

Effects of replacement of soybean meal by circular ingredients in piglet diets



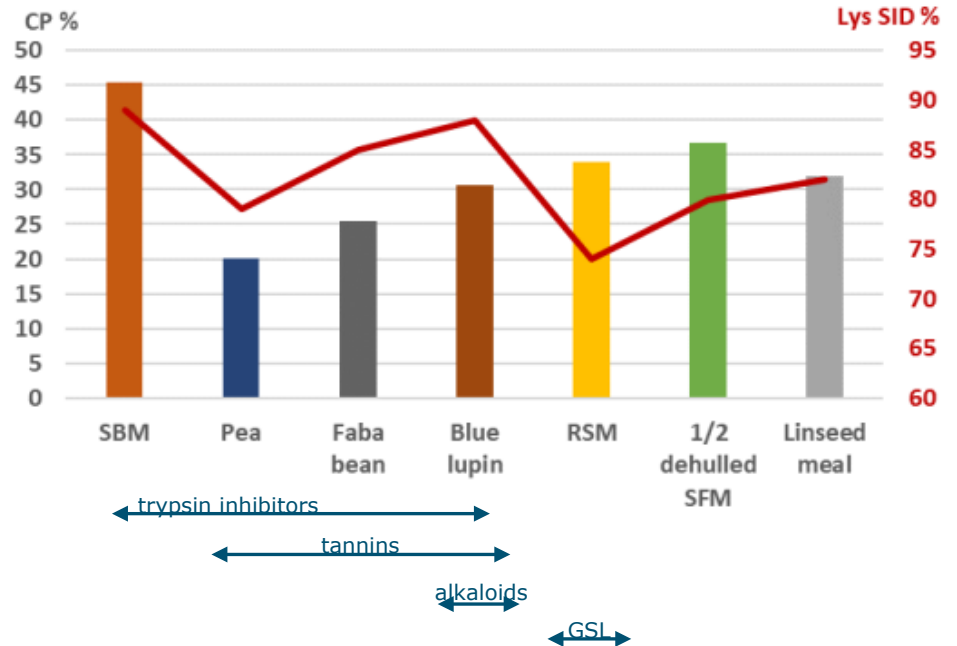
Session 74 "Balancing the feed for the economy, the environment, and society"
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Context : how replace SBM in piglet diets ?

- Pig meat as circular & sustainable food product
 - ↗ feed ingredients produced in EU
 - ↘ soy products from 3rd countries
- 29% EU self-sufficiency for ingredients with a 30-50% CP content (Parisi et al., 2020)
 - Formulation challenge for piglets
 - Legume seeds and Oil seed meals as alternatives
- Study hypothesis of a more circular formulation:
 - ↘ environmental footprint of feed
 - ↘ piglet performance & gut health, nutrient digestibility, nitrogen & phosphorus efficiency



Piglet study design

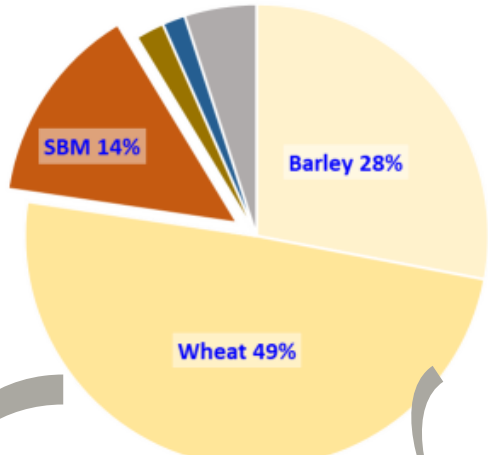
GIC of Cargill in Velddriel (NL)



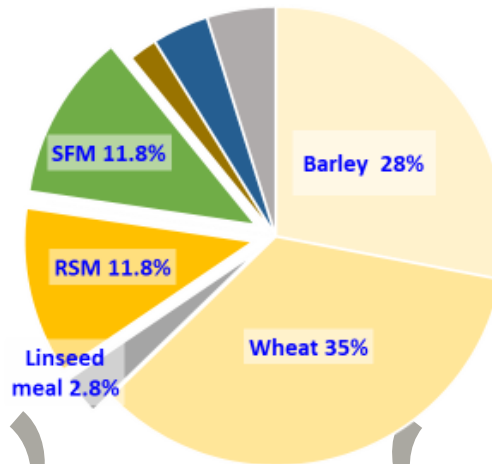
- 240 male & female piglets (Pietrain x Topigs 20) in 48 pens
 - weaning at 22.5 days of age: \Rightarrow 6.5 (\pm 0.1) kg
 - 1 week adaptation \Rightarrow 7.4 (\pm 0.1) kg
 - 5 weeks \times 6 dietary treatments \Rightarrow 24.0 (\pm 0.4) kg

- C: Control diet (14% SBM)
- C-OSM: 50% SBM replaced by Oil seed meals (50% C + 50% OM)
- OSM: 100% SBM replaced by Oil seed meals
- C-LS: 50% SBM replaced by Legume seeds (50% C + 50% LS)
- LS: 100% SBM replaced by Legume seeds
- OSM-LS: 100% SBM replaced by Oil seed meals & Legume seeds (50% OM + 50% LS)
 - Diets: 9.4 to 9.5 MJ NE/kg & 1.12 g dig lys/MJ NE, *ad libitum* from 7 d to 40 d
 - TiO as marker

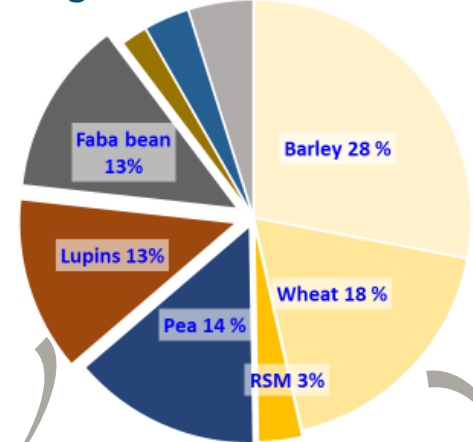
1 - Control = 100% SBM



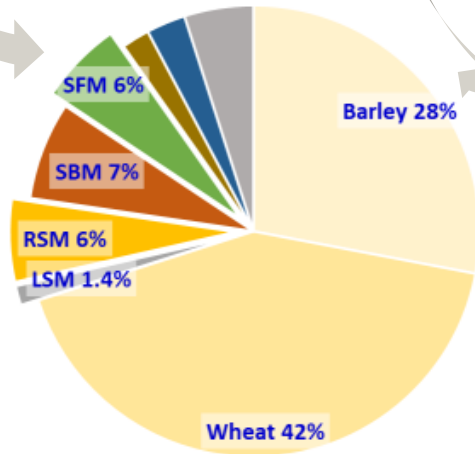
3 - OSM = 100% Oil seed meals



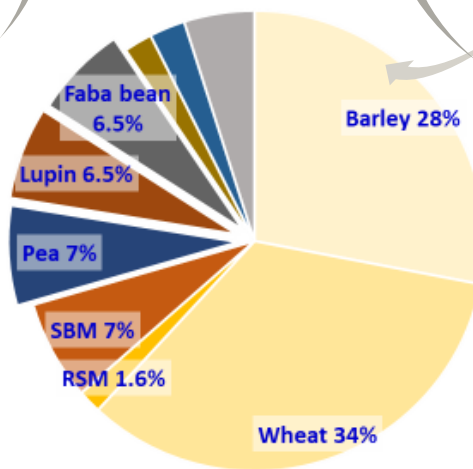
5 - LS = 100% Legume seeds



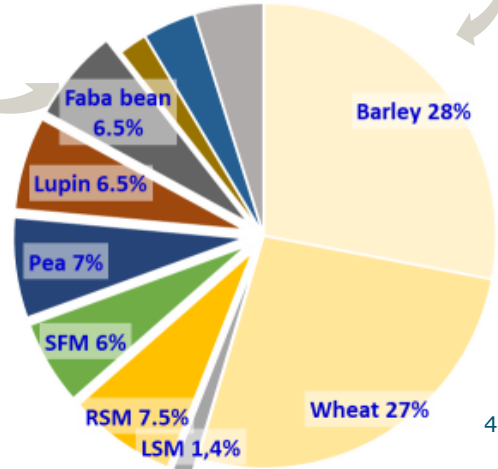
2 - C-OSM = 50% C + 50% Oil seed meals



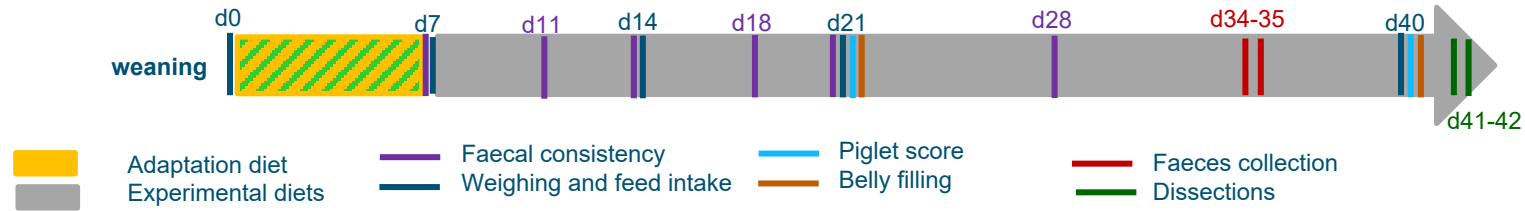
4 - C-LS = 50% C + 50% Legume seeds



6 - OSM-LS = 50% OSM+ 50% LS



Materials et methods



- Weight & intake d0, 7, 14, 21 & 40
- Faecal score d7, 11, 14, 18, 21 & 28
- Piglet & belly filling scores d21 & 40
- Collection of faeces for each pen d34-35
- Dissections d41-42
 - 48 piglets of C, OSM & LS treatments
 - Ileum digesta, pH, full & empty weights of stomach, jejunum, ileum, caecum, colon,
- Performance & faeces consistency
- Apparent ileal digestibility (AID)
 - CP
- Apparent total tract digestibility (ATTD)
 - DM, OM, Ash, CP, Fat, NSP, P
- Evaluation of N and P efficiency
- Carbon foot print

Results: performance of piglets

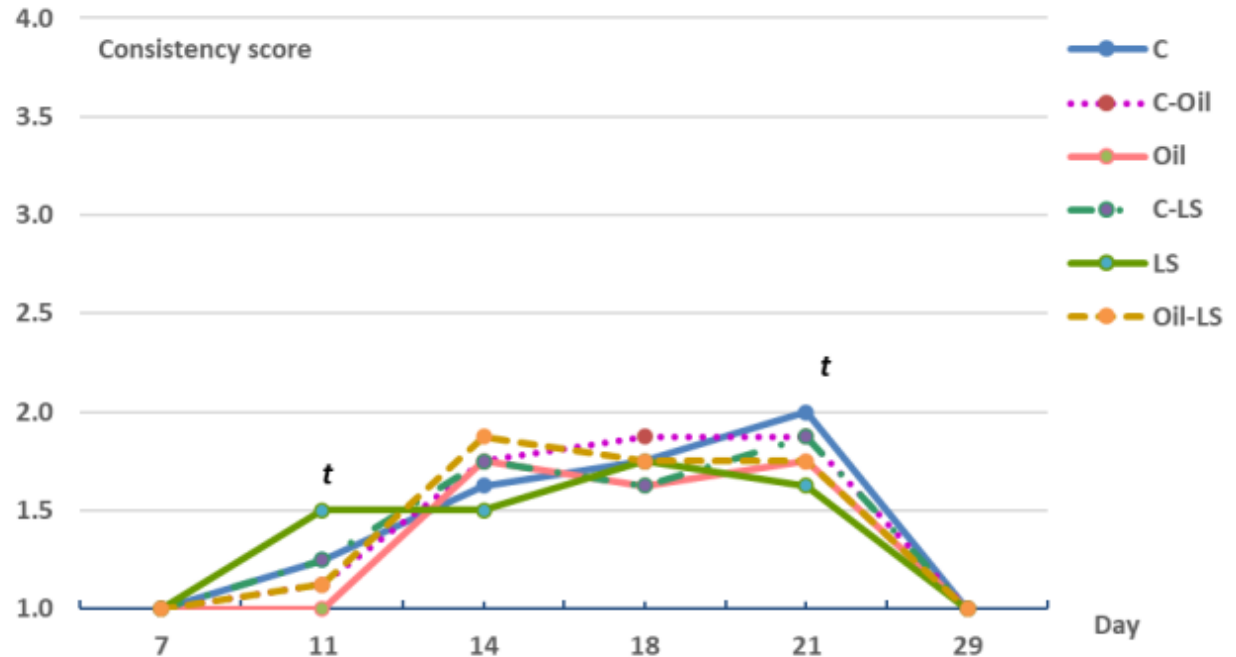
- Total experimental period : days 7- 40

Diet	C	C-OSM	OSM	C-LS	LS	OSM-LS	SEM	P value
BW day 0, kg	7.38	7.38	7.42	7.36	7.40	7.38	0.08	0.38
BW day 40, kg	23.9	24.1	24.3	23.7	24.3	23.5	0.4	0.63
ADFI, g/d	687	694	697	685	706	681	14	0.85
ADG, g/d	500	506	510	494	511	489	9.8	0.53
FCR, kg/kg	1.37	1.37	1.37	1.39	1.38	1.39	0.01	0.27

Health parameters

- Mortality: 0%, culling: 1.7% (4 p), medication: 5.4% (13 p)

- Faecal scores: only levels 1 & 2 on a 1-4 scale

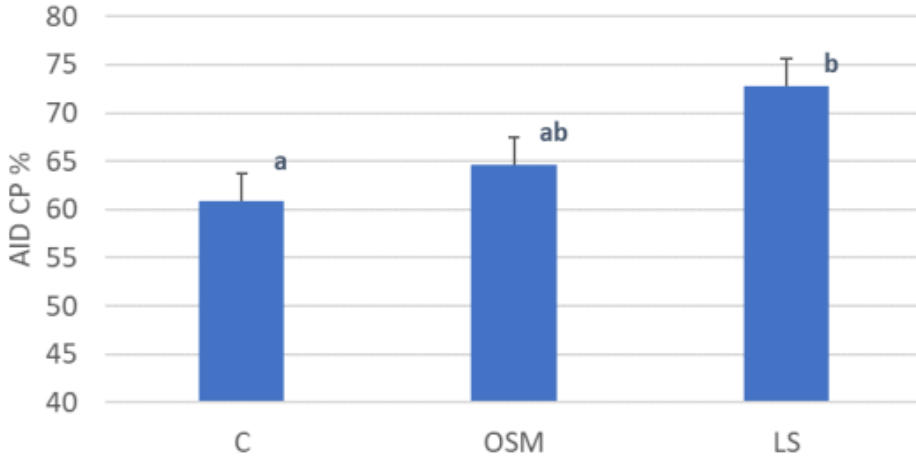


Nutrient utilization

■ Digestibility of Crude Protein in diets

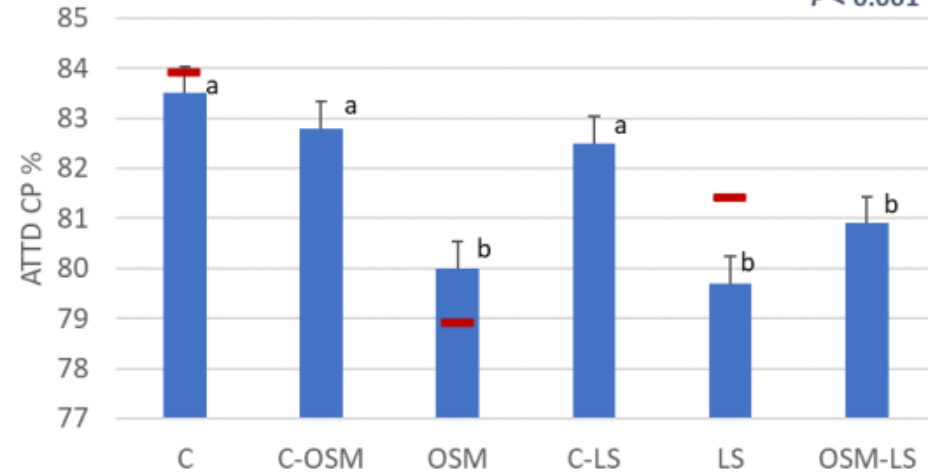
Apparent ileal digestibility CP - Distal ileum

$P = 0.03$



Apparent total tract digestibility CP

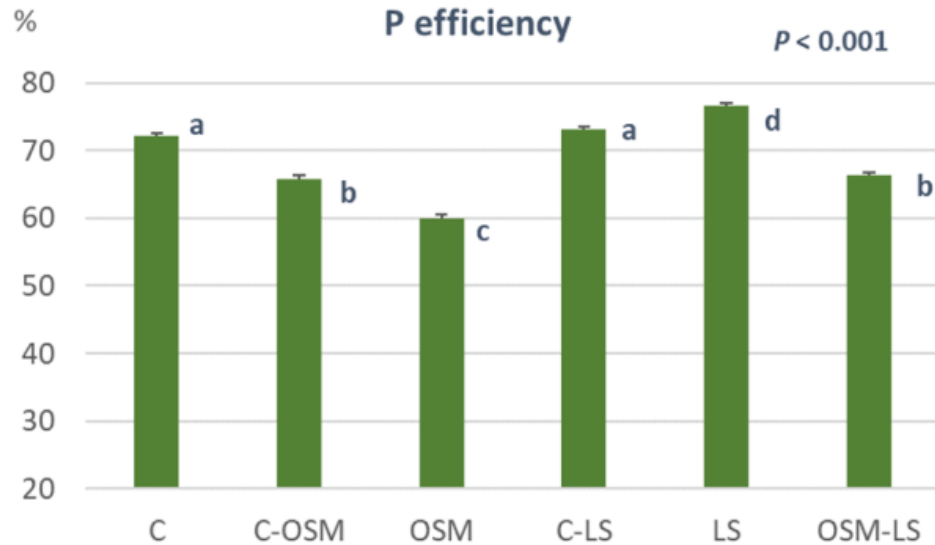
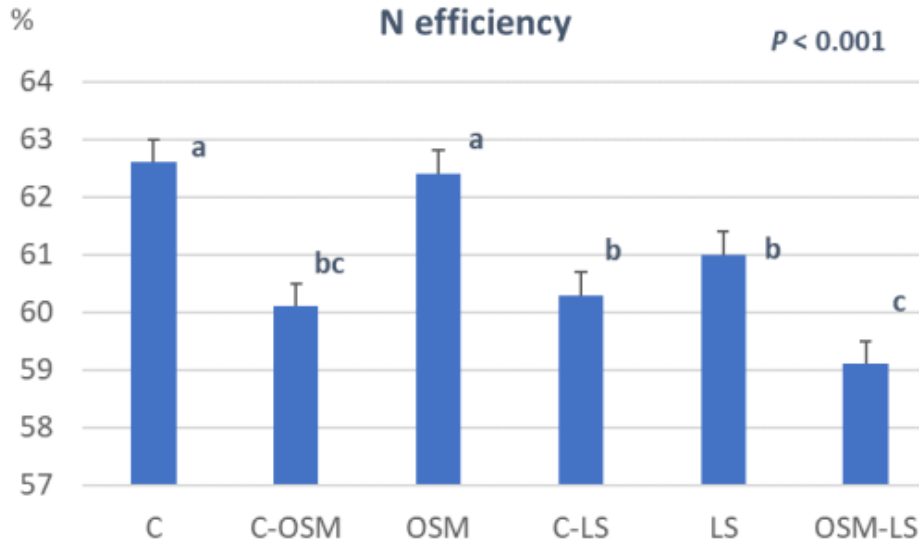
$P < 0.001$



— Calculated ATTD value from CVB Tables

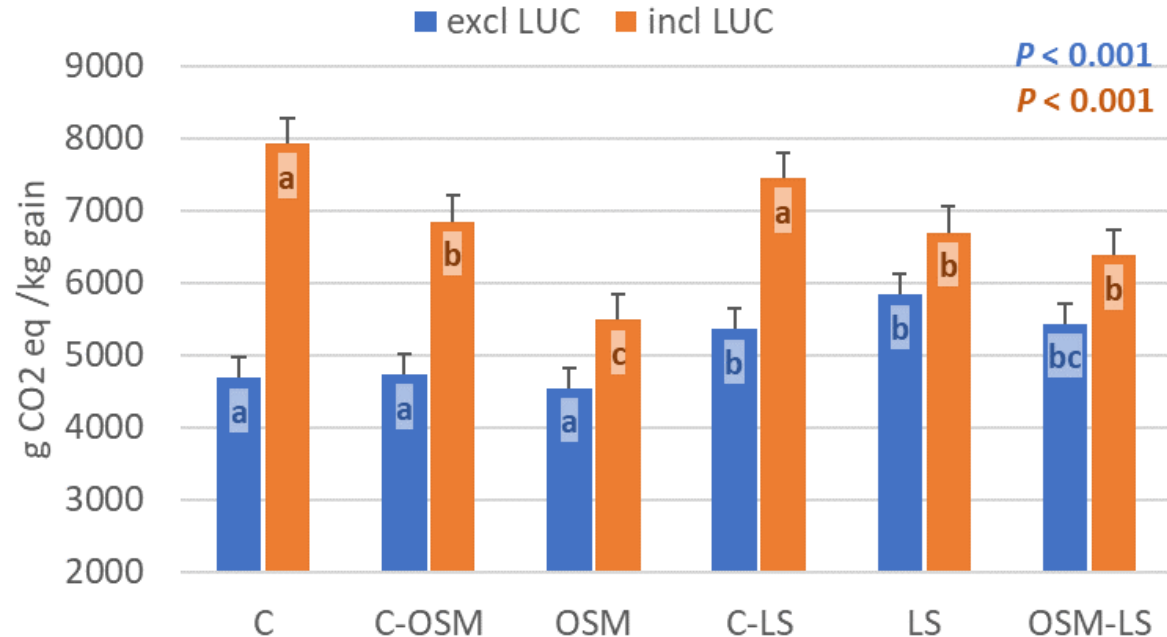
Nitrogen and phosphorus utilization

- Efficiency in diets



Environmental impact

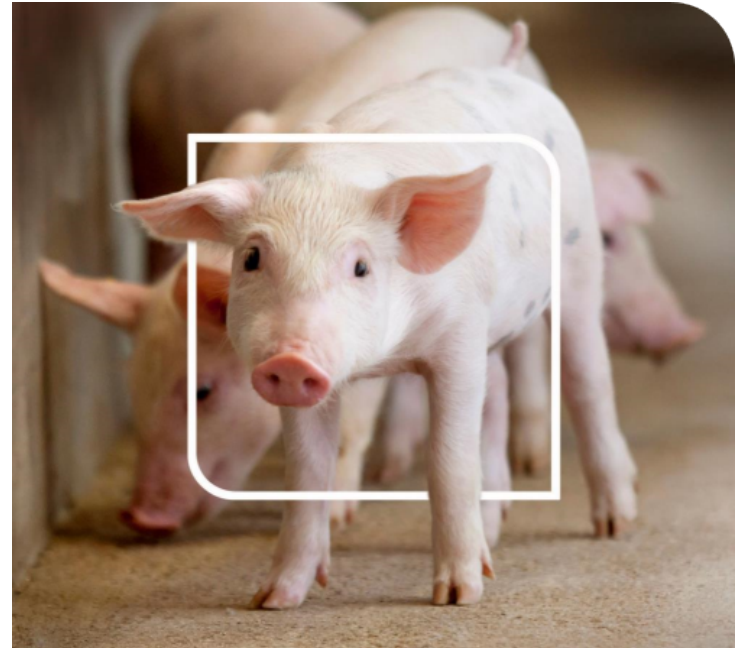
- Carbon footprint (CFP) calculated with and without land use change (LUC)



Discussion / Conclusion

- SBM can be totally / partially replaced by either legume seeds or oil seed meals or both.
 - 14.8% OSM or 20% LS, one week after weaning (7 kg BW) ★ < max limits in TI, GSL, tannins, alkaloids + [NSP]_{LS} = rec limits
- without impact on growth performance, faecal consistency and health
- with minor consequences on nutrient digestion, development of the digestive tract or P- and N- utilization
 - interaction between protein and fibre on digestibility and microbiome?
- with improved carbon footprint
 - particularly affected by land-use change

Thank you !



Dissections

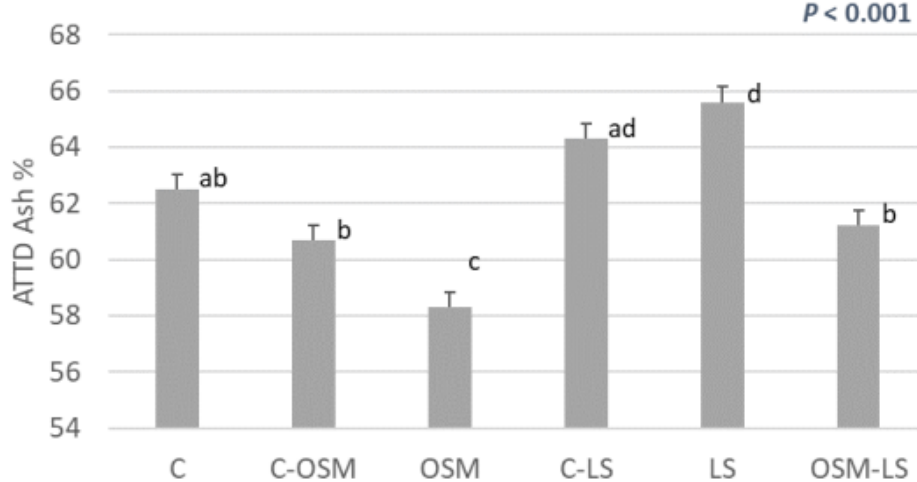
- 16 piglets by treatment

	C	Oil	LS	SEM	P value
1 Stomach pH	3.41	3.78	3.08	0.30	0.21
Stomach weight empty	144 ^a	137 ^a	164^b	4	0.001
Small intestine length	11.4	11.4	10.6	0.5	0.49
Small intestine full weight	1620	1595	1595	51	0.93
Small intestine empty weight	1067	1064	1098	35	0.76
Mid jejunum pH	6.17	6.24	6.25	0.08	0.74
Last meter ileum pH	6.25	6.49	6.48	0.11	0.26
Cecum full	174 ^a	199 ^a	269^b	12	<.001
Cecum empty	56	59	61	2	0.22
Cecum pH	5.60	5.57	5.47	0.04	0.13
Colon length (m)	2.43	2.44	2.51	0.07	0.66
Colon weight full	843 ^a	896 ^a	1056^b	35	0.002
Colon weight empty	338 ^a	345 ^a	375^b	10	0.04
Colon H	6.28	6.20	6.24	0.21	0.73

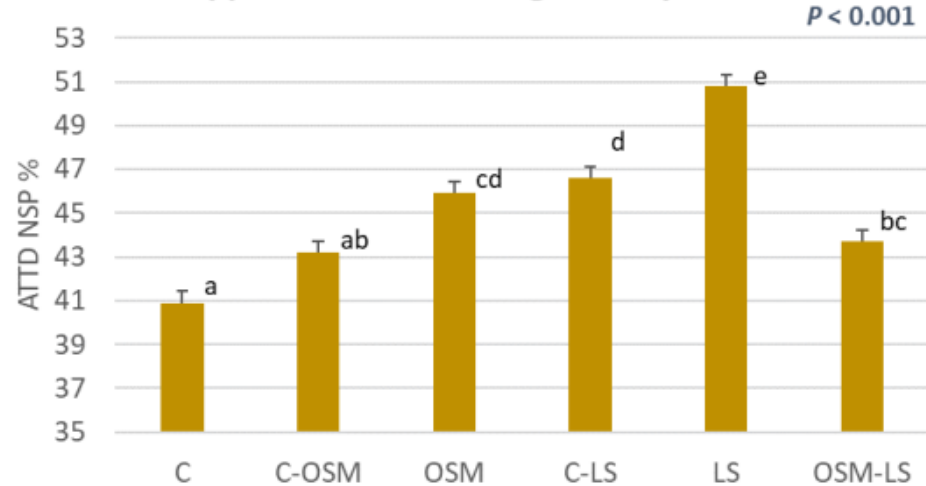
Digestibility of diets - ATTD

■ Digestibility of Ash and Non-Starch Polysaccharides

Apparent total tract digestibility Ash



Apparent total tract digestibility NSP



Digestibility of diets - ATTD

- Apparent total tract digestibility coefficients

Diet	1	2	3	4	5	6	SEM	P value
	100% SBM	50% SBM / 50 % OilSM	100% OilSM	50% SBM / 50 % Leg	100% Leg	50% OilSM / 50% Leg		
DM	84.0 ^d	82.2 ^c	80.4 ^a	82.8 ^c	81.3 ^b	80.8 ^{ab}	0.24	<0.001
OM	85.3 ^c	83.5 ^b	81.8 ^a	83.9 ^b	82.2 ^a	82.0 ^a	0.24	<0.001
CP	83.5 ^a	82.8 ^a	80.0 ^b	82.5 ^a	79.7 ^b	80.9 ^b	0.54	<0.001
Fat	76.2 ^{bc}	77.1 ^{cd}	80.4 ^e	74.6 ^{ab}	72.5 ^a	79.3 ^{de}	0.80	<0.001
Ash	62.5 ^{bc}	60.7 ^b	58.3 ^a	64.3 ^{cd}	65.6 ^d	61.2 ^b	0.64	<0.001
NSP	40.9 ^a	43.2 ^{ab}	45.9 ^{cd}	46.6 ^d	50.8 ^e	43.7 ^{bc}	0.92	<0.001
P	71.0 ^b	71.2 ^b	65.3 ^a	74.3 ^c	74.1 ^c	71.3 ^b	0.67	<0.001