

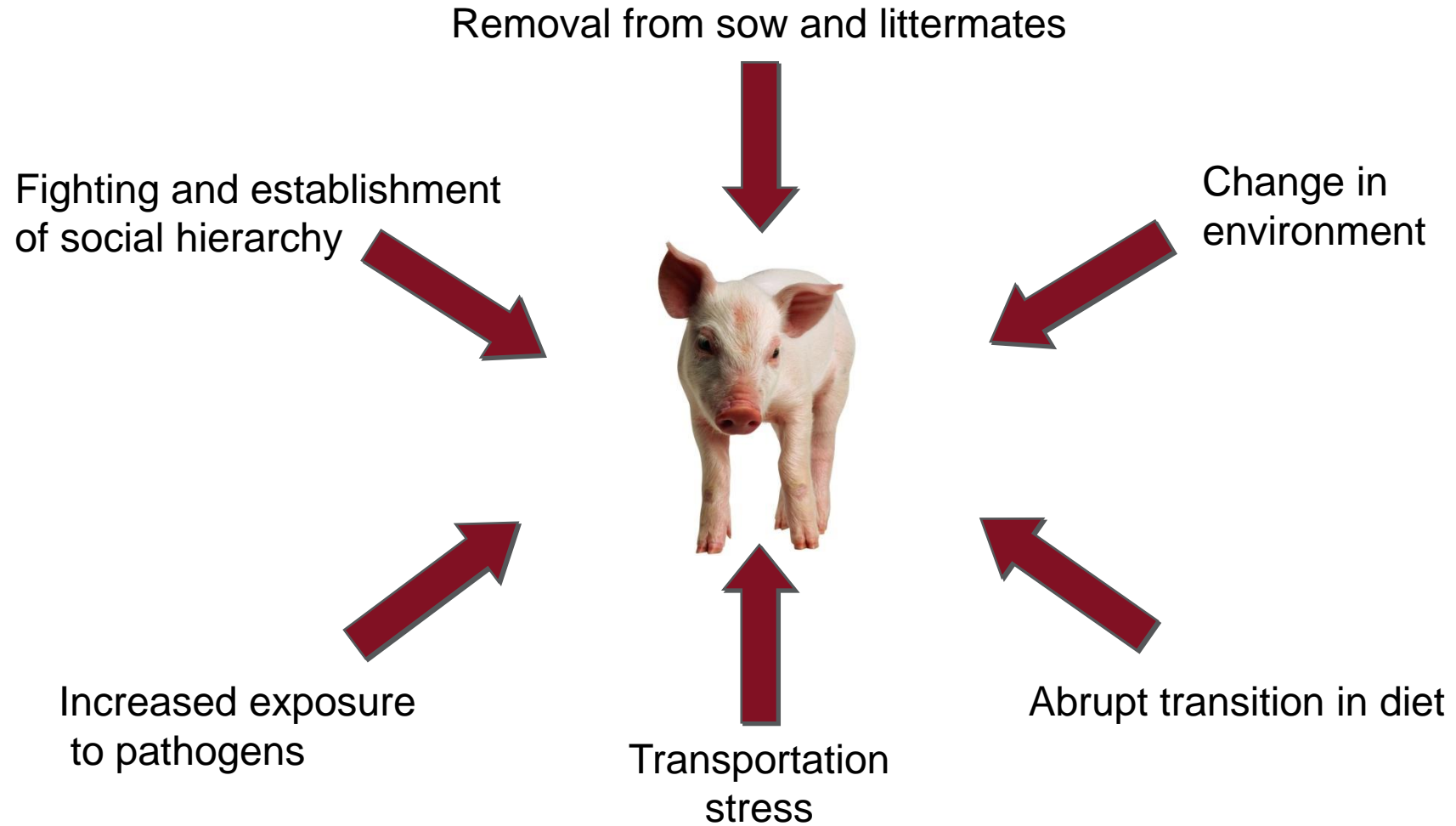


GROWING PIGS WITHOUT ZINC OXIDE: A NUTRITIONAL VIEWPOINT

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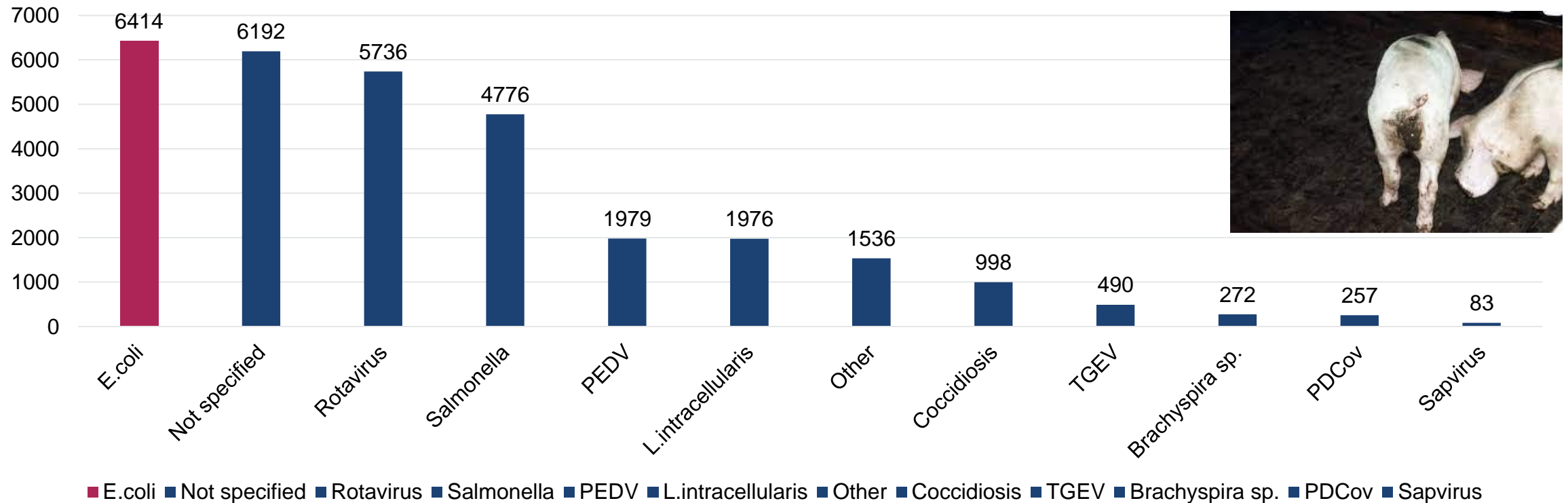


WEANING STRESS



E. COLI IS THE MAIN CAUSE OF POST WEANING DIARRRHEA

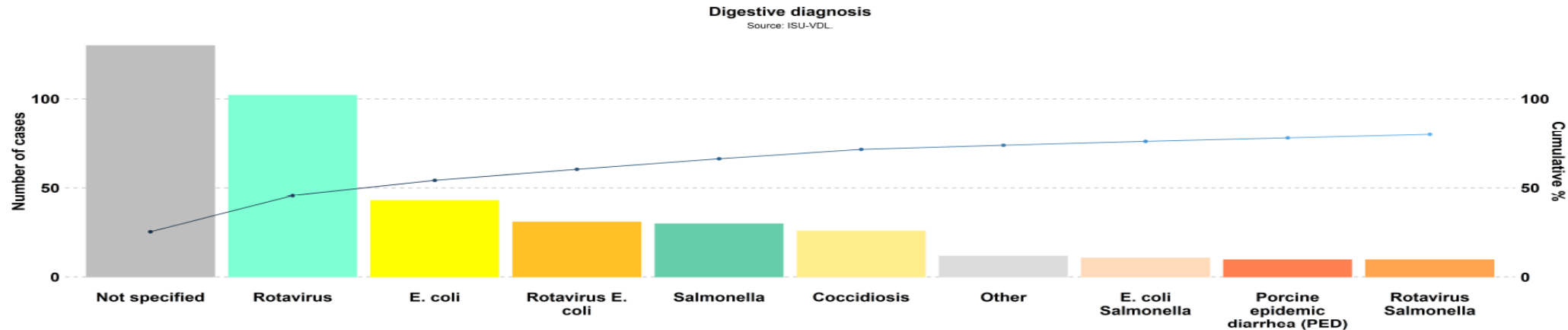
Causes of post weaning diarrhea diagnosed at ISU VDL from 2007 - 2022



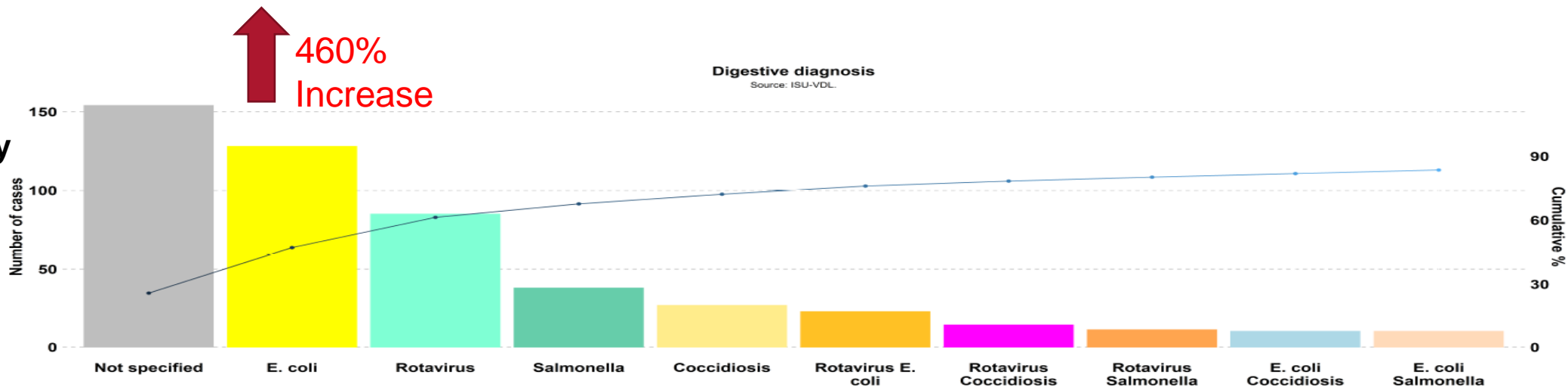
KSU Swine day. 2022 Data Courtesy of Dr. Almeida ISU VDL

RESURGENCE OF NURSERY *E. COLI* IN US

2020
June 1 to July
19, 49 days



2021
June 1 to July
3, 33 days



SDRS report # 30 and 42.

E. COLI IN EU PIG FARMS

- The EU 2020 zoonosis report suggested 42.4% positive farms (85 samples), but were data from only 2 MS. The 2021 report, indicated 11.8% but the data was reported from only 1 MS and from 51 samples...
- The Spanish zoonosis report did not collect porcine samples for analysis in 2020 and 2021....

Table 42: Summary of STEC statistics related to major animal species in reporting EU MS, 2020

Animals	N of reporting countries	N of tested animals	Positive animals	
			N	%
Cattle	3	678	35	5.2
Goat and sheep	2	37	3	8.1
Other animals	3	572	18	3.1
Other ruminants ^(a)	1	197	7	3.6
Pigs	2	85	36	42.4
Total	5	1,569	99	6.3

MS: Member State; STEC: Shiga toxin-producing *Escherichia coli*.

(a): Other ruminants includes Cantabrian chamois, deer and water buffalos.

Table 41: Summary of STEC statistics related to major animal species, reporting EU MSs, 2021

Animals	N reporting MSs	N tested sampling units	Positive sampling units	
			N	%
Cattle	5	3,316	195	5.9
Sheep and goats	1	48	7	14.6
Other ruminants ^(a)	2	121	1	0.83
Pigs	1	51	6	11.8
Other animals/not specified	2	210	20	9.6
Total	7	3,746	229	6.1

MSs: Member States; STEC: Shiga toxin-producing *Escherichia coli*.

(a): Other ruminants include Cantabrian chamois, deer and water buffalos.

EU One Health Zoonoses Report 2020, 2021

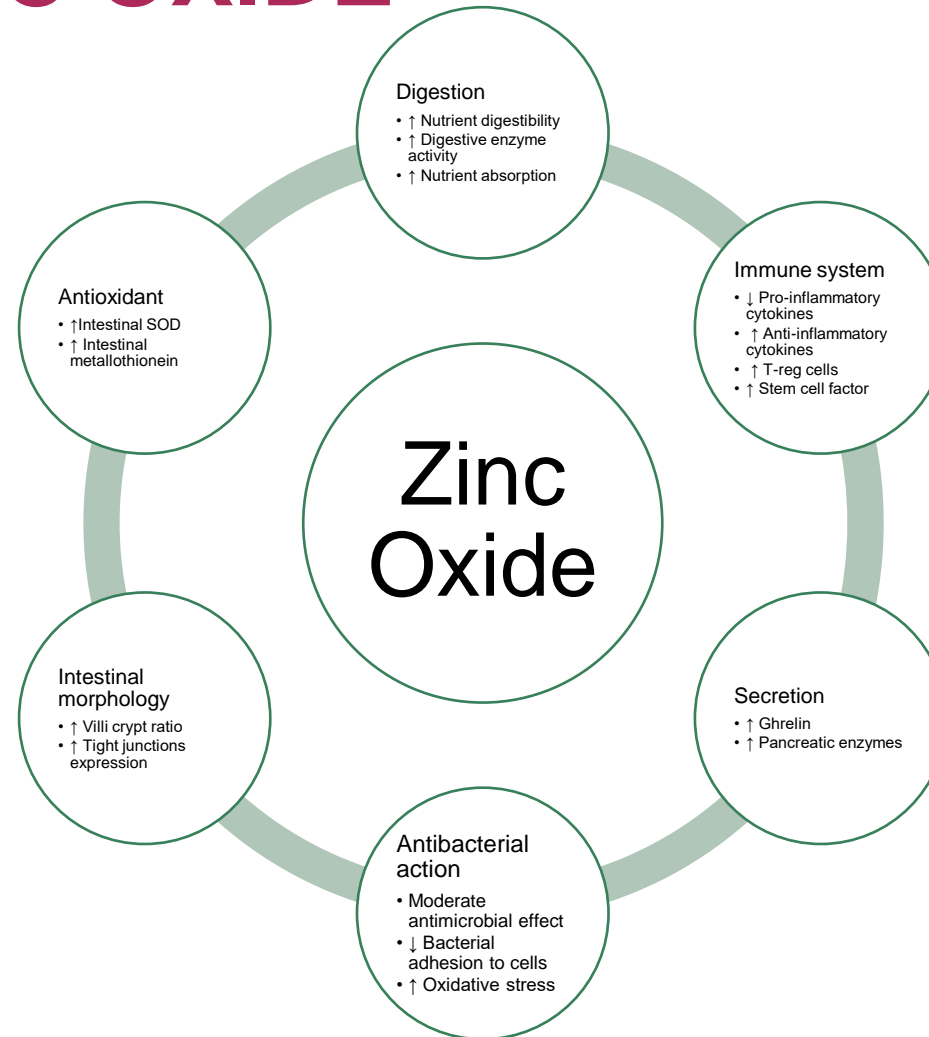
WHY IS IT REEMERGING? GENETIC OF PIGS

- Synthetic Boar Line being phased out
- Duroc being phased in
- Suspicious that E.coli related scour coincided with adaptation of pure Duroc Boar Line.
- Increased usage of stress resistant Duroc lines may be a contributing factor.



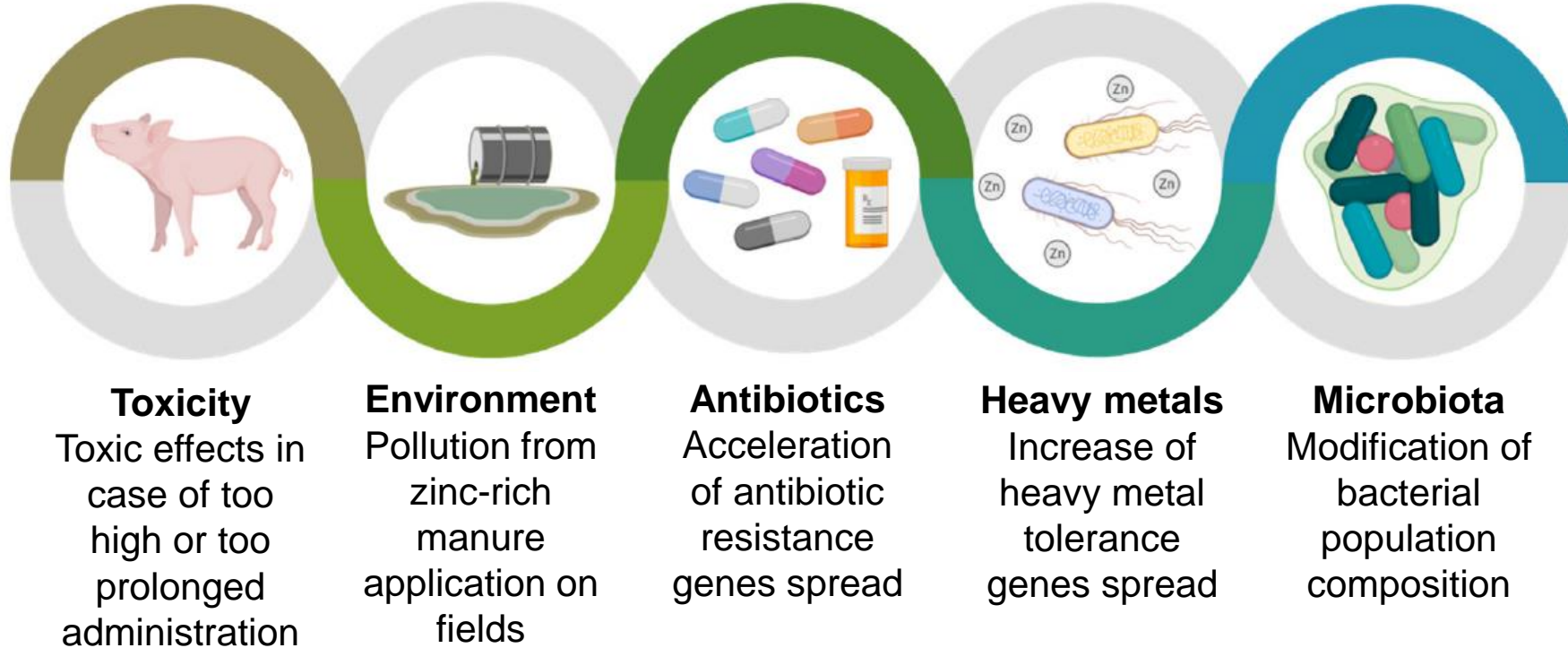
Gerhart, et al. 2022. Large Scale Practical Nutrition Research Sharing: Feeding the E. coli Challenged Pig: What We Have Learned to Date. Midwest ASAS.

MODE OF ACTION OF PHARMACOLOGICAL LEVELS OF ZINC OXIDE



Bonetti et al., 2021. Towards Zero Zinc Oxide: Feeding Strategies to Manage Post-Weaning Diarrhea in Piglets. *Animals*, 11, 6

RISK ASSOCIATED WITH THE USE OF PHARMACOLOGICAL LEVELS OF ZNO



Bonetti et al., 2021. Towards Zero Zinc Oxide: Feeding Strategies to Manage Post-Weaning Diarrhea in Piglets. *Animals*, 11, 6

EU ZNO BAN IMPACT ON GUT HEALTH

- EU has banned therapeutic use of Zinc Oxide.
- Post weaning diarrhea and edema disease caused by E.coli regain industrial attention.
- Reduction of ZnO may increase the clinical affection of Edema disease (Uemura et al, 2017).
- More than 50% of surveyed farm in EU are verotoxin gene positive farm, which means pigs are susceptible for edema disease (Mette et al., 2022).

Uemura, et al. 2017. J. Vet. Med. Sci. & Mette et al, 2022. Zero Zinc Summit.

EU ZNO BAN IMPACT ON GUT HEALTH

EFFECT OBSERVED IN SPANISH SWINE PRODUCTION

- No official data on the effect of EU ban of therapeutic use of Zinc Oxide.
- Increase mortality around 3% at nursery
- EMA and other EU Member States have approved Zinc-EDTA chelate as medical treatment with 1000 ppm Zinc for weaning piglets
- Zinc-EDTA added in the water but not as additive (limited to 150 ppm)...
- However, this probably will not resolve the environmental problem associated with Zinc

PRINCIPLES FOR DIET COMPOSITION... WHEN FEEDING WITHOUT MEDICAL ZINC

Danish experiences:

- Heat treated cereals (min. 20%)
- Milk product (high quality)
- Blood plasma (2-5%)
- Fiber source (wheatbran, SBP, commercial products)
- Course grinding (max. 50% <1mm)
- Low-protein ($\approx 17,5\%$ CP)
- Low acid binding capacity
- Organic acids added to water (0,2%) & feed (1,5%)
- Extra free aminoacids (+30%)
- Extra vitaminization & organic iron og zinc

Everybody has an opinion
about whats right and wrong

ZZS Oral
presentations
& posters

Test of feed
concepts

SvineRådgivningen

WHAT TO EXPECT FROM ZNO ALTERNATIVES

- What is expected function of alternative?
- Does alternative sustain or improve pig performance or health compared to ZnO?
- Does alternative support intestinal digestive function and/or immune system response to benefit health?
- Is alternative shelf-stable and effective under variable feed processing conditions?
- Is alternative compatible with other ingredients in feed?
- Is the alternative supported by peer-reviewed research?

REVIEW ALTERNATIVES TO FEED PHARMACOLOGICAL LEVELS OF ZNO IN NURSERY PIGS

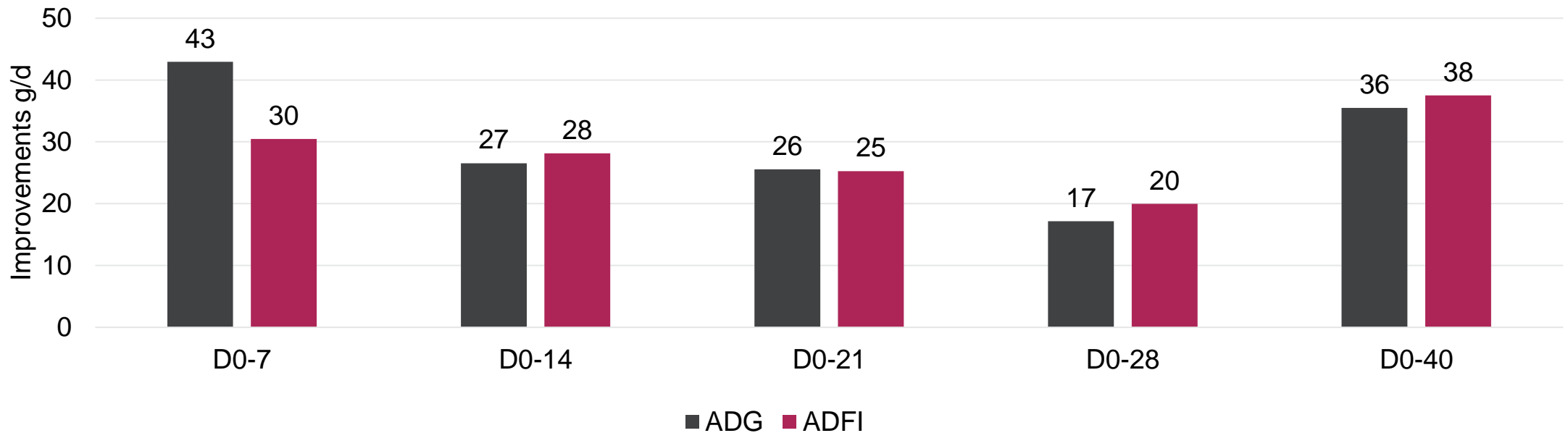
PERCENTAGE OF TRIALS REPORTING A SIGNIFICANT BENEFIT ON PIG PERFORMANCE					
ALTERNATIVE	TRIALS	ADG	ADFI	G:F	SURVIVAL
Direct-fed microbials	311	39.9	12.9	25.7	4.8
Organic acids	151	31.8	12.6	17.9	6.6
Yeast	98	23.5	12.2	11.2	1.0
Botanicals	365	23.3	9.3	16.4	0.8
Oligosaccharides	92	18.5	8.7	20.7	2.2
Prebiotics	99	11.1	6.6	9.1	0.0
Starch/fiber	281	8.9	7.8	6.8	1.4

If specialty proteins (plasma, soy isolate, etc.) were also in feed they had a profound impact on efficacy of the alternatives

Adapted from Gabler and Schweer, 2017 Minnesota Nutr. Conf.

REVIEW OF ALTERNATIVE TO FEED ZNO FOR NURSERY PIGS. PLASMA FUNCTIONAL PROTEIN EFFECT ON NURSERY PERFORMANCE

META-ANALYSIS REVIEW INCLUDING 135 PUBLICATIONS



Meta-analysis of growth performance improvements in nursery pigs in the first 40 days post weaning

Balan et al., 2020 – Effects of spray-dried animal plasma on the growth of weaned piglets – A review. J anim Physiol Anim Nutr. 2021;105-699-714

CHALLENGE STUDIES WITH E. COLI

PIGS FED SDP VS CONTROL

ETEC CHALLENGE	SDP IMPACT	AUTHOR
E. Coli, F18	↑ ADG, ↓ diarrhea	Borg et al. 1999
E. coli, K88	↑ ADG, ↓ mortality	Bosi et al. 2004
E. coli, K88	↑ ADG, ↓ Inflammation	Bosi et al. 2001
E. Coli, K99	↑ ADG	Torrallardona et al. 2007
E. coli, K99	↑ ADG	Campbell et al. 2001
E. coli, K99	↑ ADG, lactobacilli	Torrallordona et al. 2003
E. coli, F18	↓ diarrhea	Nollet et al. 1999
E. coli, O139:K82	↑ ADG, ↓ diarrhea	Van Dijk et al. 2002
E. coli, K88	↓ diarrhea, ↓ shedding	Owusu-Asiedu et al. 2003

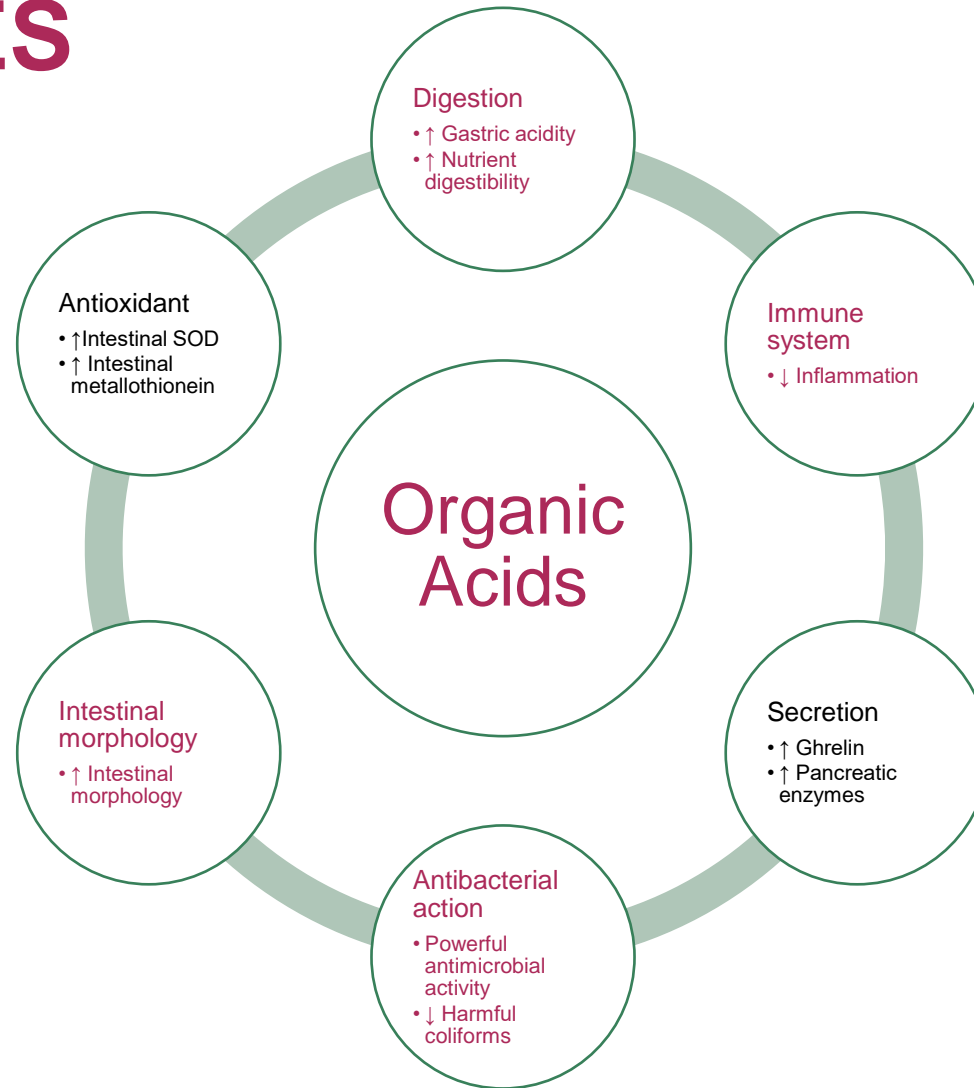
ADVANTAGES AND DISADVANTAGES OF ZNO ALTERNATIVES

DIETS FORMULATION

ZNO FEEDING ALTERNATIVES	ADVANTAGES	DISADVANTAGES
Low protein diets	<ul style="list-style-type: none">↓ Proteolytic bacteria population↓ Pathogenic <i>E. coli</i>↓ PWD symptoms↓ Pro-inflammatory cytokines	<ul style="list-style-type: none">↓ Pig productivity
High fiber diets	<ul style="list-style-type: none">↓ PWD symptoms↓ <i>E. coli</i> shedding↓ <i>E. coli</i> adhesion↑ SCFA production in digesta↓ Retention time of digesta	<ul style="list-style-type: none">Few comparisons with pharmacological ZnO

Bonetti et al., 2021. Towards Zero Zinc Oxide: Feeding Strategies to Manage Post-Weaning Diarrhea in Piglets. *Animals*, 11, 6

ADVANTAGES AND DISSADVANTAGES OF ZNO ALTERNATIVES

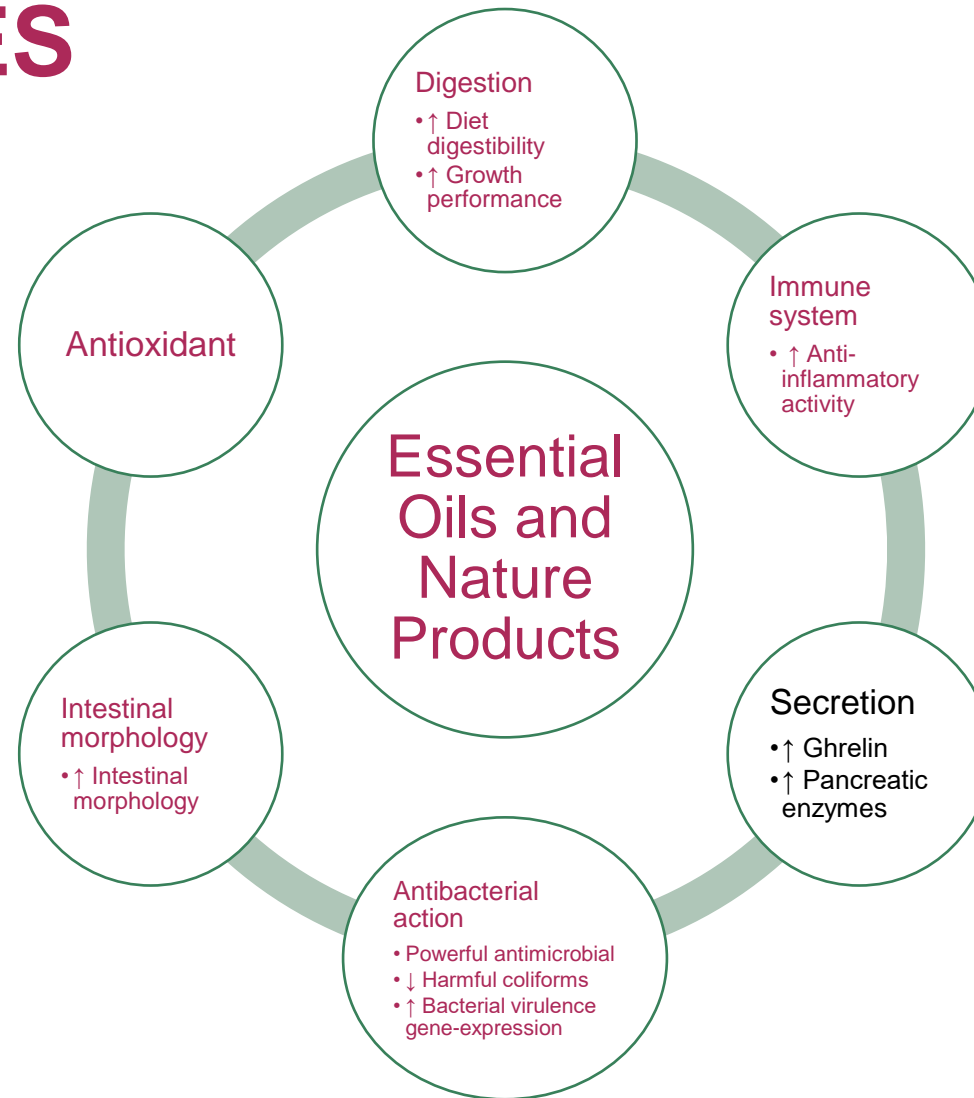


Disadvantages

- Lack of comparison with pharmacological ZNO
- Different activities between acids

Bonetti et al., 2021. Towards Zero Zinc Oxide: Feeding Strategies to Manage Post-Weaning Diarrhea in Piglets. *Animals*, 11, 6

ADVANTAGES AND DISSADVANTAGES OF ZNO ALTERNATIVES

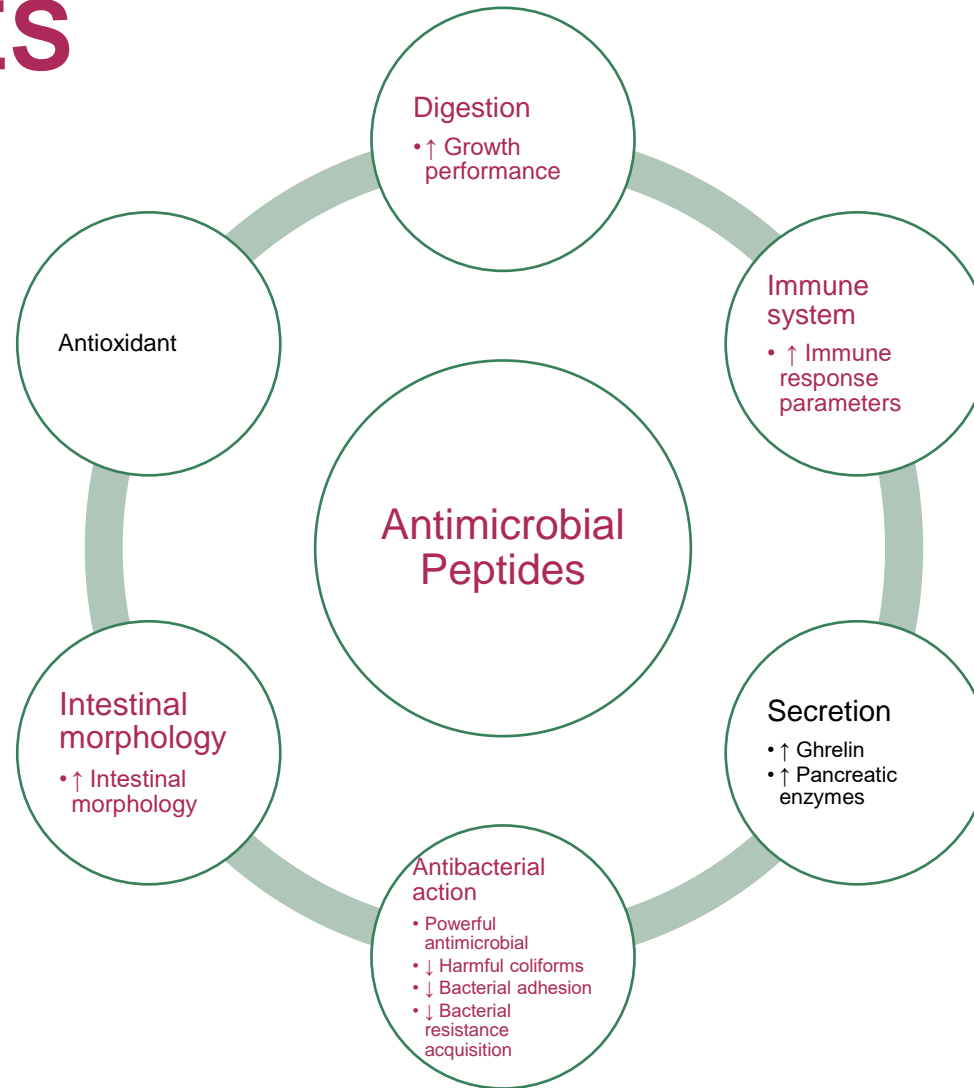


Disadvantages

- Lack of comparison with pharmacological ZNO
- High variability in efficacy among EO and Molecules

Bonetti et al., 2021. Towards Zero Zinc Oxide: Feeding Strategies to Manage Post-Weaning Diarrhea in Piglets. *Animals*, 11, 6

ADVANTAGES AND DISSADVANTAGES OF ZNO ALTERNATIVES

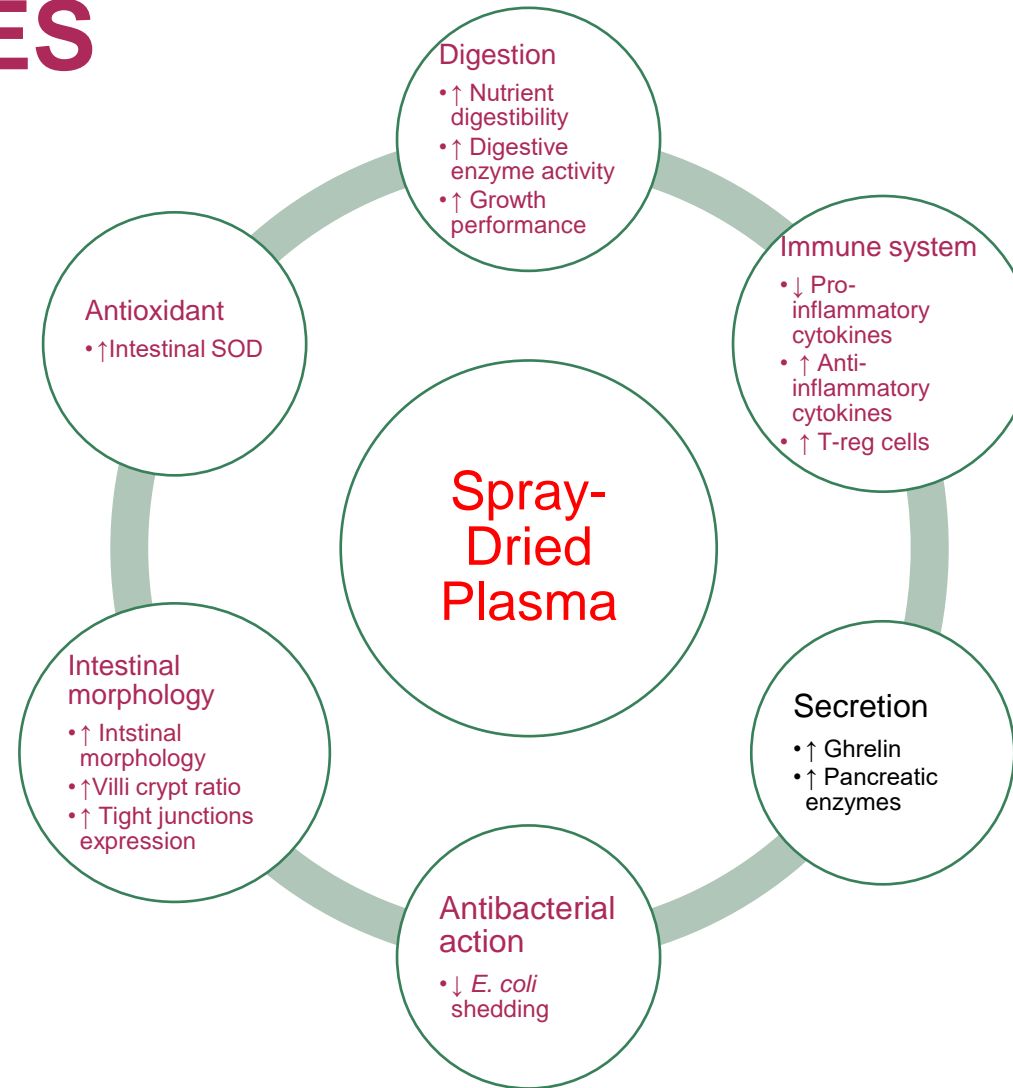


Disadvantages

- Lack of comparison with pharmacological ZNO
- Need to investigate AMP pharmacokinetics

Bonetti et al., 2021. Towards Zero Zinc Oxide: Feeding Strategies to Manage Post-Weaning Diarrhea in Piglets. *Animals*, 11, 6

ADVANTAGES AND DISSADVANTAGES OF ZNO ALTERNATIVES



Disadvantages
- Costly ingredient

Bonetti et al., 2021. Towards Zero Zinc Oxide: Feeding Strategies to Manage Post-Weaning Diarrhea in Piglets. *Animals*, 11, 6

HOLISTIC APPROACH TO REPLACE ZINC OXIDE

SEGES INSTITUTE RECOMMENDATION TO REPLACE HIGH LEVELS ZNO

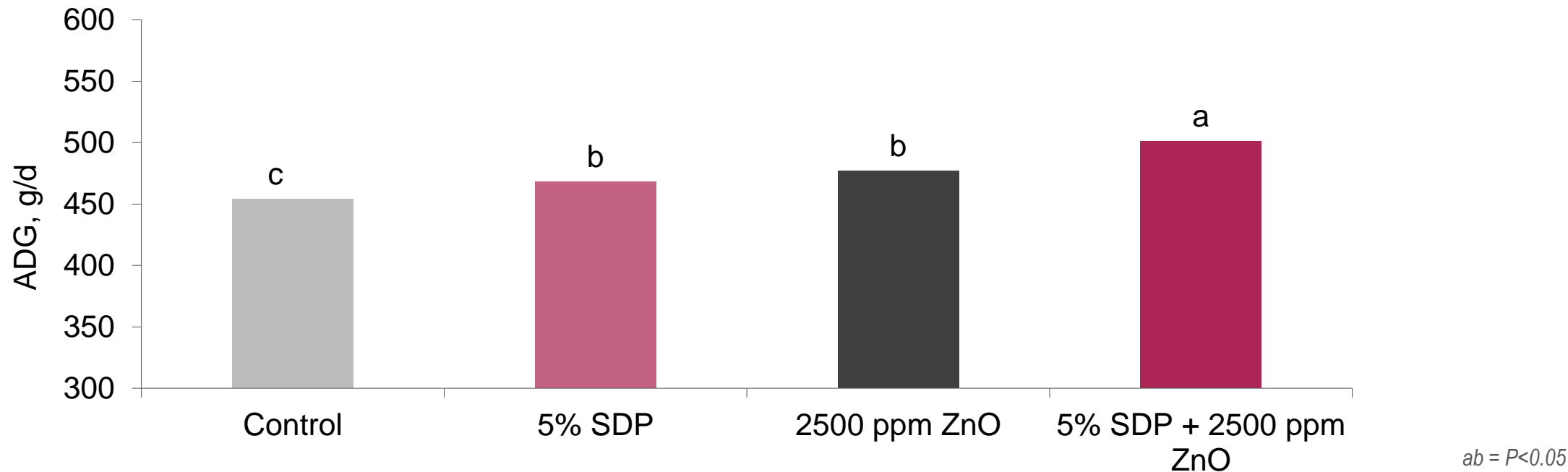
- SEGES Danish Feed Research Centre recently provide recommendations to Danish farmers for weaning diets formulation in absence of high level of ZnO
- Use of high-quality proteins, organic acids and synthetic amino acids
- Use of SDPP is recommended for weaning pigs with BW < 7Kg.

MIX	1	2	3
Weaning Weight	4-6	5-7	7-8
Supplemental Amino Acids	+5%	+5%	0
Plasma, %	5	5	0
Barley, %	20	20	20
Potato Protein, %	3-4	3-4	3-4
Soy Meal, %	0	2	7
SPC %	As per LCF Optimization	LCF Optimized	LCF Optimized
Whey Protein (lactose)	9	6	3
Lysine	L-Lysine HCL	L-Lysine HCL	L-Lysine HCL
Benzoic Acid, %	0.5	0.5	0.5
Calcium Formate, %	1	1	1
Minerals	Standard	Standard	Standard
Supplemental Vitamins	Standard	Standard	Standard

<https://landbrugsavisen.dk/svin/her-er-tre-seges-bud-p%C3%A5-zinkfrit-frav%C3%A6nningsofoder>

EVALUATION OF SDP VS ZINC OXIDE

WEANED PIGS



Both, SDP and ZnO improves growth in comparison to the control group.
There was an additive effect when both products were used together

Danish Pig Production, 2009

CONCLUSIONS

ZNO REPLACEMENT ALTERNATIVES

- Zinc Oxide at pharmaceutical levels have multi-factorial and multi-target actions
- Alternatives require a combination of several strategies and tools to complement their different modes of action and targets synergistically
- Low protein diets, high fiber content, use of organic acids, essential oils and functional proteins like spray-dried plasma should be part of the solution

SWINE



THANK YOU

FOR MORE INFORMATION, CONTACT OUR TECHNICAL SERVICES TEAM



WATCH THEM *thrive*

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