2023
GREECE
May 31 - June 2

ESPHM
14th EUROPEAN SYMPOSIUM
OF PORCINE HEALTH MANAGEMENT

Thessaloniki
Greece

NO ZINC, FEWER ANTIBIOTICS, STILL K88

EXPLORING THE OPTIONS TO MITIGATE THE HARM OF *E. COLI* K88 ON WEANER PIGS

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INTRODUCTION - PIG HEALTH MANAGEMENT

- Pressure to reduce antibiotic usage
- Recent EU zinc oxide ban
- Alternative strategies to manage piglet health are needed
- Newly developed multi-strain probiotic product, targeting *C. perfringens* and *Enterobacteriaceae (E. coli* and *Salmonella)*

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INTRODUCTION - *E. COLI* IN PIGS

- Enterotoxigenic *Escherichia coli*: ETEC
- Most common cause of post weaning diarrhea (PWD)
- Mostly ETEC with fimbria F18 and F4 (K88)
- Prevention needed to maintain growth performance and pig welfare

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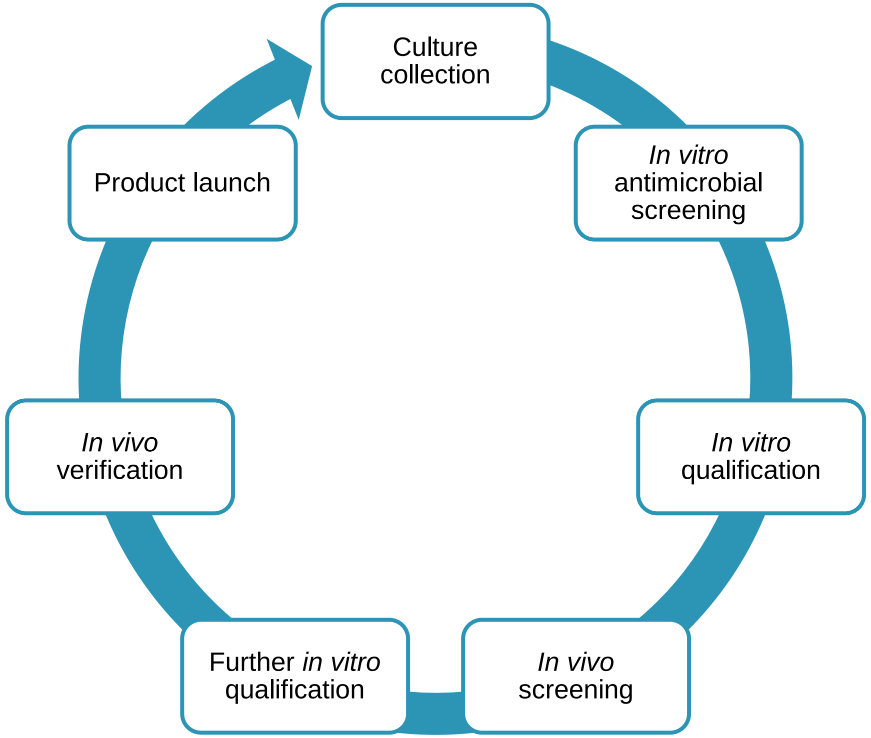
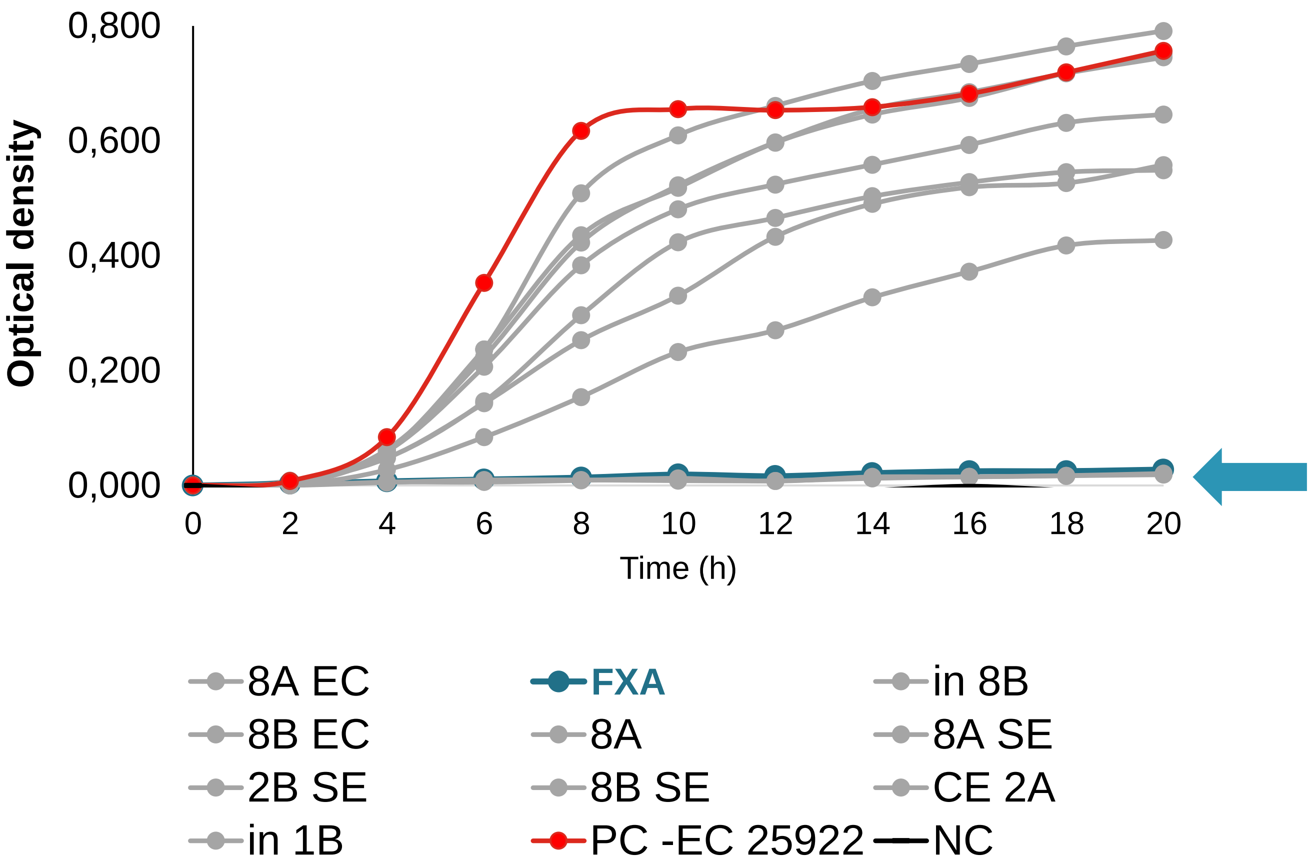
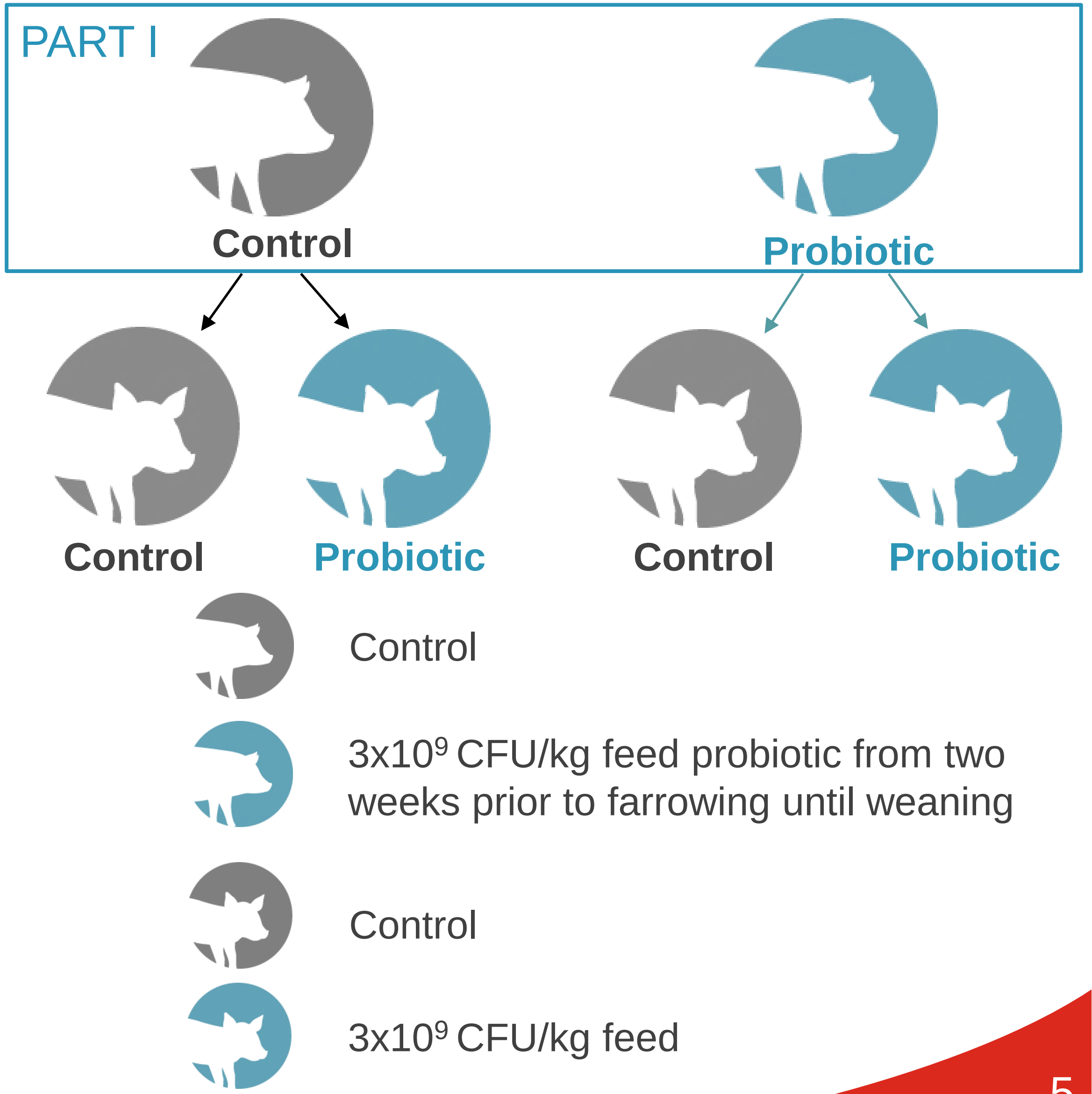
INTRODUCTION - NEW PROBIOTIC DEVELOPMENT





MATERIAL AND METHODS - SOW PIGLET TRIAL PART I

- Dankook University, South Korea
- Part I: SOW TRIAL
  - 20 Landrace x Yorkshire sows, parities 1 to 4 (average 3.4), mated with Duroc boars
  - Split in 2 groups, housed in farrowing crates from 2 weeks prior to farrowing until weaning at 21 days
  - Corn-soybean meal based diet
  - Probiotic: *Bacillus* spp. ATCC PTA-6737, PTA-127113, PTA-127114
  - Analyses: nutrient digestibility sows (chromium oxide marker), performance sows and piglets
- PART II: PIGLET TRIAL



RESULTS PART I - SOW PERFORMANCE

Control

Probiotic

The effect of Probiotic on nutrient digestibility (%) during lactation			
Nutrient	Control	Probiotic	SEM*
Dry matter	61.65^{b}	63.45^{a}	1.89
Nitrogen	60.30^{b}	61.49^{a}	0.32
Energy	61.49^{b}	62.85^{a}	0.30

* Standard error of the mean; ^{a,b} Means in rows with different superscripts differ significantly ($P<0.05$)

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RESULTS PART I - PRE-WEANING PIGLET PERFORMANCE

Growth performance of suckling piglets			
Parameter	Control	Probiotic	SEM*
Total pigs born alive	11.1	11.6	0.10
Pigs weaned	10.7	11.3	0.20
% survival during 21-day lactation	96.4	97.4	1.76
Average body weight (kg)			
Birth	1.51	1.55	0.02
Weaning	6.07[b]	6.42[a]	0.07
Average daily gain (g)	216[b]	231[a]	3
Average daily feed intake during 21d lactation period (g)	72.7	72.7	0.00

* Standard error of the mean; [a,b] Means in rows with different superscripts differ significantly ($P<0.05$)

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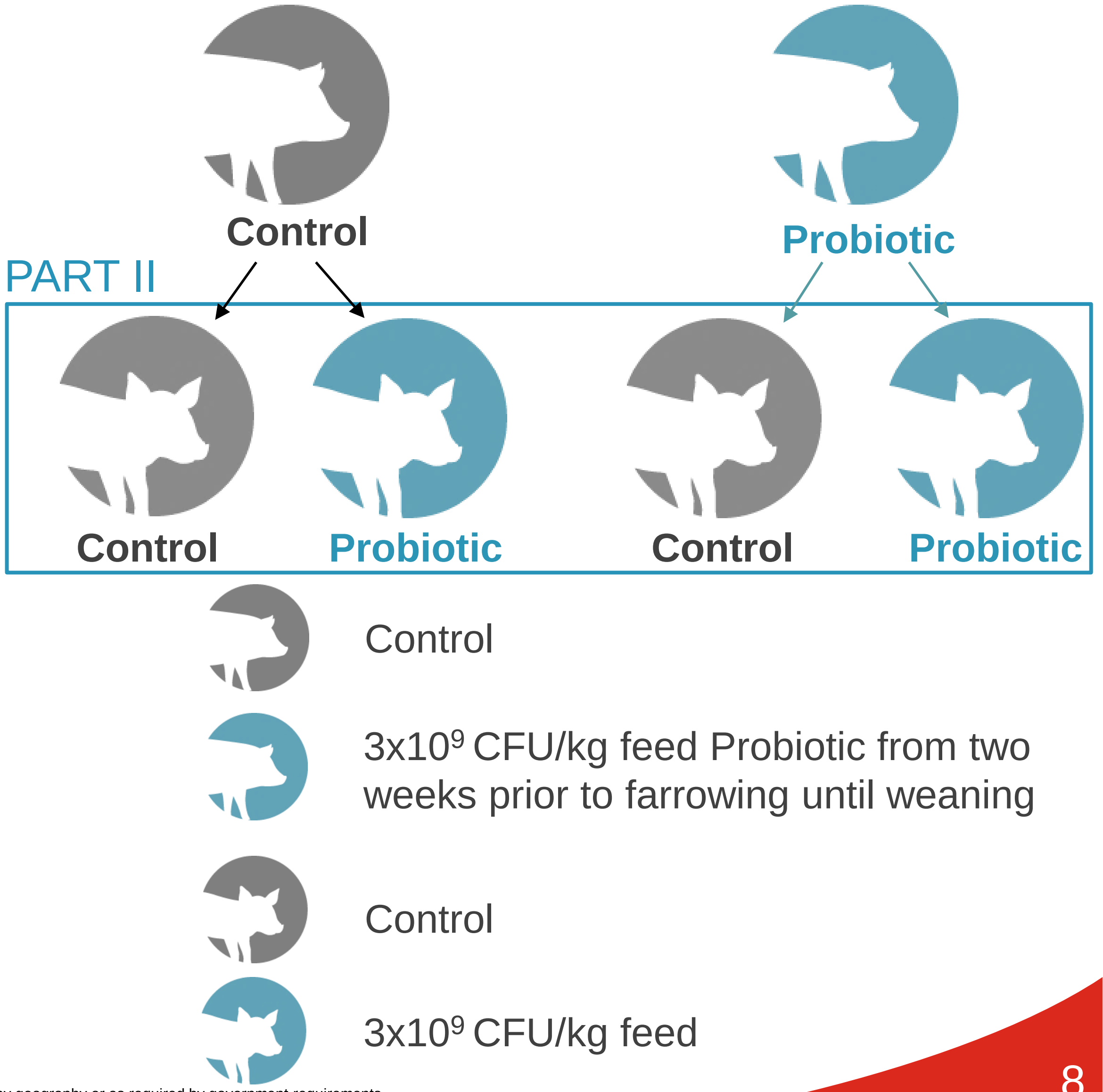
MATERIAL AND METHODS - SOW PIGLET TRIAL PART II

- Piglets from the different sows were assigned to 4 treatments at weaning (10 piglets/group) in a split-plot pattern
- Corn-soybean meal based diet
- Challenged 2 weeks after weaning: 1.5 mL of $1x10^3$ CFU/mL suspension *E.coli* K88
- Analyses
  - Performance until 9 weeks of age
  - Blood cytokine response (jugular vein prior to *E.coli* challenge and 24 h after: TNF-α, IL-6)
  - Fecal microbiota: sampling at last day of the study, DNA extraction and 16S rRNA sequencing



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RESULTS PART II - WITHOUT *E. COLI* CHALLENGE

Poster

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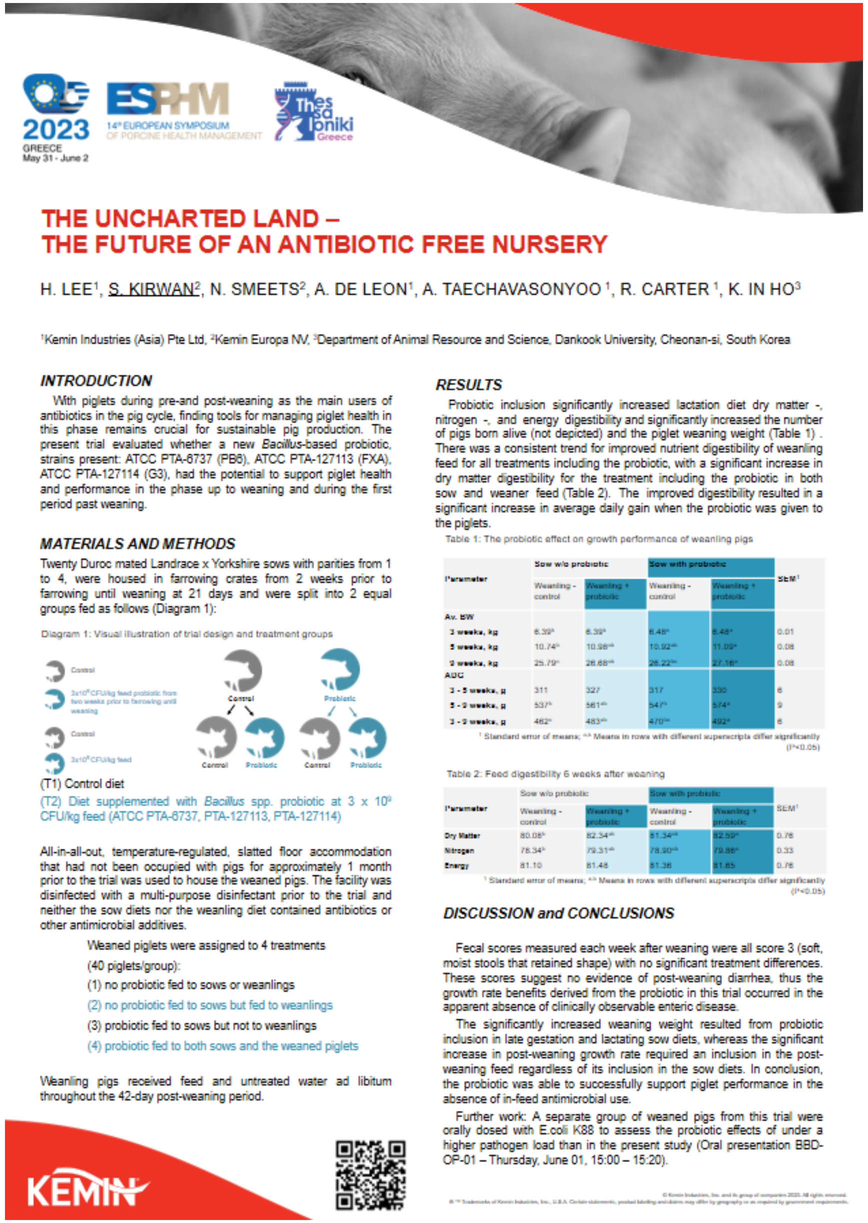

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THE UNCHARTED LAND – THE FUTURE OF AN ANTIBIOTIC FREE NURSERY

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INTRODUCTION

With piglets during pre-and post-weaning as the main users of antibiotics in the pig cycle, finding tools for managing piglet health in this phase remains crucial for sustainable pig production. The present trial evaluated whether a new *Bacillus*-based probiotic, strains present: ATCC PTA-6737 (PB6), ATCC PTA-127113 (FXA), ATCC PTA-127114 (G3), had the potential to support piglet health and performance in the phase up to weaning and during the first period past weaning.

MATERIALS AND METHODS

Twenty Duroc mated Landrace x Yorkshire sows with parities from 1 to 4, were housed in farrowing crates from 2 weeks prior to farrowing until weaning at 21 days and were split into 2 equal groups fed as follows (Diagram 1):

Diagram 1: Visual illustration of trial design and treatment groups

(T1) Control diet

(T2) Diet supplemented with *Bacillus* spp. probiotic at 3 x 10^9 CFU/kg feed (ATCC PTA-6737, PTA-127113, PTA-127114)

All-in-all-out, temperature-regulated, slatted floor accommodation that had not been occupied with pigs for approximately 1 month prior to the trial was used to house the weaned pigs. The facility was disinfected with a multi-purpose disinfectant prior to the trial and neither the sow diets nor the weanling diet contained antibiotics or other antimicrobial additives.

Weaned piglets were assigned to 4 treatments (40 piglets/group):

(1) no probiotic fed to sows or weanlings

(2) no probiotic fed to sows but fed to weanlings

(3) probiotic fed to sows but not to weanlings

(4) probiotic fed to both sows and the weaned piglets

Weanling pigs received feed and untreated water ad libitum throughout the 42-day post-weaning period.

RESULTS

Probiotic inclusion significantly increased lactation diet dry matter -, nitrogen -, and energy digestibility and significantly increased the number of pigs born alive (not depicted) and the piglet weaning weight (Table 1). There was a consistent trend for improved nutrient digestibility of weaning feed for all treatments including the probiotic, with a significant increase in dry matter digestibility for the treatment including the probiotic in both sow and weaner feed (Table 2). The improved digestibility resulted in a significant increase in average daily gain when the probiotic was given to the piglets.

Table 1: The probiotic effect on growth performance of weanling pigs

Parameter	Sow w/o probiotic		Sow with probiotic		SEM[1]
	Weaning - control	Weaning + probiotic	Weaning - control	Weaning + probiotic	
Av. BW					
3 weeks, kg	6.39^{b}	6.39^{b}	6.48^{a}	6.48^{a}	0.01
5 weeks, kg	10.74^{b}	10.98^{ab}	10.92^{ab}	11.09^{a}	0.08
9 weeks, kg	25.79^{c}	26.68^{ab}	26.22^{bc}	27.18^{a}	0.08
ADG					
3 - 5 weeks, g	311	327	317	330	6
5 - 9 weeks, g	537^{b}	561^{ab}	547^{b}	574^{a}	9
3 - 9 weeks, g	462^{c}	483^{ab}	470^{bc}	492^{a}	6

[1] Standard error of means; ^{a,b} Means in rows with different superscripts differ significantly ($P<0.05$)

Table 2: Feed digestibility 6 weeks after weaning

Parameter	Sow w/o probiotic		Sow with probiotic		SEM[1]
	Weaning - control	Weaning + probiotic	Weaning - control	Weaning + probiotic	
Dry Matter	80.08^{b}	82.34^{ab}	81.34^{ab}	82.59^{a}	0.76
Nitrogen	78.34^{b}	79.31^{ab}	78.90^{ab}	79.86^{a}	0.33
Energy	81.10	81.48	81.36	81.65	0.76

[1] Standard error of means; ^{a,b} Means in rows with different superscripts differ significantly ($P<0.05$)

DISCUSSION and CONCLUSIONS

Fecal scores measured each week after weaning were all score 3 (soft, moist stools that retained shape) with no significant treatment differences. These scores suggest no evidence of post-weaning diarrhea, thus the growth rate benefits derived from the probiotic in this trial occurred in the apparent absence of clinically observable enteric disease.

The significantly increased weaning weight resulted from probiotic inclusion in late gestation and lactating sow diets, whereas the significant increase in post-weaning growth rate required an inclusion in the post-weaning feed regardless of its inclusion in the sow diets. In conclusion, the probiotic was able to successfully support piglet performance in the absence of in-feed antimicrobial use.

Further work: A separate group of weaned pigs from this trial were orally dosed with E.coli K88 to assess the probiotic effects of under a higher pathogen load than in the present study (Oral presentation BBD-OP-01 – Thursday, June 01, 15:00 – 15:20).

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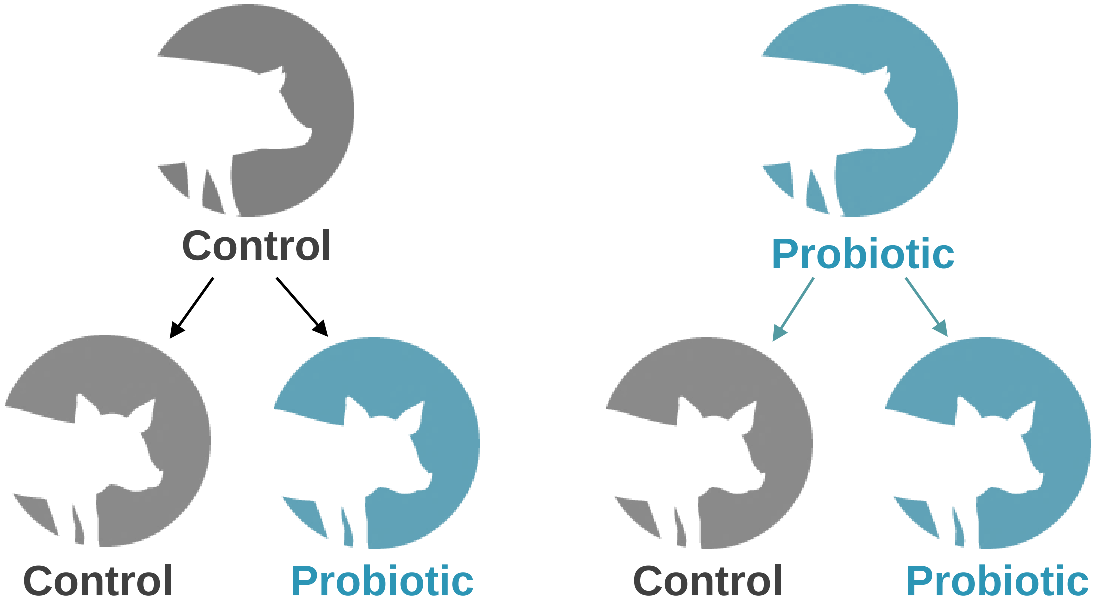

Control

3x10^9 CFU/kg feed Probiotic from two weeks prior to farrowing until weaning

Control

3x10^9 CFU/kg feed

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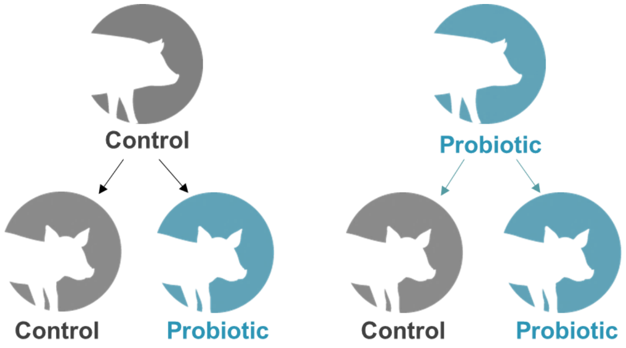
RESULTS PART II - PIGLET PERFORMANCE



Parameter	Sow w/o Probiotic		Sow with Probiotic		SEM*
	Weanling - Control	Weanling + Probiotic	Weanling - Control	Weanling + Probiotic	
Av. BW (kg)					
3 weeks	6.31	6.31	6.34	6.34	0.07
5 weeks	10.47	10.62	10.59	10.72	0.07
9 weeks	24.45^{c}	25.75^{ab}	25.09^{bc}	26.24^{a}	0.21
ADG (g)					
3 - 5 weeks	297	308	304	313	6
5 - 9 weeks	499^{b}	540^{ab}	518^{b}	554^{a}	10
3 - 9 weeks	432^{c}	463^{ab}	447^{bc}	474^{a}	5

* Standard error of the mean; ^{a,b} Means in rows with different superscripts differ significantly (P<0.05)

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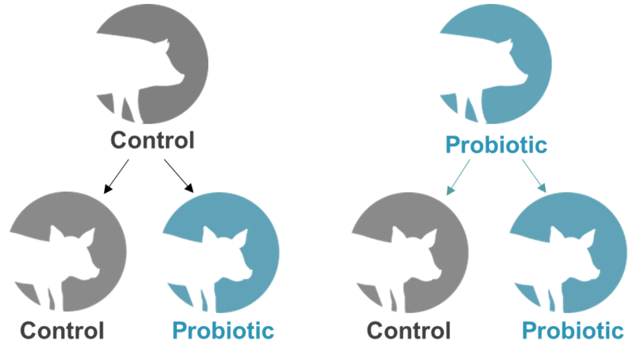
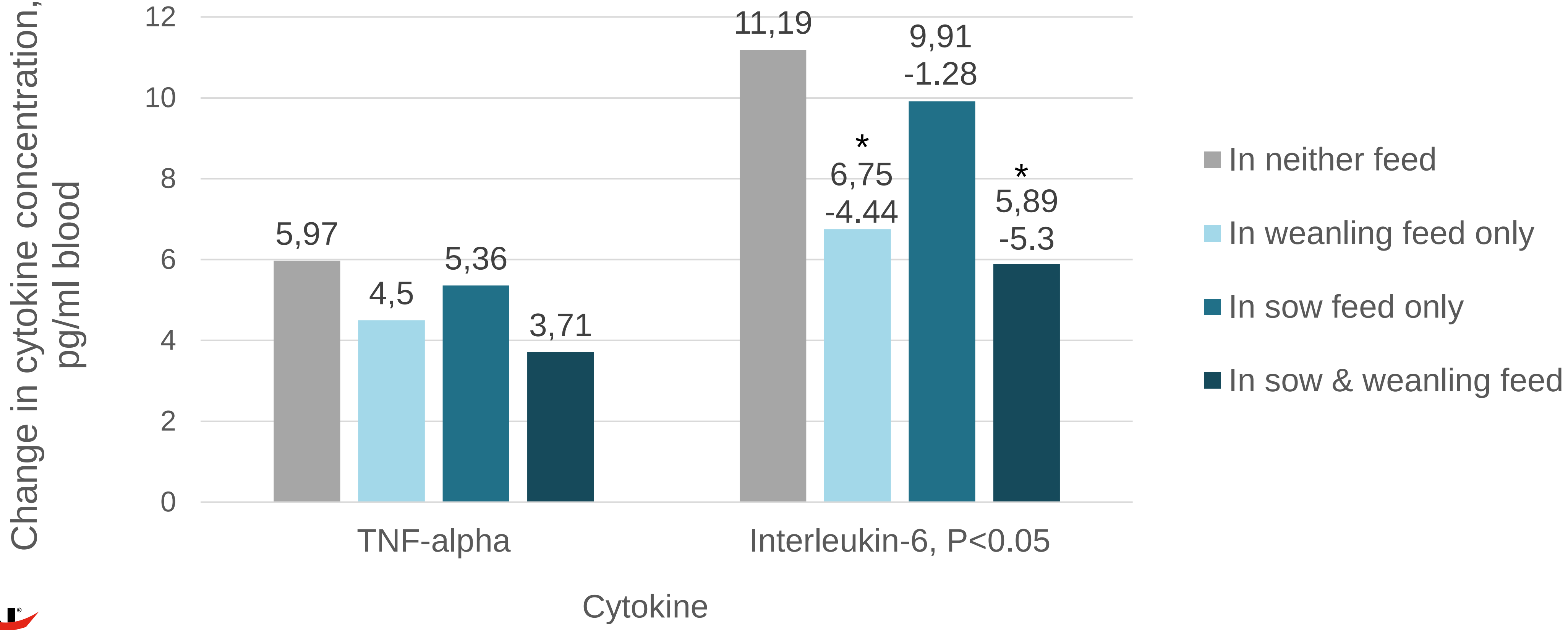
RESULTS PART II - BLOOD CYTOKINES





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* Indicates significant difference (P<0.05)

RESULTS PART II - MICROBIOME EFFECTS

- **No significant differences** for the Shannon's and Simpson's indices of diversity (Kruskal-Wallis, P>0.05)

- Pielou's evenness index showed **significantly higher uniformity of species** within the samples for the treatments that included the probiotic (Kruskal-Wallis, P<0.05) indicating good balance and stability of the microbiota.

Taxonomic distribution analysis showed a

- **Significantly lower** prevalence of ***Clostridia* and *Brachyspira*** in treatments that included the probiotic
- **Significantly higher *Lactobacilli*** prevalence for probiotic in sow feed

CONCLUSIONS

- ✓ Probiotic supplementation significantly enhanced nutrient digestibility in sows and increased piglet weaning weight
- ✓ Piglets born from probiotic supplemented sows showed higher performance when challenged with *E. coli* K88
- ✓ Production of pro-inflammatory cytokines was reduced in piglets born from probiotic supplemented sows and their microbiome was altered
- ✓ The observed changes in the sows and piglets indicate improved gut function and immune status when fed the newly developed probiotic product

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THANK YOU!

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