2022 13th EUROPEAN SYMPOSIUM OF PORCINE HEALTH MANAGEMENT

BUDAPEST • MAY 2022

FUTURE CHALLENGES AND NUTRITIONAL TOOLS TO RIDE THEM OFF

Ricardo Neto DVM

KEMIN INTESTINAL HEALTH

> “People don't like change. But make the change fast enough and you go from one type of normal to another”

Terry Pratchett

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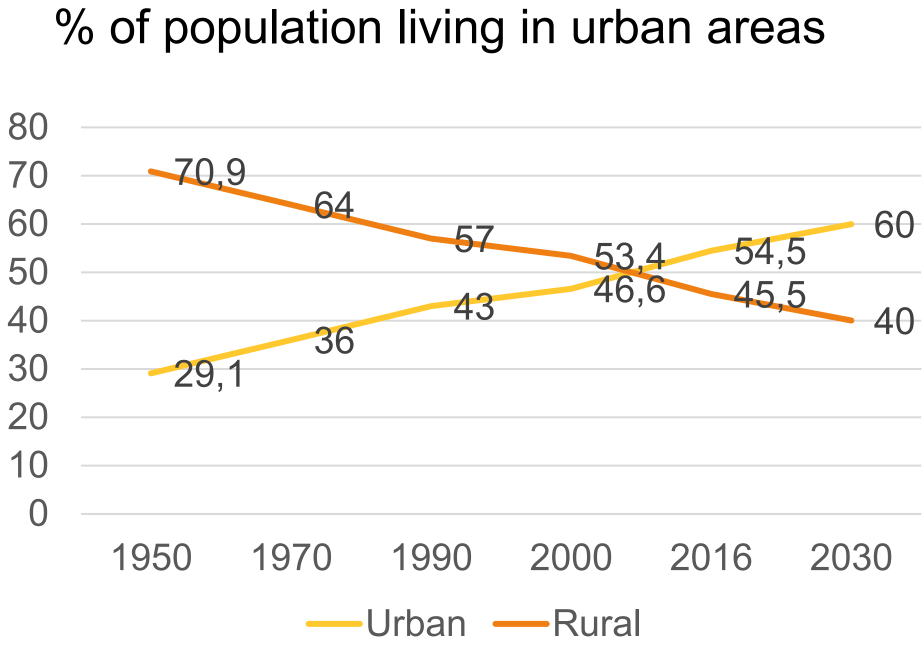
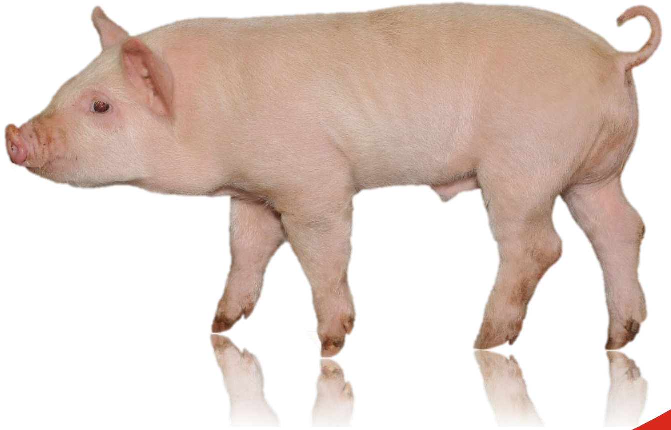
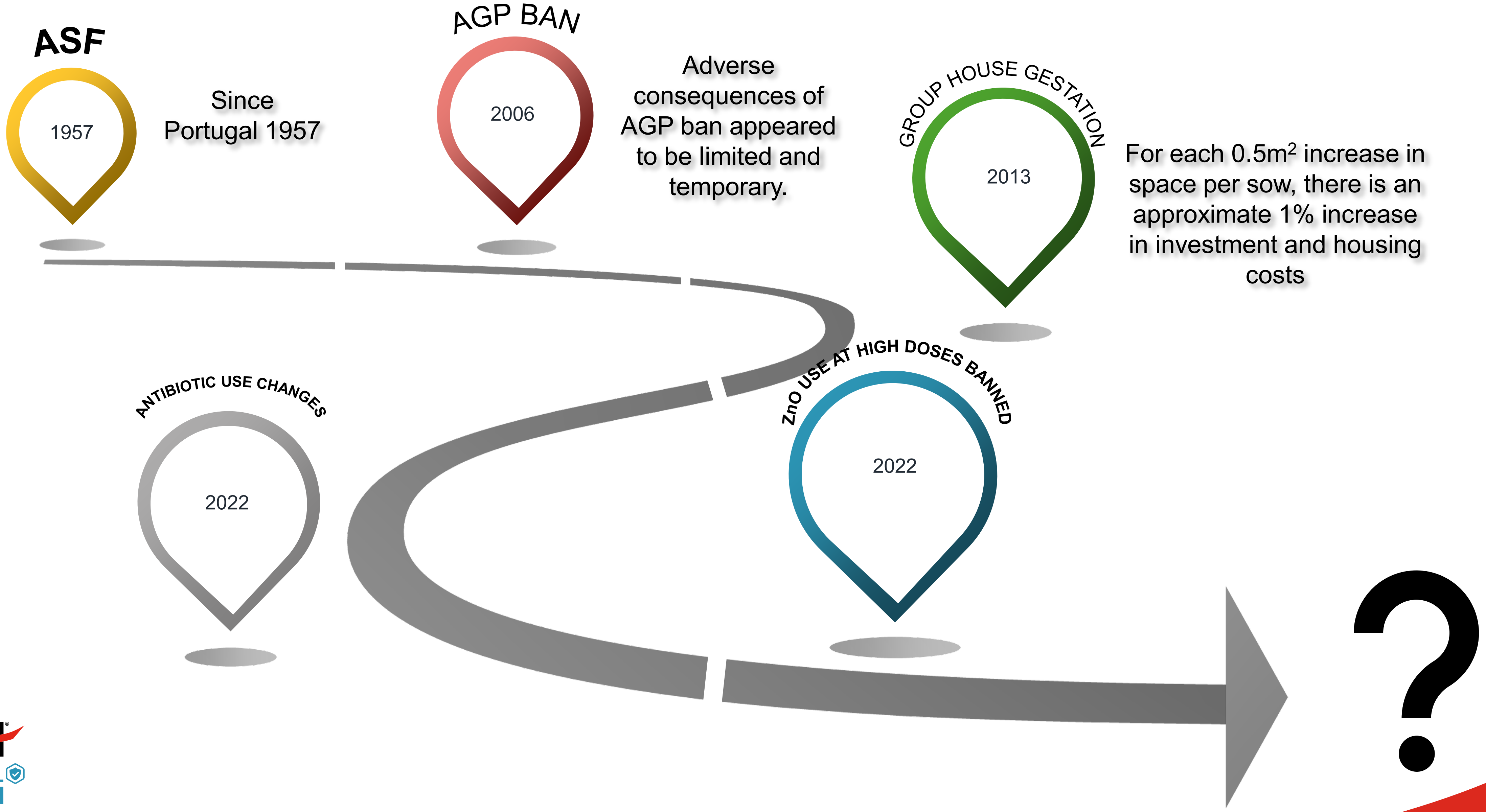
PIG PRODUCTION





PAST AND NEW CHALLENGES



Since Portugal 1957

Adverse consequences of AGP ban appeared to be limited and temporary.

For each 0.5m^2 increase in space per sow, there is an approximate 1% increase in investment and housing costs

> “Progress just means bad things happen faster”

Terry Pratchett

AND WITH PROGRESS...

- Feed growing population
- Urbanized society
- Welfare
- Antimicrobial use
- Sustainability
- New, emerging and re-emerging diseases
- Regulatory changes

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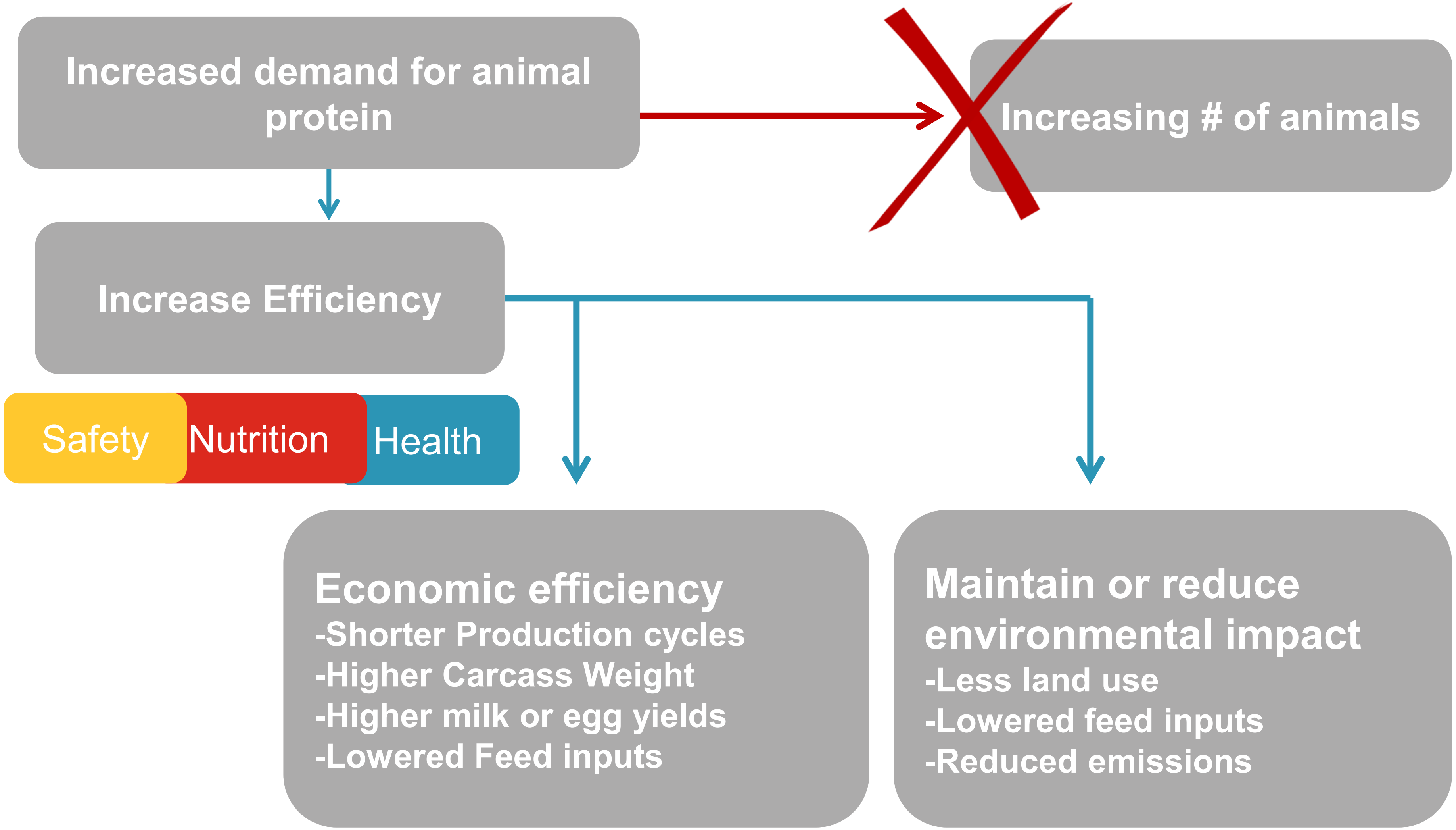
PIG PRODUCTION

DO MORE WITH LESS



Increased demand for animal protein

~~Increasing # of animals~~

Increase Efficiency

Safety Nutrition Health

Economic efficiency
-Shorter Production cycles
-Higher Carcass Weight
-Higher milk or egg yields
-Lowered Feed inputs

Maintain or reduce environmental impact
-Less land use
-Lowered feed inputs
-Reduced emissions

SEEING OUR FUTURE *SUSTAINABLY*

Companies producing animal protein should be committed to sustainability as the way to improve life today and for generations to come.

This commitment to sustainability can be applied using a model focused on people, the planet and our business.

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SUSTAINABILITY PILLARS

Healthy People

Empower employees, partners, customers and community members to contribute to a healthy future and improve life sustainably

Healthy Planet

Relentlessly and continuously manage sustainability and find ways to reduce environmental impact within operations

Healthy Business

Enable stakeholders to become more sustainable while innovating products and services that drive future transformation

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NEW CHALLENGES

Transferring the 3 pillars of sustainability to the pig industry:

Healthy People

- Quality of life
- Supply safe and high-quality protein

Healthy Planet

- Reduce the environmental impact of the pig farming industry
- Ensure resources are safeguarded for the coming generations

Healthy Business

- Profitable
- Driving changes ahead of consumer pressure

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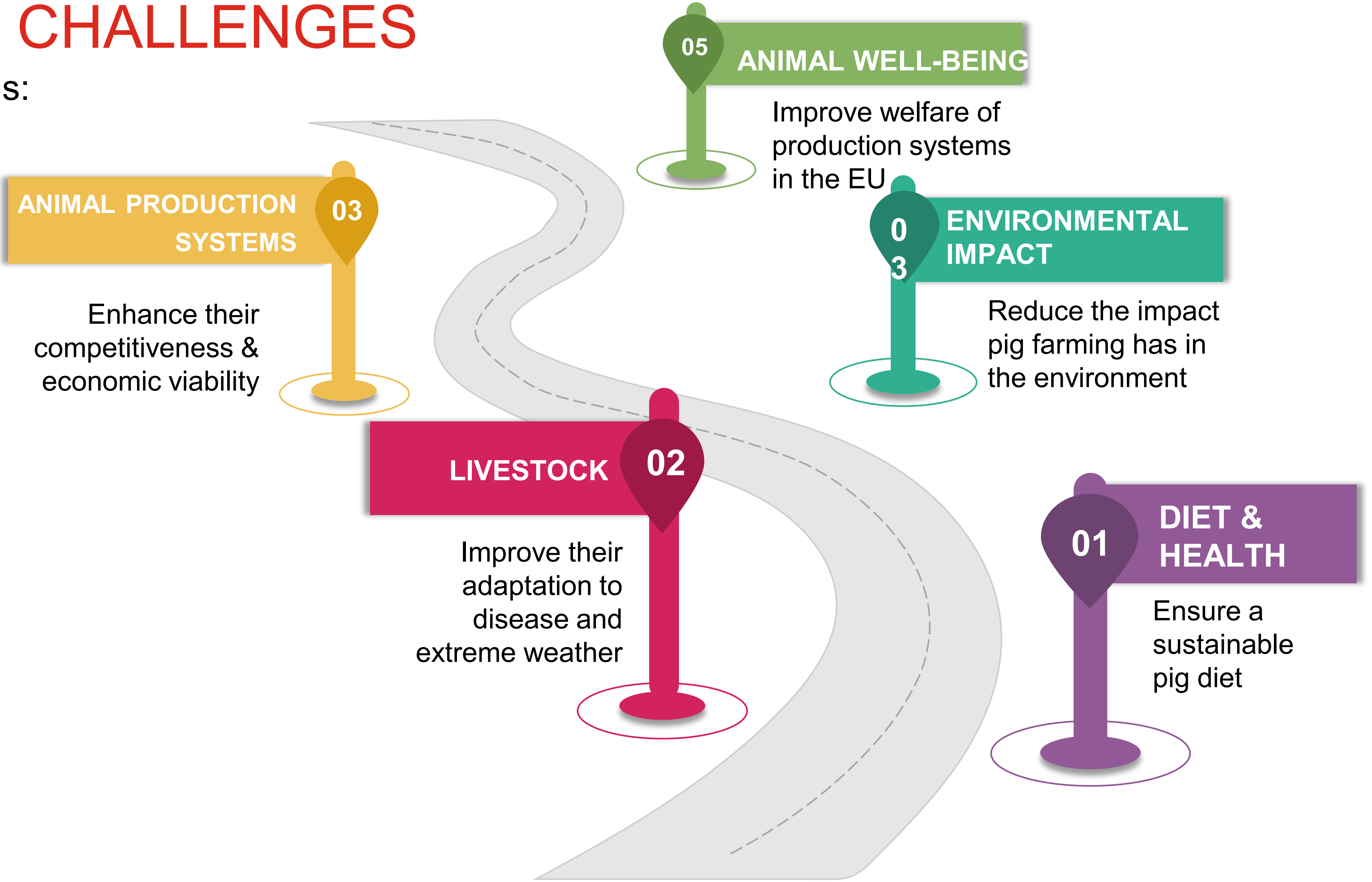
NEW CHALLENGES

EU goals:



01 **DIET & HEALTH**

Ensure a sustainable pig diet

02 **LIVESTOCK**

Improve their adaptation to disease and extreme weather

03 **ANIMAL PRODUCTION SYSTEMS**

Enhance their competitiveness & economic viability

0 3 **ENVIRONMENTAL IMPACT**

Reduce the impact pig farming has in the environment

05 **ANIMAL WELL-BEING**

Improve welfare of production systems in the EU

NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Ban of Zinc Oxide being used at high doses

Feed sources, environmental feed impact and food affordability

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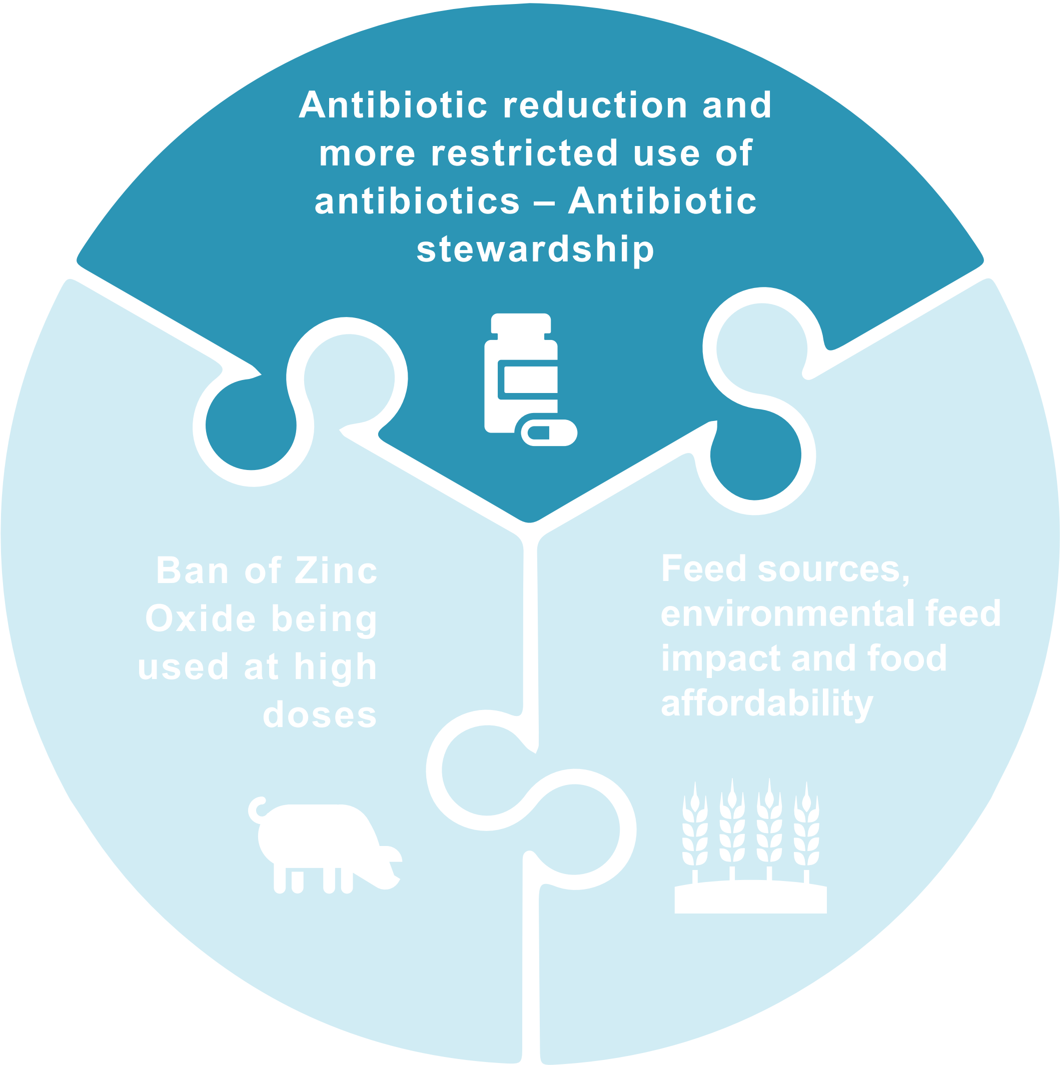
NEW CHALLENGES



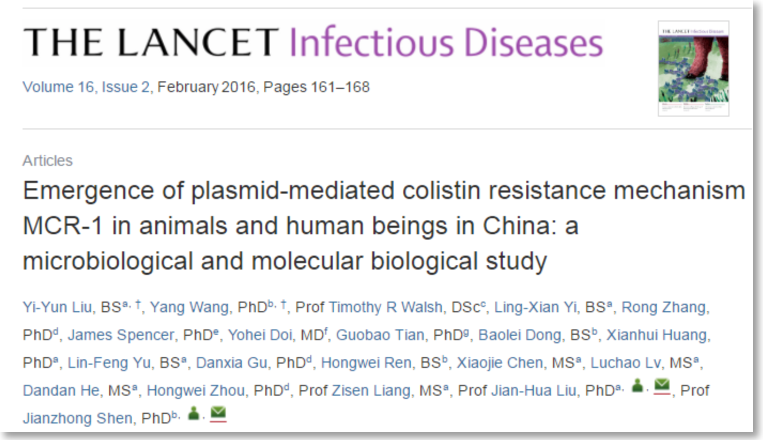
Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Ban of Zinc Oxide being used at high doses

Feed sources, environmental feed impact and food affordability

NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship



THE LANCET Infectious Diseases

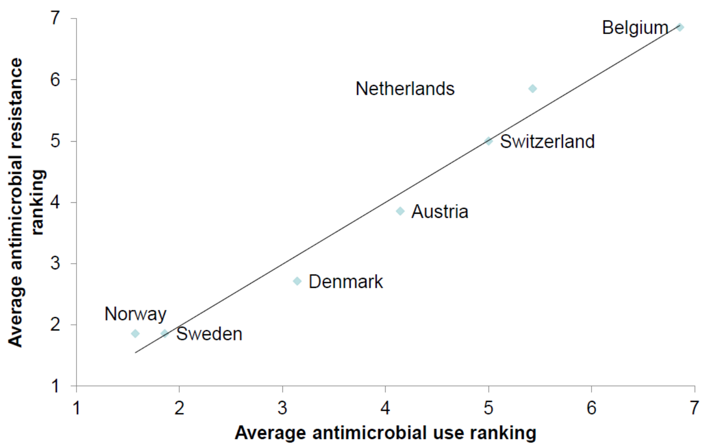
Volume 16, Issue 2, February 2016, Pages 161–168

Articles

Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study

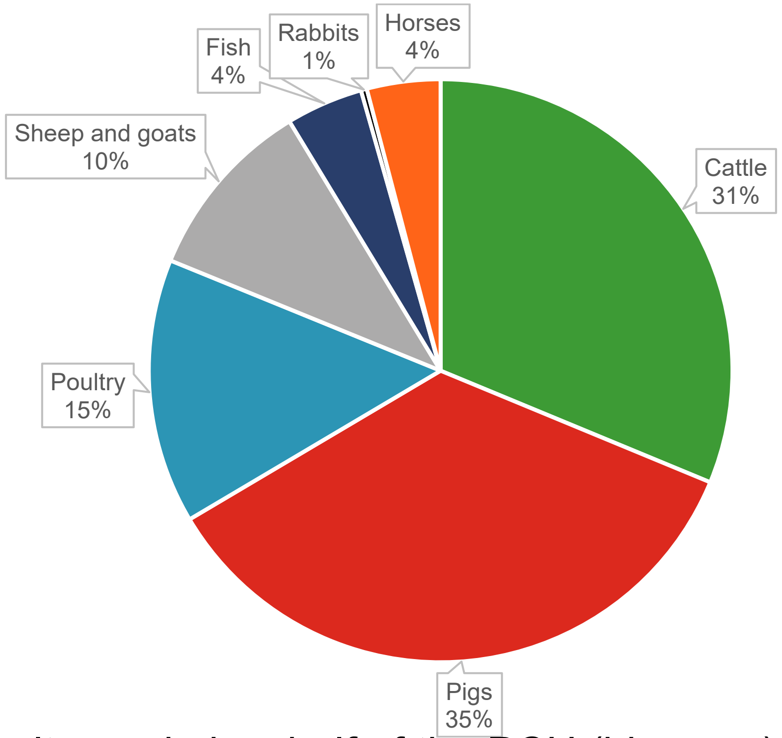
Yi-Yun Liu, BS[a, †], Yang Wang, PhD[b, †], Prof Timothy R Walsh, DSc[c], Ling-Xian Yi, BS[a], Rong Zhang, PhD[d], James Spencer, PhD[e], Yohei Doi, MD[f], Guobao Tian, PhD[g], Baolei Dong, BS[b], Xianhui Huang, PhD[a], Lin-Feng Yu, BS[a], Danxia Gu, PhD[d], Hongwei Ren, BS[b], Xiaojie Chen, MS[a], Luchao Lv, MS[a], Dandan He, MS[a], Hongwei Zhou, PhD[d], Prof Zisen Liang, MS[a], Prof Jian-Hua Liu, PhD[a], Prof Jianzhong Shen, PhD[b]

Linking antimicrobial use to antimicrobial resistance in 7 EU countries based on surveillance data



Chantziaras et al., 2013

Figure: PCU for Food producing animals in 30 European countries in 2022, adapted from ESVAC database



Poultry and pigs: half of the PCU (biomass) for farm animals in Europe

Sources: Adapted from ESVAC database

Chantziaras I. (2013)

NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

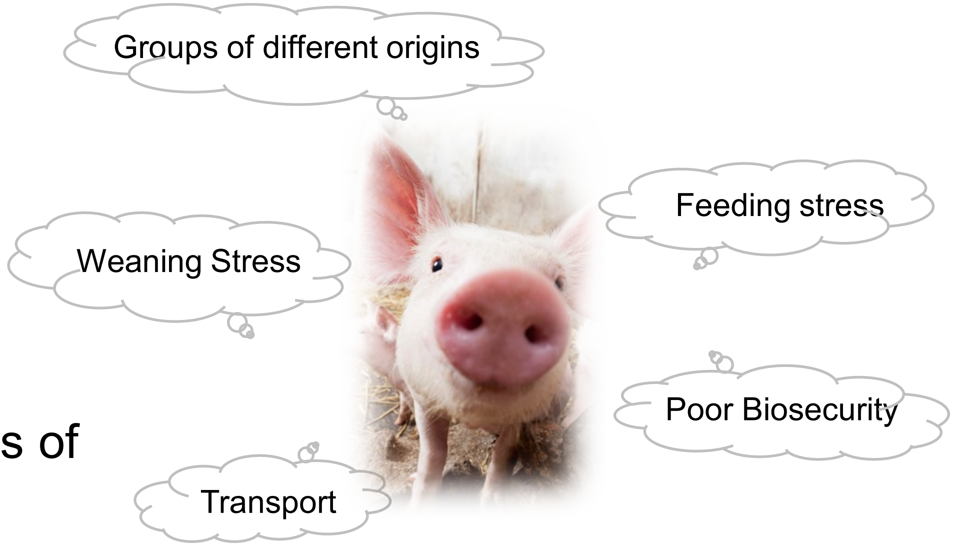
- Main reasons for antibiotic use in pig production
  - Neonatal and post-weaning diarrhoea (e.g. *C. difficile*, *E. coli*)
  - Intestinal infections (*L. intracellularis*)
  - Respiratory diseases

- Most use during suckling and weaning phase (up to 10 weeks of age), via water or medicated feed

Table: Patterns of use of antibiotics in Danish pigs production (Jensen et al. 2012)

Type of disease	Weaner pigs	Finishing pigs
Respiratory	9–17%	18–24%
Gastrointestinal infections	74–83%	56–65%

- 95% of holdings with suckling piglets use antibiotic treatments



Groups of different origins

Weaning Stress

Feeding stress

Poor Biosecurity

Transport

Gastro-intestinal infections are the first cause of antibiotic use in pigs

Lekagul et al. 2019
Schaekel F. el al. (2017)
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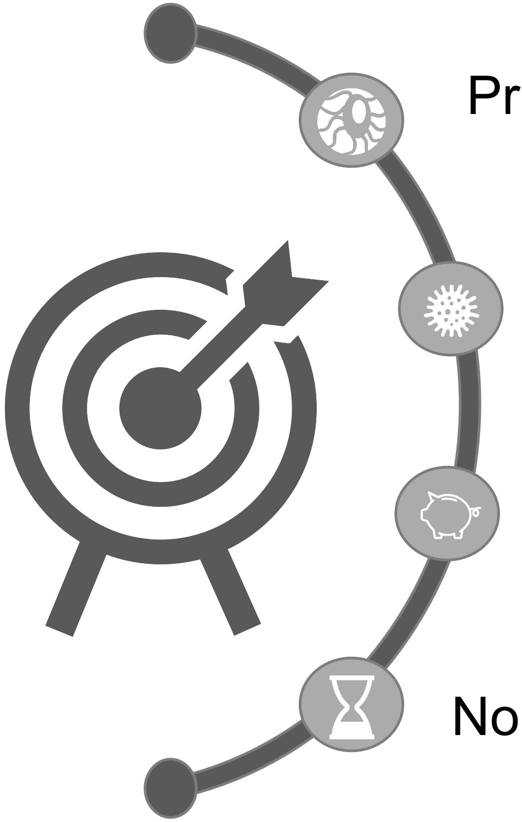
NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

To select antibiotic alternatives, the following **criteria** should be followed:



- Prevent pathogens
- Perform an anti-inflammatory activity (direct or indirect) or immune modulating effect
- Improve performance
- No resistance issues and no withdrawal periods

NEW CHALLENGES

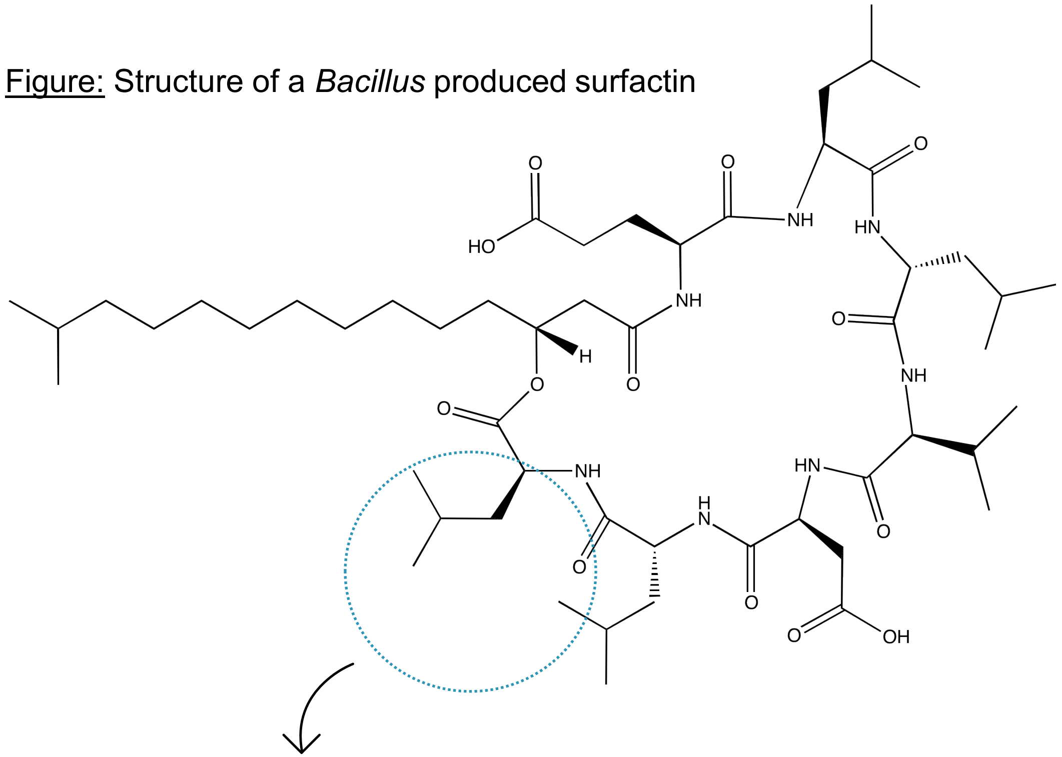
Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Probiotics - mode of action: producing antibacterial metabolites

***Bacillus sp*. PB6 producing surfactins**:

- *Bacillus* sp. PB6 produces **different functional lipopeptides**
- Lipopeptides are molecules that consist of lipids and amino acids, with biological properties
- **Surfactins**: cyclic lipopeptides with broad-spectrum antibacterial activity, including **against *C. perfringens***
  - ➢ Peptidic loop of *7* amino acids (glutamate, aspartate, valine, leucine) and a fatty acid chain

Figure: Structure of a *Bacillus* produced surfactin



Surfactin A (Leu at position 7): Inhibition of PLA_2

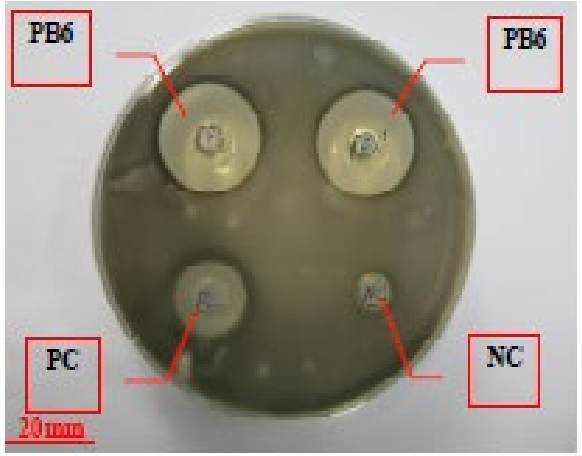
Surfactin B (Val at position 7): Lesions of the cell wall

NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

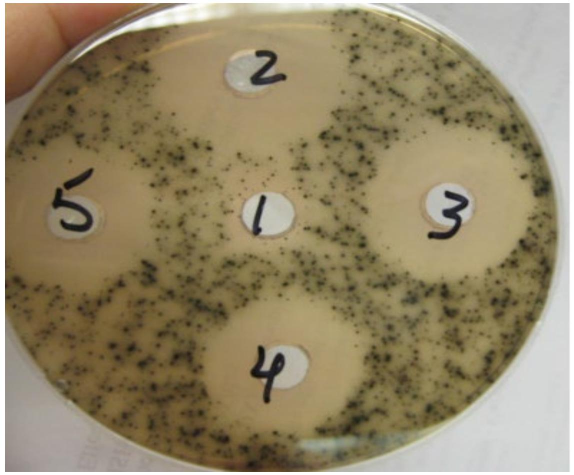
Probiotic *Bacillus sp. PB6* mode of action

Clear anti microbial activity - *Clostridium*



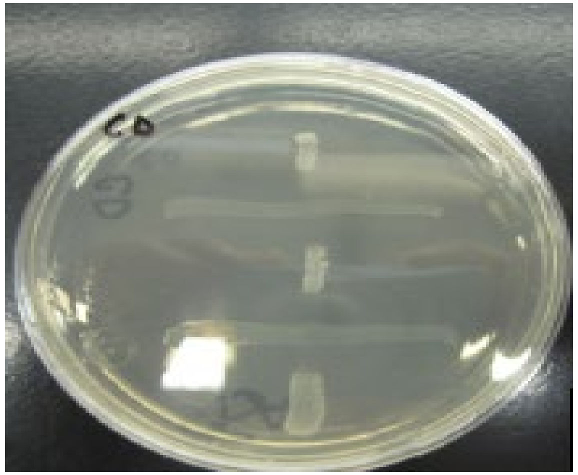
Kemin Internal Document WP-14-00076

Clostridium perfringens



Kemin Internal Document **WP-08-00140**

Clostridium septicum



Kemin Internal Document **WP-08-00140**

Clostridium difficile

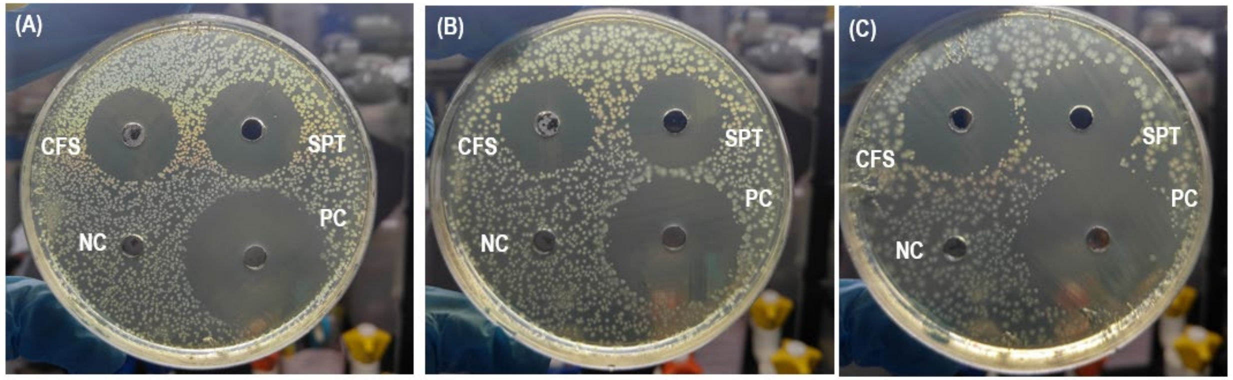
Kemin Internal Document WP-14-00076, WP-08-00140, WP-08-00140

NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Probiotic *Bacillus sp. PB6* mode of action

Clear anti microbial activity - *Clostridium*



Organism	SPT	CFS	PC	NC
C. perfringens farm isolate A	23.5	23.0	34.0	No effect
C. perfringens farm isolate B	24.5	23.5	36.0	No effect
C. perfringens ATCC 13124	25.0	26.0	36.0	No effect

A & B are Australian swine farm isolates & C is a *C. perfringens* 'culture collection'; (NC, negative control; PC, positive control (i.e. 10ppm amoxicillin); CFS, *B. subtilis* PB6 cell free supernatant; SPT, *B. subtilis* PB6 supernatant

Kemin internal reference: BB-09-00008

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NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Probiotic *Bacillus sp. PB6* trial set-up

240 weaned piglets (males and females) with an average age of 23 days and an average body weight of 6.7 kg

- Pre-Starter 1 – 24 to 31 days of age
- Pre-Starter 2 – 32 to 38 days of age
- Starter 1 – 39 to 45 days of age
- Starter 2 – 46 to 72 days of age

	Phase	Control	*Bacillus* sp PB6
Treatments	Pre-Starter 1	Flavomicin (12 PPM)	500 g / t
	Pre-Starter 2	Flavomicin (12 PPM)	500 g / t
	Starter 1	Enramicin (12 PPM)	500 g / t
	Starter 2	Enramicin (12 PPM)	500 g / t

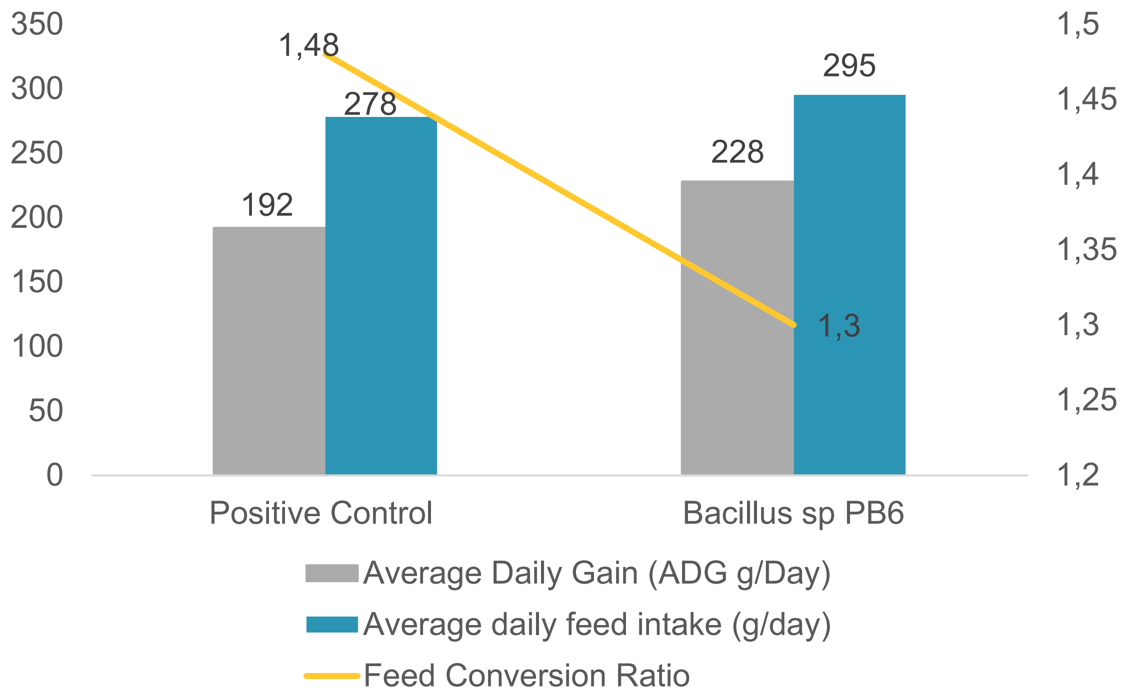
Kemin internal reference: TL-19-17420

NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Probiotic *Bacillus sp. PB6* trial results

Fig. 1 Performance results from 24-31 days of age



Significantly improved (p<0.05) ADG, feed intake and FCR

Fig. 2. Performance results from 24-72 days of age

	Positive control	*Bacillus sp* PB6	P-value
ADG (g/day)	478	481	0.7475
ADFI (g/day)	755	749	0.6374
FCR	1.58	1.56	0.1917
Diarrhea score	1.32	1.35	0.4560

No significant difference in diarrhea scores

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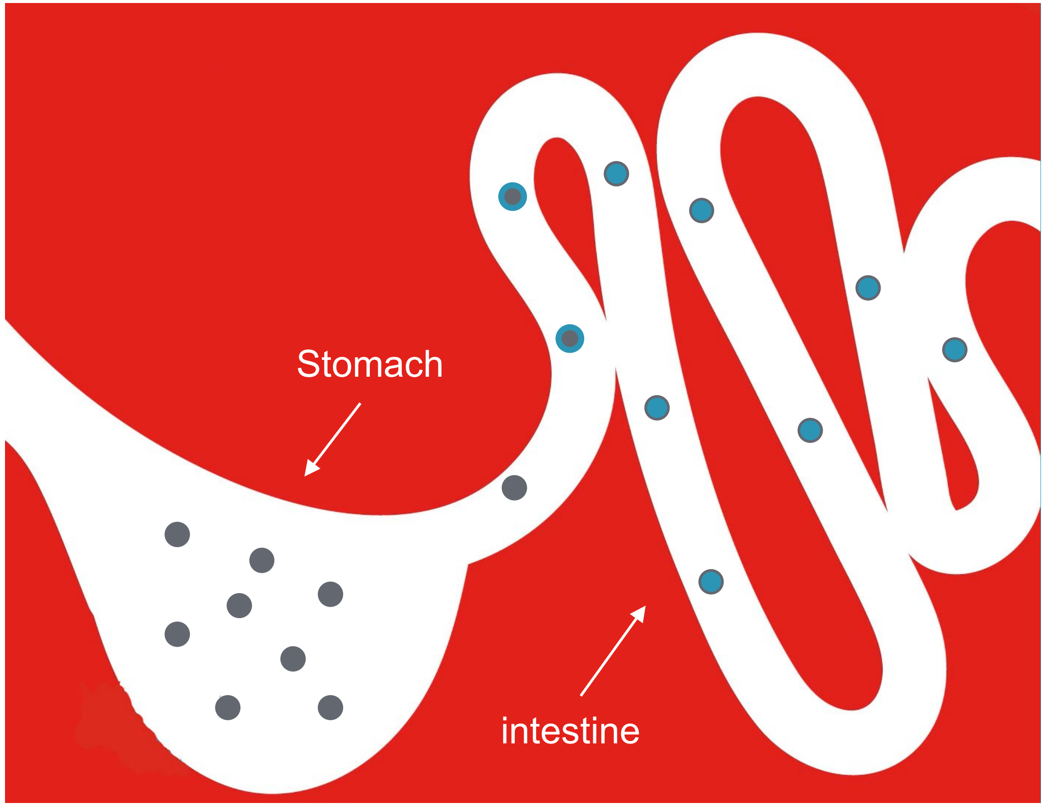
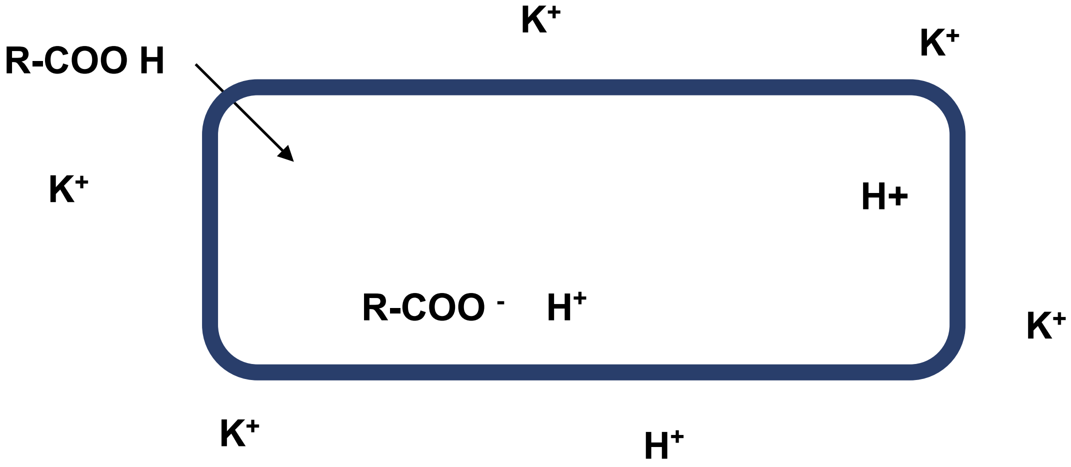
NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship



- ● Encapsulated acids pass the stomach
- ● Release of acids in the intestinal tract



The organic acids can be found in both dissociated and un-dissociated form, the un-dissociated (R-COOH) ones are lipophilic thus enter into the cellular wall, dissociates once inside giving protons, toxic for the cell.

NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Trial: Encapsulated acids – health effects in weaned piglets

Set-up

Control

- Standard commercial diets
- 1.1% fumaric acid
- 120 ppm colistin in prestarter

Encapsulated acids

- Standard commercial diets
- 1.1% fumaric acid
- 5 kg/t encapsulated acids (Citric acid and Calcium Formate)

Location	Germany
Replicates	6 consecutive groups 60 pigs/group 5391 pigs total
Trial period	7 until 30 kg
Analyses	Commercial performance Faecal microbiology (*Salmonella, Clostridia, Brachyspira)* after 4 weeks

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NEW CHALLENGES

Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Trial: Encapsulated acids – health effects in weaned piglets

Results

Fig. 1 Mortality results

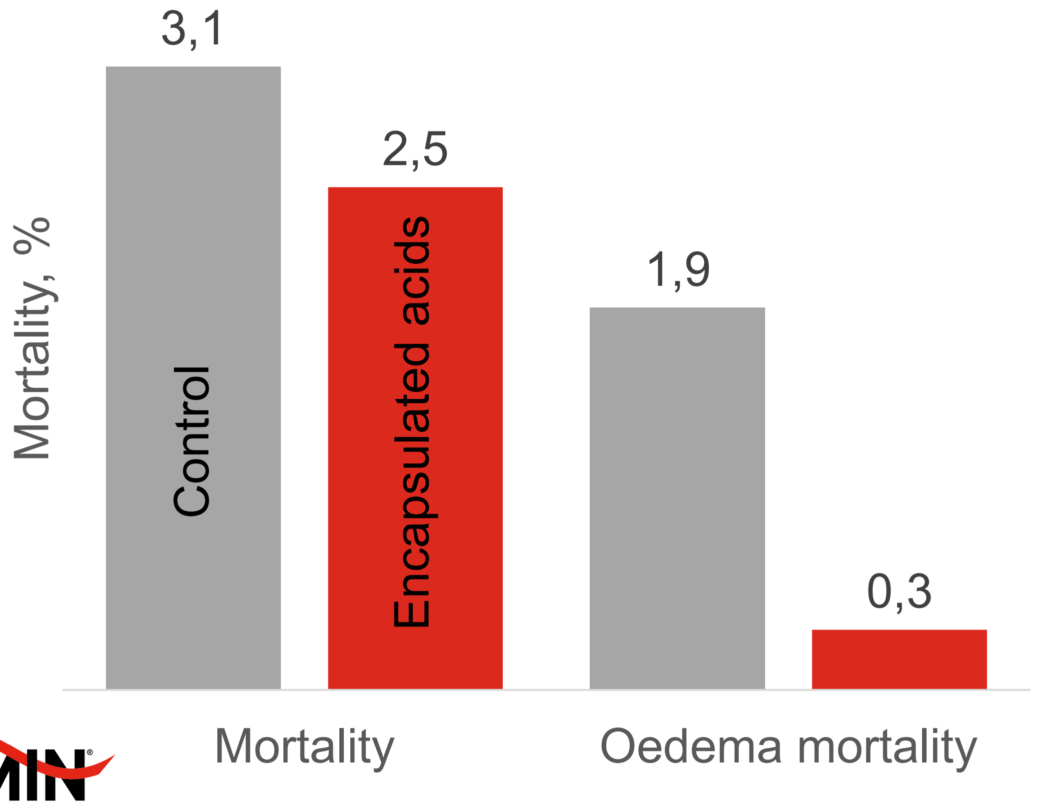
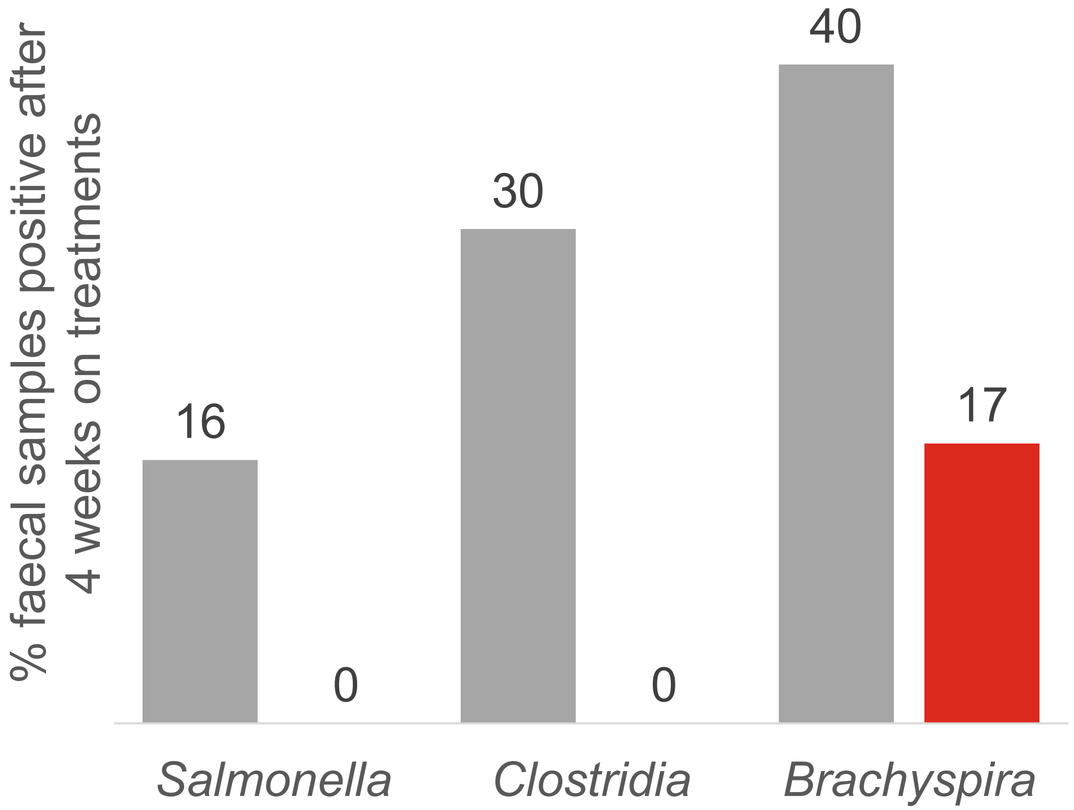


Fig. 2 Bacteriology results



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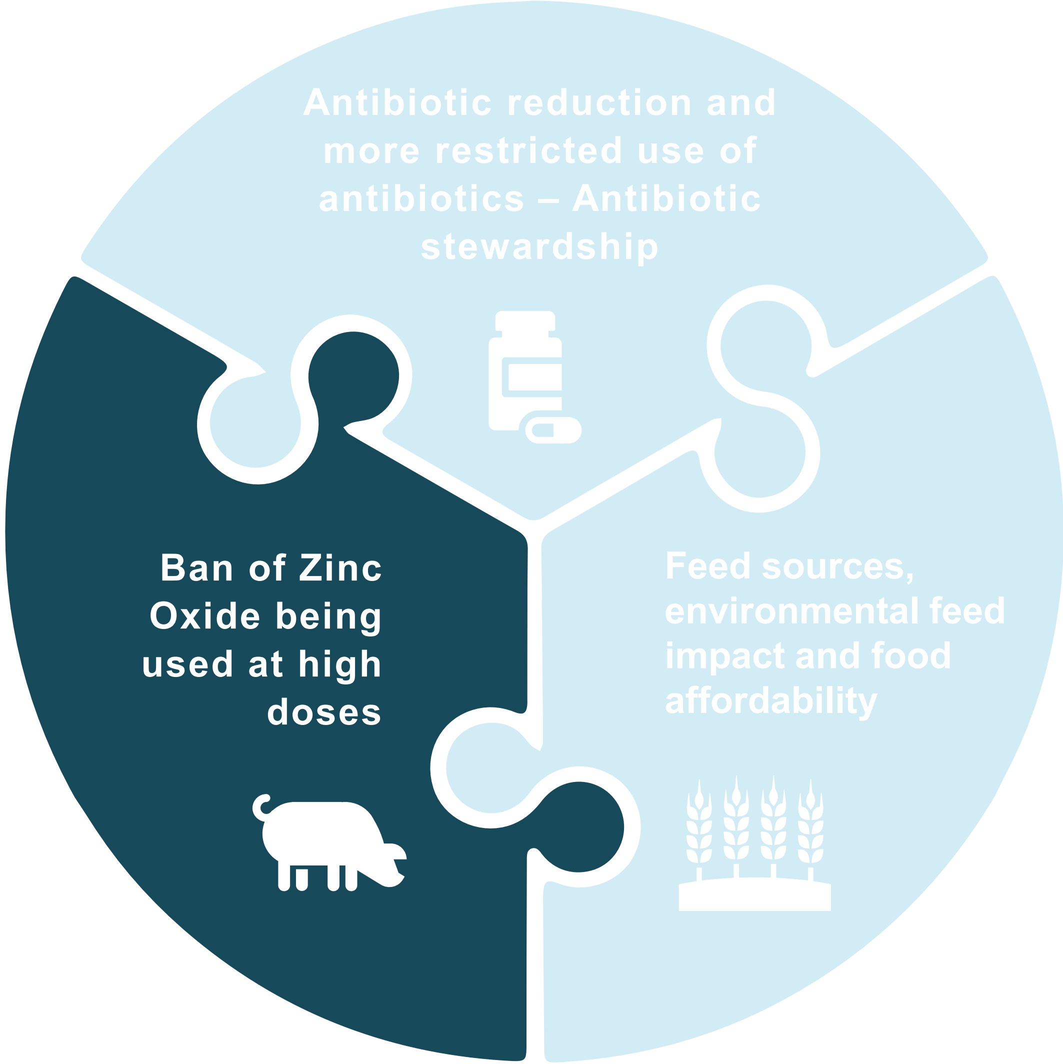
NEW CHALLENGES



Antibiotic reduction and more restricted use of antibiotics – Antibiotic stewardship

Ban of Zinc Oxide being used at high doses

Feed sources, environmental feed impact and food affordability

NEW CHALLENGES

Ban of Zinc Oxide being used at high doses

Alternatives need to tick all the boxes ZnO does at high doses

- ☑ Antimicrobial effects
- ☑ Enzyme secretion and digestibility enhancement
- ☑ Improved intestinal morphology
- ☑ Immune system
- ☑ Improve digestion of feed

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Eastaugh (2008), Baker et al. (2010)

NEW CHALLENGES

Ban of Zinc Oxide being used at high doses

Animal Feed Science and Technology 248 (2019) 114–125

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

Algae-derived β-glucan enhanced gut health and immune responses of weaned pigs experimentally infected with a pathogenic *E. coli*

Kwangwook Kim[a], Amy Ehrlich[b], Vivian Perng[a], Jennifer A. Chase[b], Helen Raybould[b], Xunde Li[b], Edward R. Atwill[b], Rose Whelan[c], Adebayo Sokale[d], Yanhong Liu[a,*]

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ARTICLE INFO

Keywords:
Algae-derived β-glucan
Gut barrier function
Gut immunity
Pathogenic *E. coli*
Weaned pigs

ABSTRACT

Most of the commercially available β-glucans are derived from yeast, while there are limited research on algae-derived β-glucan in pigs. Therefore, the objective of this experiment was to investigate the influence of dietary supplementation of algae-derived β-glucan on diarrhea, gut permeability, and immune responses of weaned pigs experimentally infected with a pathogenic *Escherichia coli* (*E. coli*). Thirty-six weaned pigs (7.69 ± 0.77 kg BW) were individually housed in disease containment rooms and randomly allotted to one of three dietary treatments (n = 12): control diet and 2 additional diets containing either 54 or 108 mg/kg of β-glucan. The experiment lasted 17 d [5 d before and 12 d post inoculation (PI)]. The inoculum used in this experiment was F18 *E. coli*, containing heat-labile toxin, heat-stable toxin b, and shiga-lie toxin 2. The inoculation doses were 10^{10} cfu/3 mL oral dose daily for 3 days. Diarrhea score (1, normal, to 5, watery diarrhea) was recorded for each pig daily to calculate frequency of diarrhea. Blood samples were collected on d 0 before *E. coli* challenge, and on d 2, 5, 8, and 12 PI to measure total and differential blood cell count in whole blood and several inflammatory markers in serum. Fresh jejunal tissues were collected from 4 pigs in the control group and high dose β-glucan group to analyze gut permeability on d 5 and d 12 PI with Ussing Chamber. Jejunal and ileal mucosa were also collected to measure the mRNA expression of several genes related to gut barrier function and immune responses. Results of this experiment revealed that inclusion of high dose β-glucan reduced ($P < 0.05$) frequency of diarrhea (29.01% vs. 17.28%) for the entire experimental period. This was likely due to the reduced ($P < 0.05$) gut permeability and increased ($P < 0.05$) mRNA expression of gut barrier function genes (*Claudin*, *Occludin*, and *MUC2*) in jejunal mucosa of *E. coli* challenged pigs as β-glucan supplemented. Supplementation of β-glucan also reduced ($P < 0.05$) white blood cells, neutrophils, serum tumor necrosis factor (TNF)-α, cortisol, and haptoglobin, and down-regulated ($P < 0.05$) the mRNA expression of several immune genes (*IL1B*, *IL6*, and *TNFA*) in ileal mucosa of *E. coli* challenged pigs, compared with the control diet. In conclusion, in feed supplementation of algae-derived β-glucan alleviated diarrhea

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Abbreviations: E. coli, Escherichia coli; BW, body weight; COX2, cytochrome c oxidase subunit 2; ELISA, enzyme-linked immunosorbent assay; FITC, fluorescein isothiocyanate; IL, interleukin; mAb, monoclonal antibody; MUC2, mucin 2; PI, post-inoculation; TNF-α, tumor necrosis factor-α; ZO-1, zona occludens 1

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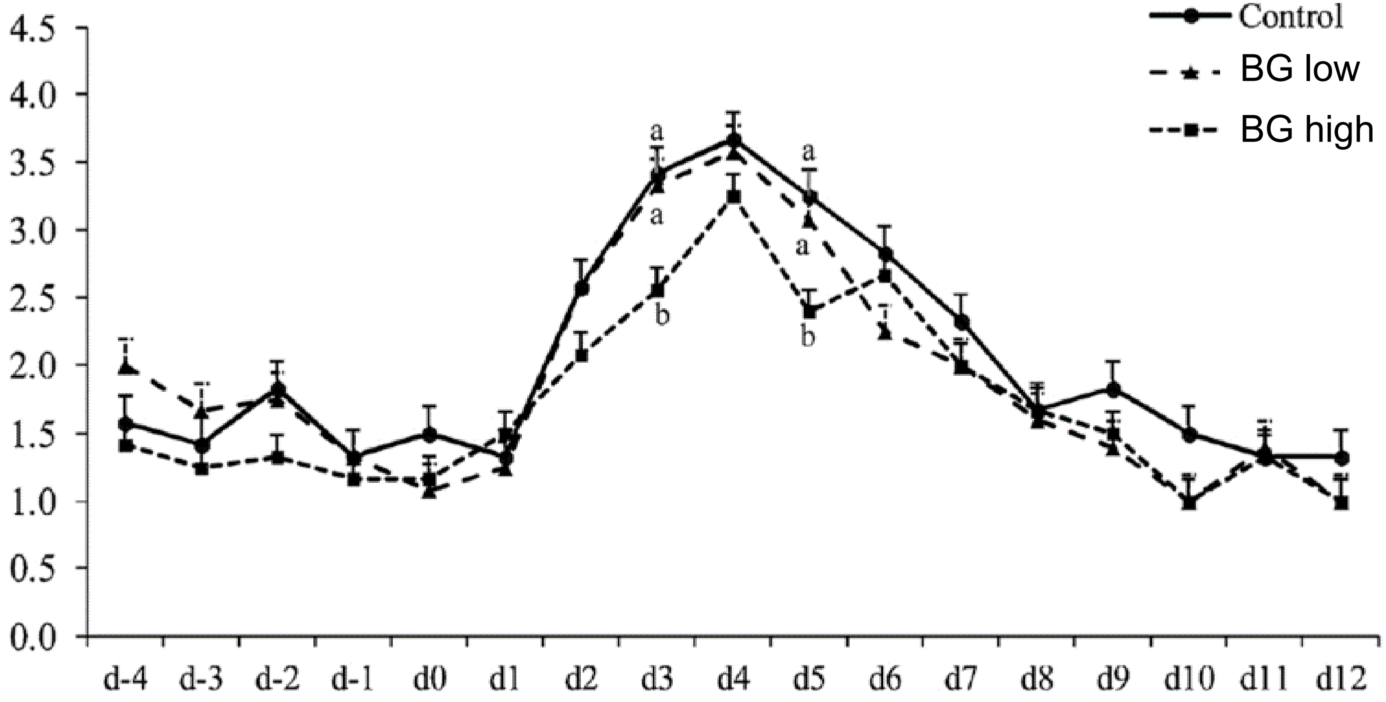
E-mail address: yahliu@ucdavis.edu (Y. Liu).

https://doi.org/10.1016/j.anifeedsci.2018.12.004
Received 14 May 2018; Received in revised form 2 August 2018; Accepted 22 December 2018

Effect of Beta 1,3 glucan on post weaning F18 *E. Coli* challenge



Improved intestinal integrity (tight junctions and mucosal protection)
Lower stress (Cortisol), APP and controlled inflammation (IL6, TNF, increased IL10)

Kim K. et al (2019)

NEW CHALLENGES

Ban of Zinc Oxide being used at high doses

Trial with combination strategy for replacing ZnO: set-up

Prestarter ZnO

3 kg/ton zinc oxide (2400 ppm Zn)
3 kg/ton free organic acids

Starter out

3 kg/ton zinc oxide (2400 ppm Zn)
3 kg/ton free organic acids

Prestarter Alternative

1.5 kg/ton slow release encapsulated Butyrate
5 kg/ton encapsulated acids
(Citric acid and Calcium Formate)
2x10^8 CFU/kg B. sp PB6

Starter in

1 kg/ton slow release encapsulated Butyrate
4 kg/ton encapsulated acids
(Citric acid and Calcium Formate)
2x10^8 CFU/kg B. sp PB6

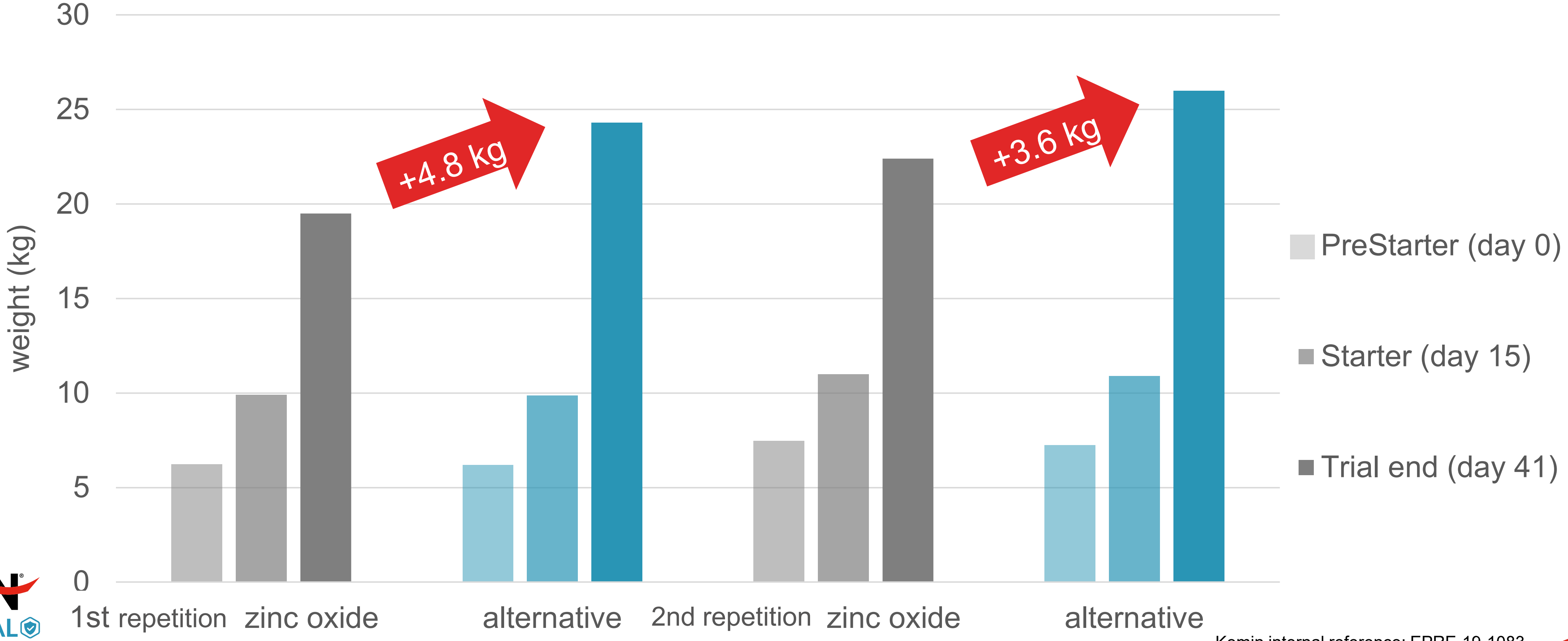
Kemin internal reference: EPRE-19-1083
Shutterstock 362076443

NEW CHALLENGES

Ban of Zinc Oxide being used at high doses

Trial with combination strategy for replacing ZnO: results

neither group showed diarrhoea



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NEW CHALLENGES

Ban of Zinc Oxide being used at high doses

Trial with combination strategy for replacing ZnO: set-up

- Control (n=538) control diet
- Premium diet group (n=534) supplemented with:
    - 4 kg/t of encapsulated formic acid, citric acid, and functional flavours
    - 750 g/t of *Bacillus* sp. PB6 (3 x 10^8 CFU/kg of feed)
    - Benzoic acid and calcium formate were also used at a similar dose level compared to the standard diet (0.5% for each product)
    - Organic acid blend supplied in the drinking water of the piglets fed the reformulated diet.
- Diarrhea was scored, body weights and feed intake were recorded throughout the study. Average daily gain (ADG) and Feed Conversion Ratio (FCR; FUp per kg gain) were calculated

Carlson et al. 2022

NEW CHALLENGES

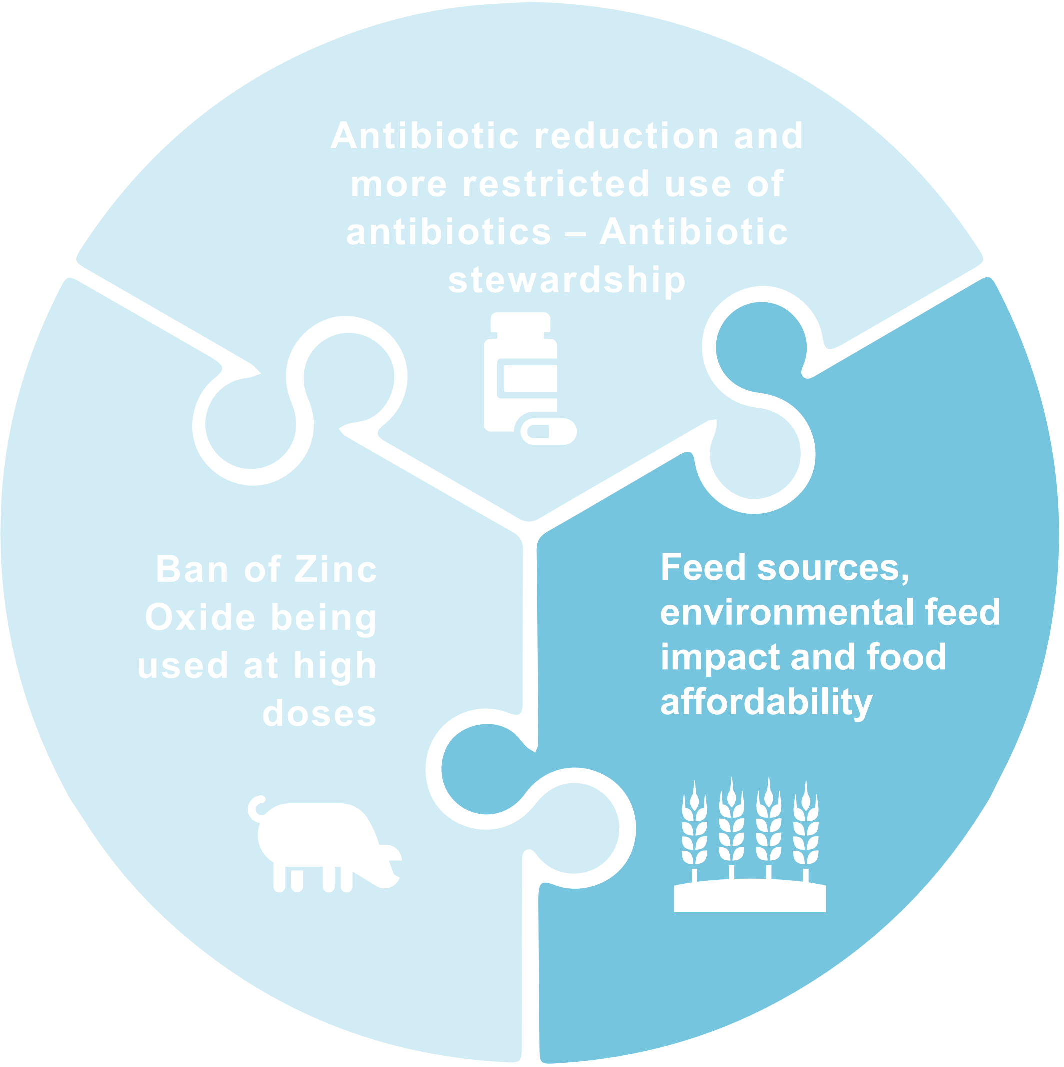
Ban of Zinc Oxide being used at high doses

Trial with combination strategy for replacing ZnO: results

	Day	ZnO diet	Reformulated diet (FormaXOL + CLOSTAT)	Diet	BW x diet	
Body weight						
Initial body weight (kg/pig)$_y$	1	4.2 (±0.5)	4.1 (±0.6)	na	na	na
Intermediary body weight (kg/pig)$_y$	14	6.6 (±0.8)	6.9 (±0.8)	na	na	na
Final Body weight (kg/pig)$_y$	43	22.8 (±1.8)	22.6 (±2.0)	na	na	na
1-14 days after weaning						
ADG (g/d/pig)$_x$	1-14	173	198	0.13	0.007	37
FI (g/d/pig)$_x$	1-14	265	275	0.53	ns	36
FCR$_x$	**1-14**	**1.51**	**1.4**	**0.03**	**<0.001**	**0.16**
14-43 days after weaning						
ADG (g/d/pig)$_x$	14-43	549	533	0.5	ns	57
FI (g/d/pig)$_x$	14-43	820	741	0.25	ns	80
FCR$_x$	14-43	1.43	1.38	0.21	ns	0.09
1-43 days after weaning						
ADG (g/d/pig)$_x$	1-43	427	424	0.85	ns	38
FI (g/d/pig)$_x$	1-43	620	599	0.32	ns	49
FCR$_x$	**1-43**	**1.44**	**1.38**	**0.03**	**ns**	**0.07**

Carlson et al. 2022

NEW CHALLENGES



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Feed sources, environmental feed impact and food affordability

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NEW CHALLENGES

Feed sources, environmental feed impact and food affordability

Green house gas emmissions

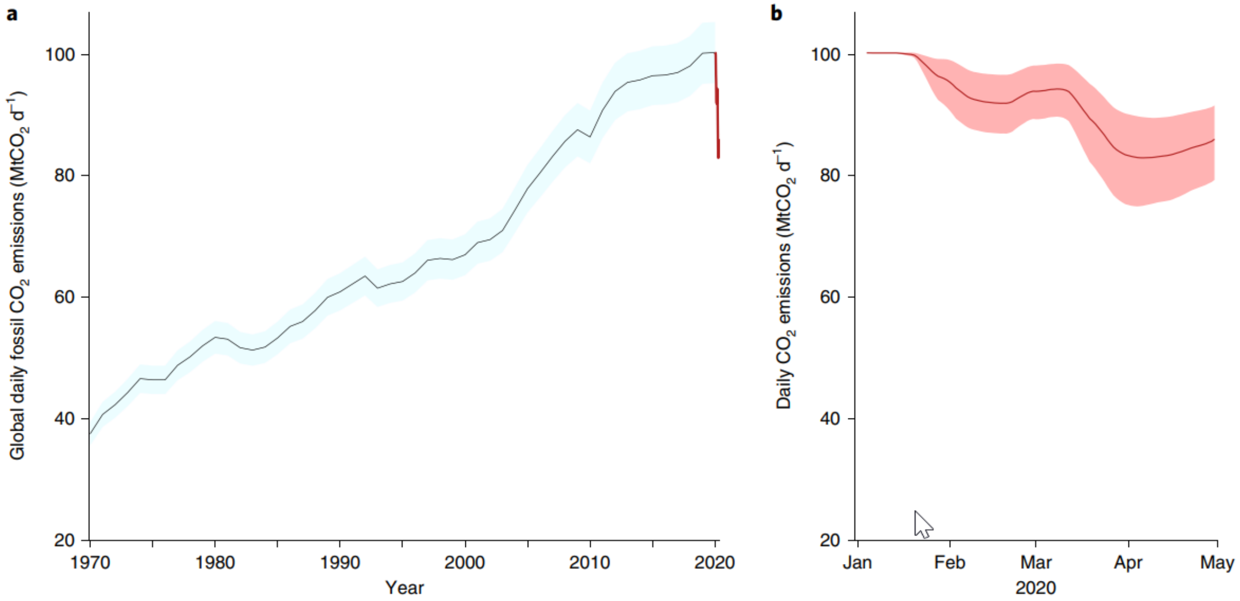
EMISSIONS IN LIVESTOCK PRODUCTION – SOME HEADLINES… WITH WIDE MEDIA COVERAGE

“Stop Eating Meat If You Want To Save The Planet, Scientists Urge” – The Huffingtonpost, 2018

“Huge reduction in meat-eating ‘essential’ to avoid climate breakdown” – The Guardian, 2018

51% of global GHG emissions come from rearing and processing livestock - Worldwatch Institute, 200

UN/FAO 2006 – Livestock’s Long Shadow (LLS) – Livestock produce 18% of the world’s GHG emissions



Corinne Le Quéré, Nature Climate Change | VOL 10 | July 2020 | 647–653

NEW CHALLENGES

Feed sources, environmental feed impact and food affordability

Green house gas emmissions

REDUCE ENERGY CONSUMPTION OF FEED PRODUCTION

Pelleting process = 60-80% of energy consumption in feed mills*

1 ton of pelleted feed = 35 kg of CO_2 emissions*

Pelleted feed throughput can be improved by 20%* with the use of **tensioactive dispersing solutions** (more feed is produced with the same energy consumption) = 7 kg of CO_2 emissions less per ton of feed

- 220 million tons of processed feed (compound and RM) produced in EU*
- Total reduction of CO_2 = 1,5 million tons of CO_2 reduction per year ~ 1,5 million go-return flights Paris-New York**

*Effect of MillSMART™ on Feed Processing Key Performance Indicators MetaData 2017 involving 14 trials. Kemin Internal Reference 18-00013

[**https://www.ademe.fr/](https://www.ademe.fr/)

*Enviros. CCA data for the period October 2006 to September 2007

**Effect of MillSMART™ on Feed Processing Key Performance Indicators MetaData 2017 involving 14 trials. Kemin Internal Reference 18-00013

NEW CHALLENGES

Feed sources, environmental feed impact and food affordability

Green house gas emmissions: Nitrogen production

SOLUTIONS - ENZYMES

- 5,4 g less of CP per kg of feed is excreted by piglets
- 0,864 g of N per kg of feed less is excreted by piglets

- Total piglet feed production in EU-27 ~ 9 million tons/year
- Potential less N excreted per year ~ 7776 tons **(9442 tons of NH_3)**
- Maximum amount of N in livestock manure to be applied in NVZ* = **170 kg nitrogen /hectare/year) – 45.741 ha of land saved**

Nitrogen is a major nutritional requirement in the diets of food-producing animals

Contribute to air and water pollution, climate change and ozone depletion

	Treatments				
Nutrient*	C	KZ 250	KZ 1000	SEM	p-value
OM (%)	82,9^{a}	83,7^{a}	84,8^{b}	0,3	<0,01
Ash (%)	51,3	49,7	50,2	0,7	0,258
DM (%)	81,1^{a}	81,8^{a}	82,9^{b}	0,3	<0,01
CP (%)	75,2^{a}	76,6^{ab}	78,2^{b}	0,7	0,021
Cfat (%)	68	70,6	68,8	1,1	0,239
Starch (%)	99,4	99,5	99,6	0,1	0,481
NSP (%)	32,9^{a}	35,4^{a}	40,5^{b}	1,3	<0,01
CF (%)	26,5^{a}	29,1^{a}	38,6^{b}	2	<0,01
GE (%)	80,4^{a}	81,4^{a}	82,5^{b}	0,4	<0,01
NE – kcal/kg (MJ/kg)	2085^{a} (8,73)	2114^{ab} (8,85)	2140^{b} (8,96)	0,05	<0.01
ME – kcal/kg (MJ/kg)	2916^{a} (12,21)	2957^{ab} (12,38)	3007^{b} (12,59)	0,07	<0,01
DE – kcal/kg (MJ/kg)	3129^{a} (13,1)	3167^{a} (13,26)	3212^{b} (13,45)	0,06	<0,01

* Nitrogen Vulnerable Zones

Kemin Internal Reference TL-18-00134 - KEMZYME® Plus dry – Unique combination of protease, amylase and NSP degrading enzymes for piglets

KEMIN®
INTESTINAL HEALTH

NEW CHALLENGES

Feed sources, environmental feed impact and food affordability

Sustainable raw material sources

Soya

Unsustainable farming practices leading to:

- **Deforestation**
- **Soil erosion**
- **Land use change**
- Monoculture

High quality protein source in pig diets because it is rich in limiting amino acids lysine, threonine, and tryptophan

Soya also have a good digestibility

NEW CHALLENGES

Feed sources, environmental feed impact and food affordability

Trial substituting soya with fava beans treated with a dual-action, organic acid-based surfactant mould inhibitor specifically for preservation of field beans (Myco CURB® BNS)

Finishing pigs

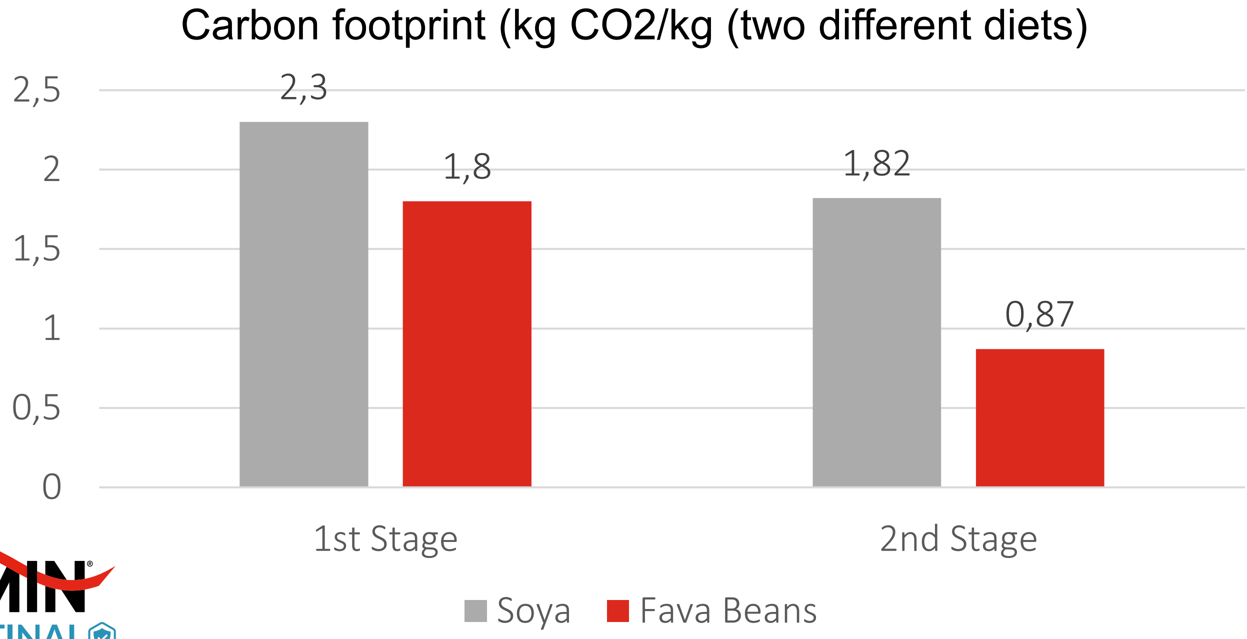
- Control group
- Alternative group in which part of the soya was replaced by beans,
  - 1st stage finisher (16.7% soya and 12.45 for the control and Bean group respectively and 10% of treated beans) feed for 4 weeks (35-65 kg live weight)
  - 2nd stage finisher feed (65 kg – slaughter, with 12.5.% and 4.77% soya for the control and Bean group and 20 Beans in Bean group)

KEMIN
INTESTINAL
HEALTH

NEW CHALLENGES

Feed sources, environmental feed impact and food affordability

	ADG, g	ADFI, g	FCR	Days on trial	Deadweight, kg/Carcass Wt	Lean weight, %	P2 backfat thickness, mm
Soya	980	2,650	2.710	83.67	(98.06)	62.56 (61.83)	11.18
Beans treated with Sodium propionate, propionic acid and a surfactant	990	**2,690**	2.717	83.42	(98.58)	62.33 (61.64)	11.40



30% reduction in kg CO_2/kg of pig meat and a 60-70% reduction in environmental footprint from harvesting and processing the beans

Kemin internal reference:TL-21-19546

WRAP-UP

Consumer sustainability demand has grown **from trend to action**

3 pillars, interconnected and cannot be taken separately:
- Healthy people
- Healthy planet
- Healthy business

Alternative strategies to support feed production becoming more efficient:
- Energy
- Resources
- Money

Improving efficiencies (FCR)

Decreasing attritions (mortality)

Antibiotic stewardship

Proactively fights for the protection of habitats

Sustainable pig industry for generations.

Thank you for your attention