



*2024 – PORK NEXUS*

**RESEARCH FINDINGS**

**IMPROVING WEAN-TO-FINISH LIVABILITY**

OMARH MENDOZA\* & CALEB SHULL

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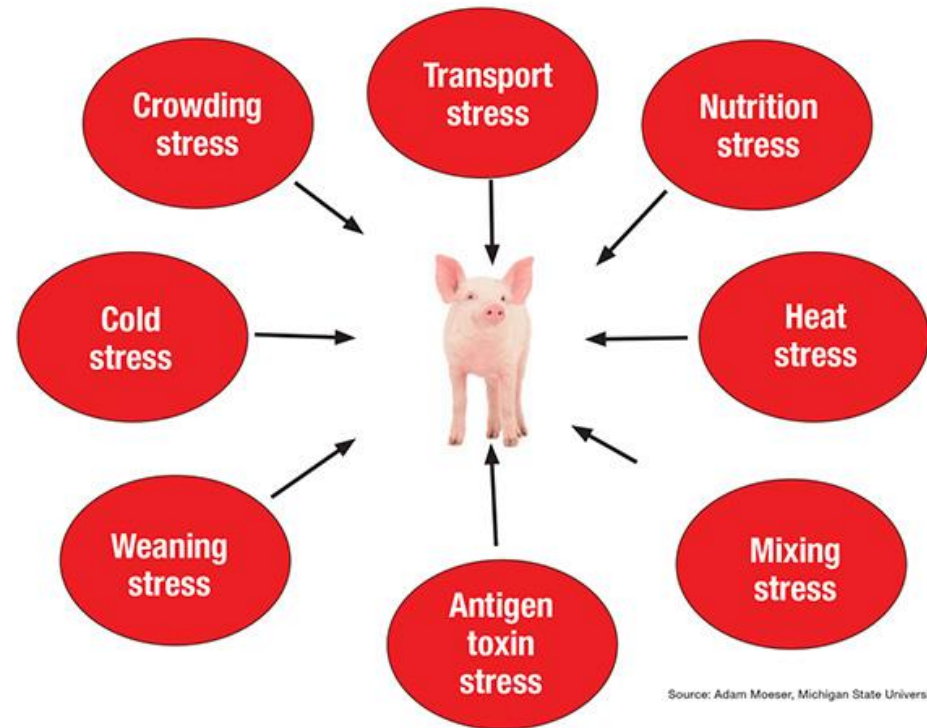
MYRTLE BEACH, SC

*Progressive Farming. Family Style.*

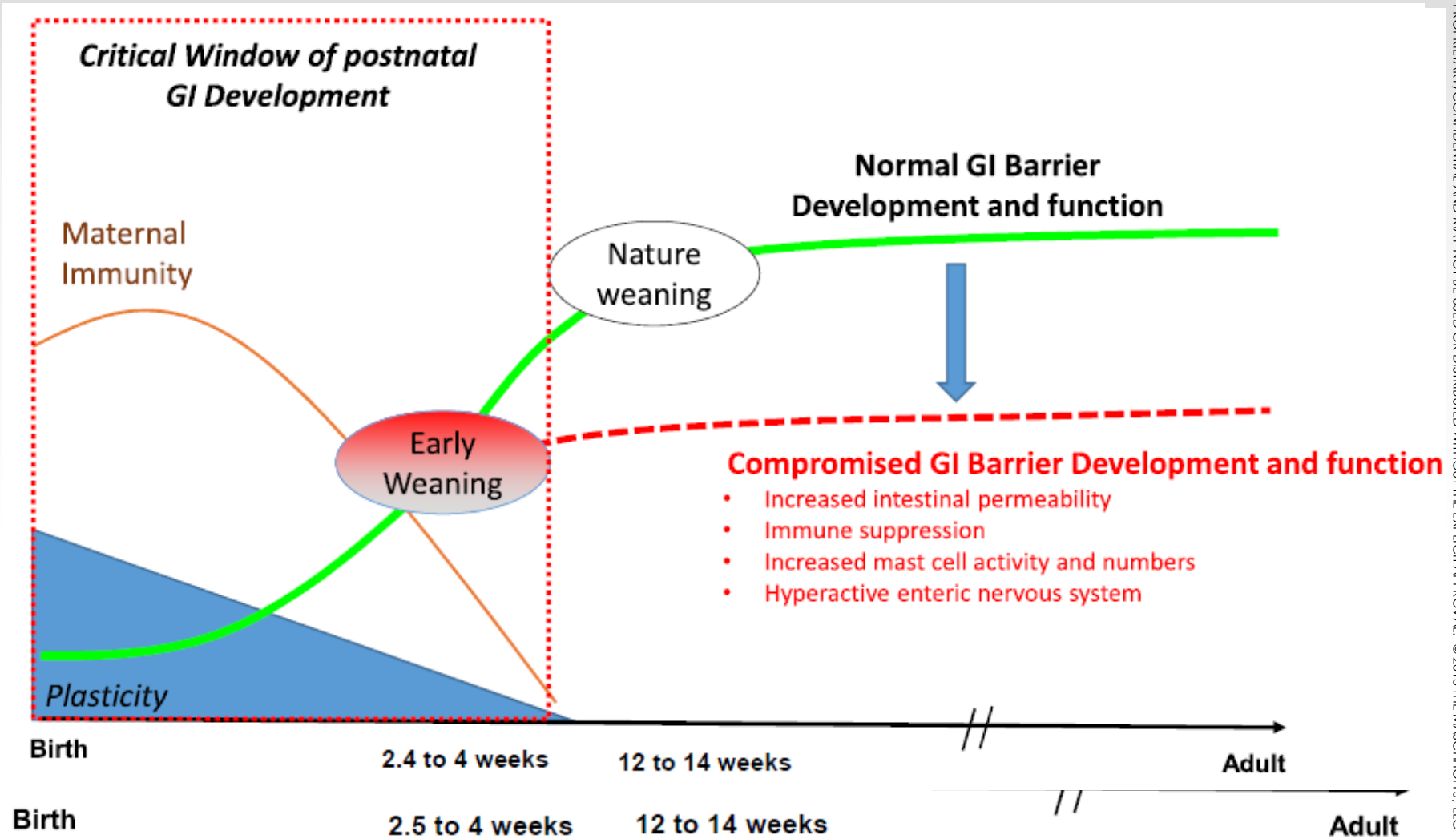
# WEANING IS A STRESSFUL EVENT!

- Resulting in low feed and nutrient intake:
  - Body weight loss
  - Intestinal morphological and functional
  - Inflammation
- Morbidity and mortality
  - Nursery mortality accounts for almost 50% of the mortality that occurs throughout the post-weaning phase (Magalhaes et al. 2023)

Figure 1. Stressors in animal production



# INDUSTRY CHALLENGES AT WEANING



# EFFECT OF TYPE OF STRESS ON PERFORMANCE IS DYNAMIC

- Response to a challenge has been described by Pastorelli et al (2012) through a meta-analysis (122 exp.)
- All challenges resulted in reduction of growth
- Reduction of feed intake or change in maintenance requirements
- Immune system responsiveness to some challenges

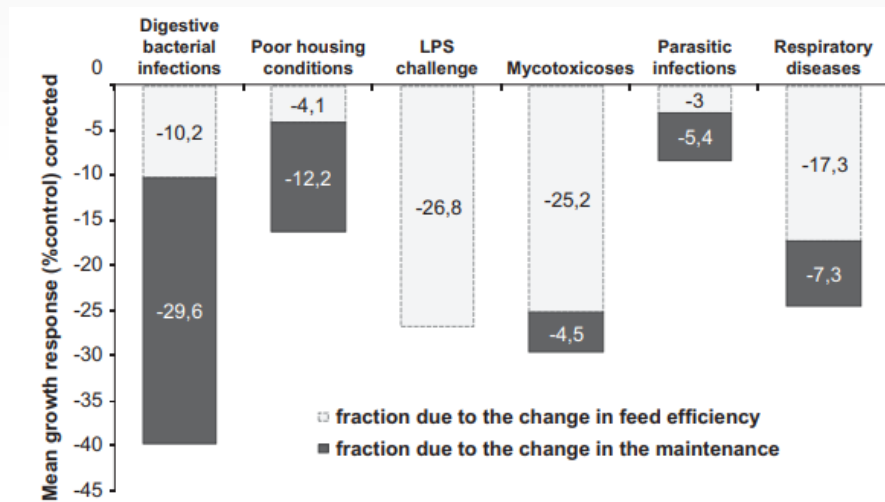


Figure 2 Partitioning of the reduction in the average growth rate following a sanitary challenge between the fraction due to the change in maintenance requirement (i.e. not associated with a reduction in feed intake) or due to the change in feed efficiency (i.e. associated with a reduction in feed intake).



# NURSERY NUTRITION PROGRAMS

- Continue to evolve year after year with incorporation of nutritional technologies, ingredients, and strategies to improve performance and optimize cost
  - Renewed focus on enhancing nursery programs using nutritional strategies and interventions to improve:
    - Feed intake
    - Hydration
    - Intestinal health

**Focus: Not only growth performance, reduction of scours, but improvement of Morbidity and Mortality**



# WHAT NUTRITIONAL TOOLS ARE AVAILABLE?



Plethora of nutritional technologies (feed additives) as potential tools to mitigate post-weaning stress, improve health outcomes (morb. & mort)



MOA: enhancing nutrient uptake, reduce inflammation and regulate intestinal condition, that could be conducive to improvements in growth performance and or survivability.



However, most products have limited research data that would allow understanding of the repeatability of the biological effects, and consequently the estimation of the return on investment



# CHALLENGES WITH NUTRITIONAL PRODUCT RESEARCH - CONTEXT

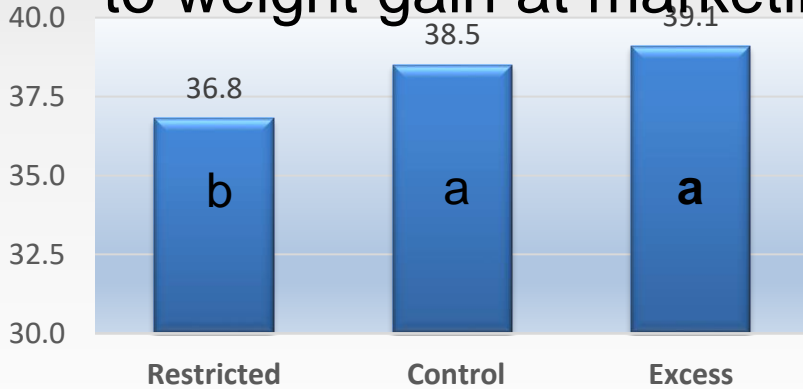
- Context of commercial practice - considerations
  - Practical dietary program
  - Antibiotics (vs. Negative Control)
  - Pharmacological levels of Zn and/or Cu (industry practice)
  - Group size, floor space, feeder and water spaces
  - Reflective of management
  - Source of pigs (i.e. single vs. comingled)
  - Stress events (transport, etc.)
  - Etc.



# CHALLENGES - EVALUATING OVERALL PERIOD PERFORMANCE

Assuming weight gain at the end of the nursery will translate to weight gain at marketing can be misleading

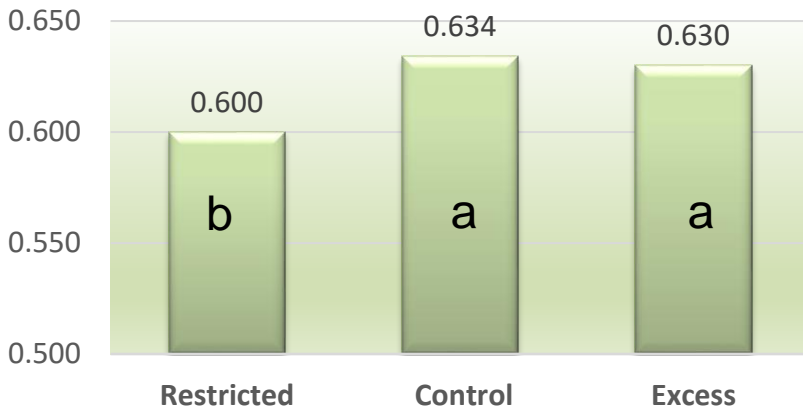
Nursery - End weight, kg



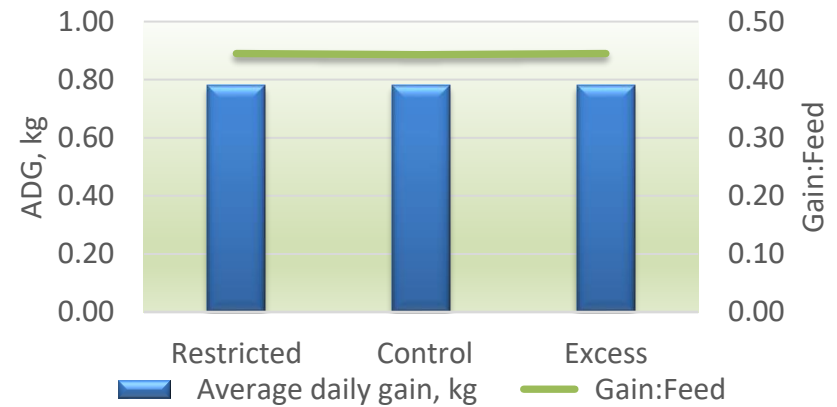
- Control (Adequate)
- Restricted (-0.20% SID Lys)
- Excess (+0.10% SID Lys)

- Nursery Performance
- Grower-Finisher
- Overall

Nursery - Gain:Feed  $P < 0.05$



Wean-to Market - ADG & G:F





# CHALLENGES - DO WE HAVE ADEQUATE REPLICATION?

- Common to see underpowered experiments
- Pig survival is often the goal immediately post-weaning
- Measuring survival requires setting up experiments with the appropriate sample size and statistical power
  - To determine adequate sample size
    - Expected outcomes
    - Measure of variability in metric of interest
    - Desired difference to be detected

Aaron and Hays (2004)

Mortality difference between treatments	Number of pigs per treatment required, n
3.5% - 3.0% = 0.5% difference	9568
4.0% - 3.0% = 1.0% difference	2592
5.0% - 3.0% = 2.0% difference	735

<sup>1</sup>Generated using a chi-square analysis and assumes a significance level of  $\alpha = 0.05$ .



# NUTRITIONAL INTERVENTIONS THROUGH DIET MODIFICATIONS OF ENTERICALLY CHALLENGED PIGS



# NURSERY NUTRITIONAL STRATEGY FOR POOR HEALTH PIGS

## (MILLER ET AL., 2021; ISU)

- Soybean Meal (high/low)
  - 15-25% SBM- typical starter diet with higher easily digestible synthetic amino acids present
  - 35-45% SBM- shown to exacerbate effects of enteric diseases (Boyer et al., 2015), but not much has been shown to improve growth
- BCAA
  - Has been shown to increase protein synthesis (Schmelze and Hall, 2000)
- MCFA
  - Improve intestinal microbiota through antimicrobial properties (Zentek et al., 2013)
- Modified Oats (MO)
  - Increased fermentability, improves intestinal lining (Frantz et al., 2003)



# NURSERY NUTRITIONAL STRATEGY (MILLER ET AL., 2021)

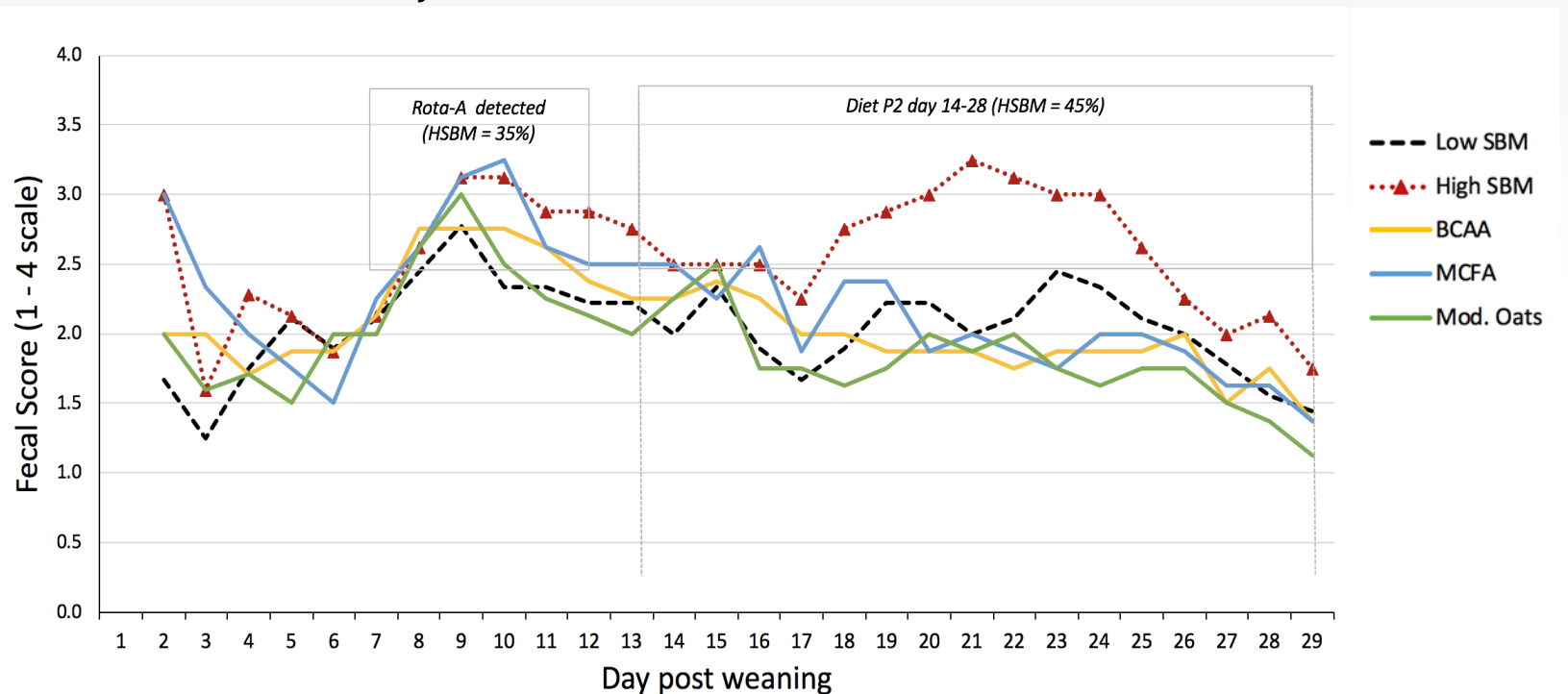
- Objective: To evaluate five dietary strategies that may improve performance of poor health nursery pigs
- Experimental Design
  - 431 weaned pigs ( $5.5 \pm 1.25$  kg starting BW; Maschhoffs proprietary genetics)
  - Randomized to pens (n=8 pens/treatment) using a completely randomized design across two rooms
- Treatments
  1. 15-25% Low Soybean Meal (**LSBM**)
  2. 35-45% High Soybean Meal (**HSBM**)
  3. 130% Increase in valine and isoleucine branched-chain amino acids (**BCAA**)
  4. 0.7% of each C8, C10, C12 (2.1% total) medium-chain fatty acids (**MCFA**)
  5. 20% Modified Oats (**MO**)



# HEALTH AND FECAL SCORES (MILLER ET AL., 2021)

- Health of the pigs
  - Vaccinated for PCV2
  - Nursery pig, d10 post placement diagnostics
    - PCR: + for Rotavirus A
    - Culture: + Hemolytic *E. coli*

1= Firm  
2= Semi-solid  
3= semi-liquid  
4= watery diarrhea



# GROWTH PERFORMANCE (MILLER ET AL., 2021)

Item	Low SBM	High SBM	BCAA	MCFA	Modified Oats	SEM	Overall P-value
Day 0	5.55	5.76	5.51	5.20	5.54	0.433	0.148
Day 14	8.35 <sup>a</sup>	8.79 <sup>a</sup>	8.22 <sup>a</sup>	7.41 <sup>b</sup>	8.55 <sup>a</sup>	0.287	0.001
Day 28	14.66 <sup>a</sup>	14.73 <sup>a</sup>	14.24 <sup>a</sup>	12.82 <sup>b</sup>	14.60 <sup>a</sup>	0.354	0.002
Day 42	23.92 <sup>a</sup>	23.74 <sup>a</sup>	23.52 <sup>a</sup>	21.94 <sup>b</sup>	23.92 <sup>a</sup>	0.501	0.042
Day 63	42.17 <sup>a</sup>	41.67 <sup>a</sup>	41.28 <sup>a</sup>	39.80 <sup>b</sup>	41.17 <sup>a</sup>	1.022	0.298

Within row, different superscript a, b indicates  $P < 0.05$  versus the LSBM control treatment

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# CONCLUSIONS (MILLER ET AL., 2021)

- When compared to the LSBM:
  - HSBM
    - Despite a higher fecal score, ADG, ADFI, and FE did not decrease
  - BCAA
    - Did not show evidence of increased protein accretion through growth performance
  - Modified oats
    - No difference in ADG, ADFI, G:F
  - MCFA
    - C:8, C:10, & C:12 at 2.1% negatively impacted pig performance
    - Why?
      - Palatability deterred intake



# **SUMMARY OF RESEARCH: NUTRITIONAL INTERVENTIONS USING NUTRIENT DENSE LIQUIDS FOR MORBIDITY & MORTALITY**





# SUPPLEMENTAL NUTRITION (MORRIS ET AL., 2017)

- Objective: Effects of supplemental nutrition program on growth performance and morb. and mortality
- Exp. Design: RCBD with a 3x3 Factorial Arrangement
  - Main effects
- Treatments:
  - Control: standard 4-phase nursery dietary program
  - As Control + 0.11 kg/pig of complex nursery starter diet
  - As Control + 7 d administration of nutrient dense liquid (NDL)
- Study Details:
  - Replicates: 57
  - Pigs/pen: 44 (mixed-gender)
  - Pigs/trt: 2,508
  - Pigs total: 7,524
  - Start wt: 5.22 kg (11.5 lb)
  - Floor space: 0.31 m<sup>2</sup> (3.3 ft<sup>2</sup>)
  - November 2015

Morris et al., 2017

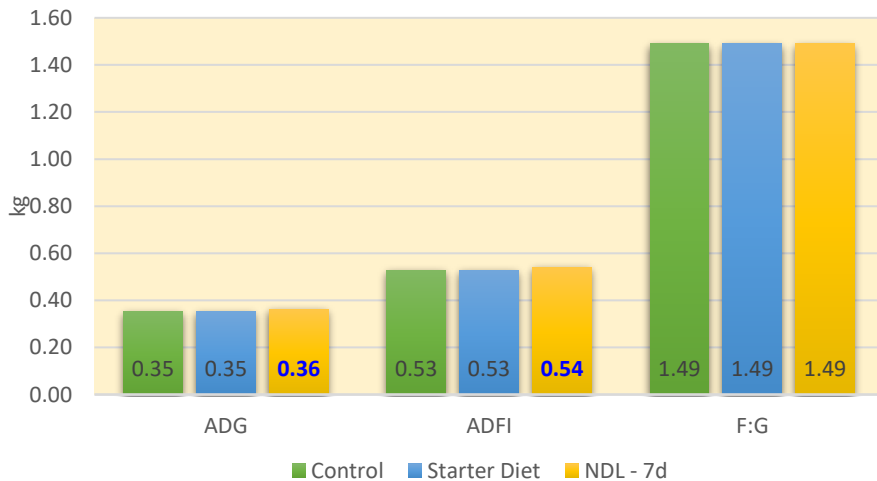
<https://doi.org/10.2527/asasmw.2017.12.214>



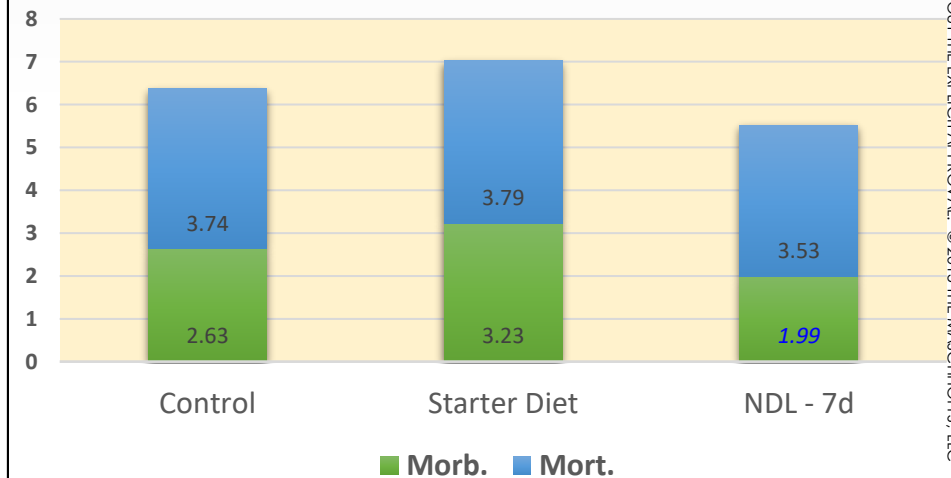
# SUPPLEMENTAL NUTRITION (MORRIS ET AL., 2017)

- Growth Perf.: NDL 7d greater ( $P < 0.05$ ) ADG and ADF
- Morb. & Mortality:
  - Morbidity levels were lower ( $P < 0.05$ ) for NDL 7d
  - There was a trend ( $P = 0.09$ ) for NDL for lower morbidity and mortality combined

Growth Performance - Start-Week 8



Morb. & Mort. - Start-Week 8



# SUPPLEMENTAL NUTRITION (VANDE POL ET AL., 2017)

- Objective: Effects of supplemental nutrition program on growth performance and morb. and mortality
- Exp. Design: RCBD with a 2 x 6 Factorial
- Treatments:
  - Control (Std. Nursery 1)
  - As Control + 0.11 Starter + NDL (1:128; 3 d)
- Study Details
  - Replicates: 57
  - Pigs/pen: 44
  - Pigs/trt: 2,508
  - Pigs total: 5,016
  - Start wt: 4.99 kg (11.0 lb)
  - Floor space: 3.3 ft<sup>2</sup>
  - June 2016

Vande Pol et al., 2017

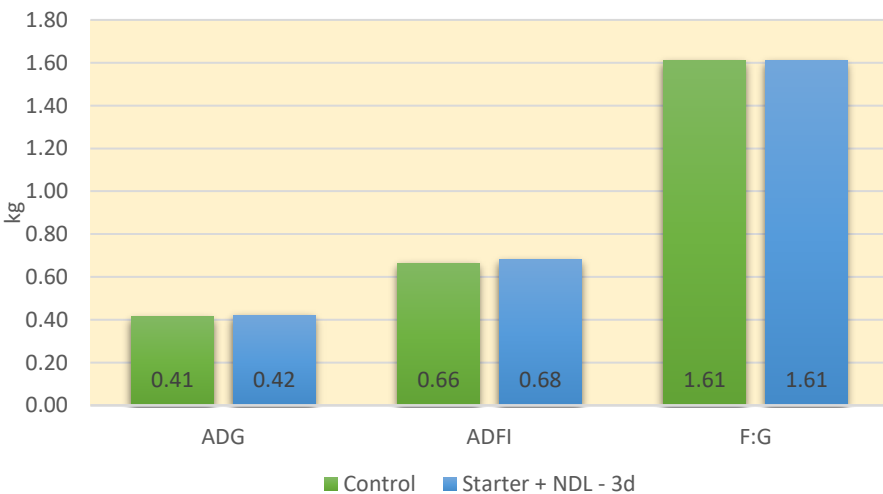
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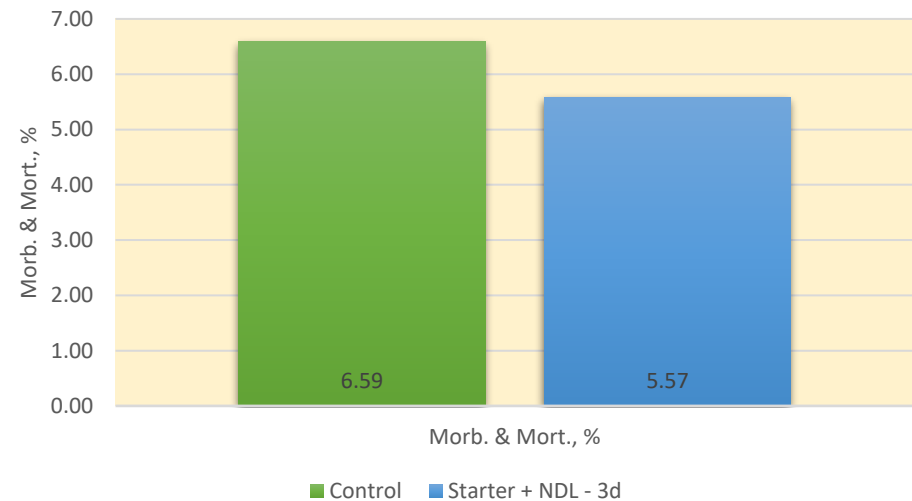
# SUPPLEMENTAL NUTRITION (VANDE POL ET AL., 2017)

- ADG was greater ( $P=0.03$ ) for nutritional intervention (Starter+ + NDL-3d)
- No effect on morbidity and mortality ( $P=0.14$ )

Growth Performance - Start-Week 8



Morb. & Mort. - Start-Week 8



# SUPPLEMENTAL NUTRITION (SCHMITT ET AL., 2018)

- Objective: Effects of administration of an electrolyte-based supplement on growth performance and morb. and mortality
- Exp. Design: RCBD with a 2 x 5 Factorial
  - Main effects
- Treatments:
  - Control (Std. Nursery 1)
  - As Control + NDL Electrolytes
- Study Details:
  - Replicates: 64 (main effects)
  - Pigs/pen: 72
  - Pigs/trt: 4608
  - Pigs total: 9,216
  - Start wt: kg ( lb)
  - Floor space: 3.2 ft<sup>2</sup>
  - January 2017

Schmitt et al., 2018

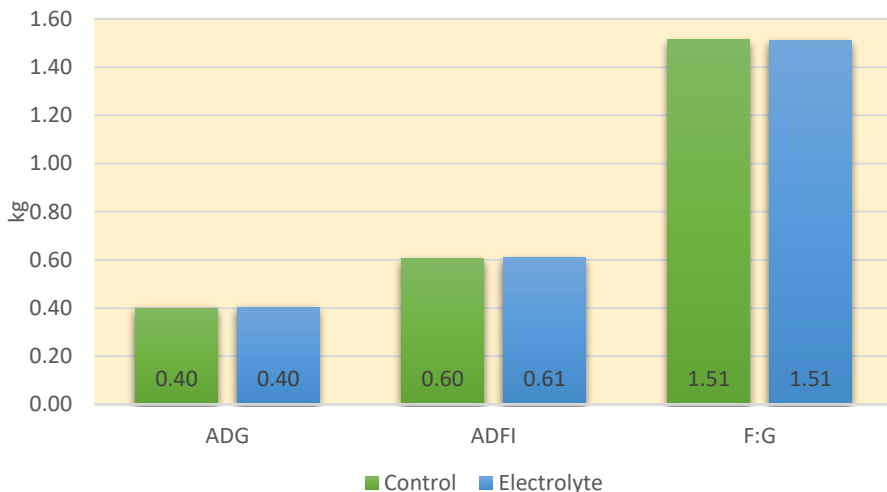
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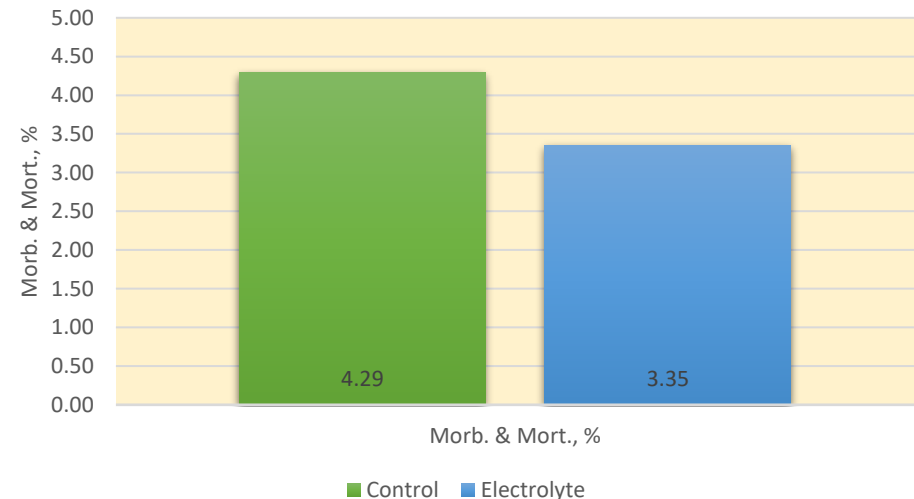
# SUPPLEMENTAL NUTRITION (SCHMITT ET AL., 2018)

- No effect on growth performance
- Morbidity and mortality were reduced ( $P=0.02$ ) for NDL (Electrolyte) compared to pigs on Control treatment

### Growth Performance - Start-Week 6/8



### Morb. & Mort. - Start-Week 6/8



# HOW MANY TRIALS ARE NEEDED?

- Value in conducting trials **multiple** times
- Understand **range of outcomes**
  - Different groups (sow farm **source**)
  - Healthy vs. **challenged**
  - Time of year (i.e. heat **stress**)
  - **Field factors** that amplify or undermine response
  - **Translatable** to operations



# NUTRITIONAL INTERVENTIONS IMPACT ON MORBIDITY & MORTALITY

- Conclusions
  - Not all studies showed significant effect from treatment
  - Aggregating the different data sets allows one to identify biologically important effects
  - Growth performance does not necessarily translate in improvement in morbidity and mortality
- In-practice
  - Understanding costs of implementation and marginal economic value
  - Success relies on the execution level on the field
  - Simplification of protocol will improve buy-in
  - System logistics will dictate preference over which intervention becomes feasible







*Progressive Farming. Family Style.*

Omarh Mendoza

[omarh.mendoza@pigsrus.net](mailto:omarh.mendoza@pigsrus.net)