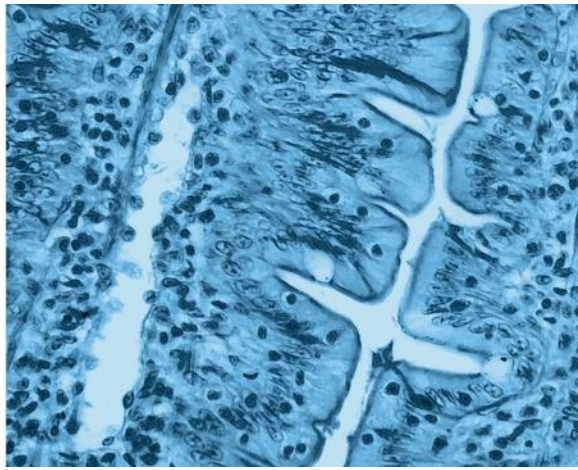
SCHOTHORST FEED RESEARCH

Fodringsseminar, Denmark

April 23, 2025



Future-proof feed practices around weaning

Anouschka Middelkoop, PhD

Knowhow to feed

Content

25 kg

Weaning

Tail biting

Dietary changes

Post-weaning diarrhoea and antibiotic use

Birth

Loose housing of sows

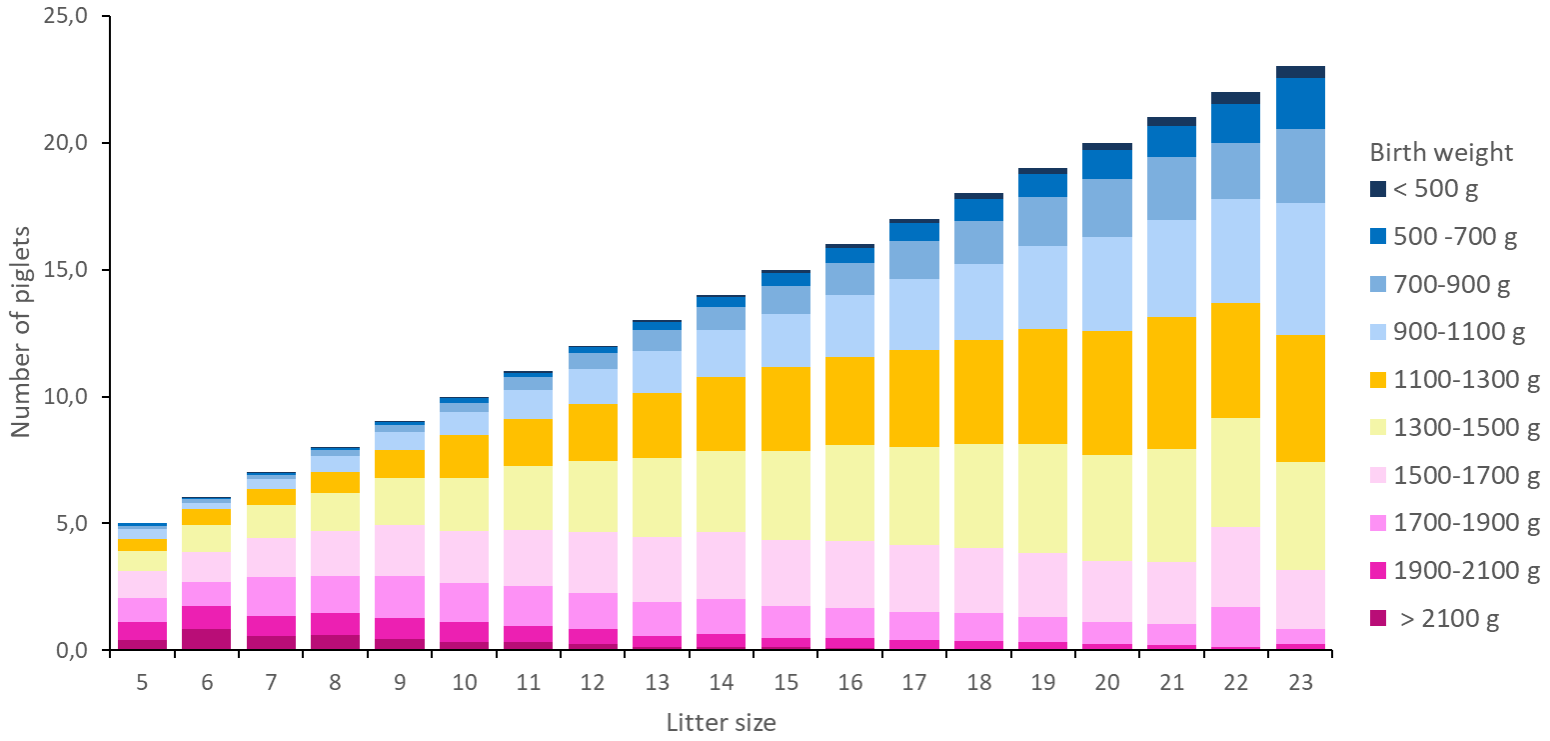
Piglet survival

IN RELATION TO: SAMMEN OM DYRENE 2024-2027

https://fvm.dk/arbejdsomraader/veterinaer/sammen-om-dyrene

A good or bad start?

- Increase in litter size
  - ↑ low birth weight piglets
  - ↑ Intra-uterine growth restricted (IUGR) piglets: currently 30-40%



Effect of litter size on birth-weight distribution. The data were collected at Schothorst Feed Research B.V. (Lelystad, The Netherlands) from 2011 to 2020, based on 114984 piglets born alive from 7952 litters.

Normal

Moderate IUGR

Severe IUGR

SFR: Huting et al., 2021; Image: Chaiyapatmaetee et al., 2025

When do you use what?

Early life programming

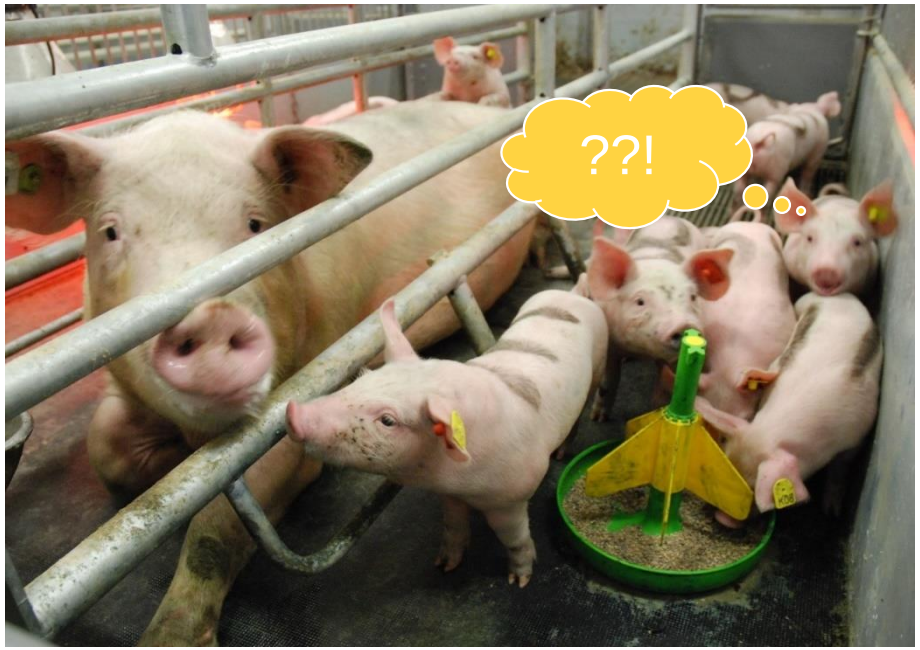
Preparing for weaning

Sow

Oral supplement	Supplemental milk	Solid feed
		
Supporting the first hours of life ↑ early piglet survival	Supplementing sow's milk ↑ pre-weaning performance	Preparing for weaning ↑ post-weaning performance

Choice dependent on goal, management and physiological stage

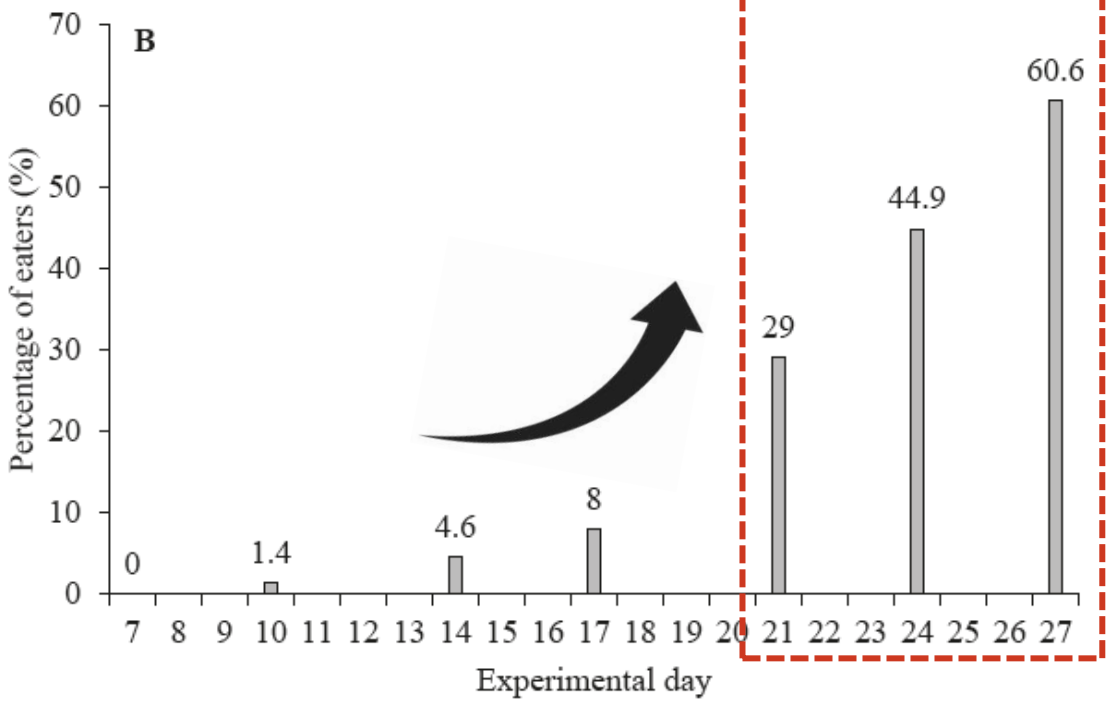
The creep feed challenge



The intake of creep feed is low, unpredictable and variable between and within litters

Image credits: A. Middelkoop, K.S. Pedersen and N. Toft

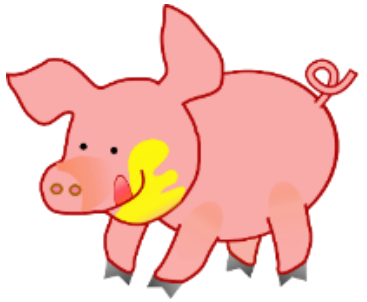
The creep feed challenge



Middelkoop, PhD thesis, 2020; Image credits: A. Middelkoop, K.S. Pedersen and N. Toft

Apply strategies that stimulate…

- The number of eaters
- The amount of creep feed consumed
- A timely onset of creep feed intake



- Social learning of feeding behaviour (e.g. feeder type, loose housing of sow)
- Exploration towards the feed(er) (e.g. dietary diversity)
- The transition to dry feed (e.g. soft pellets, porridge)

Middelkoop, PhD thesis, 2020

Learn from the sow

Learning from the sow what, where and how to eat by giving piglets access to sow feed and feeder

Single-litter systems

Multi-litter system

Family feeding vs. conventional:
73 vs. 60% eaters, $P<0.001$

Oostindjer et al., 2010, 2011; Van der Peet-Schwering et al., 2021; Van Nieuwamerongen et al., 2015

Learn from the sow

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Example in a free farrowing system

"Sows can move freely during the farrowing and lactation period"

Images: Left: Brummelhuis; Right: Verba Family Feeder

Learn from the sow and other piglets

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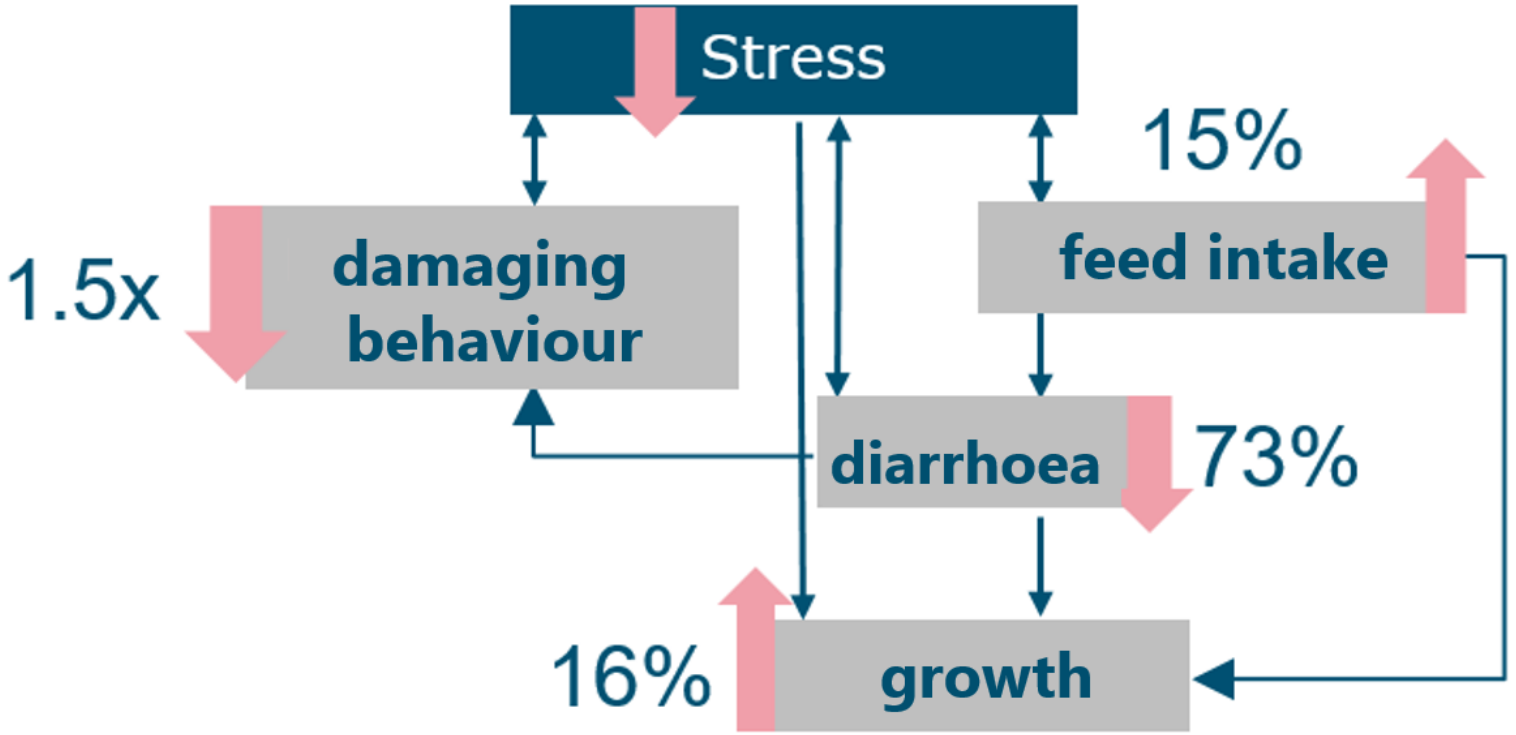
Example of a group system / co-mingling

"Pigs live in stable social groups, which are formed in the pre-weaning period"

Images: Left: J. Pluske; Middle: R. Specht; Right: Unknown

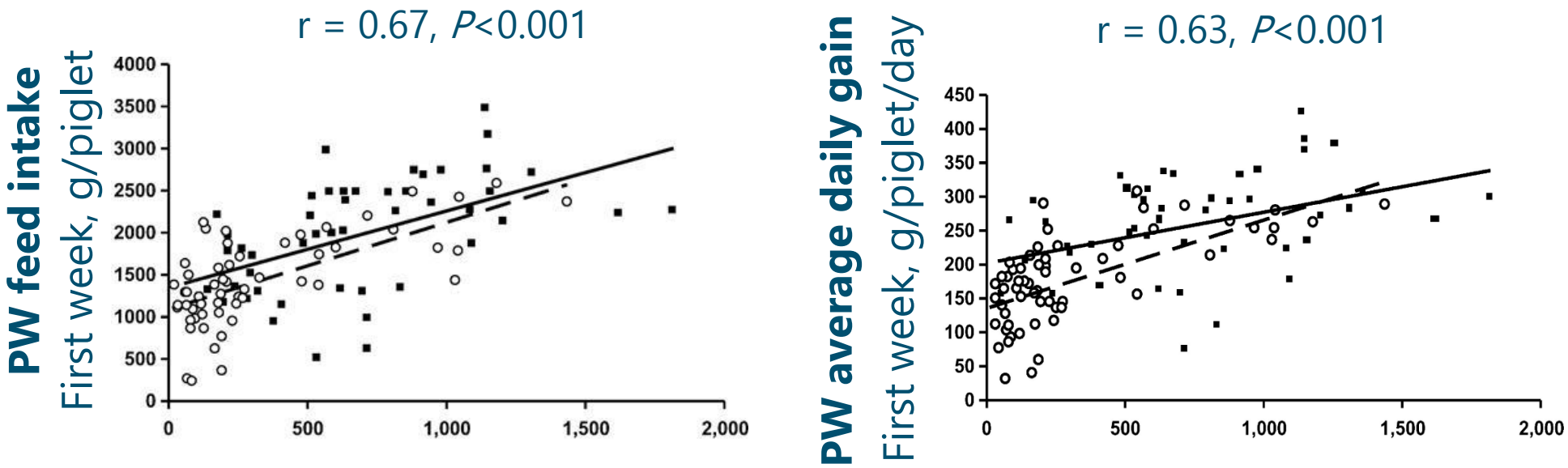
Enrichment to develop foraging behaviours

Post-weaning effects:



Middelkoop, PhD thesis, 2020; Middelkoop et al., 2019; Video: A. Middelkoop

Effects around weaning



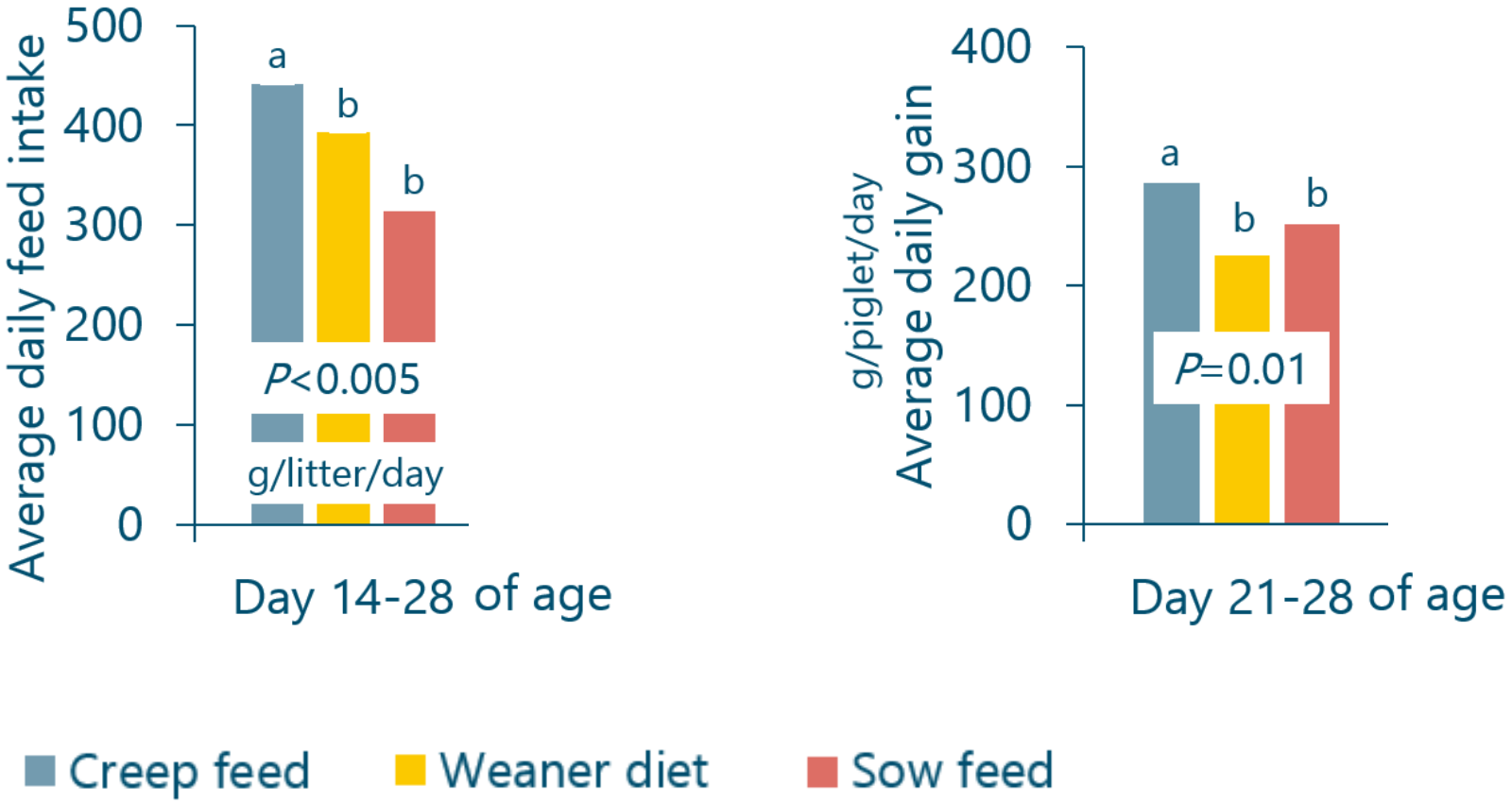
Feed intake before weaning, g/piglet

Day 7-27 of age

Strong correlation when same diet is fed pre- and post-weaning,
but how will these graphs look like when a different diet is fed post-weaning?

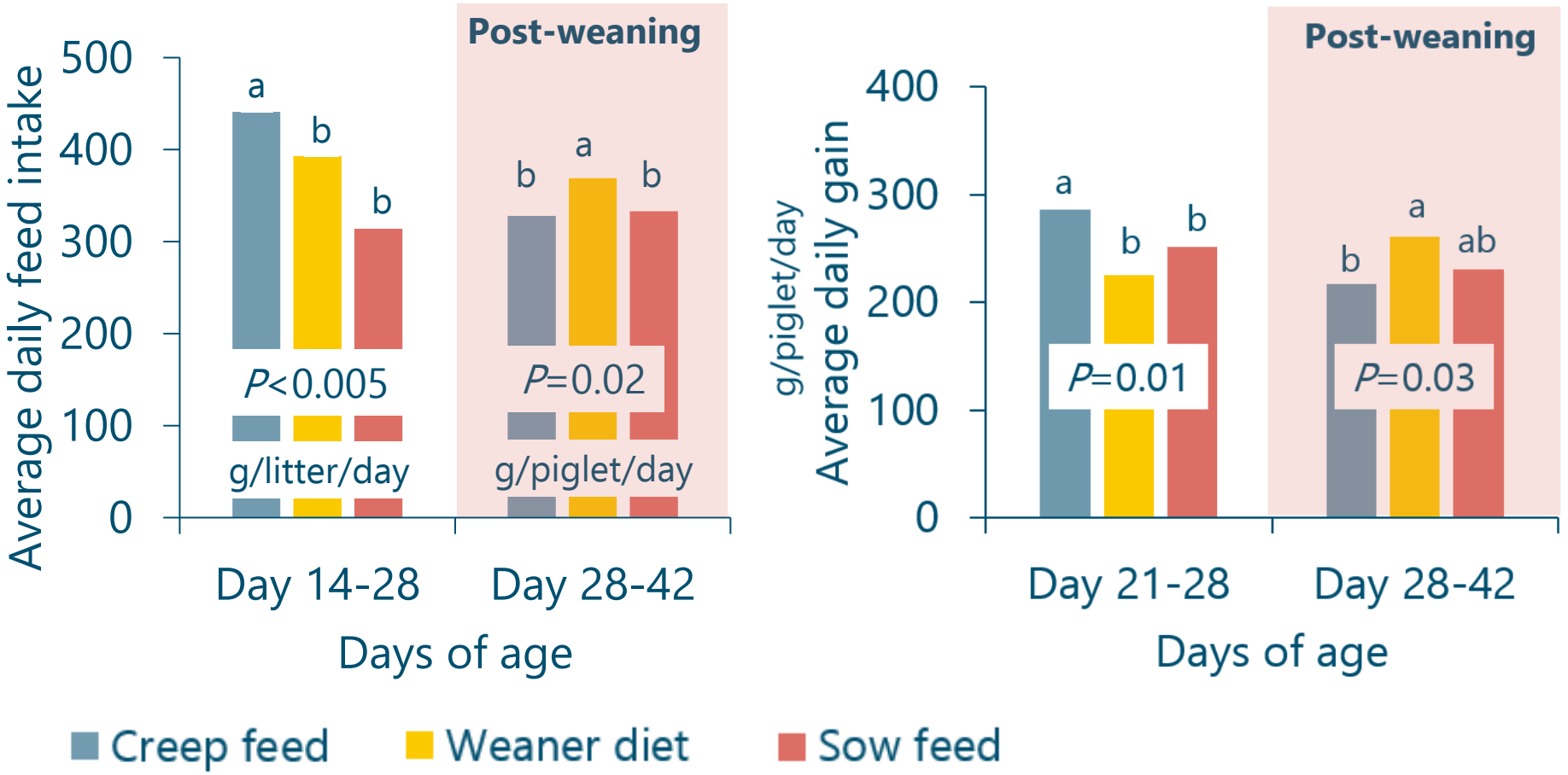
Kuller et al., 2004

Importance of a transition diet



Heo et al., 2018

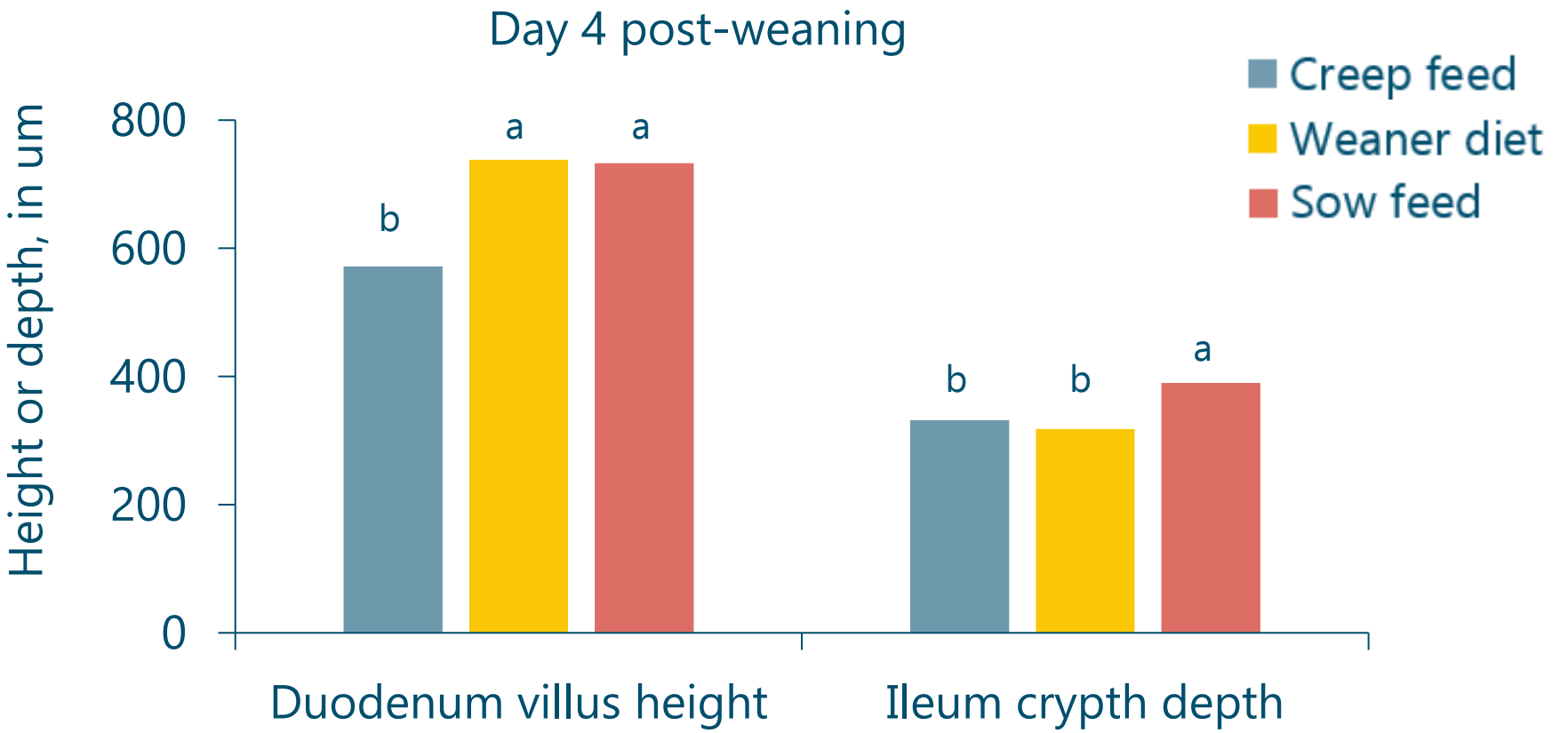
Importance of a transition diet



Similarity more important than absolute creep feed intake for post-weaning benefits?

Heo et al., 2018

Importance of a transition diet



Piglets eating the sow and the weaner diet pre-weaning showed longer villus height in the duodenum.
Piglets eating sow diet pre-weaning showed deeper crypts in the ileum.

Heo et al., 2018

Importance of a transition diet

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- Litters were given a sow lactation diet, weaner diet, both (in separate feeders) or none from D14-28 of age

Pre-weaning effects	Sow diet	Weaner diet	Both	None	SEM	*P*-value
ADFI, D14-21, g/piglet/d	6.02	4.14	6.68	-	1.41	NS
ADFI, D21-28, g/piglet/d	13.85	13.83	30.62	-	4.37	NS
ADFI, D14-28, g/piglet/d	9.88	9.04	13.62	-	2.55	NS
ADG, g/piglet/d	259^{a}	223^{b}	239^{ab}	221^{b}	0.01	0.01
Weaning BW	8.59	8.19	8.25	8.17	0.14	0.08

A diverse diet by combining the sow and weaner diet stimulated feed intake numerically. The sow diet stimulated ADG of piglets in the last week before weaning, resulting in a trend for heavier pigs at weaning

Sands et al., 2021

Importance of a transition diet

SCHOTHORST FEED RESEARCH

- Litters were given a sow lactation diet, weaner diet, both (in separate feeders) or none from D14-28 of age

Effects in the first week post-weaning, D0-7 PW	Sow diet	Weaner diet	Both	None	SEM	*P*-value
ADFI, g/piglet/d	172	185	176	163	10	NS
ADG, g/piglet/d	181^{ab}	209^{a}	192^{a}	163^{b}	15	<0.05
G:F	1.05	1.10	1.09	0.99	0.05	NS

Providing the same diet before as after weaning improves ADG in the first week post-weaning

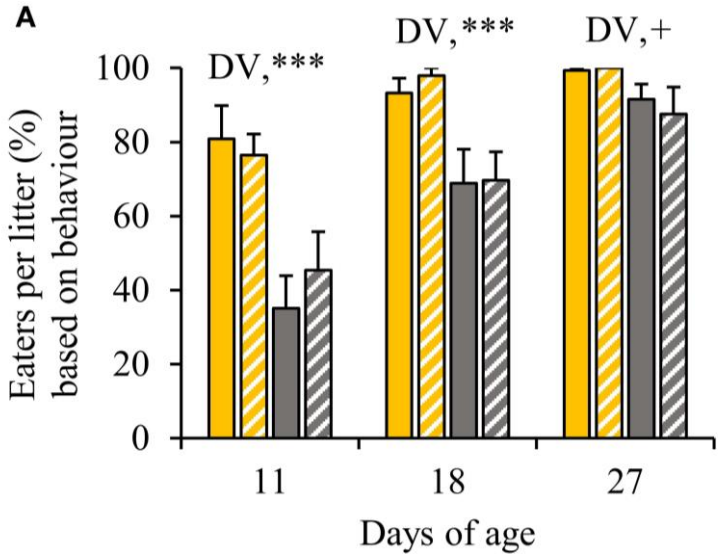
Sands et al., 2021

Dietary diversity for piglets

- Diverse diet vs. monotonous diet, ↑ 1 kg/piglet, d4-28

Feed intake, g/piglet	DD	MO	*P*-value
d4–12	72 ± 17	9 ± 6	**<0.0001**
d12–19	206 ± 38	64 ± 17	**<0.001**
d19–23	291 ± 53	58 ± 14	**<0.001**
d23–28	696 ± 96	129 ± 18	**<0.001**
Total, d4–28	1267 ± 169	260 ± 38	**< 0.0001**

Yellow = DD Grey = MO



Middelkoop et al., 2019

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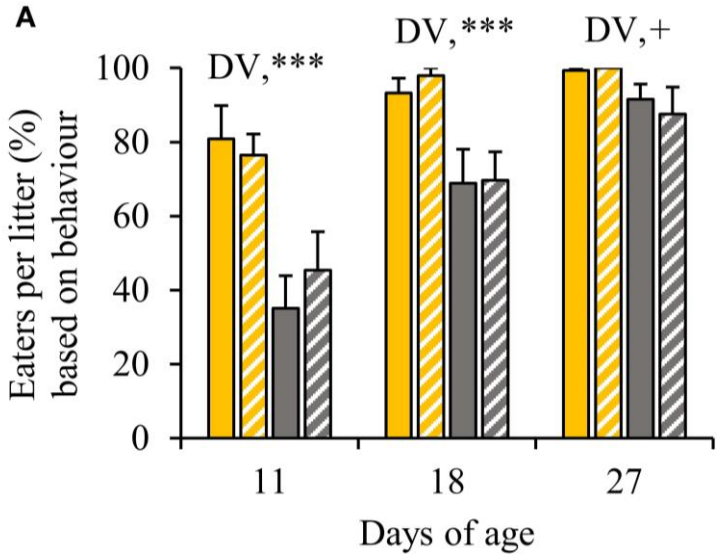
Total, d4–28	1267 ± 169	260 ± 38	**< 0.0001**
Creep feed intake, g/piglet			
d4–12	6 ± 2	9 ± 6	0.82
d12–19	37 ± 10	64 ± 17	**0.07**
d19–23	44 ± 12	58 ± 14	0.49
d23–28	92 ± 21	129 ± 18	0.17
Total, d4–28	178 ± 34	260 ± 38	**0.08**

Yellow = DD Grey = MO



Middelkoop et al., 2019

Dietary diversity for piglets

Minor positive effects post-weaning

Pre- and post-weaning feeding management should match

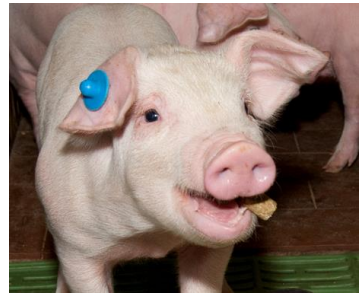
Match in diet around weaning, more important than actual intake?!

Middelkoop et al., 2019

Development of feeding behaviour

- Intake of fluids: from birth
- Intake of solid feed: piglets need to learn this

% of piglets drinking supplemental milk	Litter size	Determined by	Week 1	Week 2	Week 3
De Greeff et al., 2016	13.5	Marker	13%	51%	87%
Kobek-Kjeldager et al., 2020	12-15	Video	59%	65%	61%
Christensen and Huber, 2021	12	Marker	64%	86%	97%



Images: Top: De Snuitgeverij; Middle: FWI, UK; Bottom: Coppens Diervoeding

Supplemental milk vs. creep feed

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- Creep feed (CF, pelleted) or supplemental milk or none were given from day 5-21 of age
- The CF contained corn and fishmeal with no milk-products

 	Pelleted CF	Liquid SM	None	SEM	*P*-value
ADFI, g DM/litter/d	132[b]	452[a]	-	18	<0.001
Eaters, %	77.3[b]	96.9[a]	-	3.5	<0.001
BW at D21	6.02[b]	6.33[a]	5.92[b]	0.14	<0.001

Supplemental milk increases DM intake and % of eaters compared to creep feed, improving pre-weaning performance in terms of body weight

Christensen and Huber, 2021

Supplemental milk vs. creep feed

2×2 design with hygiene and liquid/dry feeding as factors

- Low: only water wash (no detergent/disinfectant/drying)
- High: detergent + water + disinfectant + drying

- High hygienic pigs had a 43% higher ADFI than low hygienic pigs before weaning, without an effect on ADG
- Liquid feeding of suckling piglets increased their ADFI in high, but not in low hygiene conditions

Choice for liquid or dry feed is dependent on the hygiene conditions on the farm

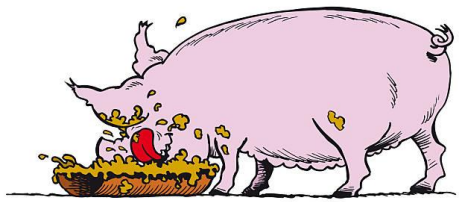
Vasa et al., 2025

Porridge vs. pellets

- Mix creep feed with water or supplemental milk
- Pellets vs. porridge* from D4-21
- Thereafter a pelleted transition diet was given (D21-28)

* Creep feed pellets-to-water ratio of 1:3 was used

Daily creep feed intake (g/d) based on dry matter	Pellets	Porridge	*P*-value
D4-21	5.6	9.5	<0.001
D21-28	41.0	50.4	0.01
Total, d4-28	14.5	19.7	<0.001



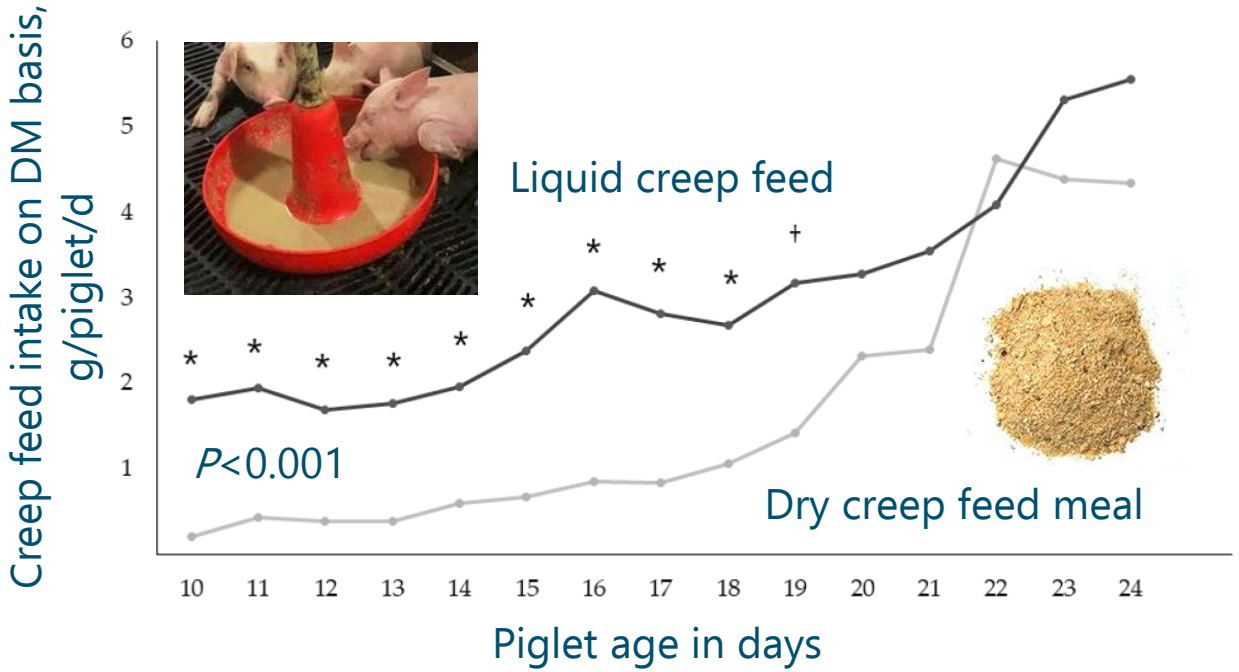
Clouard et al., 2018

Porridge vs. meal

Mix creep feed with water or supplemental milk

- Meal vs. porridge* from D10-24

* Creep feed meal-to-water ratio of 1:1.5 was used



Liquid creep feed (20.1 g/piglet) increased creep feed intake on DM basis between D10-18 vs. dry creep feed meal (5.4 g/piglet), but not thereafter until D24

Byrgesen et al., 2021

Porridge vs. meal

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However, meal stimulates pre-and post-weaning ADG, resulting in heaver pigs at 61 days of age vs. porridge

Average daily gain, g/piglet/d	Meal	Porridge	*P*-value
Pre-weaning, D10-24	241	224	0.031
Post-weaning, D24-61	411	378	0.087
Body weight at D61, kg	21.6	19.7	<0.01

*Weaning at day 28, but body weights were not determined at this day

➢ How can we explain this?

Mixing creep feed with water or supplemental milk can be used to stimulate DM intake in early lactation but one should swith to dry feed timely before weaning for proper post-weaning performance

Byrgesen et al., 2021

Porridge vs. meal

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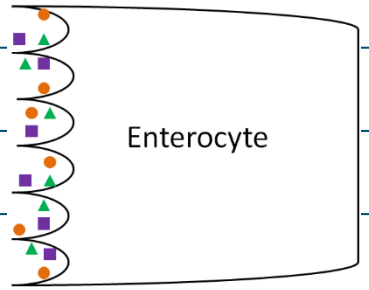
Meal-fed piglets had greater enzyme activity vs. porridge-fed piglets

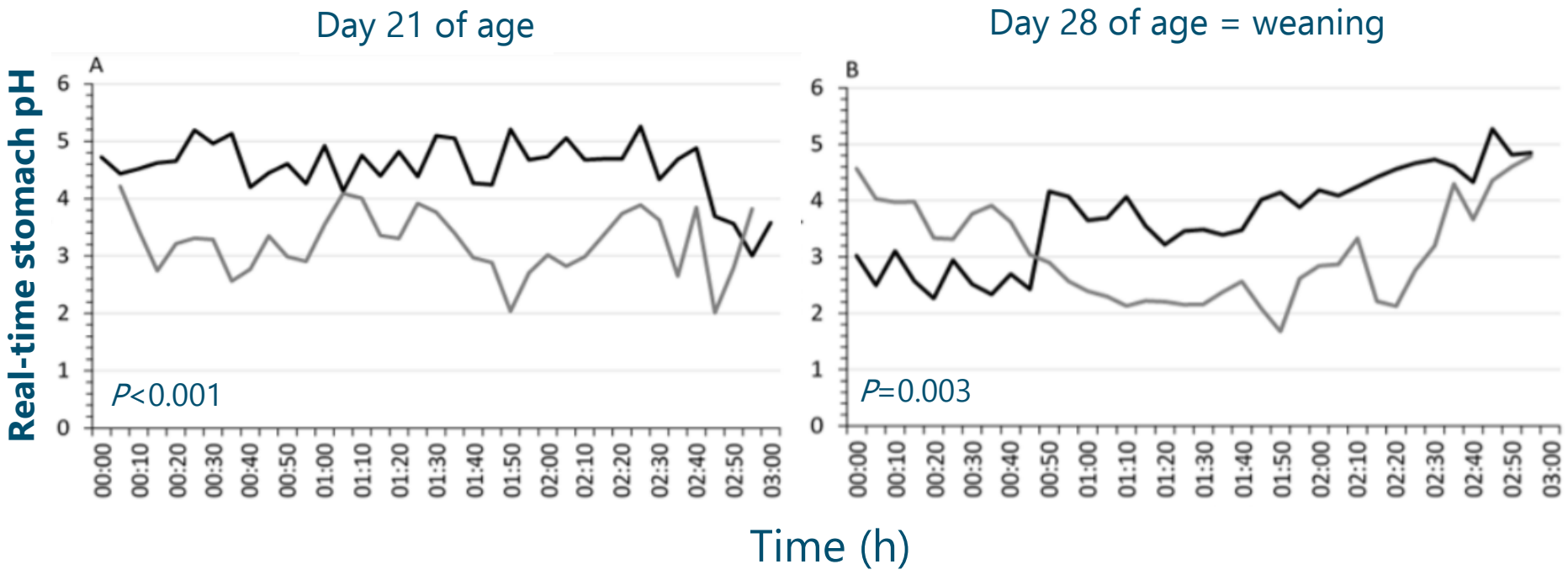
Enzyme activity in the proximal small intestine at D24, U / g	Meal	Porridge	*P*-value
Maltase ●	16.9	11.0	<0.01
Sucrase ■	7.3	3.4	<0.001
Lactase ▲	25.4	14.1	0.001



Increased maltase and sucrase activity suggest an increased digestive capacity of meal versus porridge-fed piglets, which may indicate improved mucosal maturation

Byrgesen et al., 2021; Lyderik et al., 2023

Reduce stomach pH

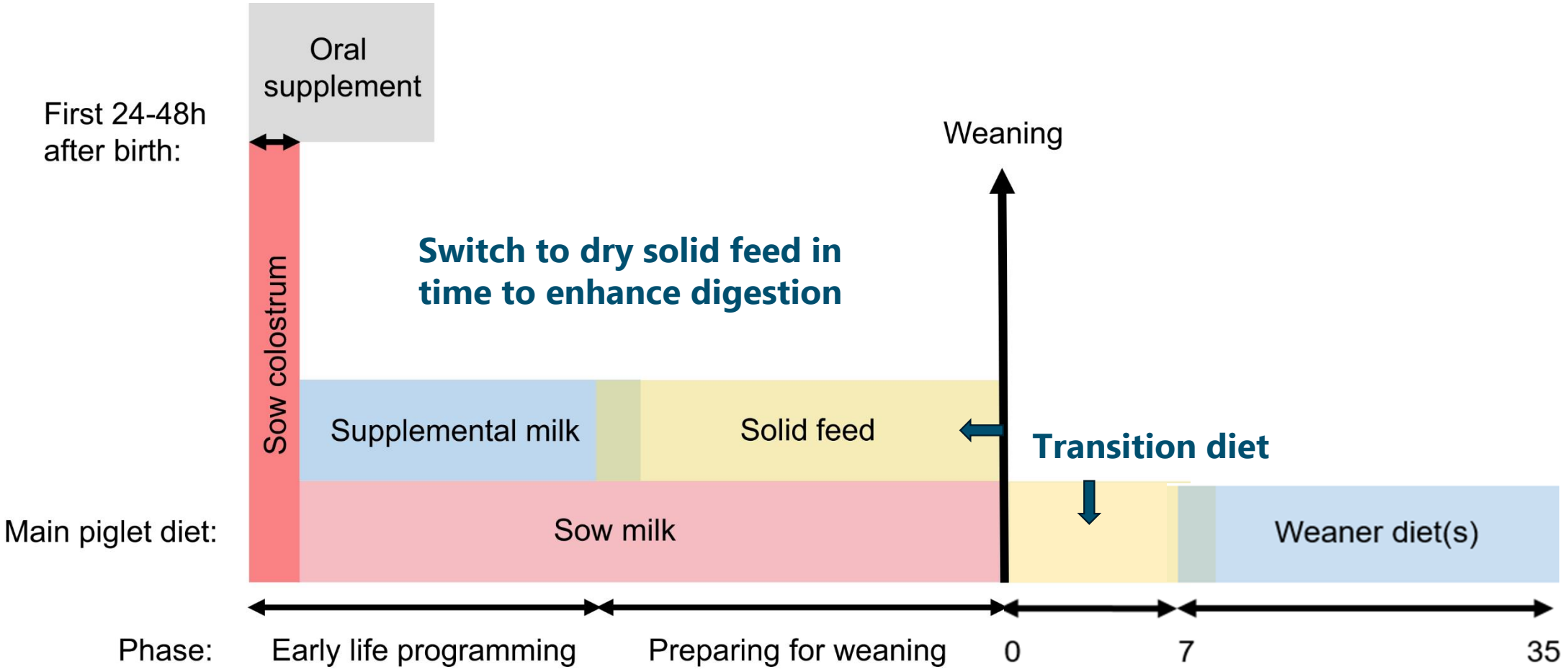


No creep feed provided	4.55[a] at day 21	3.70[a] at day 28
Creep feed provided from day 14-28 of age	3.24[b] at day 21	3.08[b] at day 28

Solid feed reduced stomach pH, which suggests that HCl secretions were more efficient

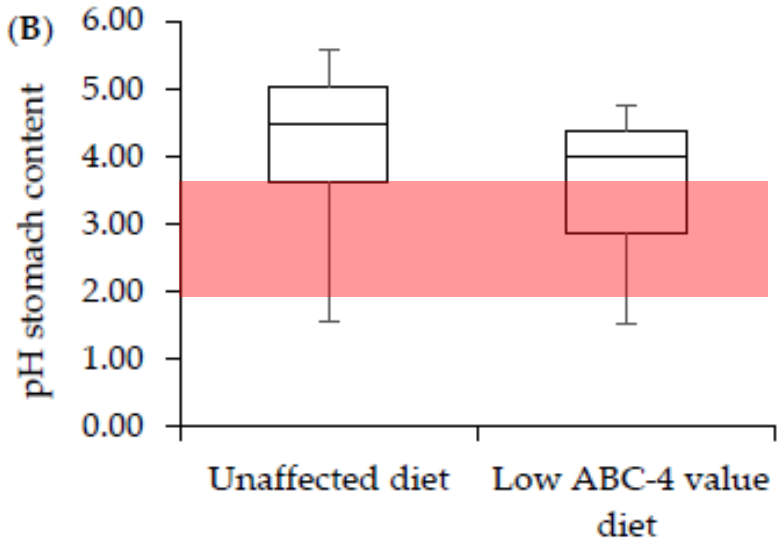
Lee et al., 2021

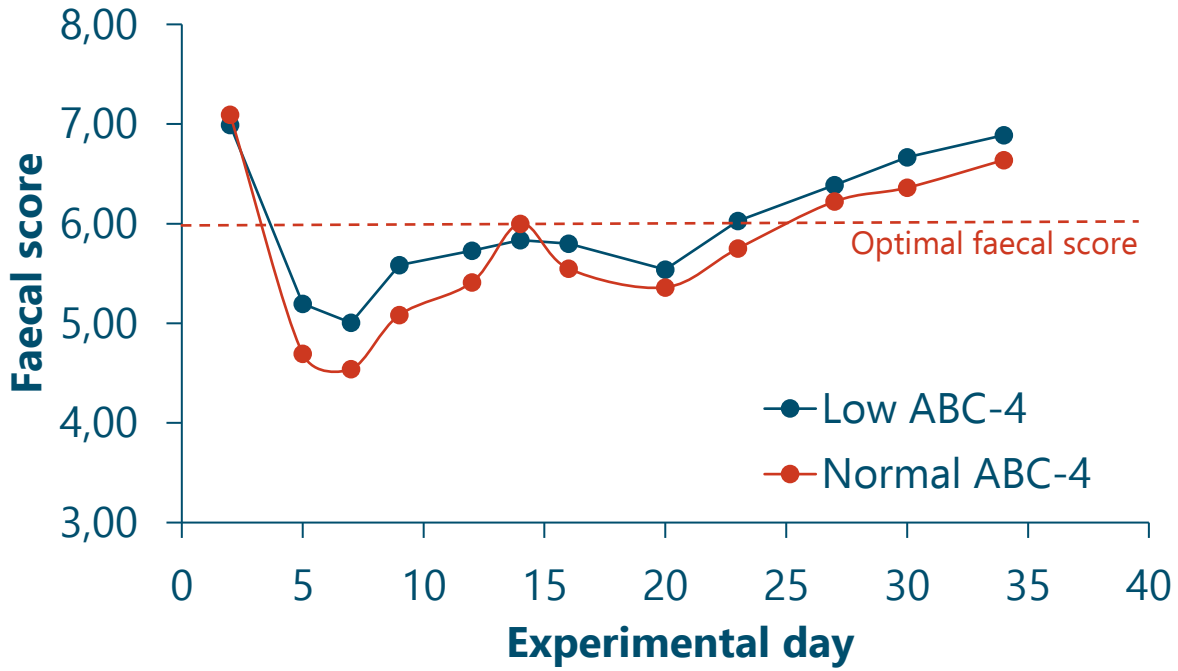
Structured nutritional approach



SFR: Huting et al., 2021

Reduce stomach pH



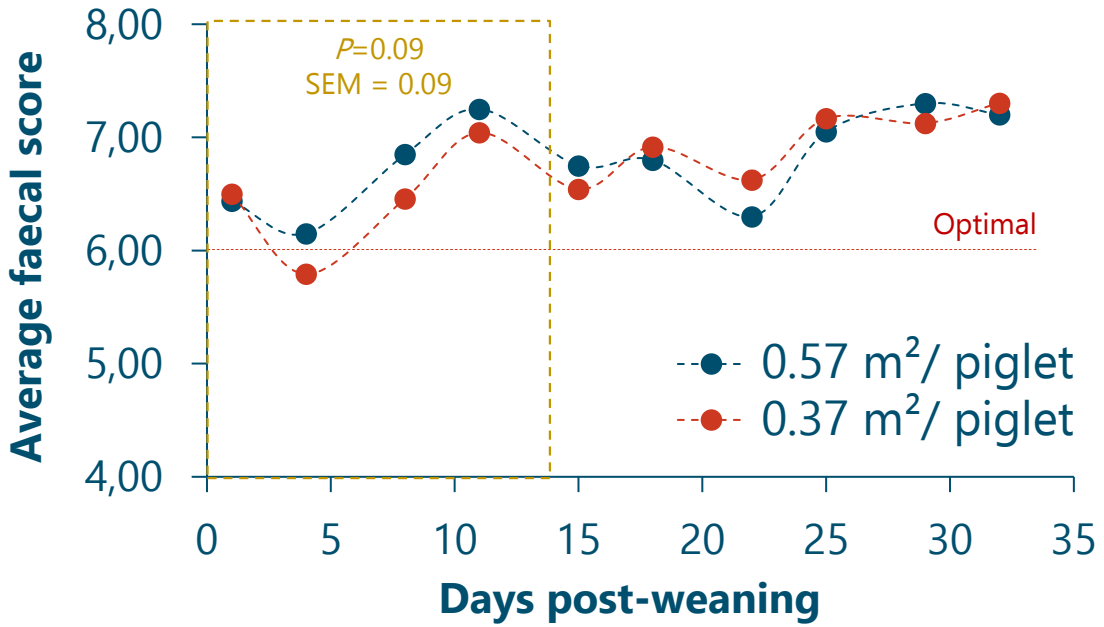


Dietary acidification can lower the stomach pH and improve the faecal score of weaned piglets

SFR: Huting et al., 2021

Stocking density

Piglets at 0.37 m² grew 7% faster than piglets at 0.57 m²



Description	Intact tail	Damaged tail	Incomplete tail
0.57 m²/ piglet	97.9	0.0	2.1
0.37 m²/ piglet	95.8	3.5	0.7

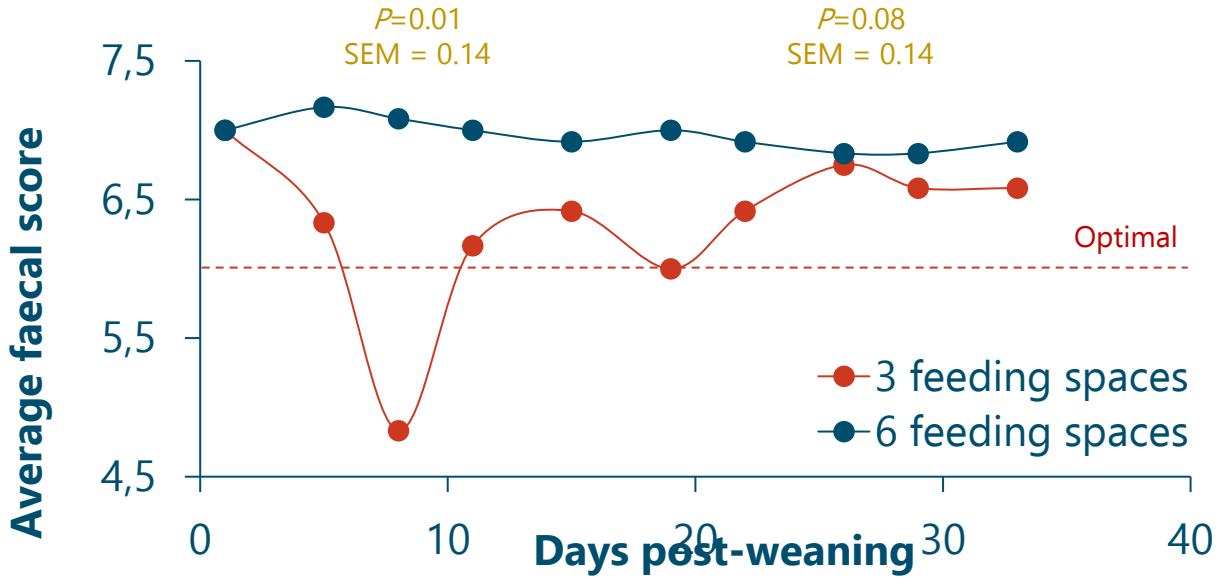
P=0.12

Stocking density not only affects pig performance, but also gut health and behaviour

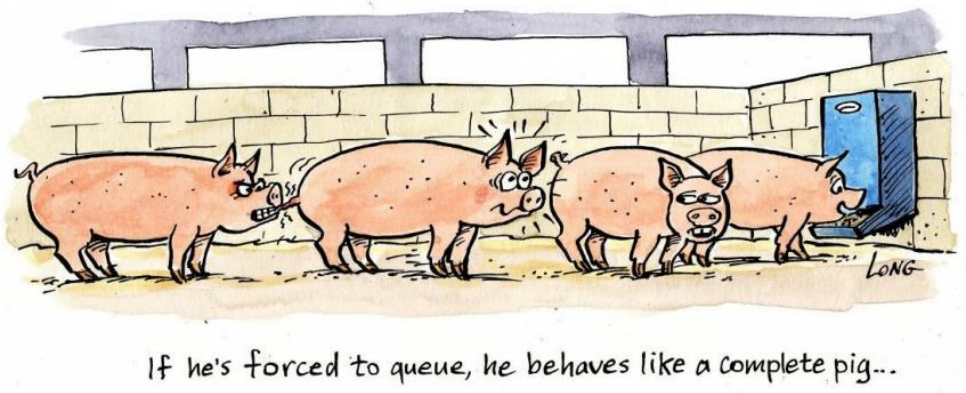
Huting et al., 2024

Feeding places

Piglets with 6 feeding spaces had a lower FCR between D0-14 (1.4 vs. 1.7; *P*=0.06)



6 piglets/pen,
comparing 1 vs. 0.5 feeding places per piglet



Increasing the nr. of feeding places improves post-weaning FCR and faecal consistency

SFR: Huting et al., 2023; Cartoon: S. Long

Feeding places

Ammonia CO_2 Draught
Too few places to eat/ pig Humidity
Irregular feeding Diet composition
Housing density Drinking water (availability, amount)
Available staff Enrichment material
Hygiene Type floor Gender Body weight
Genetics Health

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Description	Intact tail	Damaged tail	Incomplete tail	*P*-value
	Day 14 PW			
3 feeding places	95.8	4.2	0.0	NS
6 feeding places	100	0.0	0.0	
	Day 28 PW			
3 feeding places	93.8	6.3	0.0	0.03
6 feeding places	87.5	10.4	2.1	

Because of different rooms and floor?

Tail biting is a multi-factorial problem

SFR: Huting et al., 2023

Functional fibre

Bacterial binding

Fermentability Viscosity

Water binding capacity

Physical effect

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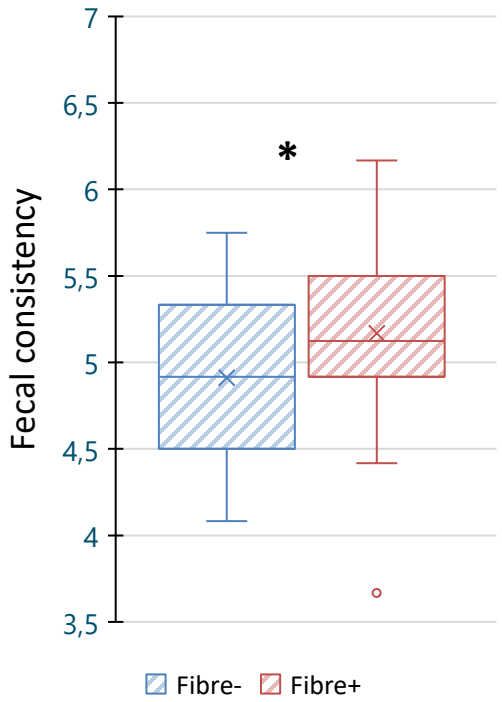
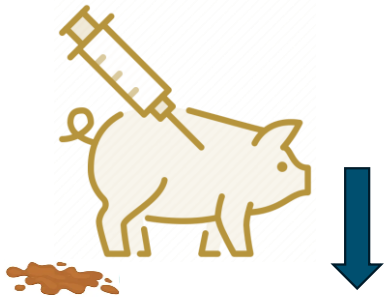
Week 1+2 PW





Reduction in diarrhoea related AB treatments due to fibre strategy

No effects on piglet performance!

AVANT

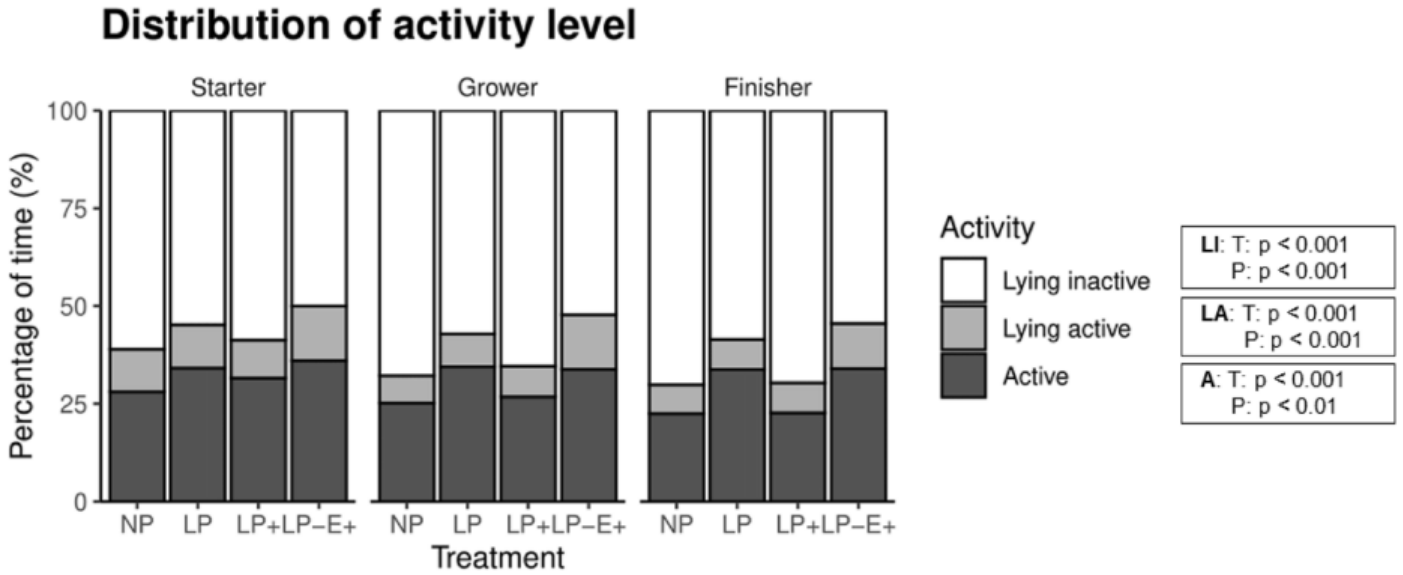
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 862829.

An optimised fibre content of the diet can reduce post-weaning diarrhoea and associated treatments, but requires a farm-specific approach based on farm type and management e.g. hygiene, weaning age

AVANT EU-Project, 2025

Amino acids and enrichment

- **NP**: Normal CP diet (175 g/kg, 159 g/kg, and 143 g/kg)
- **LP**: Low CP diet (-20% CP of NP)
- **LP+**: Low CP diet + EAA (EAA at same level of NP)
- **LP-E+**: Low CP diet + enrichment (wooden beam, rope, and straw 350 g/d)



LP and LP-E+ had a worse ADFI, ADG and FCR, and were more active, than NP and LP+ pigs

Reducing the dietary protein level impairs pig performance and increases activity level

Minussi et al., 2023

Amino acids and enrichment

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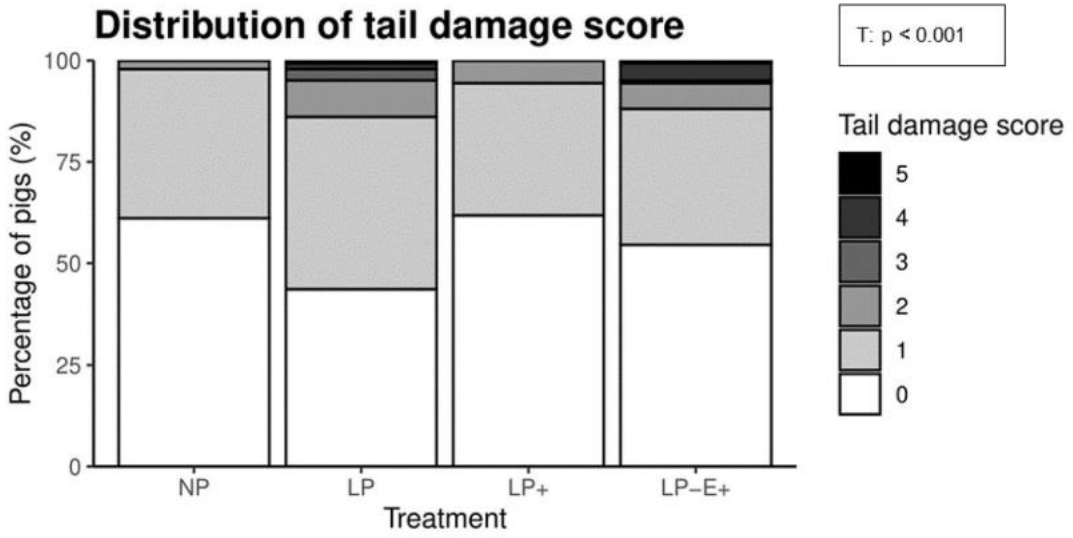
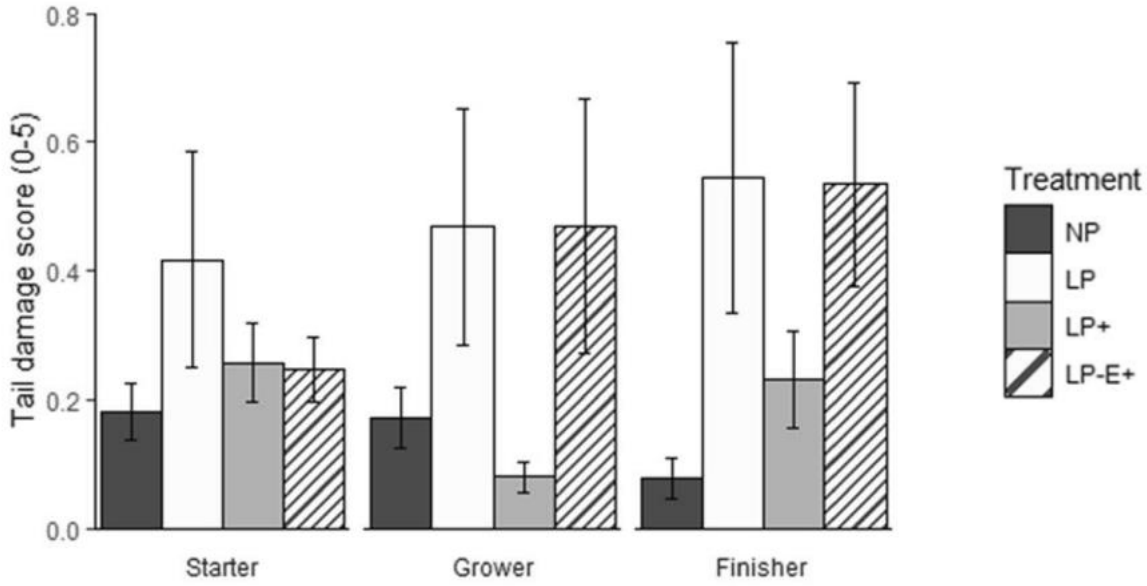
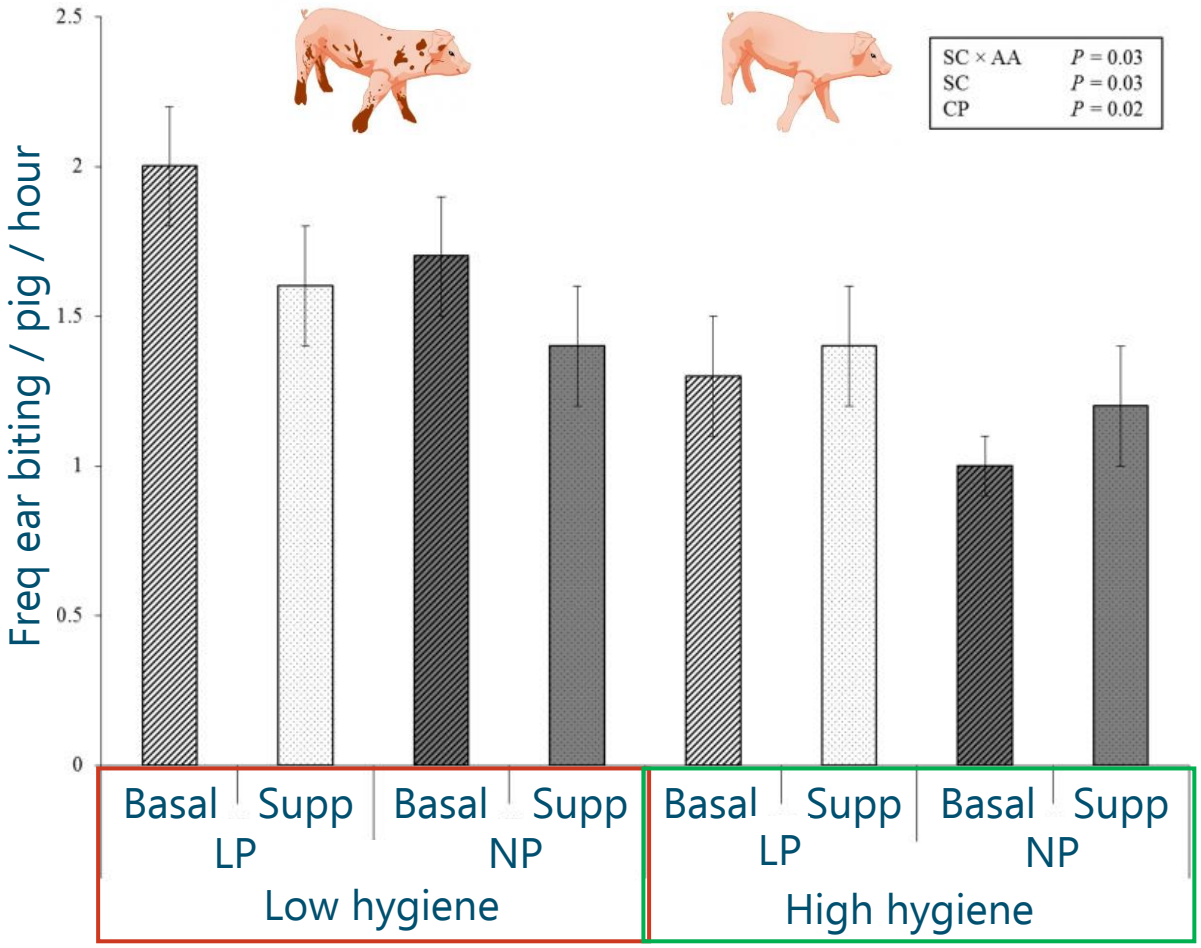


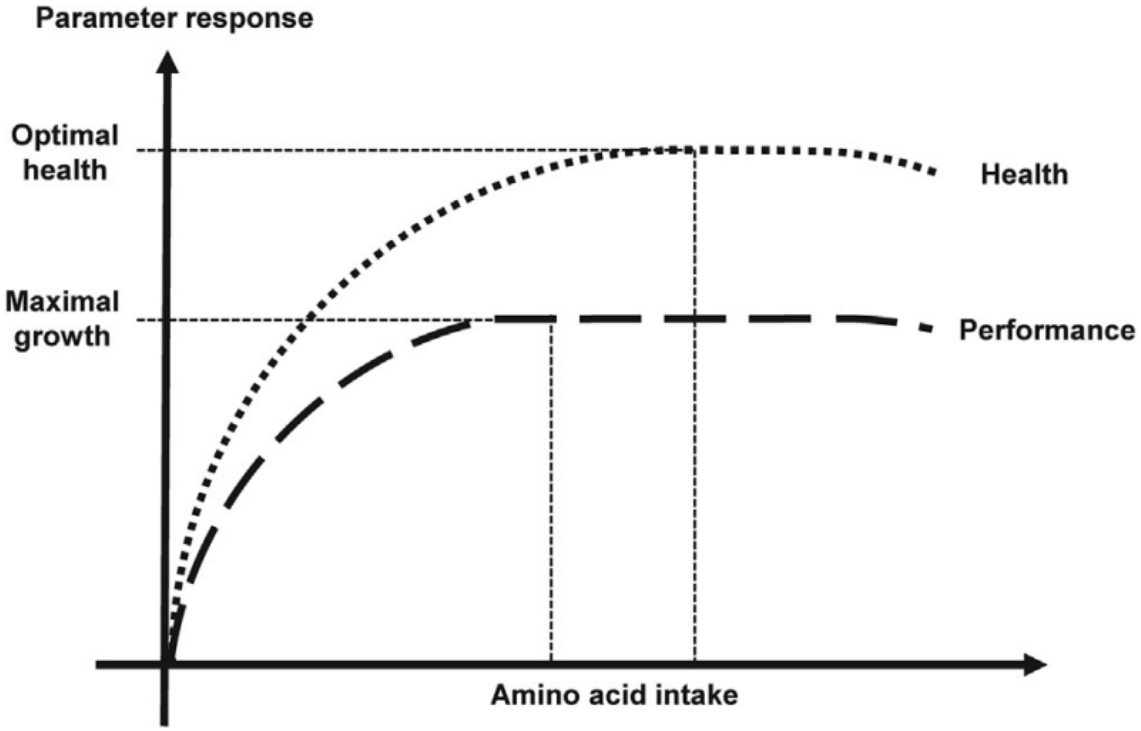


Reducing the dietary protein level can increase the risk for tail damage
Amino acid supplementation was more effective than extra enrichment in counteracting these negative effects

Minussi et al., 2023

Amino acids and hygiene





AA supplementation especially relevant at low hygiene status → Relationship health, CP level and damaging behaviour

Van der Meer et al., 2017; Chalvon-Demersay, 2021

Take home message

Pre-weaning

➢ Loose housing of sows in the farrowing room provide opportunities for piglets to develop their feeding behaviour

➢ Create a structured nutritional approach over time based on pre- and post-weaning management

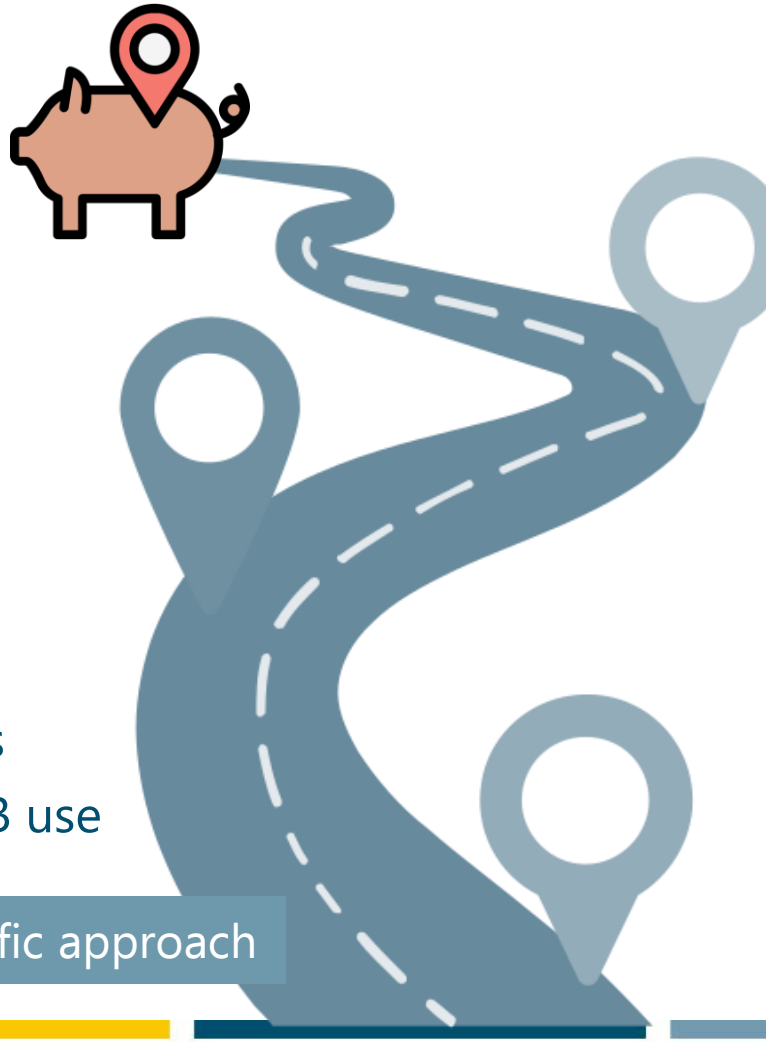
- Use a transition diet (in dry form) 1 week before to 1 week after weaning

Post-weaning

➢ Increase the nr. feeding spaces/piglet to improve faecal consistency

➢ Adding essential AA to LP diets is necessary for pig health and intact tails

➢ Dietary acidification and an optimized fibre level can reduce PWD and AB use



Farm-specific approach

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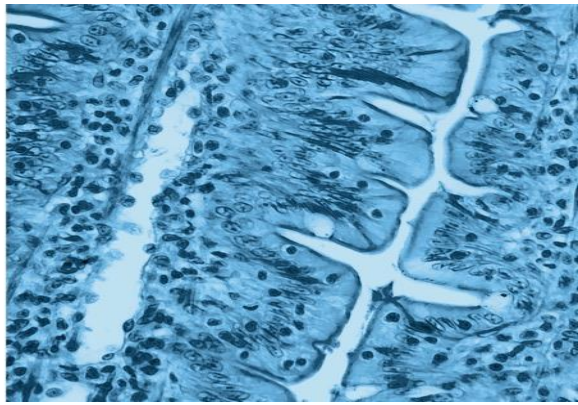

Thank you for your attention

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Knowhow to feed