Influence of fermentation and enzyme addition on digestibility of a rapeseed cake rich diet in pigs.

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Motivation

Fluctuating prices on cereals

Need for alternative ingredients for feed

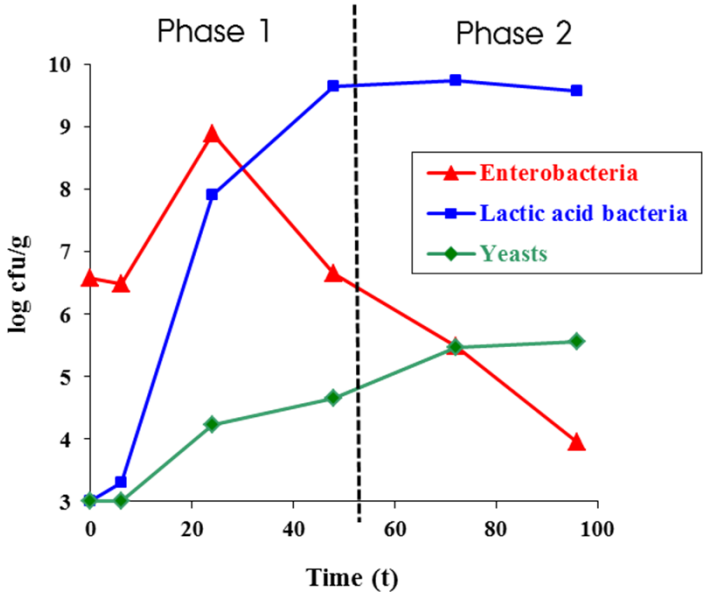
Locally grown crops (Denmark)

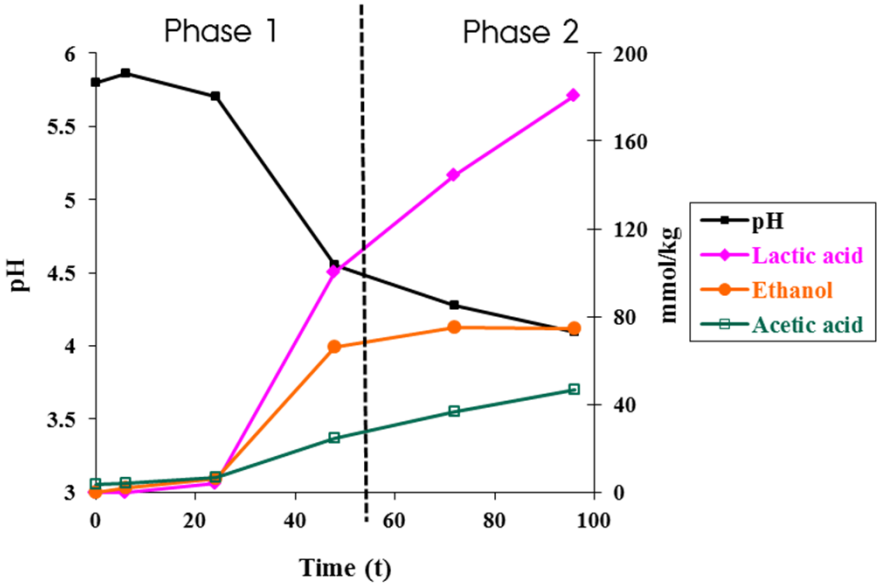
- **High moisture maize**
- **Rapeseed cake**
- **Peas**

Increased production of biodiesel
More rapeseed cake available

Peas and rapeseed cake are valuable protein sources
NSP, lignin and LMW sugars constitute a nutritional problem

Background - Fermented liquid feed





Advantages:

- Beneficial impact on gastrointestinal health (Reducing numbers of pathogens in GIT)
- Increased nutrient digestibility (phosphorus, CP, AA, calcium) Decrease in NSP concentration

Background – enzyme addition

Well known strategy to increase nutrient digestibility
Commonly used in dry feed

Aqueous matrix of FLF suitable for enzyme addition

***In vitro* screening of 9 enzyme mixtures** (phytases and carbohydrases) on fermented rapeseed cake.

GluXylPec (NovoZymes A/S):
Decrease in total- and insoluble-NSP, increase in soluble CP

Aim

To increase the digestibility in pigs

of a diet based on locally grown crops,

through liquid fermentation and enzyme addition

Experimental design - diets

Experimental diets:

n-FLF	non-fermented liquid feed
FLF	fermented liquid feed
FLF+enz	FLF + β-glucanase, xylanase, pectinase mixture

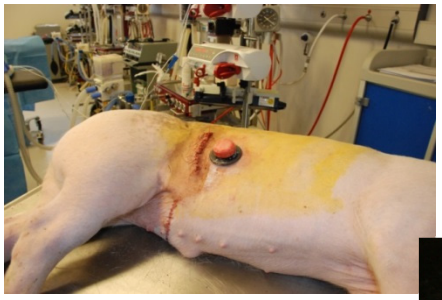
Control: Wheat, barley and soybean meal (non-fermented liquid feed)

Feed:water = 1 : 2.75
Temperature = 20 °C
Fermented until steady state

Ingredient, g/kg, as-fed	Exp. diet
Maize, high moisture	**394.5**
Rapeseed cake	**200.0**
Peas	**200.0**
Barley	166.3
Soybean meal	21.9
Calcium carbonate	10.4
Sodium chloride	3.3
Monocalcium phosphate	1.6
Vitamin- mineral premix	1.7
Phytase, 500 FTU/kg	0.1
Cr_2O_3, inert marker	0.2

Experimental design – animals and feeding

Eight barrows
Simple T-shaped cannula at distal ileum
Recovery period: 8 days



Fed four diets according to a double Latin square design
Adaption period: 10 days

Sampling of ileum and faeces

Results - Composition of the diets

Item	Control	Experimental diets		
		n-FLF	FLF	FLF+enz
Microbial counts, log cfu/g				
Lactic acid bacteria	4.1[a]	7.0[b]	9.5[c]	9.6[c]
Enterobacteriaceae	4.4[a]	3.8[b]	3.1[bc]	<3.0[c]
Yeasts	3.2[a]	4.6[b]	4.1[b]	7.1[c]
pH	5.9[a]	5.4[b]	4.1[c]	3.9[d]
Organic acids, mmol/kg				
Lactic acid	0.5[a]	20.6[a]	214.1[b]	272.3[c]
Acetic acid	2.9[a]	6.8[a]	25.5[b]	56.4[c]
Ethanol, mmol/kg	0.0[a]	4.3[a]	10.9[b]	49.9[c]

Effect of enz addition: Microbial activity increased

Results - Composition of the diets

Item, g/kg DM	Control	Experimental diets		
		n-FLF	FLF	FLF+enz
Non-Starch Polysaccharides				
Total	159.5[a]	154.6[a]	159.1[a]	127.6[b]
Insoluble	119.0[a]	116.6[a]	119.3[a]	102.8[b]
Soluble	40.5[a]	38.0[a]	39.8[a]	24.9[b]
P	4.1[a]	4.8[b]	4.7[b]	4.9[b]
Phytate-P	-	2.1[a]	0.9[b]	1.0[b]

Effect of enz addition: More substrate for microflora

Results - Apparent Ileal Digestibility

	n-FLF	FLF	FLF+enz
Total-NSP	154.6[a]	159.1[a]	127.6[b]

Item, %	Control	Experimental diets			P-values		
		n-FLF	FLF	FLF+enz	Diet	Period	D x P
Crude protein	67.6[a]	62.8[ab]	62.2[ab]	59.4[b]	0.007	0.31	0.39
P	22.5[ab]	19.5[a]	36.1[b]	32.6[ab]	0.02	0.20	0.36
DM	59.8	58.4	59.3	58.9	0.90	0.26	0.63
Total-NSP	6.7[a]	9.2[a]	13.6[a]	31.1[b]	<0.001	0.42	0.88
Insoluble-NSP	1.2[a]	4.4[a]	9.0[a]	26.2[b]	<0.001	0.65	0.89
Soluble-NSP	22.9[a]	24.0[ab]	27.5[ab]	45.8[b]	0.03	0.45	0.79

Effect of enz addition

Results – Apparent Total Tract Digestibility

Item, %	Control	Experimental diets			P-values		
		n-FLF	FLF	FLF+enz	Diet	Period	D x P
Crude protein	74.3[a]	69.0[b]	73.2[a]	74.0[a]	0.004	0.49	0.93
P	34.5	31.8	46.1	46.9	0.02	0.74	0.98
DM	76.6[a]	74.5[b]	76.2[ab]	77.2[a]	0.004	0.44	0.05
Total-NSP	47.9	50.4	54.3	56.7	<0.001	0.01	0.02
Insoluble-NSP	32.1[a]	38.1[ab]	42.3[b]	45.0[b]	0.001	0.08	0.05
Soluble-NSP	93.1	92.8	90.2	91.7	0.79	0.86	0.50

Conclusions

- Fermentation of the experimental diet resulted in a microbiologically healthy feed
- **Fermentation** decreased phytate-P in the diet and increased digestibility of P and NSP
- **Enzyme addition** decreased NSP in the diet and increased digestibility of NSP further
- Next step: growth performance study

Take home message:

Fermentation and enzyme addition are valid strategies to improve the nutritional value of 'suboptimal' pig feed

Acknowledgements

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Enzyme supplier:
NovoZymes A/S, Bagsværd, Denmark