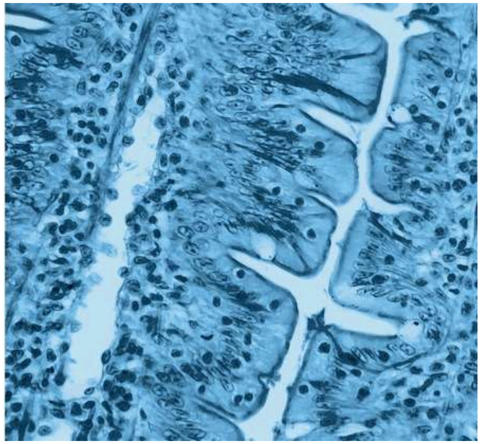
XLVII Meeting Annuale SIPAS

Gugno 2022



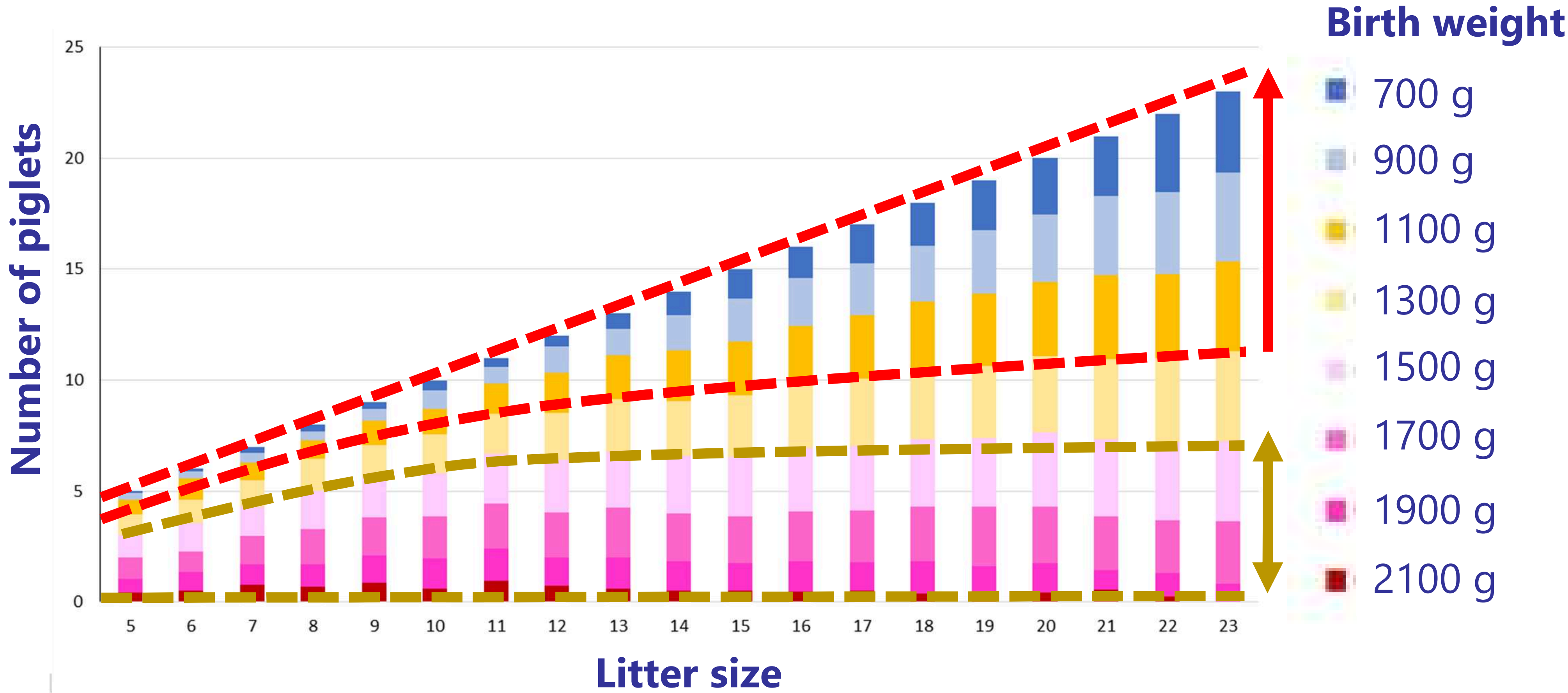


Programmi di alimentazione per suinetti dopo lo svezzamento senza antibiotici e Zno. L'esperienza Olandese

Francesc Molist, PhD, DVM

Genetic development sow - consequences

- Bigger litters → more piglets with a low birth weight (<1100 g)



(SFR / 3113 litters / 2011-2017, unpublished)

Types of feed piglets encounter in their life

SCHOTHORST FEED RESEARCH

Colostrum
The first 24 hours

Milk replacer

Weaning

Creep feed

Sow milk

Post weaning

Week 1 | Week 2 | Week 3 | Week 4 | Week 5....

PW diet

Pre-weaning

- Important colostrum intake.
- Long-lasting effects are due to different programming of the gut immune system. What are the long lasting effect of modifying the gut microbiota?
- Creep feed supplementation as early as possible.
- Develop an stable microbiota and oral tolerance & a robust GIT.
- Minimize the negative effects associated with weaning.
- Role of complex diets vs. simple diets pre-weaning is poorly understood.

Development of the gut microbiota: interventions via de sow and/or via pre-weaning diet(s)

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SIMPLE AND UNSTABLE COMMUNITY

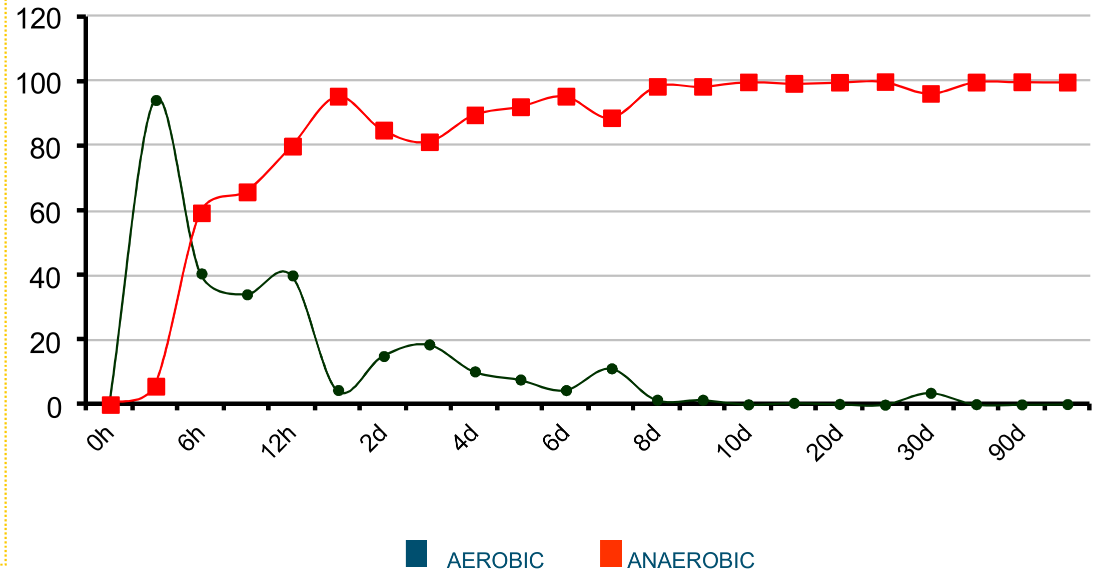
COMPLEX AND STABLE COMMUNITY

ANAEROBIC

ANAEROBIC FACULTATIVE

STERILE GIT

Vagina | Feces | Farm



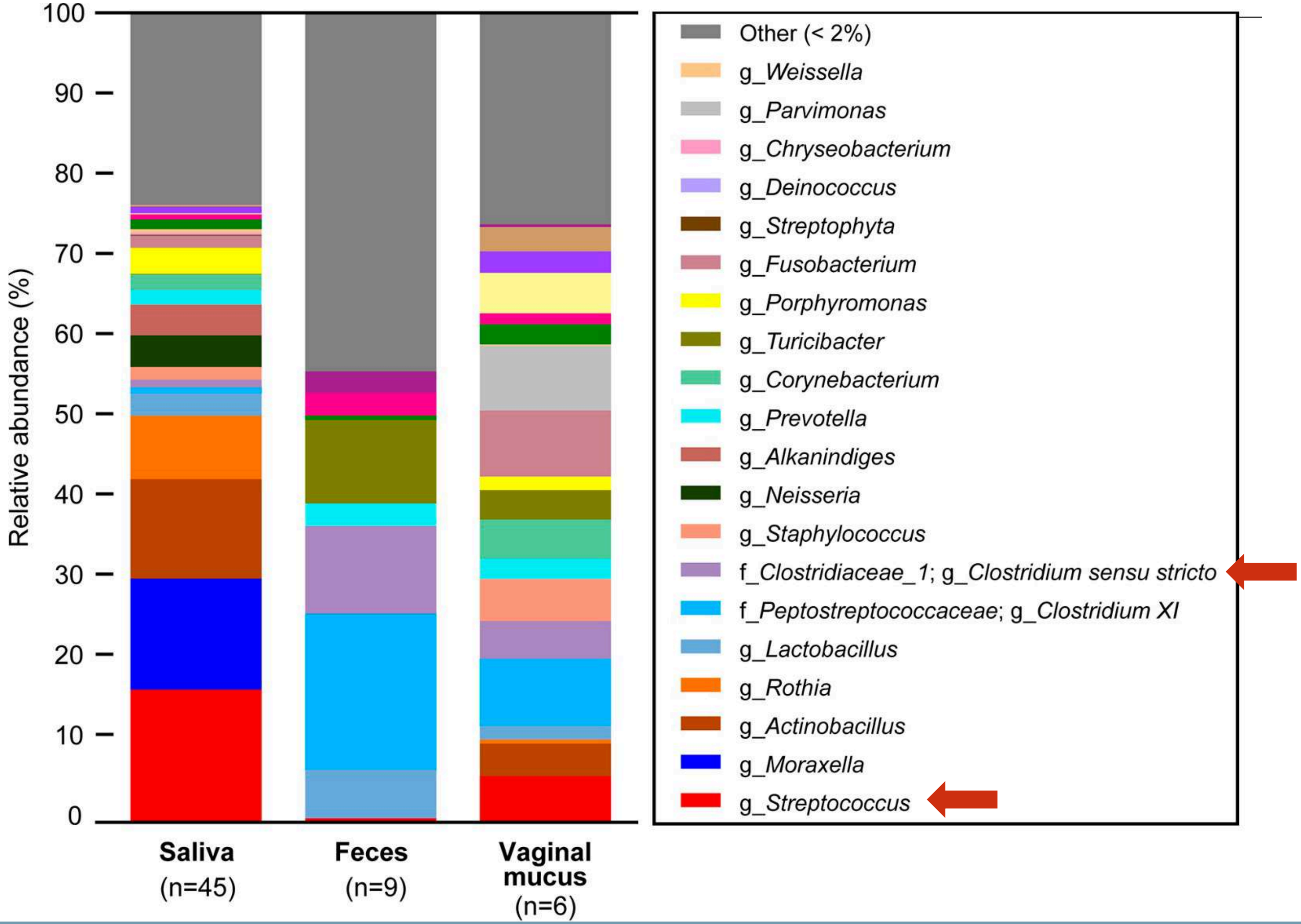
>500 different species

ANAEROBIC 99%

90 % Gram +
10 % Gram -

Swords, 1993

Composition of bacteria in the sows



Probably we need different strategies to reduce *S. suis* problems vs. Clostridium neonatal diarrheas

Feeding strategies in pre-weaning diets

SCHOTHORST FEED RESEARCH

Colostrum
The first 24 hours

Focus on developing microbiota and innate immune system > **Role for prebiotics via milk replacer or creep feed?**

Milk replacer

Focus on having a robust GIT and preparing the piglets for the weaning period > **Role complex vs. simple diets**

Weaning

Creep feed

Sow milk

Post weaning

Week 1

Week 2

Week 3

Week 4

Week 5....

Diet around weaning

Post-weaning

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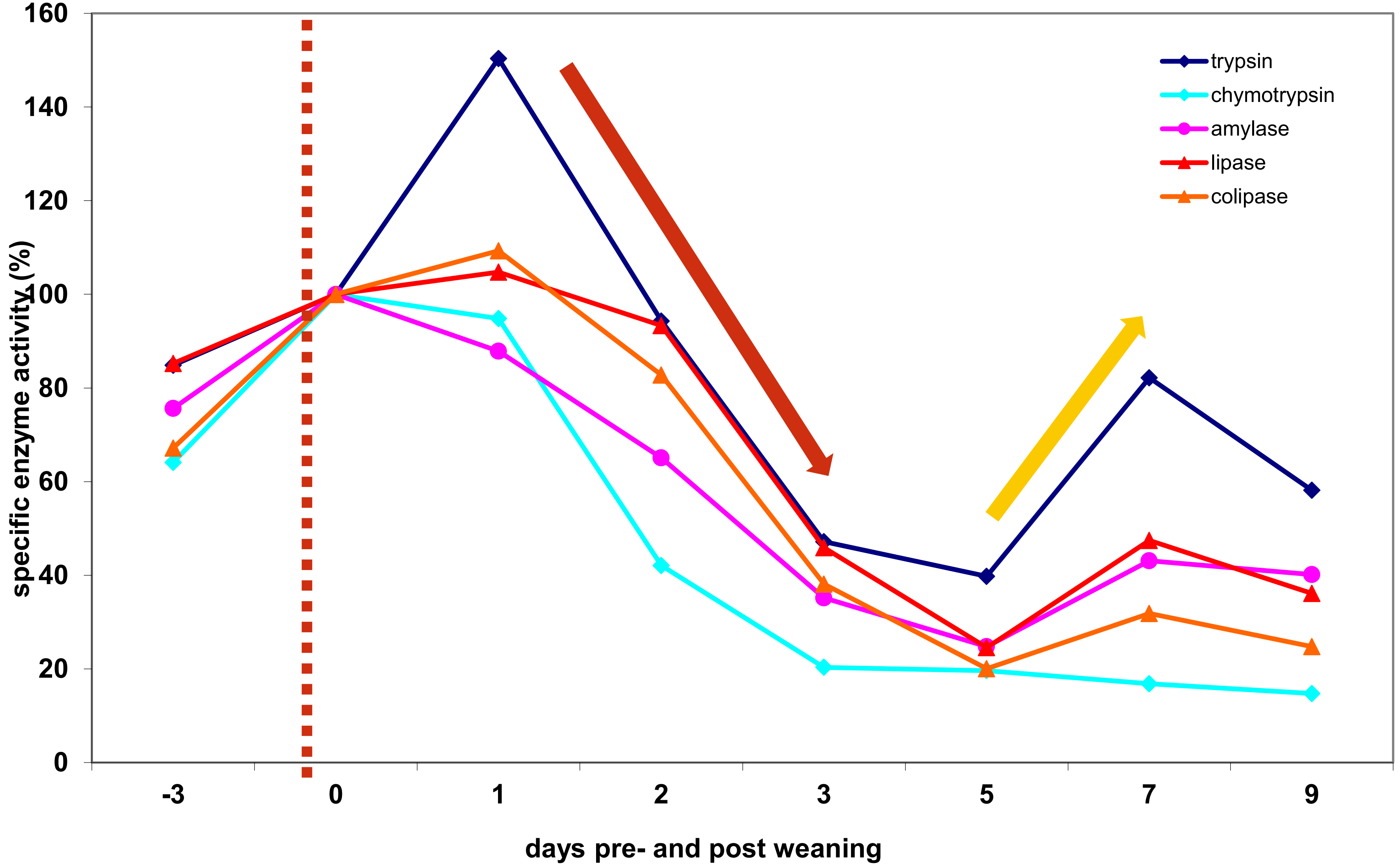
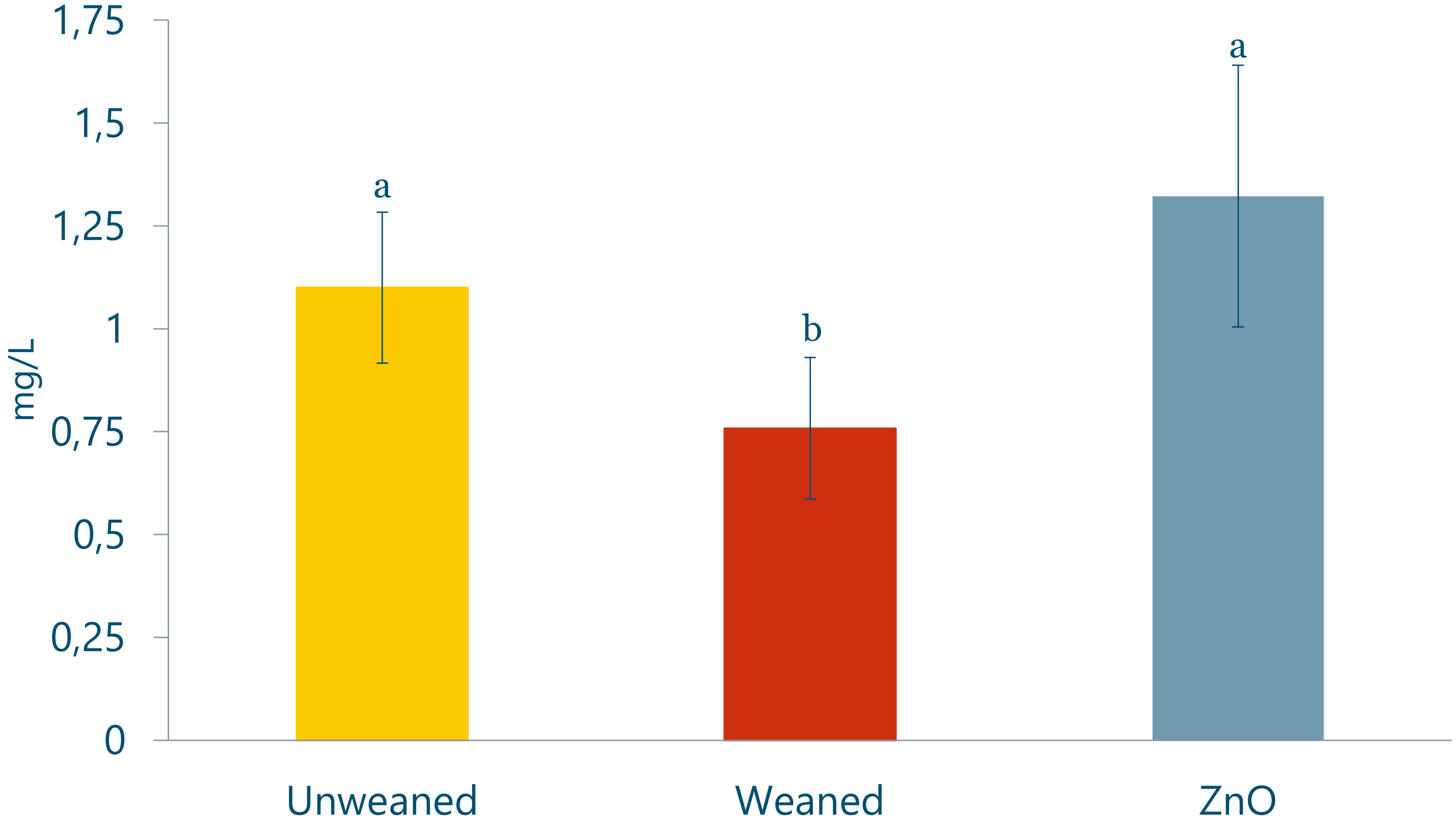
- Important feed intake with control of substrate.
- Phase feeding with nutrient adaptations can help to minimize the risk factors.
- Important management to reduce stress.
- Better knowledge nutrition and vaccination.
- Better understanding substrate – bacteria interactions.
- Animals should remain healthy and then they should grow

PW effect on pancreas enzymes



Hedemann, 2004

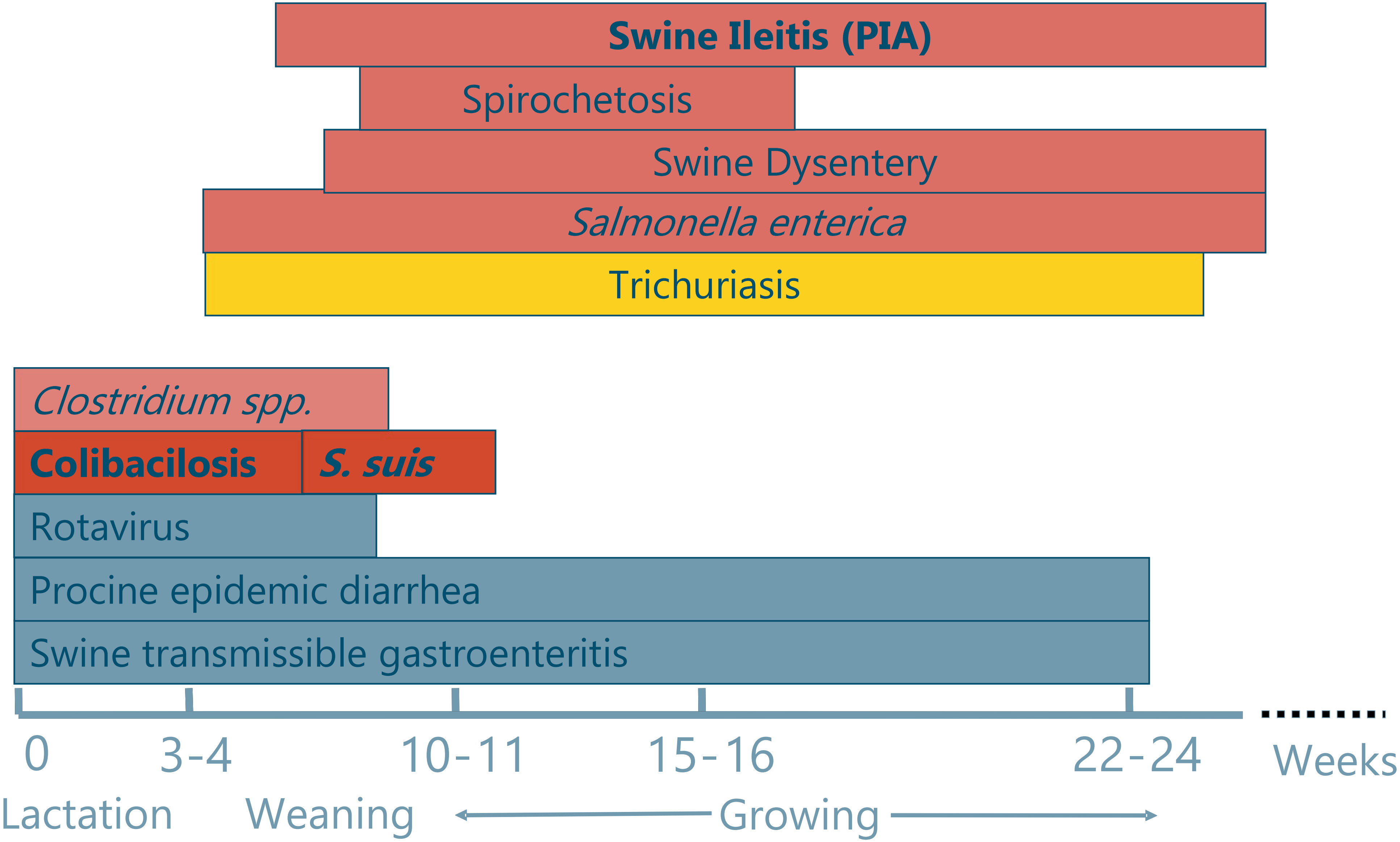
Zn concentration in Plasma at 28 d of life



Davin et al., 2018

- **Weaning creates a deep in the Zn plasma levels.**
- **Supplementation of 2000 ppm of ZnO was the only solution to keep Zn plasma levels high. What means this?**

Current gut health challenges in the pig industry



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WEANING

20 DAYS

5 - 10 days

ACUTE PHASE

- Anore a & i estinal stasis
- N & absorption
-
- Int
- Intesti al da age

PW diarrhea (PWD)

5-10 days

MATURATION PHASE

- Feed in
- Nu
- R ve

Excess nutrients increase the risk of *S. suis*

How we can help the piglets to have a good start?

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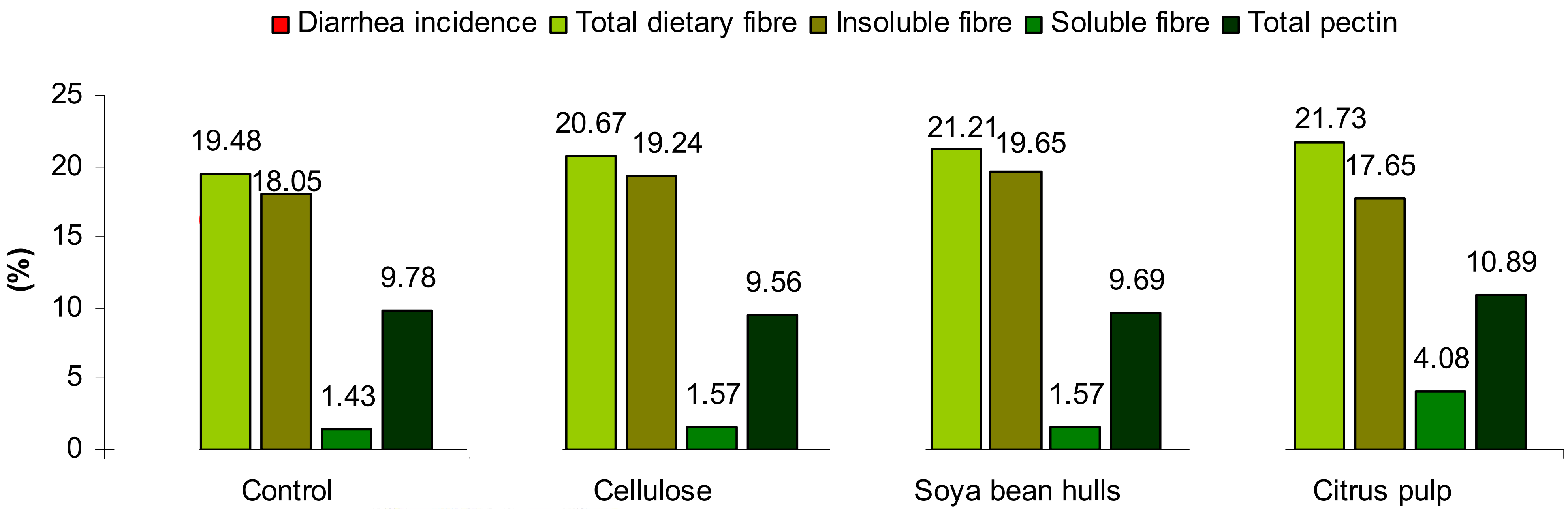
MODIFIERS OF THE MICROBIOTA OF THE GIT

- Acidifiers
- Prebiotics
- Probiotics
- Symbiotics
- Plant extracts
- Minerals: ZnO & Cu
- Dietary fibre
- Low CP diet
- Role of fat

PROMOTERS OF FOOD CONSUMPTION AND PRODUCTION ENHANCERS

- Palatable ingredients
- Digestible ingredients
- Flavours
- Synthetic amino acids

Effect of diet composition on diarrhea incidence the first 2 weeks PW



	21 and 35 days of age			
	C	CEL	SH	CP
Corn	47.13	45.09	44.19	38.73
Soybean meal	29.63	29.98	29.49	29.32
Milk product[2]	17.14	17.14	17.14	17.14
Soybean oil	1.48	1.96	1.86	1.62
Citrus pulp	-	-	-	9.00
Soybean hulls	-	-	3.00	-
Purified cellulose	-	1.50	-	-

The analytical characterization does not predict the functional effect of fibre ingredients in piglets.

Fonseca et al., 2012

What is the role of fibre in PW diets?

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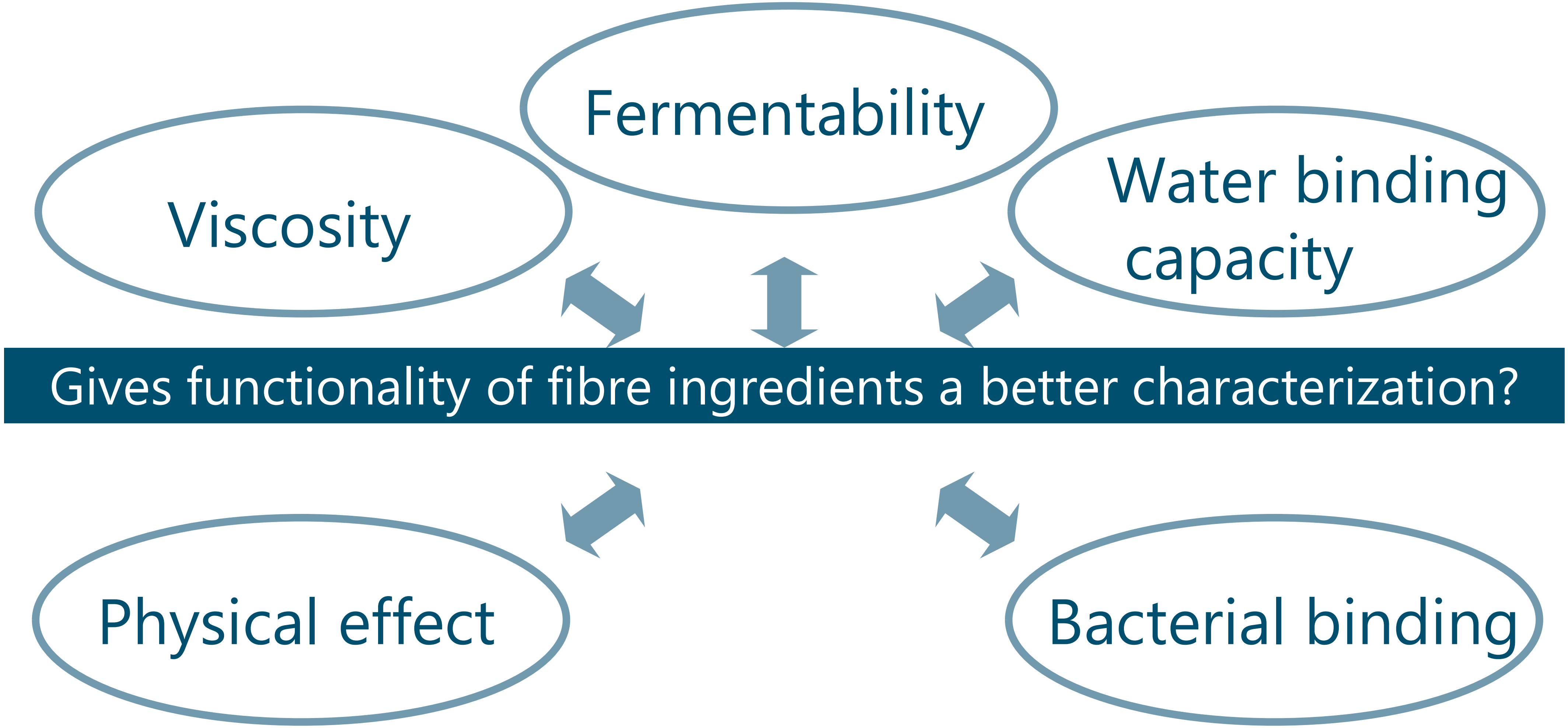
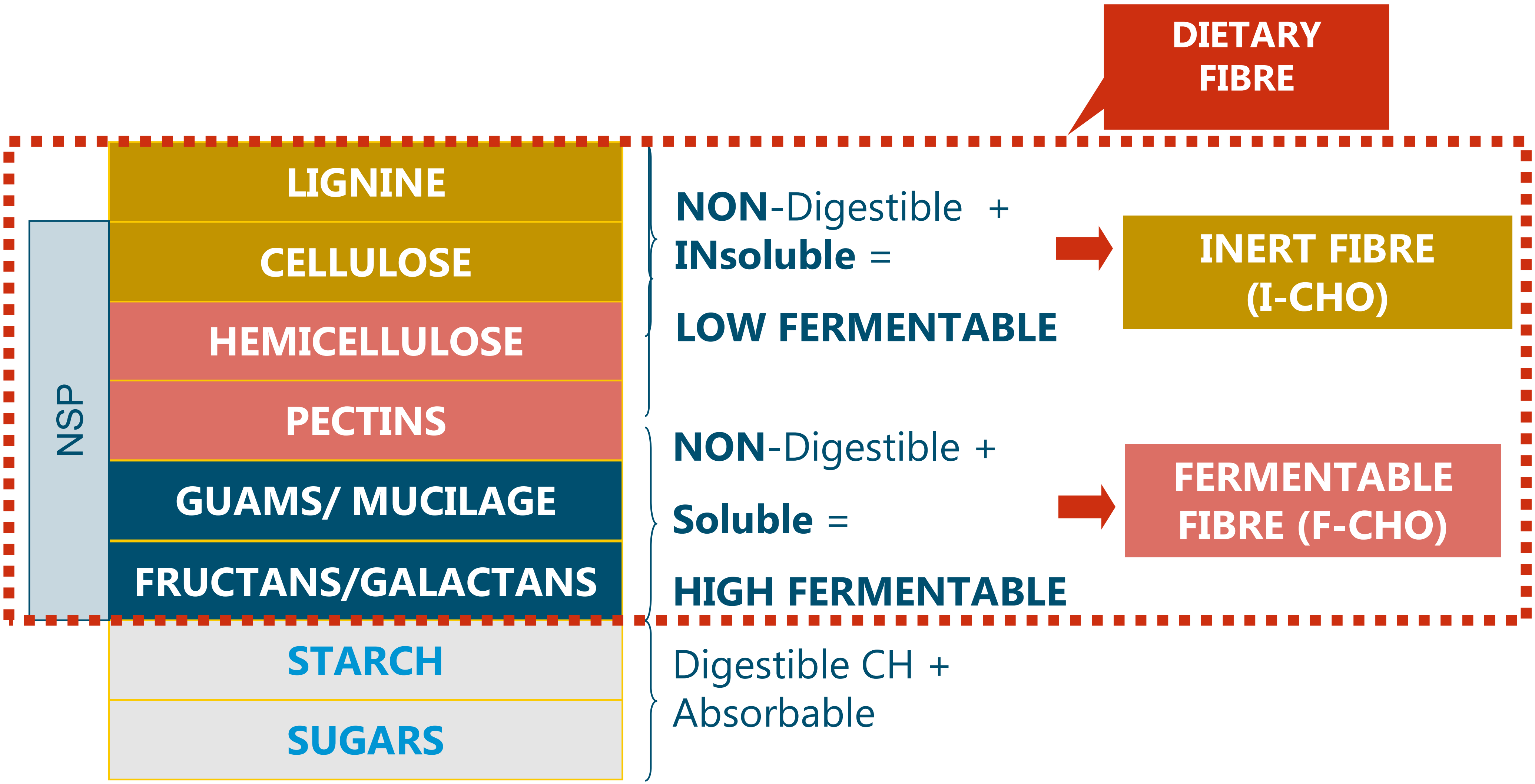


Fermentability & Solubility



Fermentability & Solubility

OAT HULLS
STRAW
WHEAT BRAN (WB)
RICE HULLS
SUNFLOWER HULLS

SOYBEAN HULLS

INERT FIBRE

CITRUS PULP
OLIGOSACHARIDES
INULIN

→ RAPID FERMENTABLE

SUGAR BEET PULP (SBP)
RESISTANT STARCH

→ SLOWER FERMENTABLE

FERMENTABLE FIBRE

STARCH

SUGARS

Digestible CH + Absorbable

Is the inclusion of inert fibre better than fermentable fibre in PW diets?

INERT FIBRE

Improve digestive function
Modifies microbiota GIT
Enhances microbial fermentation
Reduces nutrient digestibility
Penalizes animal performance

NSPs

FERMENTABLE FIBRE

Slows gastric emptying
Proximal fermentation in the hindgut
Increases luminal viscosity

Fermentability & Solubility

Diet composition

Fermentable (x3)

Inert (x1)

Table 1. Formulation and chemical composition of the experimental diets[1]

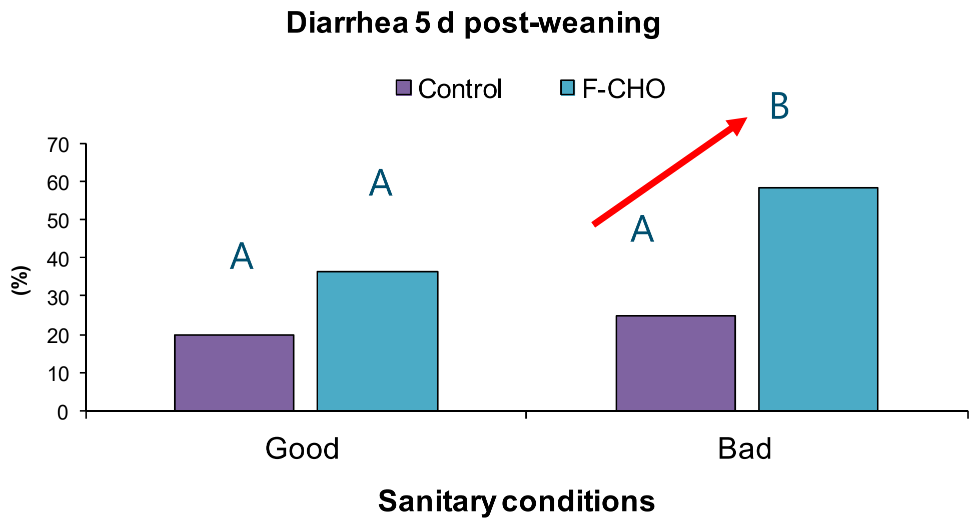
Item	Control I	Fiber I	Control II	Fiber II
	Experimental diet			
	Phase I		Phase II	
Ingredient, g/kg (as-fed basis)				
Wheat	225	198	350	303
Corn	200	175	200	172
Barley	120	105	150	129
Soybean meal (48% CP)	240	230	250	230
Dried whey	150	150	-	-
Dehydrated sugar beet pulp	-	60	-	90
Soybean hulls	-	20	-	30
Vegetable oil	25	25	10	10
Dicalcium phosphate	10	9.8	11.2	11.5
Calcium carbonate	11.3	9	11.2	7.3
L-Lys·HCl	5.6	5.2	4.6	4.2
DL-Met	2.7	2.7	1.6	1.6
L-Thr	2.5	2.4	1.9	1.9
L-Trp	0.8	0.8	0.4	0.4
Salt	2	2	4	4
Premix[1]	5	5	5	5
3-phytase[2]	0.1	0.1	0.1	0.1
Calculated composition, g/kg DM				
NE, MJ/kg	10.4	10.0	9.8	9.3
Digestible Lys	13.0	12.5	11.6	10.9
Digestible P	3.8	3.7	3.2	3.1
Chemical composition, g/kg DM				
Ash	64.5	64.9	58.8	60.1
CP (N × 6.25)	219.1	212.3	220.2	213.0
Ether extract	47.2	46.0	31.6	32.2
Starch	381.5	341.5	488.8	425.9
GE, MJ/kg	18.77	18.65	18.55	18.41
Crude fiber	32.5	48.9	35.8	63.9
NDF	109.6	112.5	122.3	153.2
ADF	34.6	50.1	39.3	69.0
ADL	2.1	8.6	3.9	9.9
Total dietary fiber	120.9	169.1	145.8	216.8
Water insoluble fiber	102.6	140.7	122.7	186.1

Montagne et al., 2012

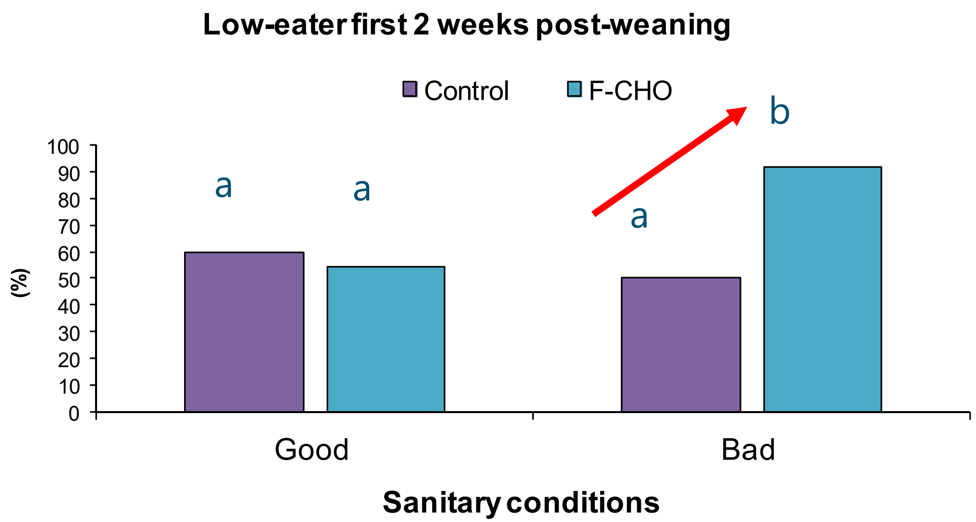
2x2 Experimental design:

- **Level of F-CHO**: high and low
- **Sanitary conditions**: good and bad

Interaction between F-CHO and health status of the animals



P diet x sanitary conditions = 0.07

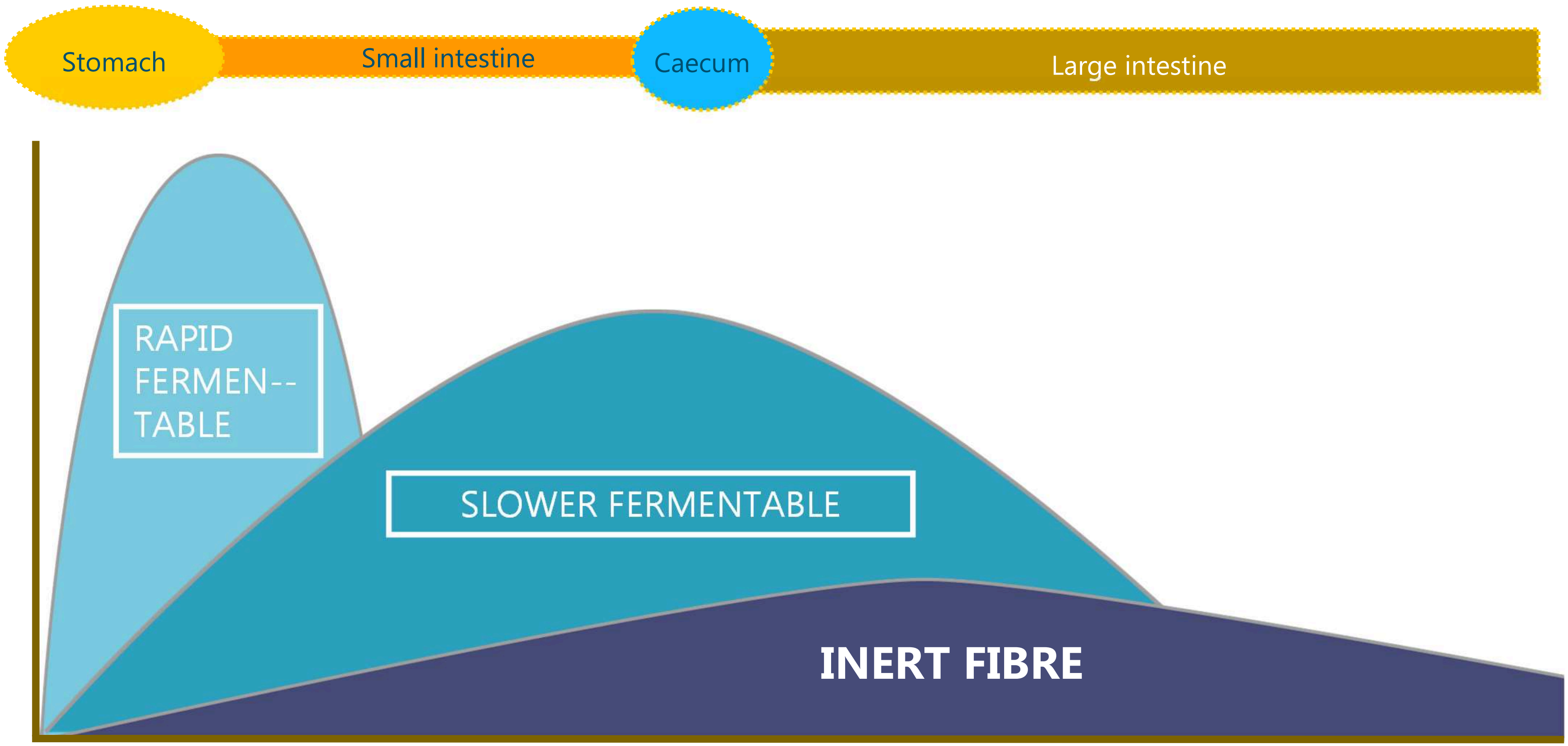


P diet x sanitary conditions = 0.01

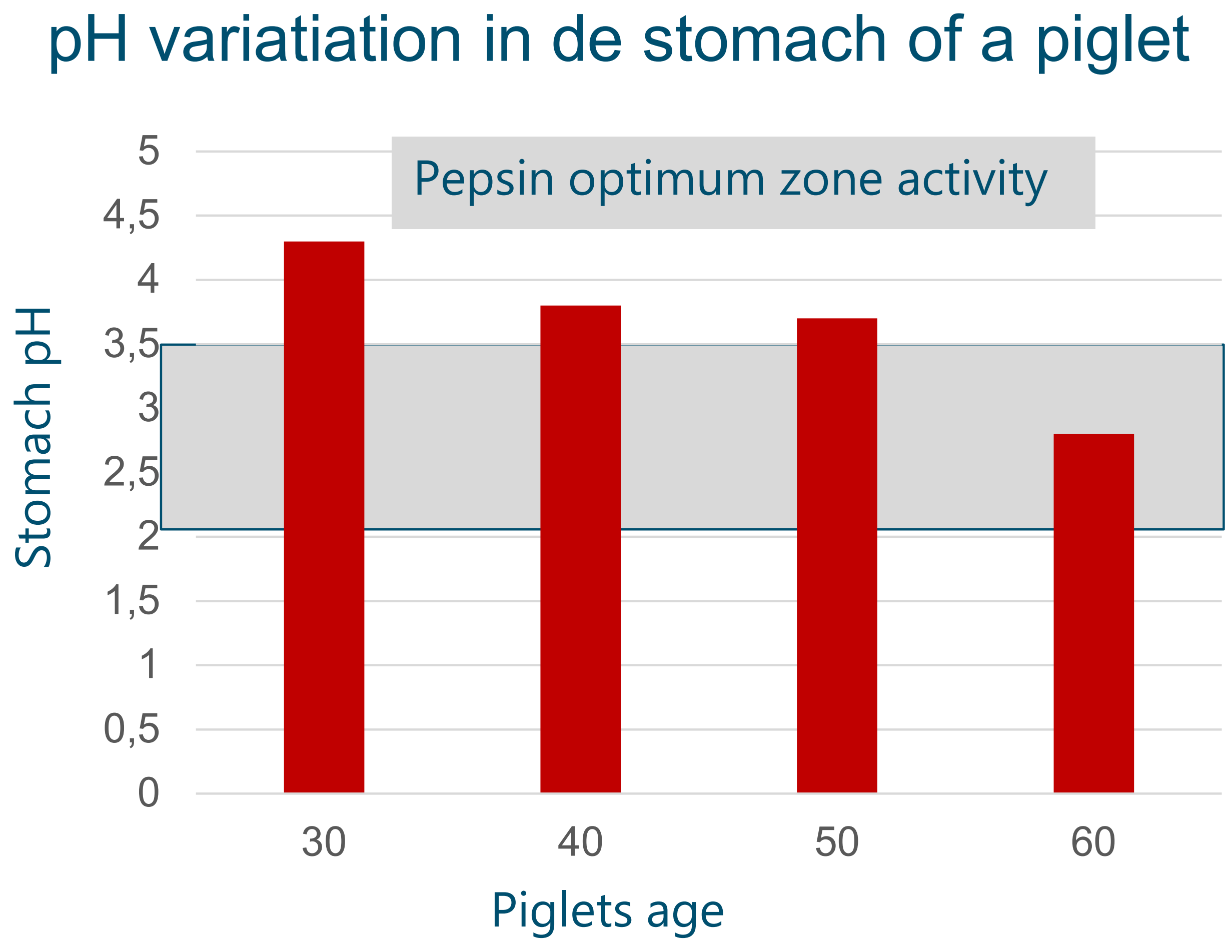
Montagne et al., 2012

In situations with bad sanitary conditions, the utilization of F-CHO sources in the first week post-weaning is an additional risk factor

FERMENTATION KINETICS
Piglets need a fully developed GIT to ferment fibre ingredients



Protein digestion and stomach pH in piglets



- **Piglets younger than 60 days have difficulties to acidify stomach pH**

Acid binding capacity (ABC)

The Acid Binding Capacity – ABC) is the amount of acid or base (in mEq) required to change the pH to a certain value. This is usually pH 4, which results in the **ABC-4 value**

Higher ABC-4 = higher buffer capacitity

- Energy (starch and fat): little influence on ABC-4
- Crude protein sources: strong impact on ABC-4: high buffering capacity > control CP level in piglets!
- Minerals: strong impact on ABC-4: high buffering capacity
- Organic acids: strong impact on ABC-4: reduce pH

Protein source and age of piglet

- Protein digestibility of different feedstuffs in piglets (weaned at 12 days of age)
- Factors influencing **digestibility**:
  - Enzyme production
  - Fermentation capacity

	Age of the piglets (wks)		
	3.5	**4.5**	**5.5**
Milkpowder	93	94	95
Soycomil	85	87	88
SBM	78	84	86
Fishmeal	86	89	91
Potato protein	87	-	91

Borggreve, et al., 1982

The older the animal > the higher the protein digestibility
Digestibility vegetable protein sources is lower, especially in case of ANF

Fiber & CP fermentation

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Level of protein

(15 %) **Performance**

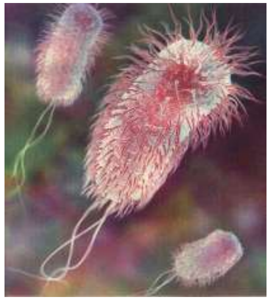
¡ Importance! Essentials Aa (Iso, Val)

(19 %)

+

Fermentable Carbohydrates in pigs of 35 d old

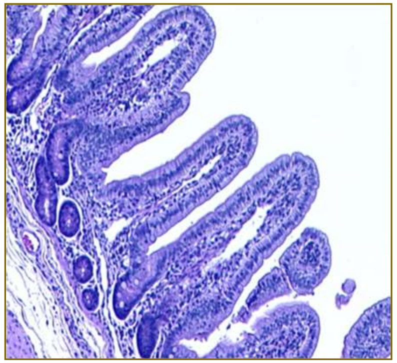
(23 %) ***Protein Fermentation***



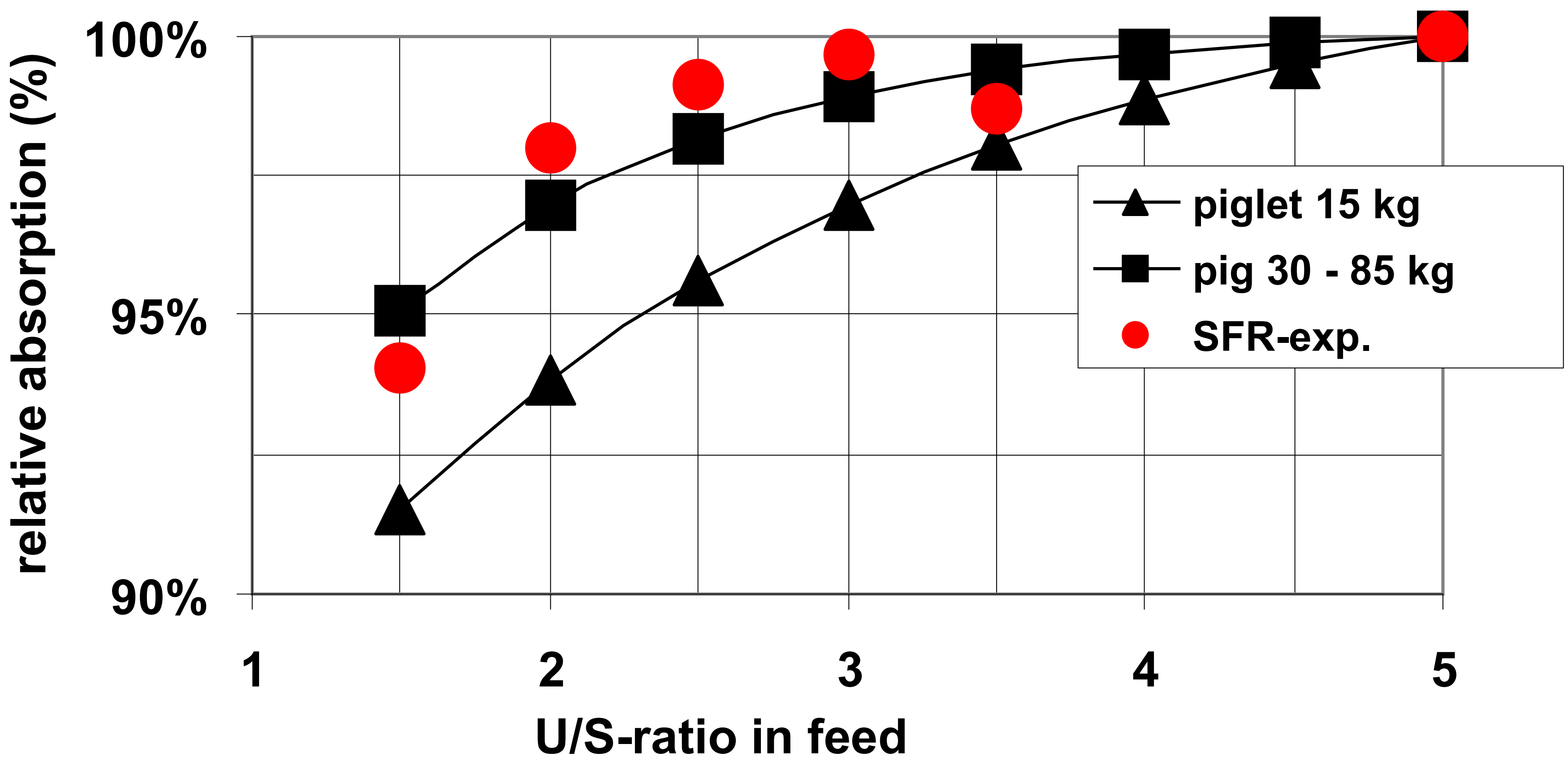
N-ammonia

-

gut integrity



Effect of U:S-ratio on fat digestibility (according to Wiseman et. al. and Schothorst experiment)



MCFA's- Intestinal health

Treatment	Stomach				Duodenum			
	Total	*Lactobacilli*	*Streptococci*	*E. coli*	Total	*Lactobacilli*	*Streptococci*	*E. coli*
A	7.0^{a}	7.2^{ac}	4.2^{a}	4.6^{a}	6.4^{a}	6.9	1.6^{a}	4.9^{a}
B	7.0^{ac}	7.6^{a}	0.6^{b}	0.8^{bc}	6.1^{a}	6.8	0.0^{a}	4.8^{a}
C	5.9^{b}	6.6^{bc}	5.3^{a}	2.0^{b}	5.6^{b}	5.9	4.7^{b}	1.8^{b}
D	6.9^{ac}	7.3^{a}	5.1^{a}	0.0^{c}	5.9^{a}	6.4	4.7^{b}	1.8^{b}
S.E.M.	0.13	0.13	0.48	0.48	0.13	0.19	0.54	0.51

a,b,c: different superscripts in the same column denote significant differences at least $P < 0.05$.

Dierick et al., 2002

- A: control feed (incl. 2.5% soya oil)
- B: control feed + 2.5% MCFA - C8 and C10 (instead of soya oil)
- C: feed B + lipase
- D: Control feed met 1.5% organic acids

Take home message pre-weaning

SCHOTHORST FEED RESEARCH

Colostrum
The first 24 hours

Focus on developing microbiota and innate immune system

Milk replacer

Focus on having a robust GIT and preparing the piglets for the weaning period

Weaning

Creep feed

Sow milk

Post weaning

Week 1

Week 2

Week 3

Week 4

Week 5....

Diet around weaning

Take home message post-weaning

Focus on GIT health

- Lower CP & ABC-4.
- Functional AA.
- Lower FCHO.
- Higher ICHO.

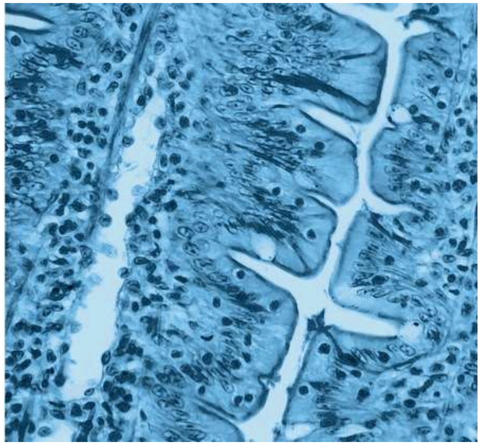
Keep health and improve ADG

- Higher Lys/NE ratio.
- Higher CP & low ABC-4.
- Medium FCHO.
- Medium ICHO.

Prepare for G/F period

- Important Lys/NE ratio.
- U/S ratio.
- Higher FCHO.
- Lower ICHO

SCHOTHORST FEED RESEARCH



Thank you for your attention

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