

Feeding To Fit Pig Health

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A short journey

- Pre-weaning – what can we do to wean more, bigger pigs ready to grow after weaning?
- Post-weaning – what can we do to optimize performance of the pigs we have?
 - Management
 - Nutrition
- Future opportunities



The pig feeding challenge

- More and more pigs are born per sow:
 - Lower birth weight
 - More small pigs
 - More low viability pigs
- More pig have to share colostrum and milk
- More pigs are weaned (at young age)
 - Lower weaning weights
 - More small pigs are weaned
- Health challenges
 - Virus infections suppress immunity (PRRS/Circo)
 - Bacterial infections reduce performance

Raising healthy pigs is a real challenge!

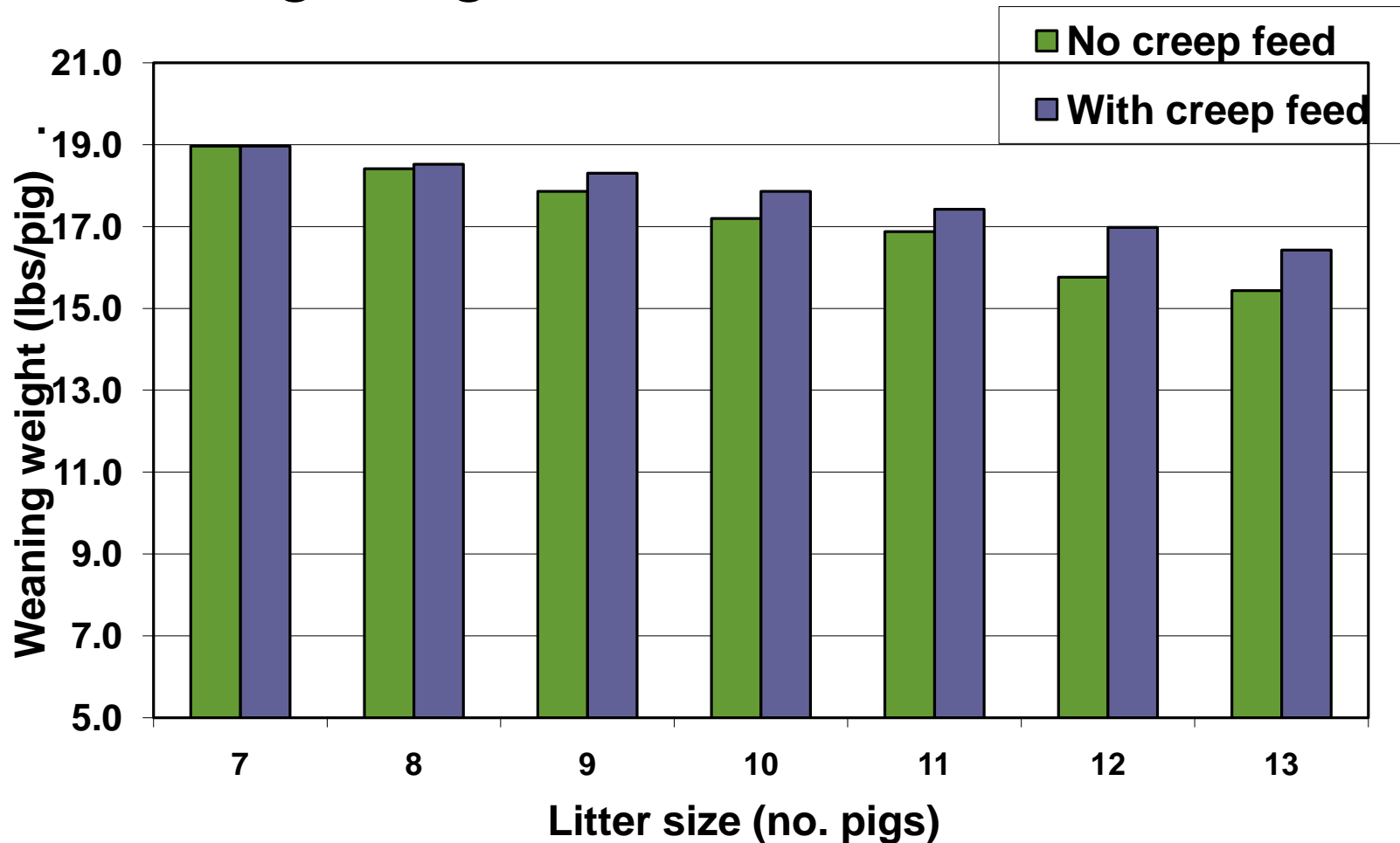
To prepare pigs for life away from the sow, they need to be able feed themselves.

- Creep Feeding is the practical opportunity we have to prepare pigs before weaning



(This may not be a practical way to deliver the creep feed)

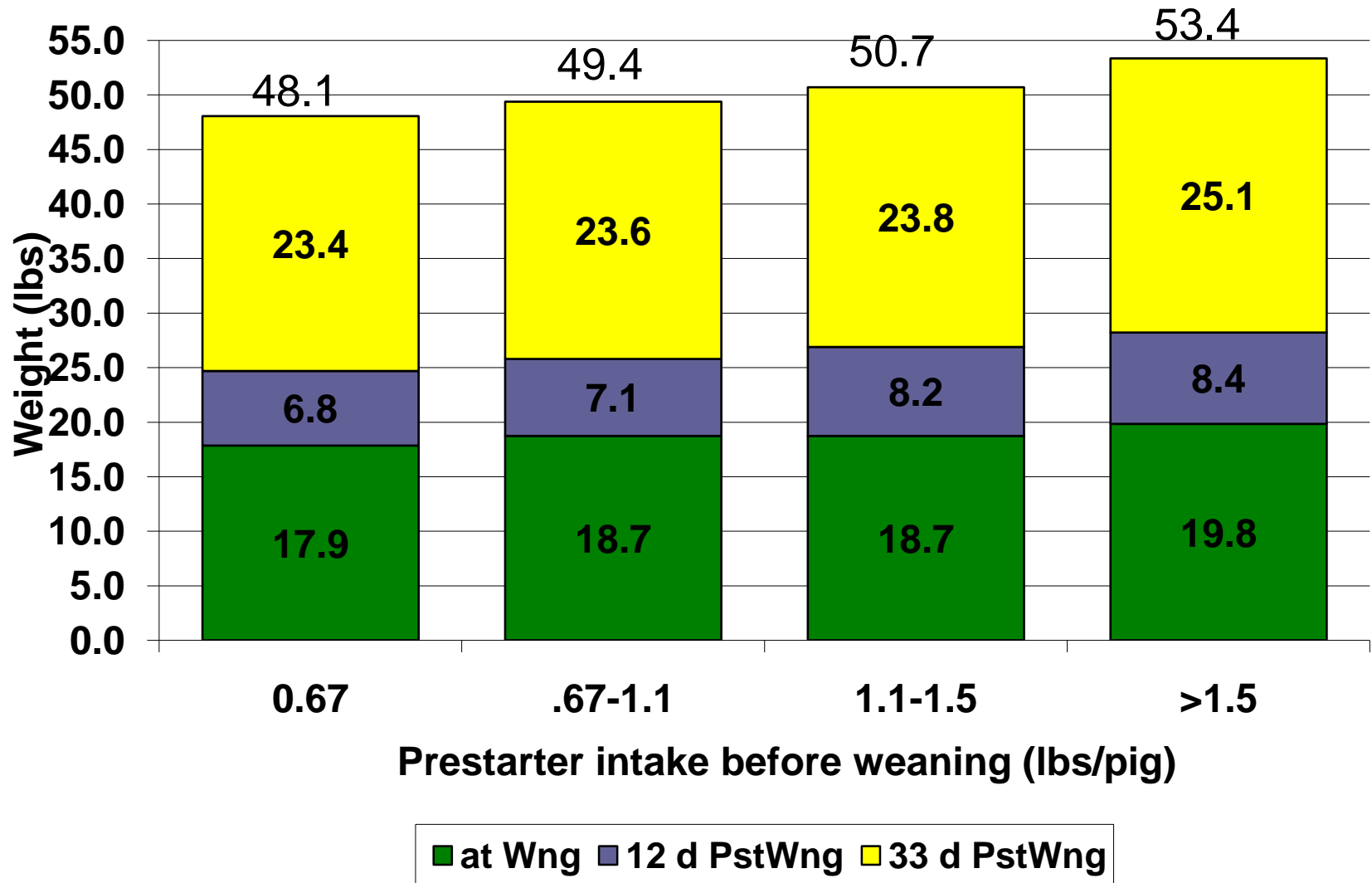
Effect of litter size and creep feed on weaning weight



The larger the litter, the more critical creep feeding is to weaning weight

Source: Kavanagh, 1995

The importance of creep feeding on post-weaning performance (4-week weaning)



Source: CAN GIC NL

Effect of varying creep feed duration on pre-weaning and post-weaning performance

(Yan et al., 2011, AAJAS)

- 21 day weaning age
- Duration of creep feeding: 6, 11 and 16 days
- Creep feed
 - 24% Lactose
 - 4% SD Porcine Plasma
 - 6% Isolated Soy Protein
 - 10% Fermented SBM

Effect of varying creep feed duration on pre-weaning and post-weaning performance

Days creep feeding	16	11	6	0
ADG, lbs/pig				
Day 0-21; pre-wng	.46	.46	.43	.44
D 21-28; wk 1 post-wng	.50	.46	.43	.43
Diarrhea score, 7d post-wng	4.25 ^b	4.75 ^b	6.20 ^{ab}	9.80 ^a
Sows				
Estrus interval, days	4.50 ^b	4.50 ^b	5.00 ^a	5.30 ^a
Back fat loss, mm	0.23	0.18	0.57	0.38
Epinephrine, pg/ml	14.1 ^b	22.1 ^{ab}	33.0 ^a	34.2 ^a
Norepinephrine, pg/ml	101 ^b	159 ^{ab}	171 ^{ab}	190 ^a
Cortisol, Ug/dl	2.78 ^b	2.84 ^b	4.16 ^a	4.28 ^a

Source: Yan et al., 2011

Consider a special creep feed; not standard starter feed

- Piglets enzyme systems are not well developed limiting digestion of most standard starter feed at young age
 - Lower protein reduces fermentation in hind gut
 - Simple or processed carbohydrates including lactose
 - Limited supplemental fat
 - Highly palatable
- Good pellet or crumble
- No medication:
 - Antibiotics may reduce palatability and lower feed intake
 - Risk of under-dosing → increase risk of resistance?

Feeding the pig before weaning

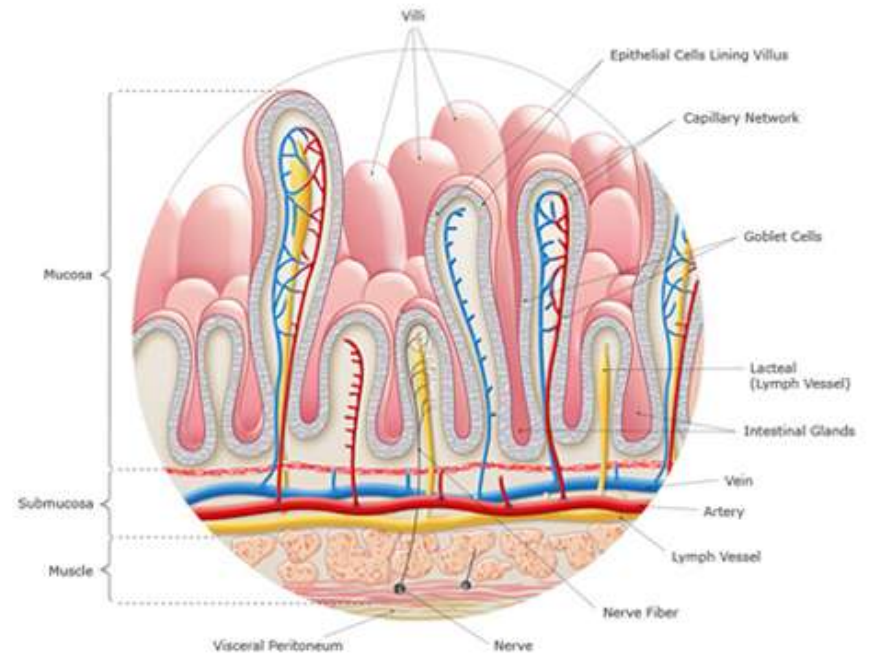
- **The more feed intake the better**
 - Feed a creep feed designed for this purpose
 - Start at about 5 days of age – optimal; 10 days at the latest
 - Supply fresh feed to the animals daily
- Supply water that pigs can readily access
- Ideal feeder:
 - maximum height of 3 inches
 - Mat is OK, if feed can be managed to limit waste and provide access almost continuously
 - placed where activity is



Post-weaning pig feeding

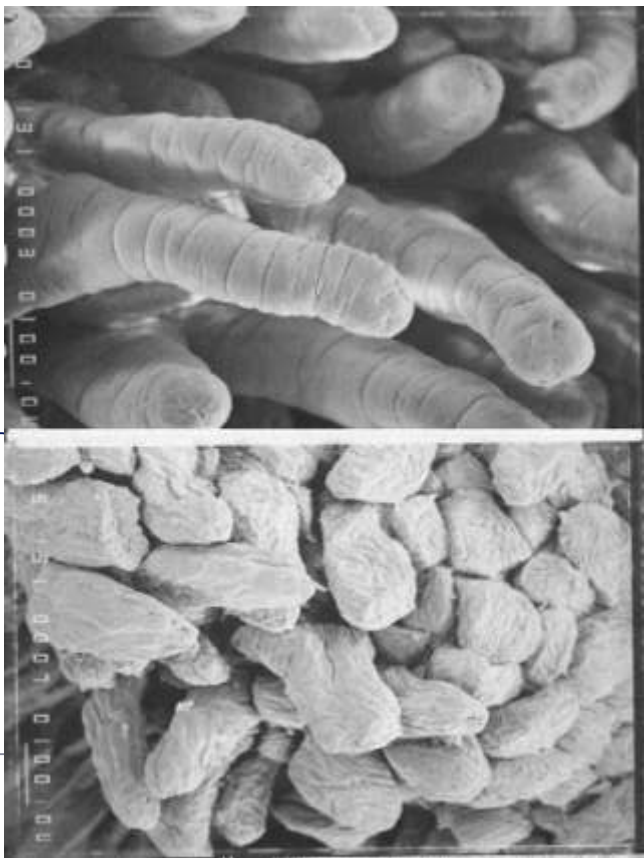
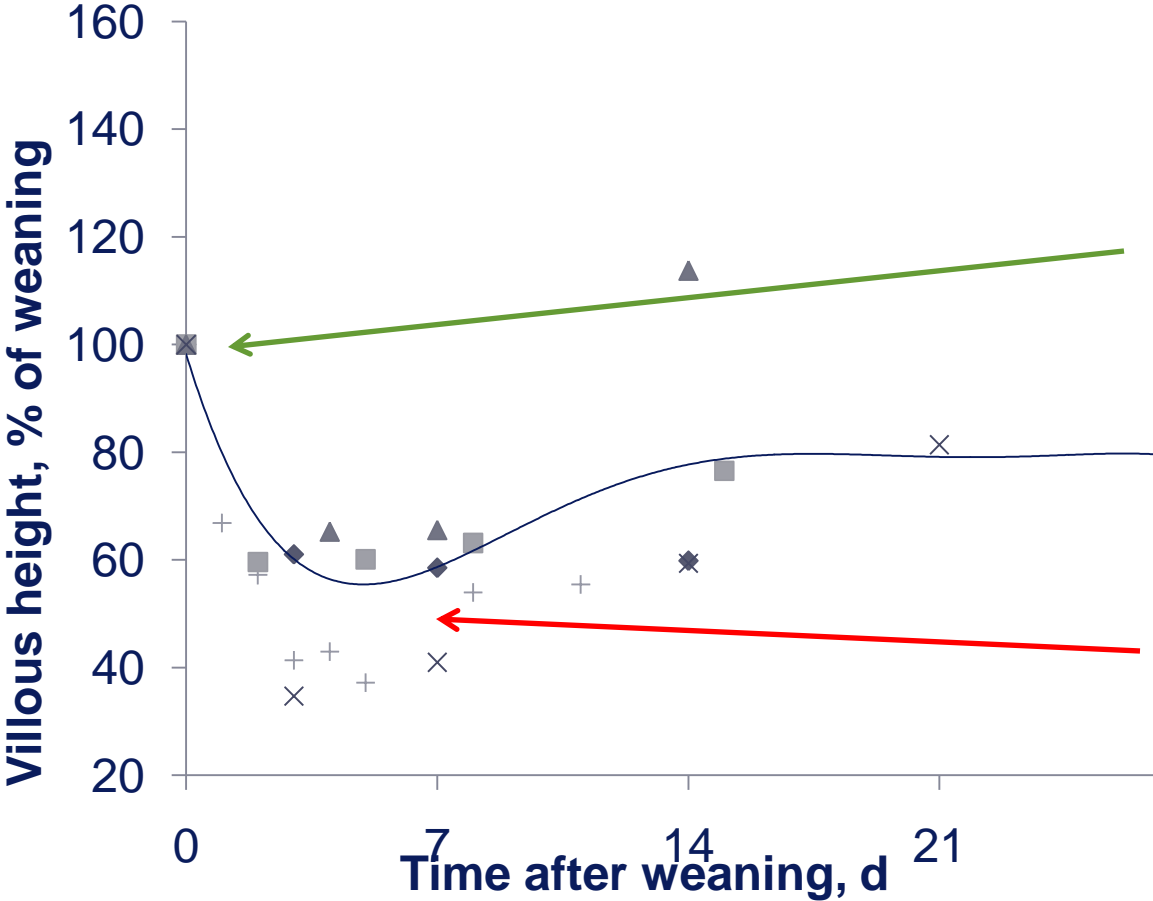
How do we help pigs recover from weaning?

The importance of healthy gastro-intestinal tract



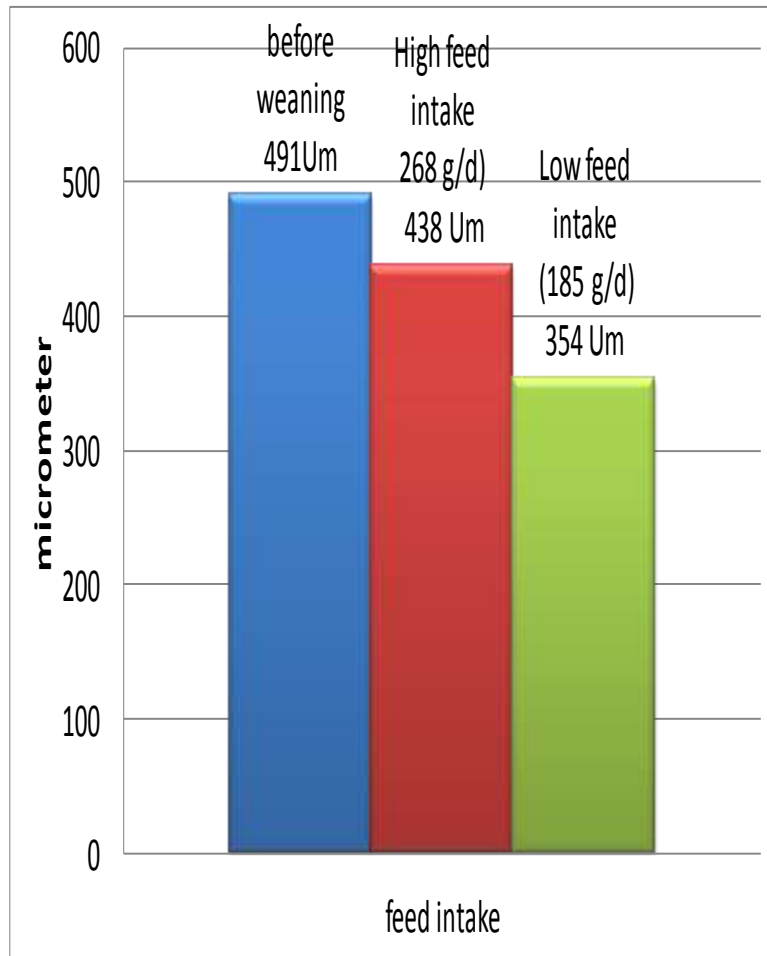
Picture: CAN research NL

After weaning, villus length is reduced substantially

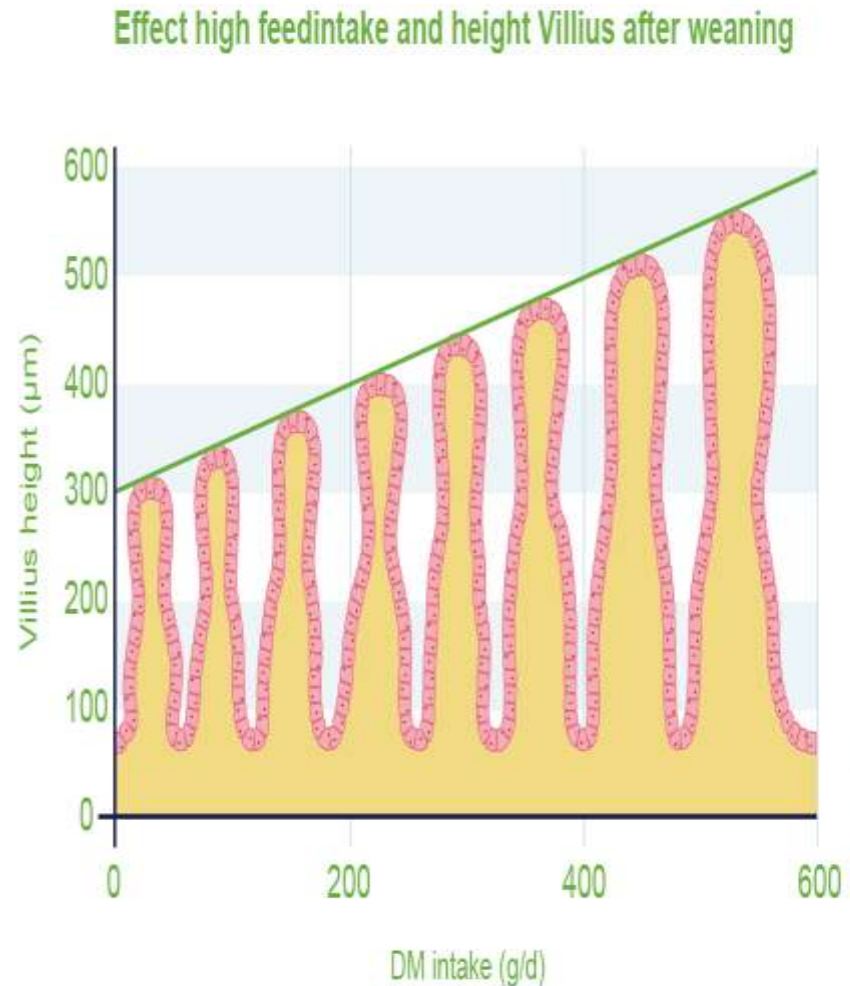


Source: CAN NL Research, Wijtten 2011

High feed intake after weaning results in longer intestinal villi

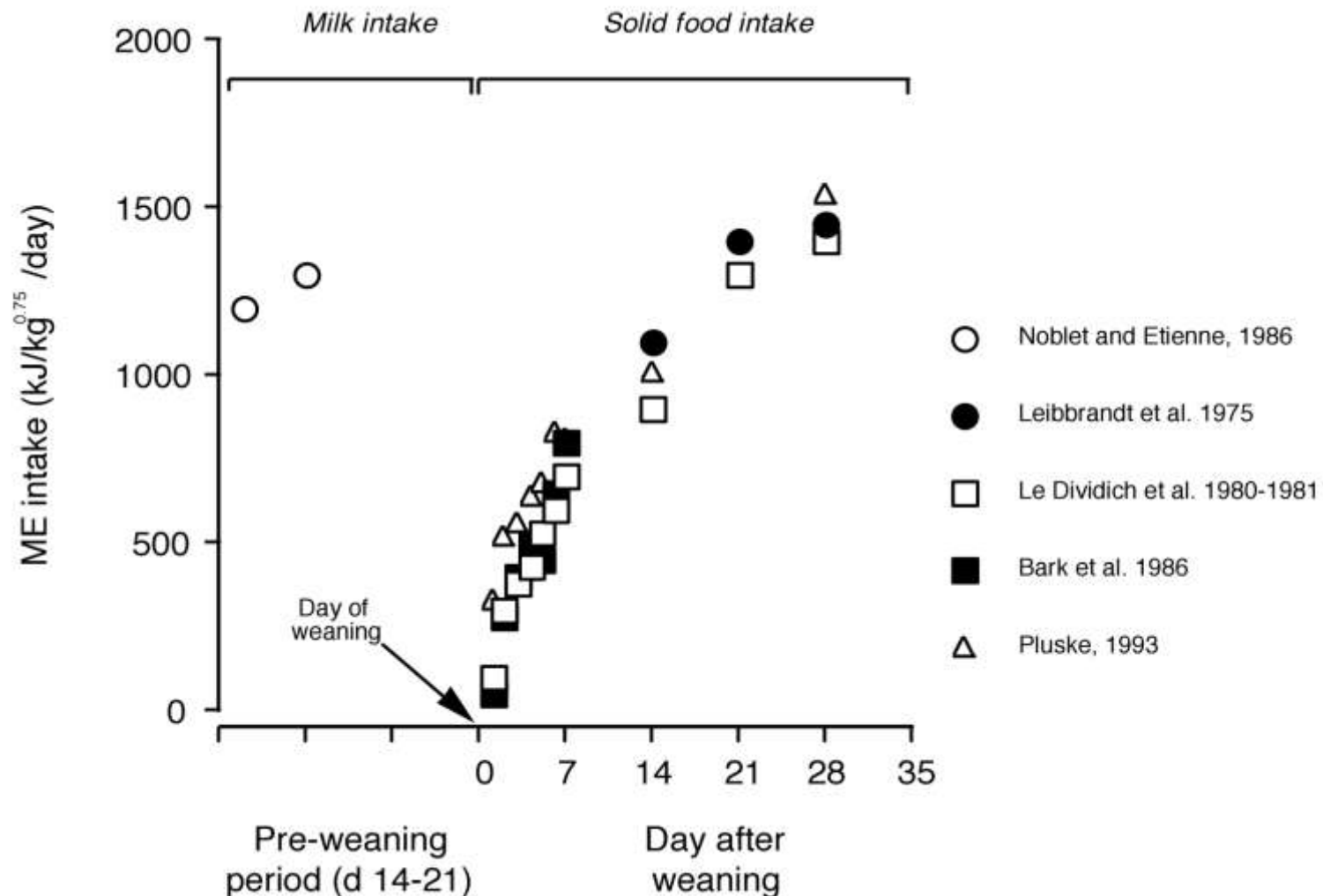


Source: Verdonk et al. 2007

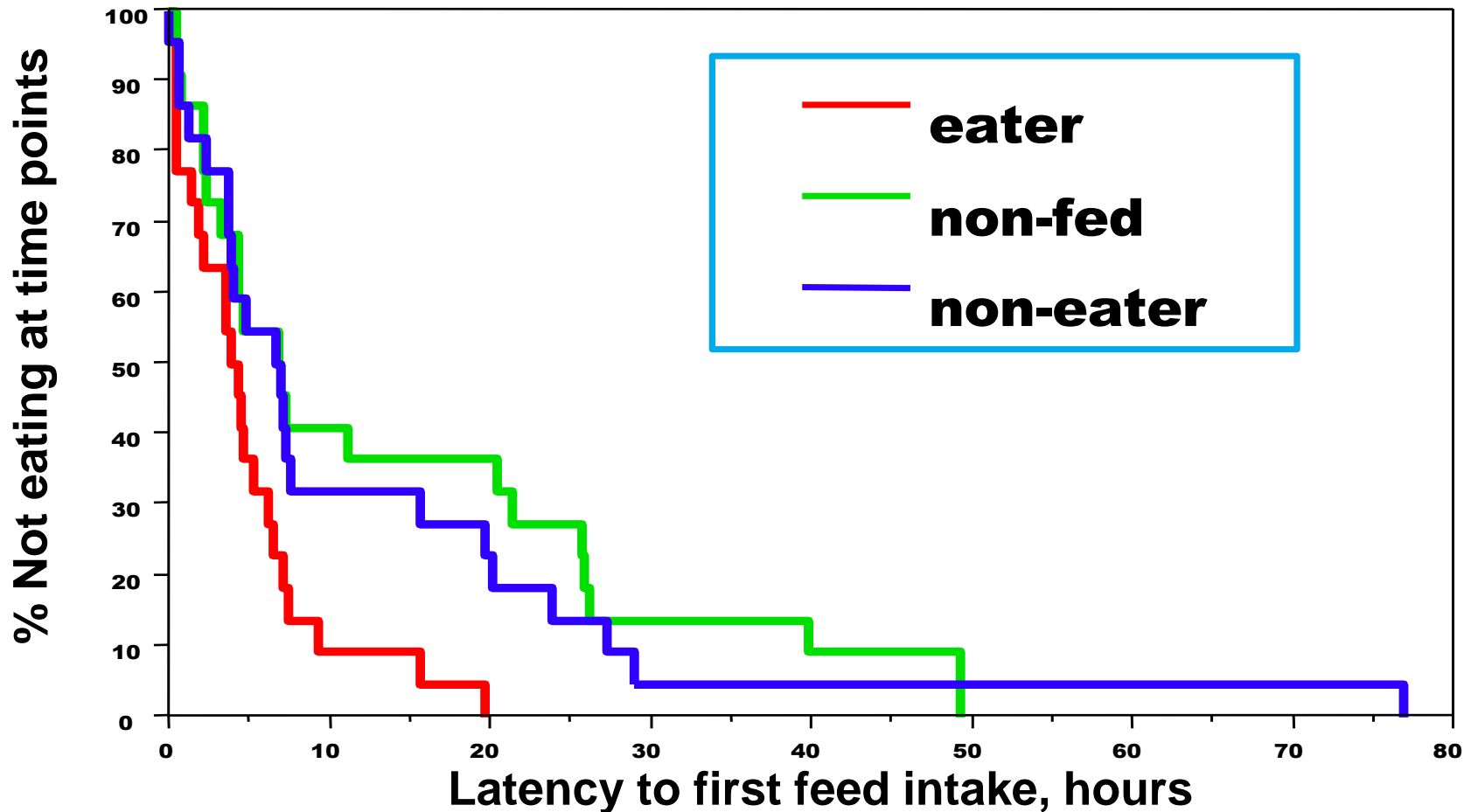


Pluske et al.
cited by Wijten 2011

Newly weaned pigs are in an energy deficient state - energy intake can take 7-21 days to equal that right before weaning



Pigs that consume more creep feed in lactation eat more quickly after weaning



Source: Bruininx *et al.*, 2002

How many days to feed creep feed post-weaning?

Trial 1:

CAN - Spain (weaning age 24 days, 7 kg weaning weight)

Change creep feed to prestarter feed:

4 days post weaning

6 days post weaning

8 days post weaning

10 days post weaning

Trial 2:

CAN - Netherlands. (weaning age 21 days, 6.2 kg weaning weight)

Change creep feed to prestarter feed:

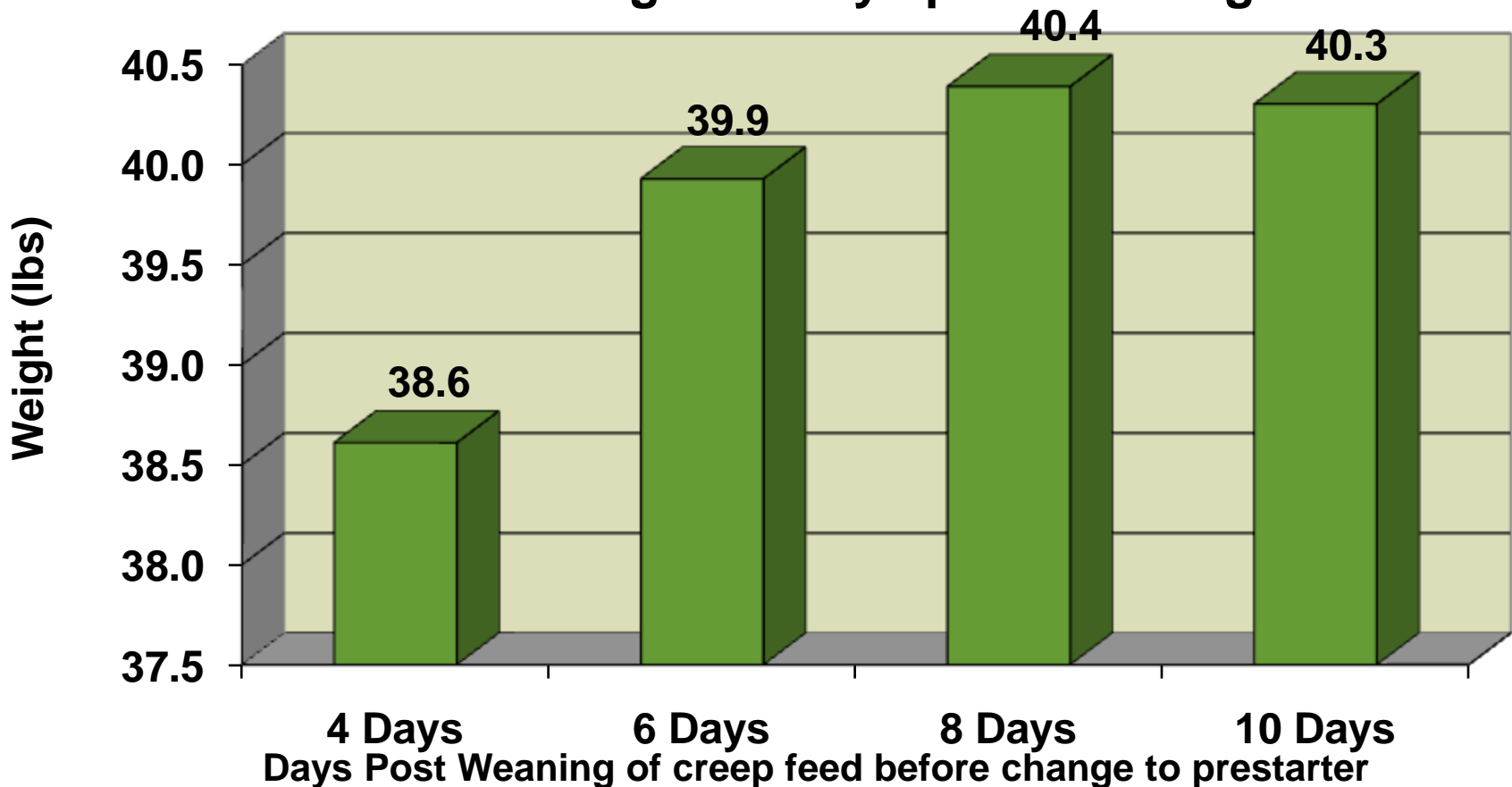
2 days post weaning

4 days post weaning

7 days post weaning

Trial 1 TAC Spain

Effect of longer creep feed (phase 1) feeding
on weight 25 days post weaning

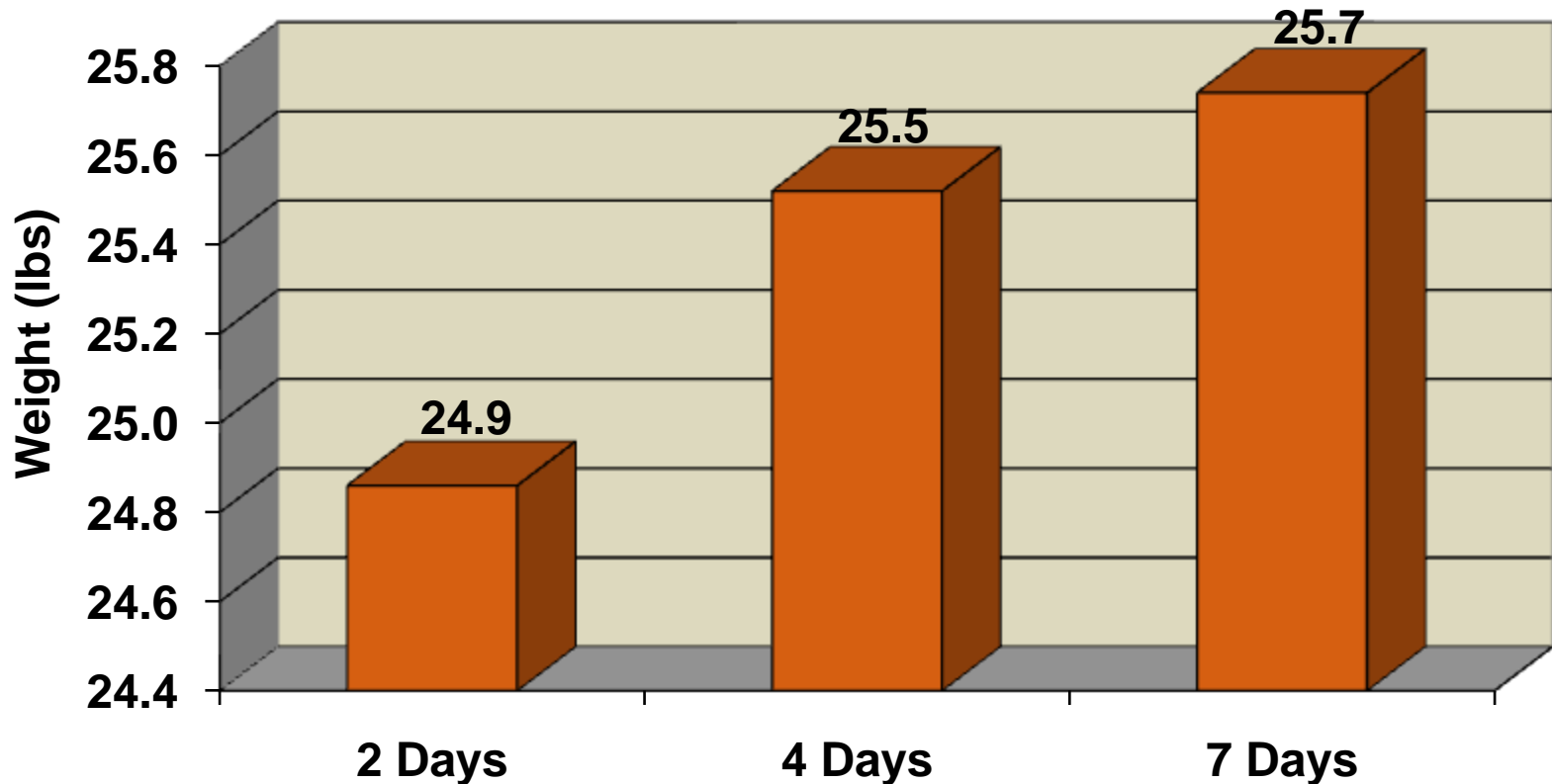


Optimal benefit ~1 week of Creep Feed after weaning

Source : CAN TAC Spain

Trial 2 GIC Netherlands

**Effect of longer creep feed (phase 1) feeding
on weight 21 days post weaning**

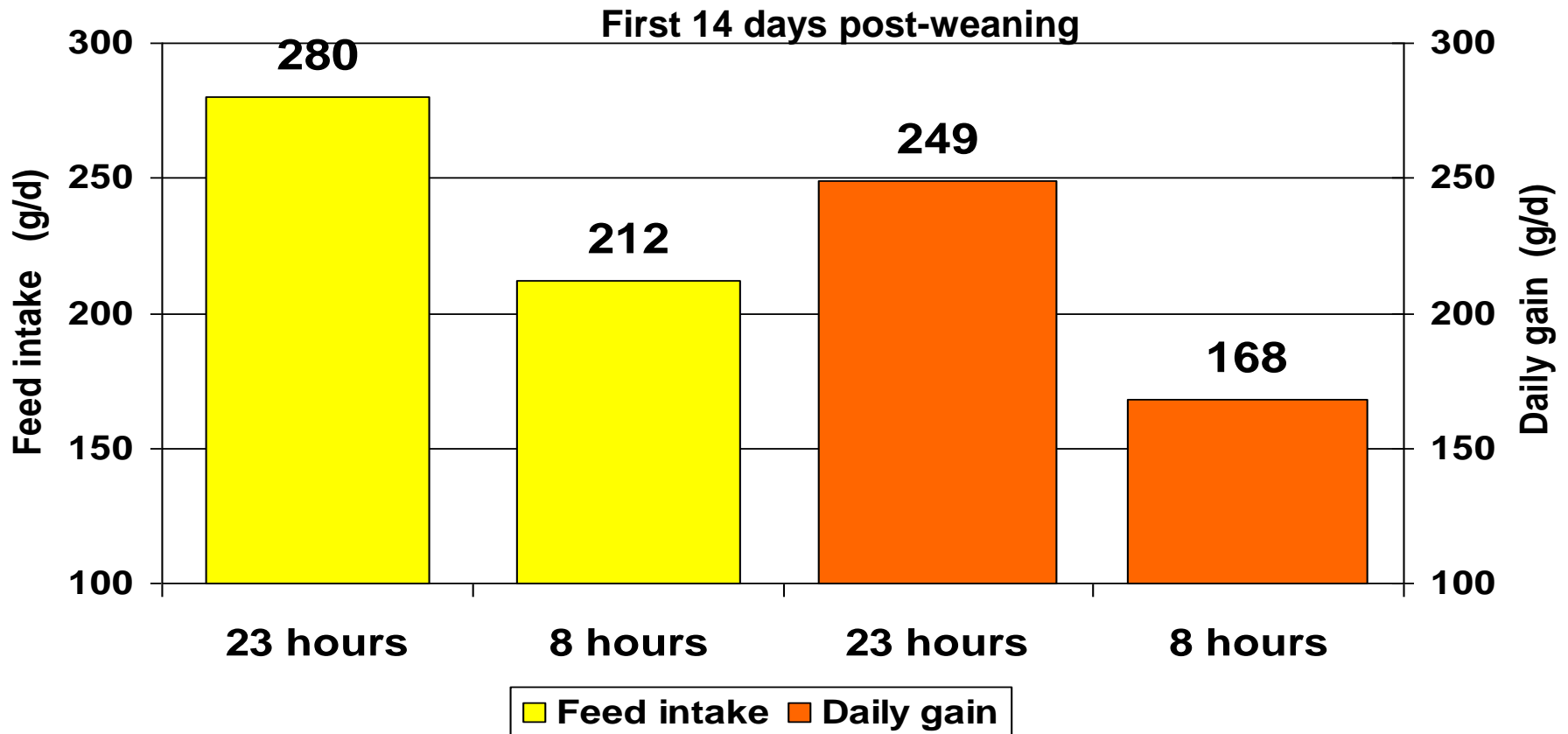


Days Post Weaning of creep feed before change to prestarter

Optimal benefit ~ 4-7 days of Creep Feed after weaning

Source : CAN GIC NL

Effect of light on post-weaning performance

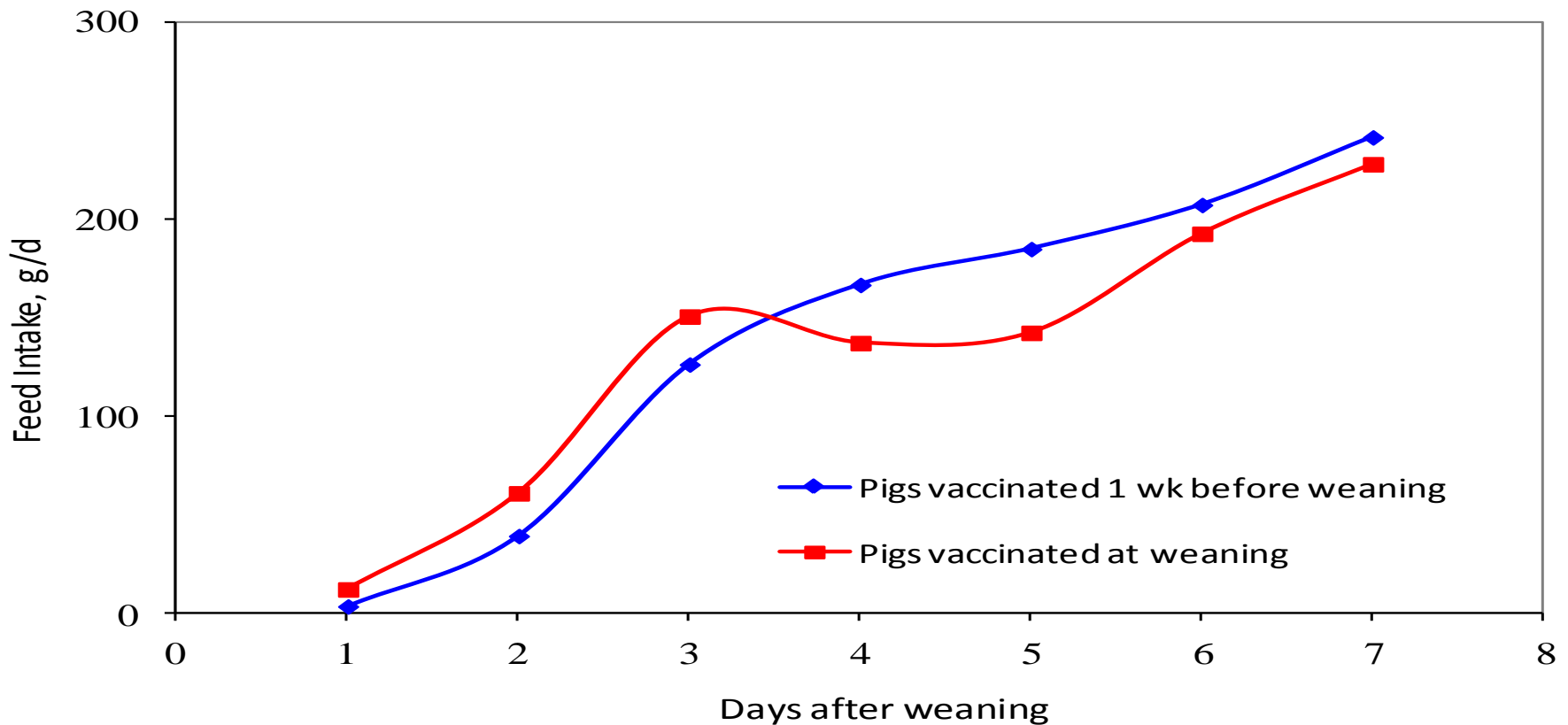


Don't leave pigs in the dark!

Source: Van den Boogaart, 2001

Vaccination time can affect feed intake

- Daily intake pattern of pigs vaccinated 1 week before weaning or with weaning at 21 days of age.



Source: Mavromichalis et al.

Water intake is a key to post weaning feed intake

- At least 1 nipple waterer per 10 pigs
- With more than 1 nipple have them a minimum of 3 feet apart
- Have enough output from the nipples

Table 2. Influence of water delivery rate on performance of weaned pigs from 3-6 weeks of age (Barber et al., 1989).

Water Delivery Rate	175 ml/min	450 mL/min
Water intake (L/day)	0.78	1.32
Feed intake (g/day)	303	341
Daily gain (g)	210	250
FCR	1.48	1.37
Time drinking (min/day)	4.46	2.93

- Clean water system

Effect of sorting pigs going into the nursery

	Sorted on weight	Not sorted on weight
Weaning wt (lbs)	10.8	10.8
Final weight (lbs)	52.0^a	53.1^b
Gain, (g/p/d)	.91^a	.93^b
Intake, (g/p/d)	1.23^a	1.26^b
FCR	1.36	1.36

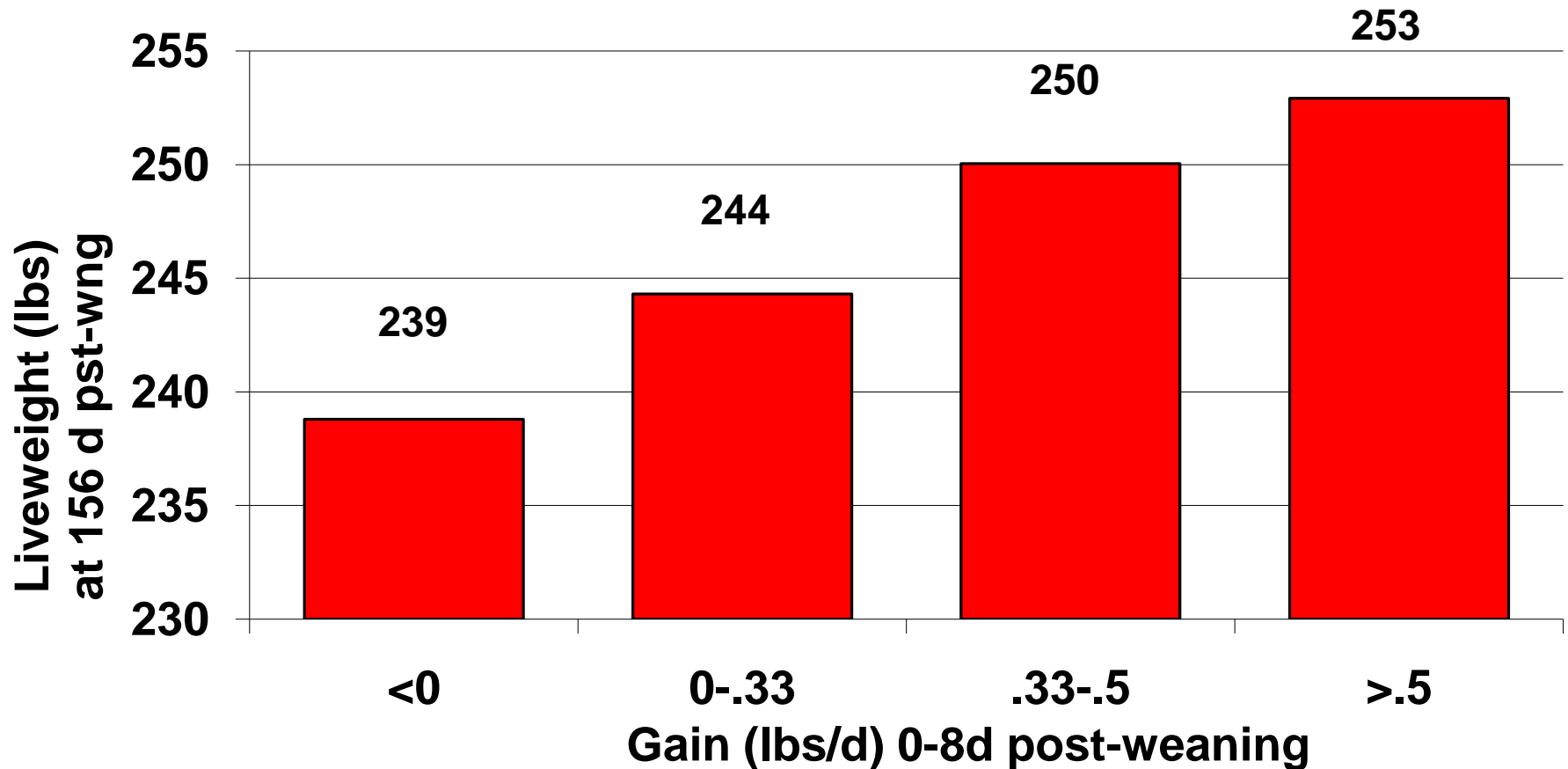
ab $p < 0.01$

*Source: CAN NA research
1760 piglets day 0 to 45 Pst-Wng*

Suggestions to enhance early, post-weaning feed intake

- Creep feed in suckling period (beginning at 5-10 d of age) → more and earlier intake post-weaning
- Keep same feed post-weaning as before weaning
 - Relatively higher energy: protein → more intake, less diarrhea
 - Palatable & familiar
- Feeder:
 - Preferably open feeders to promote group eating
 - Enough light to see inside the feeder
 - Plenty of feeder space
- Light is important to encourage finding the feeder and increase imitation and curiosity – keep the lights on
- Sorting probably reduces intake the first few days after weaning

Early post-weaning gain & final weight



Source: Tokach et al., 1992

Optimizing feed intake of piglets in the first week post weaning pays off!

- Pigs that eat more are more resistant to disease and have better health through out the growth period
- Improved average gain in the total nursery period
- Better uniformity → better utilization of the building and less risk of violating all-in-all-out principles
- Better “life-time performance”

Balancing diets for varying health conditions

- Macro-nutrients...Protein, Carbohydrates & Fats
 - Should we adjust sourcing and levels according to stress and health levels?
- Additives...
 - How might conditions affect which ones we choose and how much benefit we get?



Protein and amino acid nutrition

- Protein paradox –
 - Requirements for amino acids are high to reach maximum growth
 - Protein in excess of digestive capability leads to fermentation and diarrhea; reduced with lower protein diet
 - Specific amino acid requirements to counteract gut health challenges vary from those for growth and may not be supplied at adequate levels with a low protein diet balanced to a typical ideal protein ratio
 - Glutamine & glutamate – increase innate and adaptive immunity (macrophage and lymphocyte) under challenge; increase gut integrity and cell division; fuel source for gut mucosal cells
 - Alanine & glycine – may increase anti-secretory peptide
 - Threonine – required for mucus proteins and gut repair
 - Tryptophan – may increase villus/crypt ratio, but may reduce intake
- Optimal protein and amino acid feeding approach and levels may differ depending on health status and stress levels

Carbohydrates

- Lactose is expensive, but important, especially to challenged pigs
 - Energy source for young or challenged pigs
 - Acts as a prebiotic, as ~30% may be left undigested by the end of the SI
 - Effects may be partially replaced by other carbohydrates, fermentable fiber, prebiotics, or some acidifiers, but somewhat health dependent
- Fiber effects vary
 - “No” fiber diets may alleviate diarrhea, \$\$\$
 - Fermentable, soluble fibers (psyllium, beet pulp, chicory (inulin), etc.) may enhance gut health and favor larger, more diverse bacterial populations & high LAB’s, but effects may be limited in high lactose diets
 - Insoluble fiber (brans) absorb water, reduce binding of some bad bacteria to reduce diarrhea, but dilute energy in the diet
- “Grain” fibers (especially arabinoxylans) and raw starches
 - Generally, neutral, but with health challenges or very young pigs may increase risk of diarrhea
 - Processing or, potentially, enzyme supplementation may help

Fats

- Concentrated energy sources, BUT
 - One of the first and most predictive indicators of gut damage is reduction in fat digestibility
 - Medium chain fats and some unsaturated fats are generally well utilized, but expensive
 - Less expensive, more saturated fats are fine for healthy pigs beyond 4 weeks of age, but may not be with digestive tract challenges
 - In creep feeds and immediately post-weaning, if conditions are challenging, it is probably best to limit fat to modest levels (<2% added)

Which additives work? Why? When?

Zinc oxide – very consistent, relatively low cost additive improves performance, especially in stressed & challenged pigs

Acidifiers – reduces diarrhea, improves digestibility, improves gain and FCR; complement or partially replace antibiotics

Probiotics – yeast & bacteria

- Competitive exclusion
- Metabolites & enzymes
- Immune protection
- May aid gut repair

Enzymes – diet and sometimes health dependent

Additives can complement each other; or not...depends on MOA's, levels, health challenges

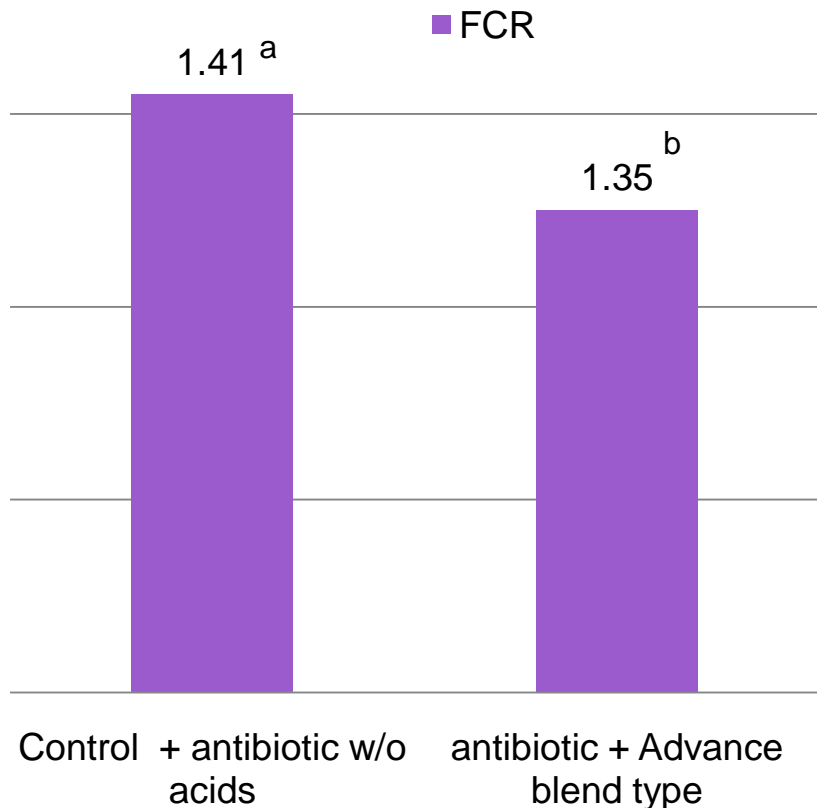
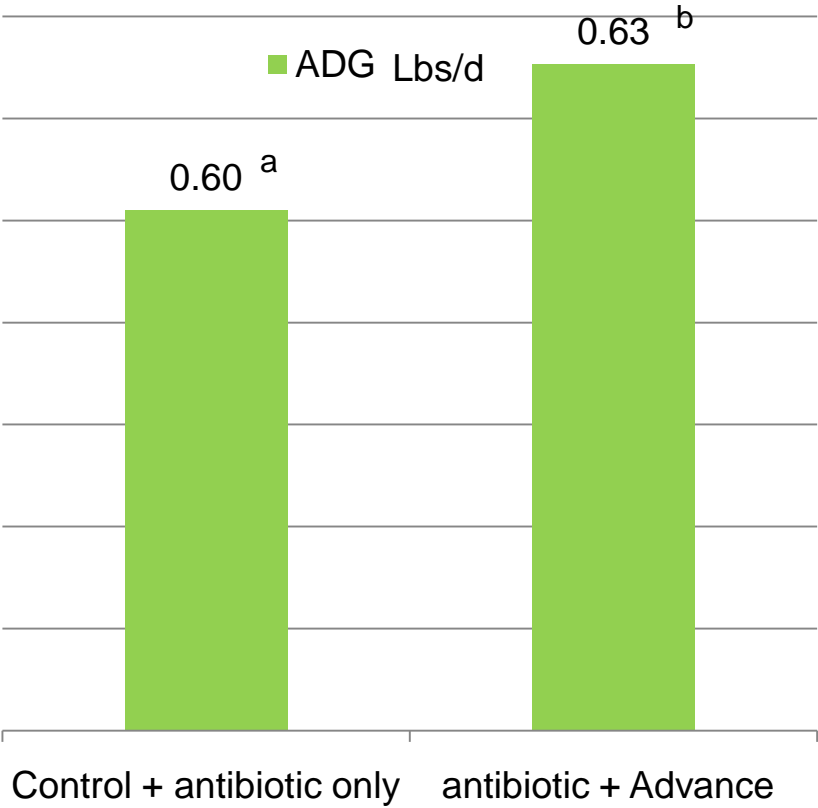


Zinc oxide – an effective and instructive additive

- Concerns and regulations in parts of the world limit use, may become an issue in US; replacement requires understanding of how and why it works
- Recent research is shedding light on zinc oxide
 - Increase IgA in the gut
 - Reduce genetic expression of inflammatory cytokines
 - Increase anti-microbial peptide secretion from bone marrow
 - Reduce translocation of bacteria to lymphocytes and blocks cascade leading to mast cell (limit immune system activation)
 - Prevent barrier leakage of macro-molecules following stress
- Similar measures may help us identify, understand and improve success with other additives

Promote ProHacid Advance improves ADG & FCR on top of antibiotics

14 days post-weaning



a,b Means within a row with different superscripts differ significantly (p<0.05)

Source : Cargill Application Center, NA, 2012, Antibiotic: Pulmotil, with 235 ppm Cu (from CuSO4) and 3000 ppm Zn (from ZnO)

Variable challenges – adjusting nutrition

High health, low stress, eating well

- Lower cost diets to reduce production cost; limit lactose and plasma
- Push nutrient levels higher to attain genetic potential
- Allow more plant proteins and starches
- Adjust additive package to maximize efficiency and lower cost of gain

Low health, high stress, eating poorly

- Wean to creep feed
- Invest in key nutrient sources – plasma, lactose
- Lower plant proteins and protein levels to reduce gut damage & diarrhea
- Use combinations of additives to support gut repair, intake, and reduce diarrhea

Future opportunities

- Better models of gut immunity, microbial status, management effects & opportunities to improve these
- Understanding and providing precursors to better protect the gut
 - Barrier function
 - Healthier commensal bacterial populations
 - Faster gut repair when damaged
 - Feeding to enhance immunity, cytokine modulation
- Control of gene expression to limit inflammatory, secretory factors, and gut damaging effects
- Combating oxidative stress and gut damage by nutrition
- Better targeted delivery of additives and nutrient precursors to key areas of the gut

All we need to do is sort this out...

