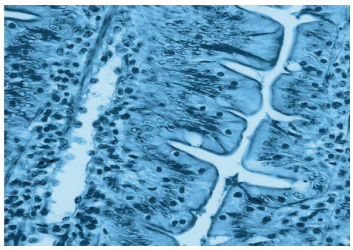




Start right with your piglet nutrition

Jan Fledderus

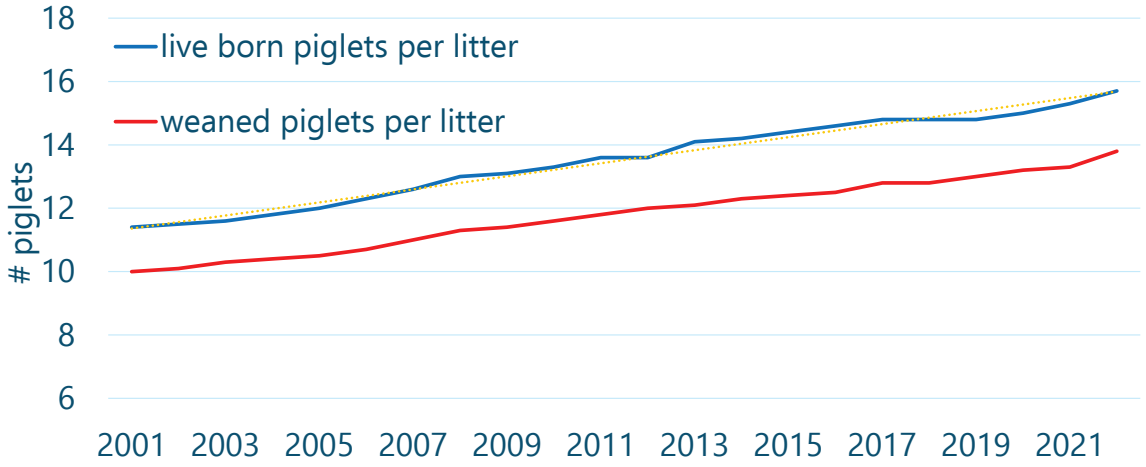
Knowhow to feed

This presentation

SCHOTHORST FEED RESEARCH

- Developments in piglet production
- Protein and amino acid requirements
- Focus on protein and fibre to improve gut health

How does litter size affect piglet quality?



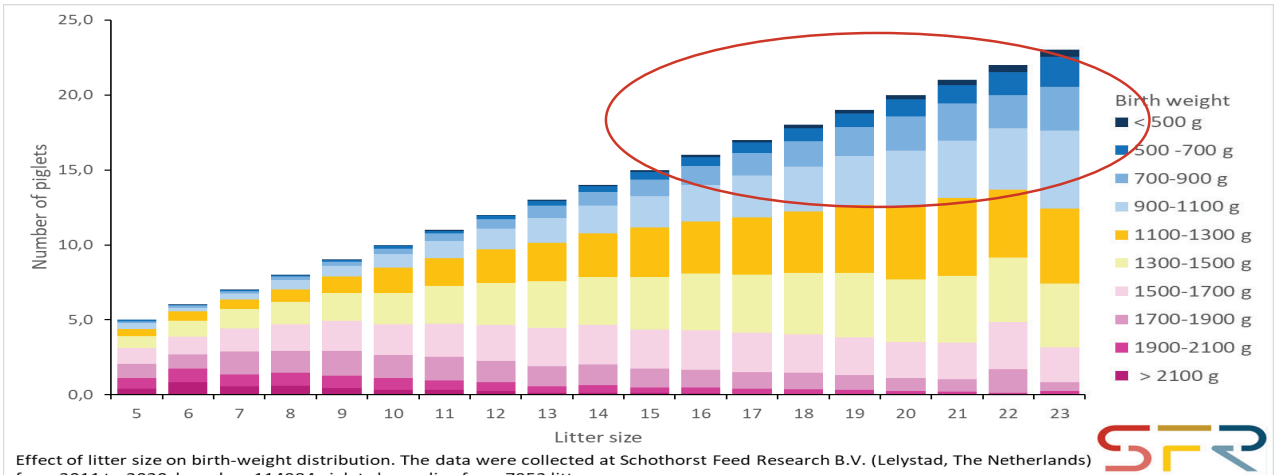
➢ +0,5 live born piglet per year

Agrovision 2001 - 2023

How does litter size affect piglet quality?

➢ 114.984 piglets in SFR dataset 2011 - 2020

➢ Large litters = more piglets with birth weight <1100 g



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.

SFR farm, 2020

Developments in pig quality

- Genetic improvements
  - Daily gain & Gain to Feed
  - Muscle mass

- Changes in nutrient requirements and optimum diet composition?

Developments in piglet feed composition

- Challenges after weaning
  - Feed intake
  - Immunity dip & intestinal absorption capacity
  - Diarrhoea & growth

- Diet "solutions"
  - Antibiotics → EU ban on "growth promotors" 2006
  - Pharmacological Cu-content → EU restriction
  - Pharmacological Zn-content → EU ban 2022

- European piglet feed strategy anno 2025
  - Around weaning = focus on "gut health"
  - After approx. one week post weaning = focus on "growth and FCR"

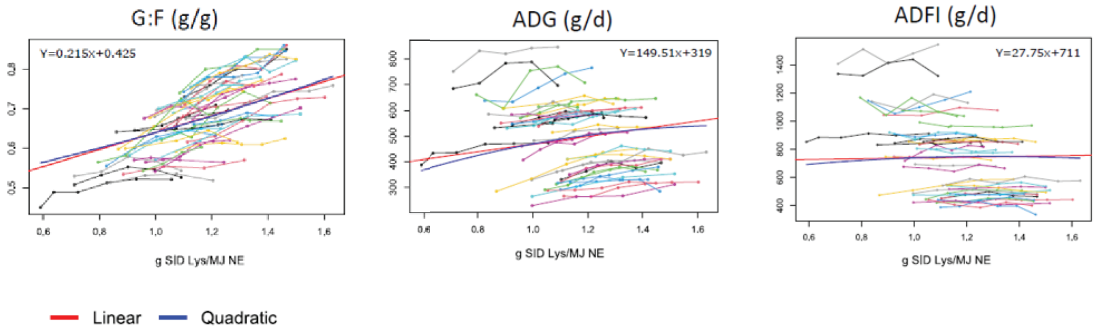
New amino acid recommendations for piglets

SID Lysine requirements for piglets

- Desk study by CVB
  - Body weight 5 – 30 kg
  - Animal performance (ADG, feed intake, G:F)
  - Dose response trials, with at least 4 lysine levels
  - SID Lysine should be first limiting amino acid
  - Crude protein should not be limiting protein deposition
  - Final dataset = 24 papers, 41 experiments, 206 treatment means

Goedhals et al, 2025

SID Lysine requirements for piglets



- ADG and Gain to Feed
  - No linear plateau model fit
  - Mainly linear increase
- Feed Intake
  - Not affected by SID lysine concentration

Goethals et al, 2025

SID Lysine requirements for piglets

- ADG and Gain to Feed → linear increase within the tested SID Lysine range
- Not possible to determine the optimum level
- Pragmatic decision = SID Lysine requirement is at least:
  - 1.3 g/MJ
  - 5.45 g/Mcal
  - 13.0 g/kg (NE-value of 10.0 MJ/kg or 2385 kcal/kg)

How much protein is needed to utilize lysine for body protein?

Item	Content in body protein[a]	Maximum efficiency (k_{AA})[c]
Protein	1.0000	0.81
Lysine	0.0696	0.72
Methionine	0.0188	0.64
Cystine	0.0103	n.a.
Methionine + cystine	0.0291	0.51
Threonine	0.0370	0.61
Tryptophan	0.0095	0.57
Isoleucine	0.0346	0.60
Leucine	0.0717	0.76
Valine	0.0467	0.71
Phenylalanine	0.0378	0.82
Tyrosine	0.0286	n.a.
Phenylalanine + tyrosine	0.0664	0.75
Histidine	0.0279	0.93
Arginine	0.0626	1.54

Van Milgen et al., 2008

- Body protein = 6,96% lysine
- Metabolic efficiency of turning digested lysine into body protein = 72%
- Average metabolic efficiency of turning amino acids into body protein =81%
- Needed for 100 gram body protein:
  - 100 / 81% = 123.5 gram SID amino acids
  - 6,96 / 72% = 9.7 gram SID lysine
- Theoretical **max ratio** of 9.7 g SID Lys / 123.5 g SID AA = **< 7,83% SID Lysine / SID AA**

Van Milgen et al, 2008

How much protein is needed to utilize lysine into body protein?

CP g/kg diet	SIDC CP = **90%**	SID Lys g/kg diet	SIDC CP = **85%**	SID Lys g/kg diet	SIDC CP = **80%**	SID Lys g/kg diet
160	144	**11.3**	136	**10.6**	128	**10.0**
170	153	**12.0**	145	**11.3**	136	**10.6**
180	162	**12.7**	153	**12.0**	144	**11.3**
190	171	13.4	162	**12.6**	152	**11.9**
200	180	14.1	170	13.3	160	**12.5**
210	189	14.8	179	14.0	168	13.2
220	198	15.5	187	14.6	176	13.8

- SID Lysine requirement defined as 1.3 g/MJ = 5,45 g/Mcal = 13.0 g/kg
- Assumed maximum ratio for SID Lys/SID CP <7,83%

Goethals et al., 2025

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What is the optimum CP-content for piglet diets?

- Growth performance
- Gut health

Stomach function and protein digestion

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High stomach pH-value → *Bad nutrient digestion*

Impaired microbial barrier function

"Undigested protein → substrate for pathogenic bacteria"

"Proliferation of pathogenic bacteria and production of toxic metabolites"

Post-weaning diarrhoea ↑

Protein digestion starts in the stomach

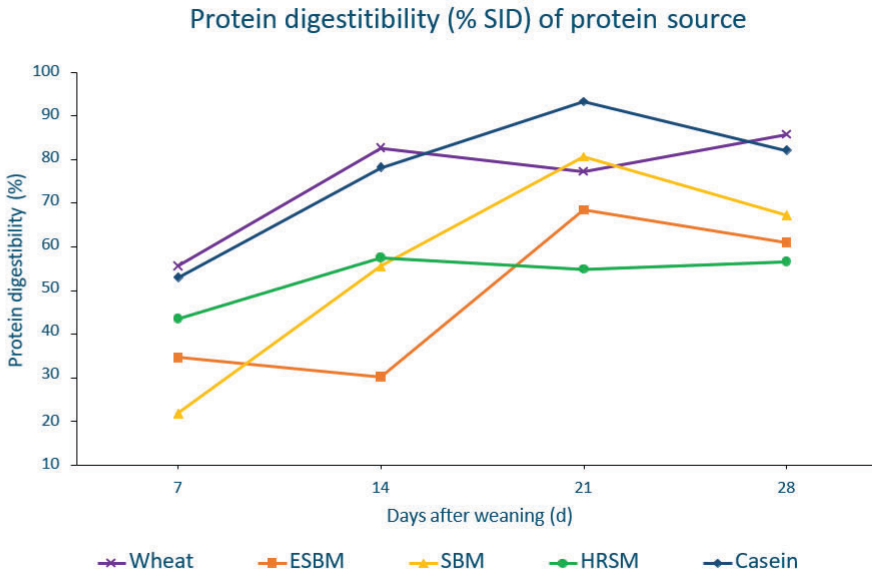
Acid environment in the stomach:

- Stomach pH-value decreases with age
- Acid environment due to Lactic acid and HCl
  - Microbial barrier
  - Favours protein digestion
- Pepsinogen ➔ pepsin
  - Optimum pH 2.0 - 3.5
  - Proteins are hydrolysed to peptides

Low protein digestibility in first weeks post weaning

SID of protein sources (not diets)

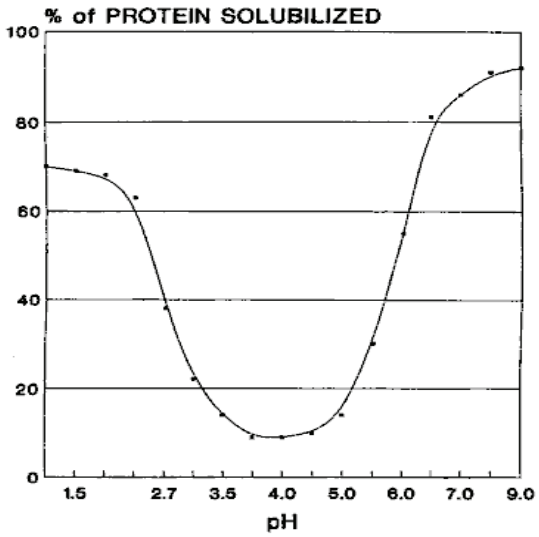
Wheat
SBM: soybean meal
ESBM: enzyme-treated soybean meal
HRSM: hydrothermally treated rapeseed meal
CAS: casein



Nørgaard et al. 2019

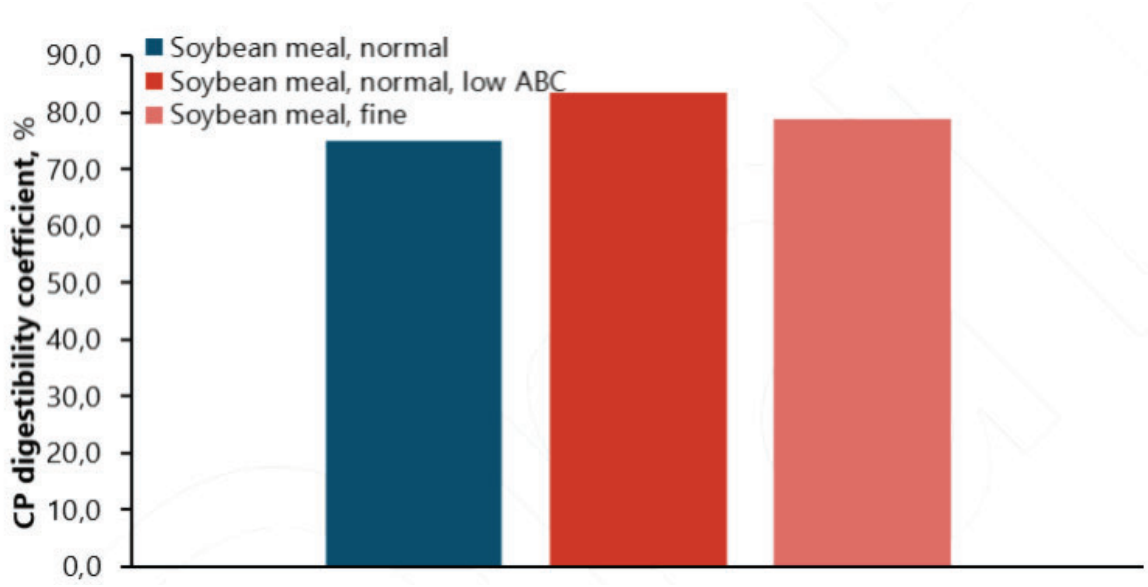
pH dependent solubility of SBM protein

- Around pH 4
  - Iso electric point
  - Low protein solubility
- Reduction of stomach pH is necessary to improve SBM digestibility



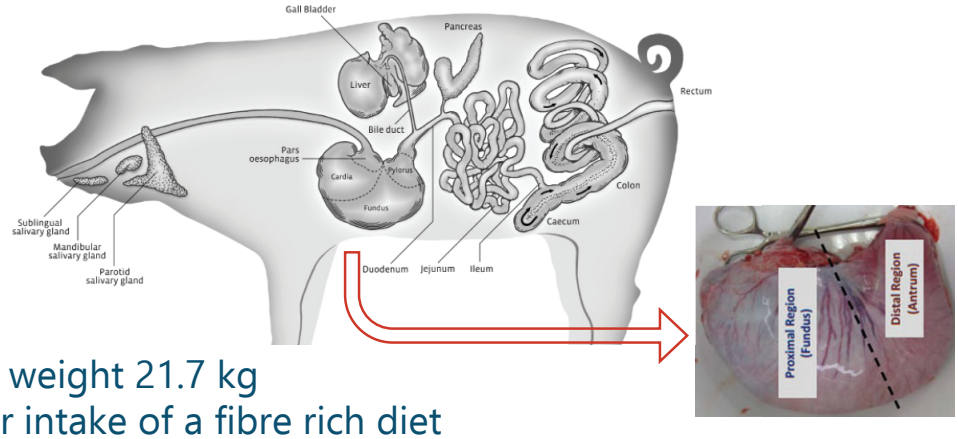
T. Gunathilake, 2015

Improved SBM protein digestibility after fine grinding or reduced dietary ABC-4



SFR LVB-59, 2020

How can fibre optimize the stomach function and gut health?



- Initial body weight 21.7 kg
- 30 min after intake of a fibre rich diet
- Average pH-value in different sections of the stomach:
  - Proximal region = 6.4
  - Distal region = 3.2

Nadia and Bornhorst, 2021

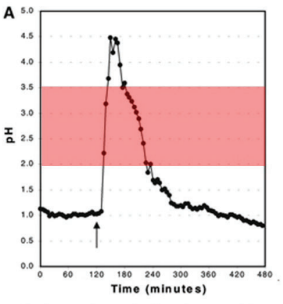
Effect of fineness of grinding of barley

Collaboration with OnePlanet and Wageningen University

- Different pre-treatments of barley
  (inclusion of 40% in experimental diets)
  - Fine
  - Coarse
  - Fine & Extruded

- Piglets swallow a "smart pil" for continuous measurement of the pH-value

- Development of pH-value and digestion kinetics



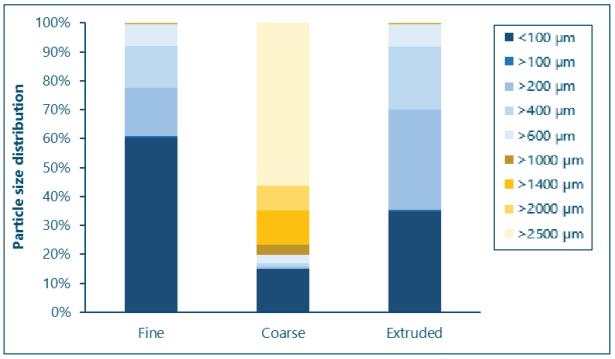
In vivo gastric autotitration – human subjects

SFR draft results 2025

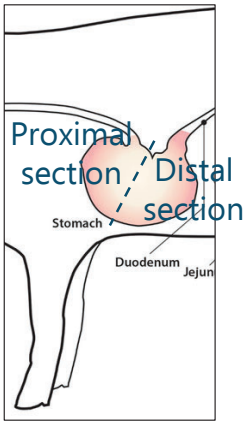
Effect of fineness of grinding of barley on stomach physiology in weaned piglets

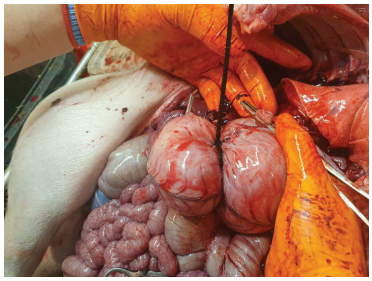
- Barley (40% inclusion in diets)
  - Fine
  - Coarse
  - Fine & extruded
- Diets were fed as crumbles, from 4 mm pellets
- Wet sieve analyses of particle size
  - Barley
  - Experimental diets

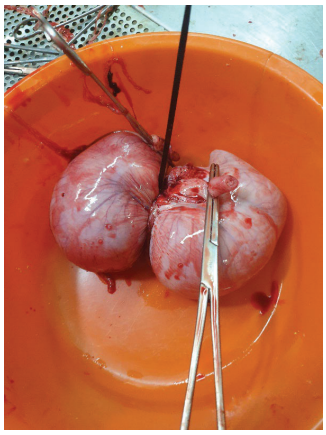
Particle size distribution of barley



Effect of fineness of grinding of barley on stomach physiology in weaned piglets

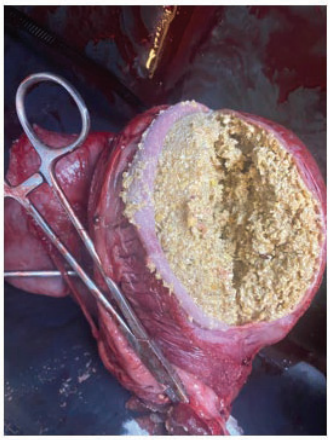


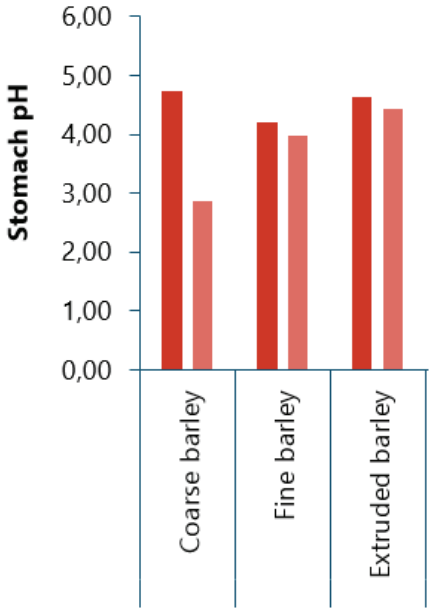




SFR draft results 2025
SFR ▪ Banff Pork Seminar ▪ January 2026
Knowhow to feed

Effect of fineness of grinding of barley on stomach physiology in weaned piglets



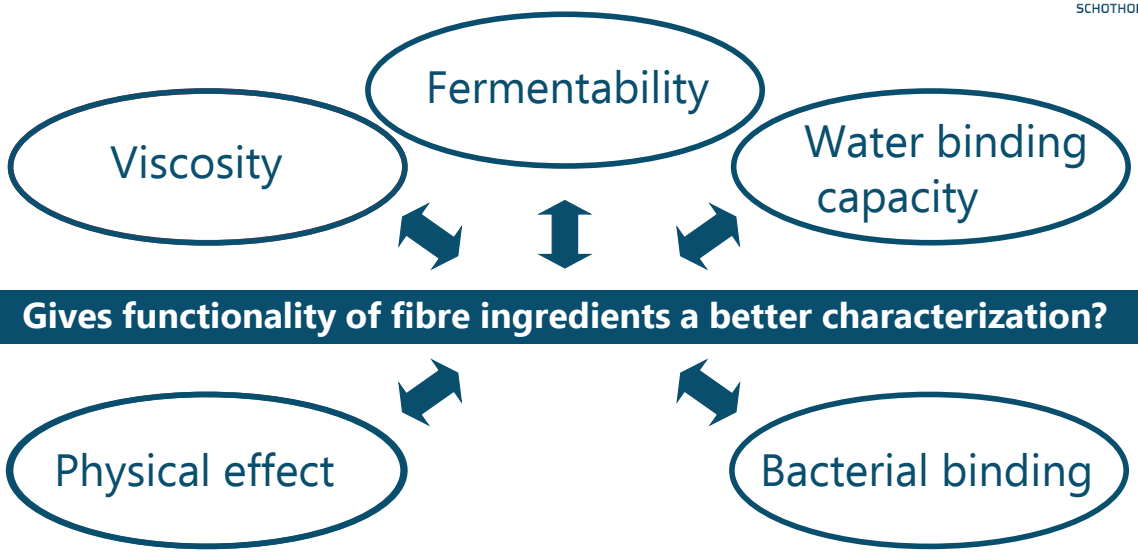


SFR draft results 2025

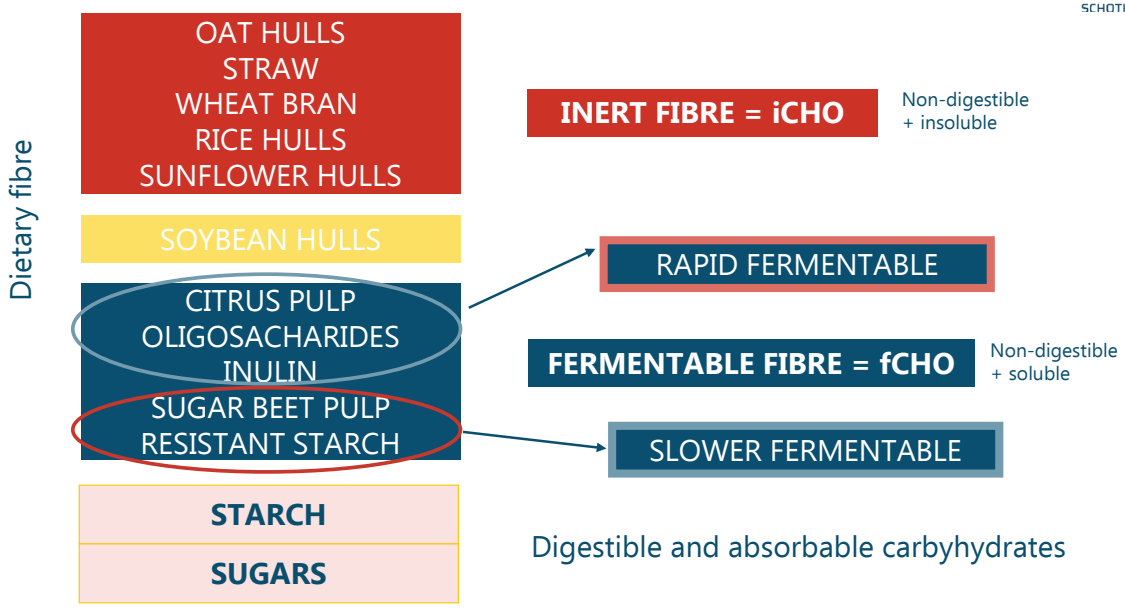
Different ways to express fibre

- Crude fibre
- NDF, ADF and ADL
- Non-Starch Polysaccharide (NSP)
- Dietary fibre
- fCHO and iCHO

Fibre characteristics



Fermentability of fibre



Diet dilution using two sources of inert fiber

Treatment groups:

- Standard weaner diet (negative control)
- Standard weaner diet diluted with iCHO (**10% oat hulls + 5% wheat straw**)

Diet dilution using sources of inert fiber

	Control	iCHO
NE (Kcal)	2330	2030
Moisture (g/kg)	119	116
Crude ash (g/kg)	80	85
Crude protein (g/kg)	191	169
Crude fat (g/kg)	54	52
Crude fibre (g/kg)	**29**	**74**
iCHO (g/kg)	**48**	**128**
fCHO (g/kg)	**96**	**96**
Calcium (g/kg)	7.0	7.0
Digestible P (g/kg)	3.6	3.6

Effect of diet dilution with iCHO in weaned piglets

➢ Diet dilution by 10% oat hulls + 5% wheat straw

D0-14 PW	Control	iCHO	*P*-value
ADFI, g/pig	284	328	<0.001
ADG, g/pig	230	240	0.102
G:F	0.81	0.73	<0.001
Faecal score	5.3	5.5	0.005

Dissection D5+D14 PW	Control	iCHO	*P*-value
E. coli in ileum, log10/g	4.8	3.8	0.02
E. coli in colon, log10/g	5.6	3.9	0.002

SFR studies; Flis et al., 2017

Research & Implementation by SFR

➢ Validation feed trials
- Optimize SID Lysine / NE
- Optimize SID Lysine / SID AA

➢ Digestibility trials to determine piglet specific nutrient utilization
- NE-value
- Amino Acid digestibility coefficients

➢ Implementation in SFR Feed Recommendations

Take home messages

- Developments in nutrition requirements
- Optimize SID Lys/NE and SID Lys/CP for maximum growth
- Stomach pH-value and retention time are main factors in protein digestion
  - Formulate on ABC4
  - Use the positive effect of fibres
- Optimize fibre inclusion in piglet diets
  - Content
  - Composition (fermentable versus inert fibre)
  - Particle size
- Processing technology
  - Differentiate in fineness of grinding between proteins and fibres

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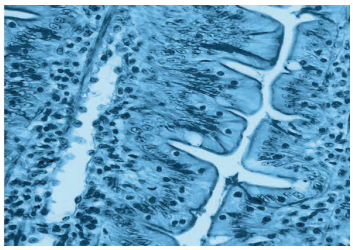

Thank you for your attention

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