on milk an add several 2 qt electrolyte feedings per day until scours slow
    - Reason if calf doesn't have adequate fat reserves, feed removal can cause death by starvation/hypothermia before scours stop

Moderate fluid loss (7% BW)

- Calf is:
  - Body position – dull lying down but upright
  - Skin – “tents” for 5 sec
  - Eyes – sunken slightly with a slight gap
  - Oral membranes – warm but sticky
  - Limbs – cold

  RX to survive ½ gallon of warm special high energy electrolyte solution by esophageal feeder twice several hours apart

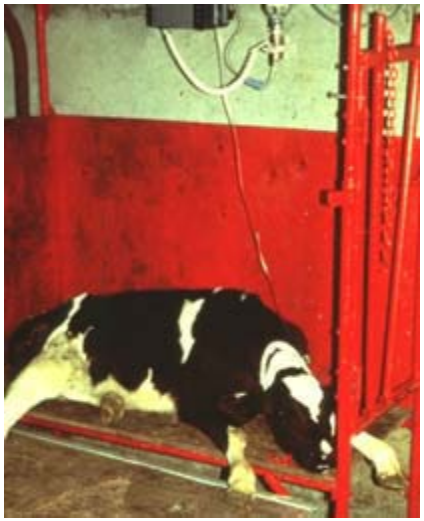
  Move to warm area where calf can be monitored

Severe fluid loss (> 9% BW)

- Calf is:
  - Body position – lying flat in a coma
  - Skin – stays “tented”
  - Eyes – deeply sunken with big gap
  - Oral membranes - cold, pale and dry to touch
  - Limbs – cold

  RX only 1 gal of special electrolyte fluids by IV drip will save calf

  SQ and oral fluids won’t be absorbed b/c circulation is too poor



University of Arizona

- Hypothesis: Calves with diarrhea have altered absorption capacity; therefore, SQ electrolytes are more effective

Fluid volume must replace loss and keep up with continuing losses

- Enough electrolyte fluids must be given to:
  - Replace % BW lost
  - Meet maintenance requirements
  - Keep up with ongoing loss of 1 to 4 L per day in the diarrhea

  For a 7% dehydrated 80 lb calf, this is 6 to 9 qt of electrolyte solution the first day (~ 4 packages of product)

Common Infectious Diarrheal Agents

- Bacteria
  E. Coli strains
  Salmonella serotypes

- Viruses
  Rotavirus
  Coronavirus

- Protozoa
  Cryptosporidia
  Coccidia

Key E. coli characteristics

- Normal gut flora of all mammals so E coli is ubiquitous
- Three disease forms:
  - Colisepticemia – any strain
  - Enterotoxigenic – specific strains
  - Enterpathogenic – specific strains

- OTC antibiotics are usually not effective

Colisepticemia is caused by any *E. coli*

• Spreads through calf's body to cause abscesses in the brain, eyes, kidneys, and joints
• Occurs when calf ingests manure, mud or other material before or along with colostrum
• Virtually impossible to treat successfully
• Prevented by:
– calving in **clean, dry areas**
– cows having clean udders
– Harvesting colostrum cleanly and keeping refrigerated or frozen
– feeding 4 qts of high quality colostrum within 4 hours of birth

E. coli **are everywhere in manure contaminated mud!**

Bad conditions > First mouthful is *E. coli!*

Enterotoxigenic *E. coli* (ETEC)

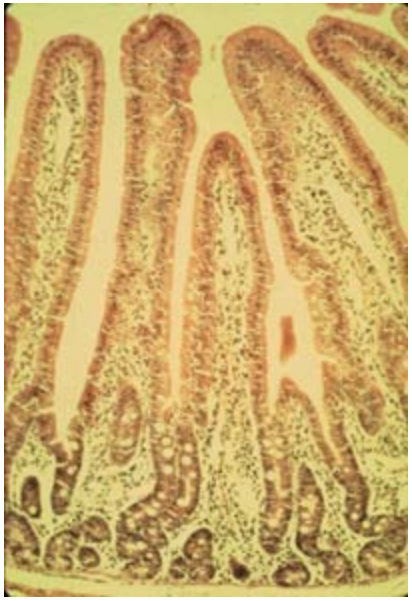
- **Specific strain (K99)** attaches to intestinal cells and causes a hypersecretory diarrhea
  - Toxin turns on cell's fluid pump
- Almost the only diarrhea that **occurs within first 3 days of life,** often in first day
  - Calf can die of dehydration **before diarrhea appears!**
- Prevented by feeding colostrum containing K99 antibodies
- Cow vaccine available

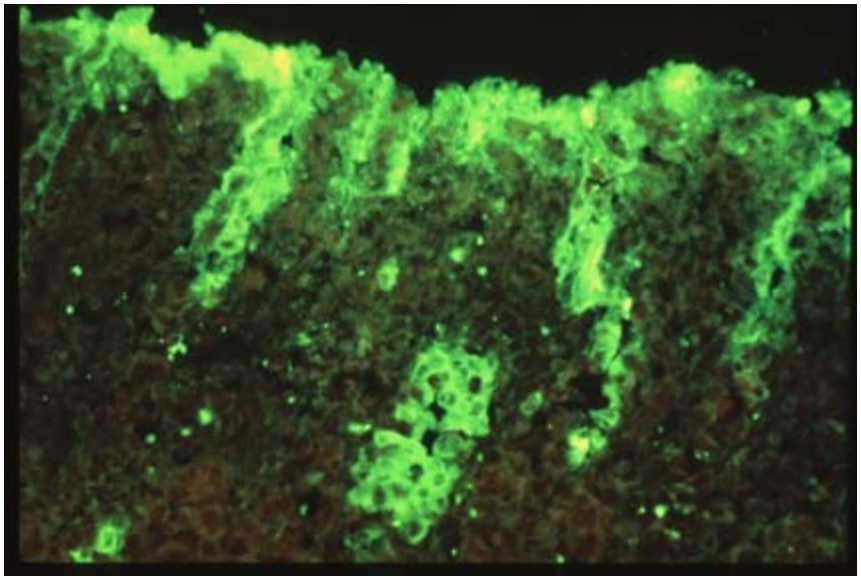
Enteropathogenic *E. coli* (EPEC)

- *E. coli* strains attach to gut wall and secrete toxins
- Cause both excess secretion and malabsorption as well as general systemic effects on the calf
- No vaccine

Corona & Rotaviral Diarrhea

- Virus kills cells of intestinal villi, causing malabsorption diarrhea
- **Calf begins shedding 10^{11} virus per gram of feces 3 days after infection.**
- **Carrier cows continually shed low numbers of virus**
- **Virus survives weeks in the environment**
- Vaccines available
- Antibiotics are ineffective (virus)





Salmonella Diarrhea

- Calves can shed it in feces, urine, **saliva and nasal secretions**, contaminating everything they touch and **everything that touches them** (hands, esophageal feeders, nipples, ...)
- Salmonella survive in the environment for **months**

Only **direct sunlight** kills it in the environment

- Usually resistant to OTC antibiotics

Salmonella Diarrhea

- Antibiotics:
  - Depress the normal bacterial flora, making the animal more susceptible to infection and prolonging the diarrhea
  - May be required if infection is systemic; use injectable
- Vaccines of questionable effectiveness
- This is a **zoonotic disease**, meaning that humans get it!
  - Practice careful personal sanitation with hands, boots, clothes

Cryptosporidial Diarrhea

- Ubiquitous organism that survives for months in the right environment
- No practical antibiotics are effective
- **Not killed by most disinfectants**
- Killed by complete drying
- This is a zoonotic disease, particularly for the immunocompromised

Given that most diarrheal agents:

- Are ubiquitous (*holoendemic*)
- Survive well in the environment
- Aren't curable with drugs
- Establish carrier states in herd mates
- Often co-evolved with their bovine host


10/09
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Effects of direct-fed microbials on performance of Holstein steers

- Potential benefits

  Increase performance

  Decrease morbidity

- McDonald (2005)
  - Vetlife Benchmark Performance Program
    - 7,387 lots containing 10,900,504 cattle
      - Feedlots using DFM
        - » increased ADG 1.9 and 1.4% for steers and heifers
        - » Improved efficiency 1.9 and 3.9%

- Krehbiel et al. (2003)
  - Calves received DFM gel with first treatment were less likely to be treated again 96 h
- Mode of action
  - Alteration in intestinal microorganisms (maybe altered ruminal fermentation)
    - Competitive nature of DFM for pathogens
  - Improved immune response
  - Increased gut permeability

- Exp 1.
  - 43, 1-d old calves (42 kg BW)
  - 3 qt (2.8 L) commercial milk replacer (20:20) fed at 0700 and 1400 daily
  - Microbial treatment (control or *lactobacillus acidophilus* and *Propionibacterium freudenreichii* 5 x 10^8) mixed with milk replacer and added directly to bottles
  - Dry feed (59% steam-flaked corn, 20% ground alfalfa hay, 12.5% soybean meal, 6% molasses, and 2.5% supplement) offered starting on d 5

- d 50 calves abruptly weaned and 11 calves from each treatment euthanized at the University of Arizona Meats laboratory under approved procedures

  Digestive tract tissues harvested within 25 min including rumen (dorsal sac adjacent to spleen) and ileum (2.5 cm of distal end)

- Remaining calves fed for 14 d and tissues harvested as previously described

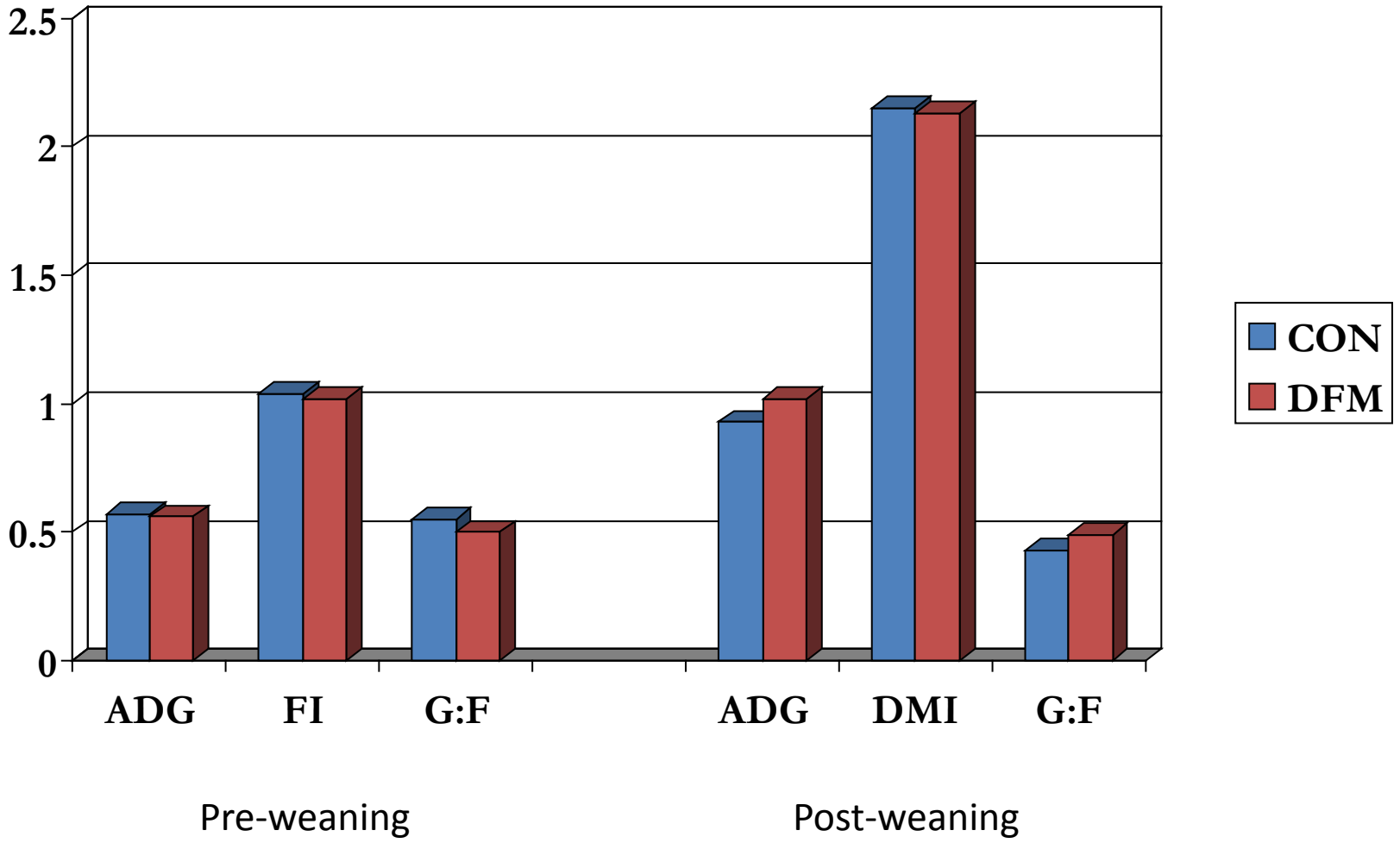
- Rumen and ileal samples were placed in 10% buffered formalin, sections were infiltrated with paraffin wax at the University of Arizona Veterinary Diagnostic Laboratory

  Sections were stained and bright field micrographs were determined using a Leica DM 5500 microscope

- Exp. 2
  - 300 1 to 3 d-old Holstein calves obtained from a commercial dairy
    - Calves were received in 3 blocks (100 calves/block)
  - Placed in commercial wooden hutches with 3 calves/hutch)
  - Fed a commercial milk replacer (22:20) for an average of 56 d
  - Offered dry feed starting on d 5
  - Treatments *P. freudenreichii* (1×10^9)
    - Control *L. acidophilus* 1×10^5 *L acidophilus* 1×10^6

- Upon weaning, transferred to the University of Arizona Feedlot (Tucson) and fed for approximately 12 mo.
  - Pens (33 total with 6 to 9 head/pen)
  - Calves were individually weighed during the experiment
  - Managed according to SOP's for the feedlot (vaccination for IBR-PI3-BVD-BRSV, Clostridial, implanted)
  - Harvested at a commercial facility in Tolleson, AZ

Exp. 1 Effects of direct-fed microbials on pre-weaning and 14-d post weaning performance



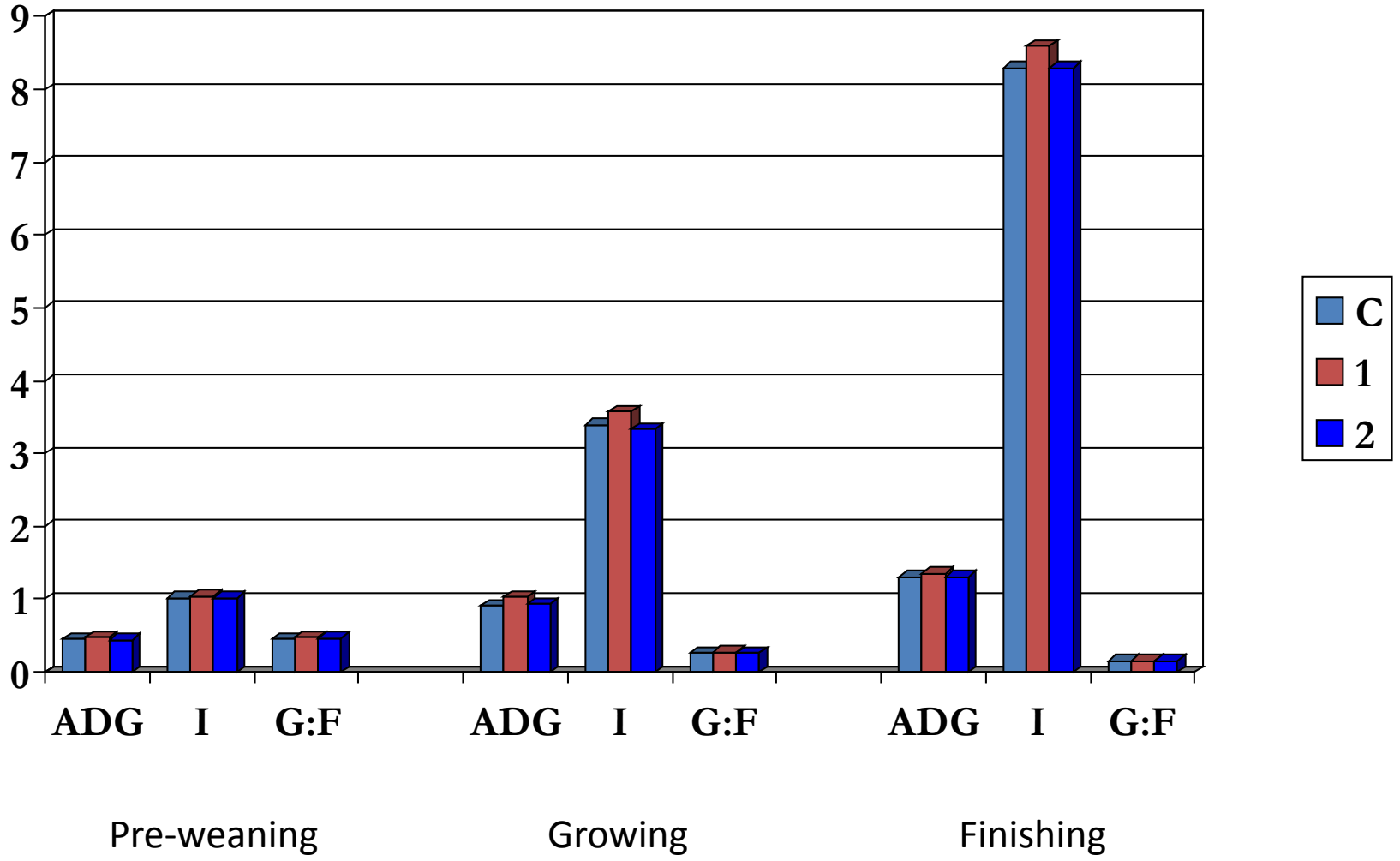
Exp. 1 Effects of direct-fed microbials on pre-weaning and 14-d post weaning ruminal morphology

Papillae ht, µm	CON	DFM	P <
Weaning	971	867	
Post-weaning	1,064	1,128	
Papillae width, µm			
Weaning	130	128	
Post-weaning	120	138	0.01
Density No./ µm			
Weaning	.0041	.0042	
Post-weaning	.0031	.0024	0.03

Exp. 1 Effects of direct-fed microbials on pre-weaning and 14-d post weaning ileal morphology

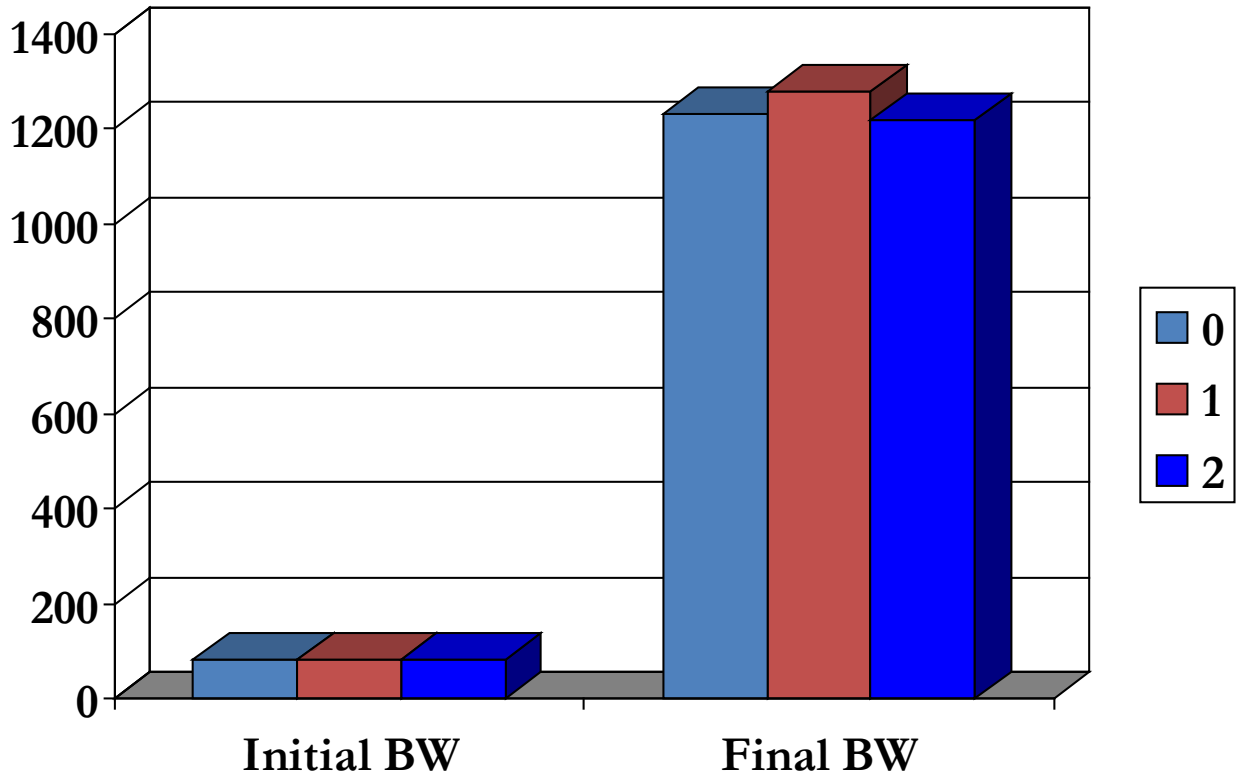
Villus ht, µm	CON	DFM	P <
Weaning	462	543	0.01
Post-weaning	554	503	0.07
Crypt depth, µm			
Weaning	295	349	0.03
Post-weaning	387	397	
Total (villus + crypth)			
Weaning	756	891	0.01
Post-weaning	940	899	

Exp. 2 Effects of direct-fed microbials on pre-weaning and 14-d post weaning performance



Summary

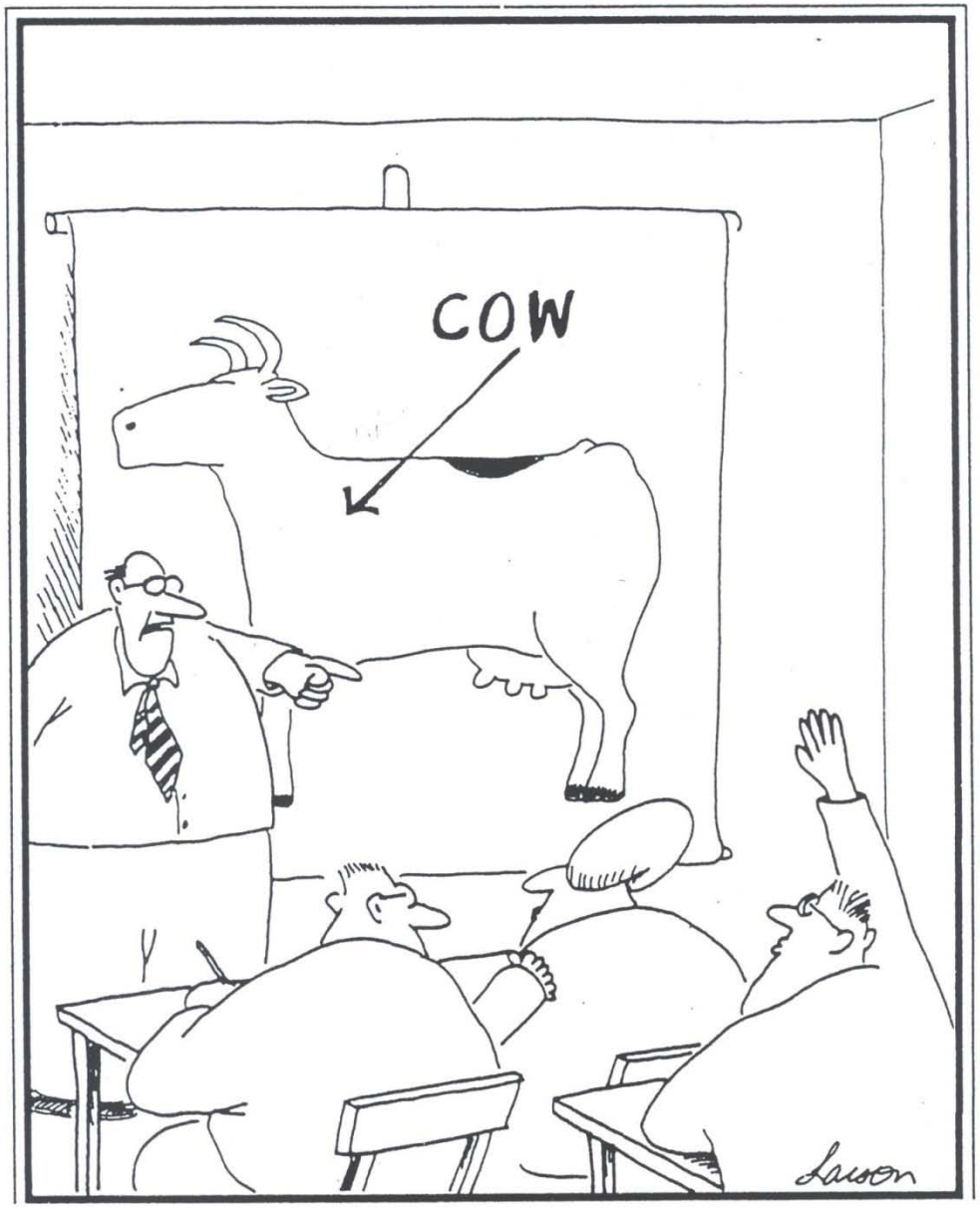
- Direct-fed microbials altered morphology of digestive tract



Housing

Commercial California brand calf crates

	Status			
	Nonscouring	Scouring	SEM[2]	P-value
No. of Animals	9	14		
Genus				
Streptococcus	6.998	26.418	9.224	<0.05
Escherichia	15.896	18.826	6.193	0.641
Bacteroides	30.254	6.993	9.546	<0.05
Fusobacterium	11.647	13.995	9.400	0.805
Enterococcus	5.623	9.690	4.355	0.361
Shigella	6.293	5.933	1.946	0.855
Lactobacillus	0.331	4.062	2.750	0.189
Ruminococcus	2.017	2.219	1.528	0.896
Clostridium	3.555	0.808	1.583	0.097
Akkermansia	2.530	1.288	1.208	0.316



"Yes ... I believe there's a question there in the back."