Amino acid composition and digestibility of home-grown pea and faba bean varieties

Jos Houdijk, Lesley Smith, Helen Massey O'Neill, Julian Wiseman, Simon Kightley, Meike Rademacher and Ilias Kyriazakis

The Green Pig Consortium

SAC

The University of Nottingham

NIAB

premiernutrition

QMS
QUALITY MEAT SCOTLAND

BPEX

Harbro
QUALITY LIVESTOCK NUTRITION

BOCM PAULS

LINK collaborative research

EVONIK
INDUSTRIES

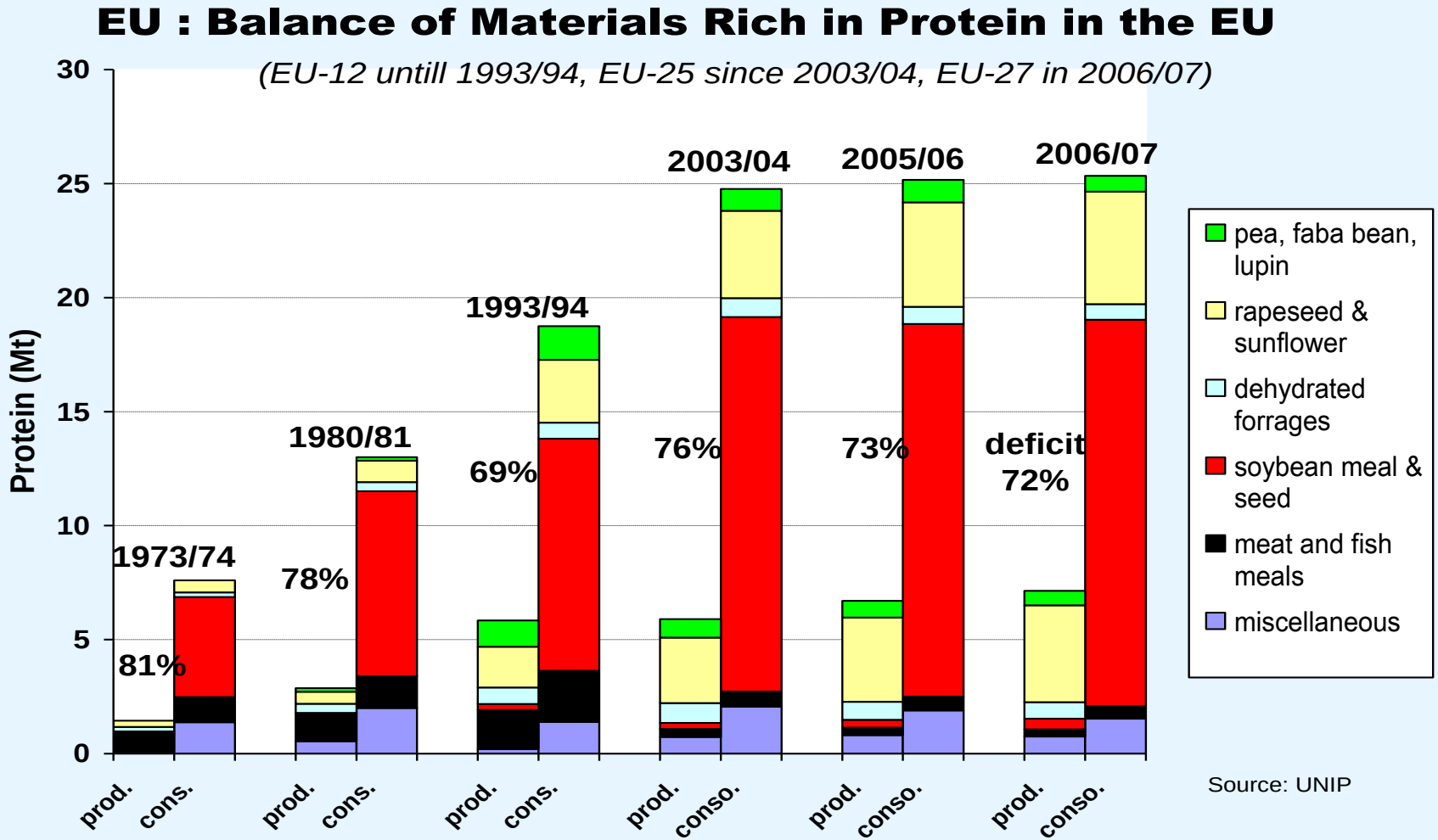
Soil Association

PGRO

UNIP
Interprofession des protéagineux

defra
Department for Environment Food and Rural Affairs

Protein use for animal feed in Europe



Source: UNIP

UK soybean meal supply

- Soybean meal (SBM) supply to the UK comes from direct import or UK produced from imported soybeans

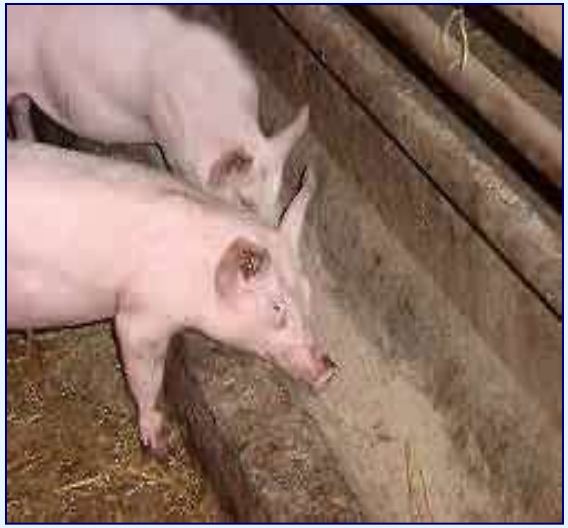
	2006 (000's tonnes)	2007 (000's tonnes)
Import	1834	2097
UK crush	446	478
Export	87	50
Net UK supply	2193	2525

Data from Oilword (2008)

The UK Pig industry

- The UK pig industry relies heavily on SBM, using over 300,000 tonnes a year for grower and finisher pig diets alone.

- SBM reliance impacts on UK pig production sustainability
  - environmental impact (importing protein)
  - price fluctuations
  - availability (Chinese markets)
  - limitations for organic producers



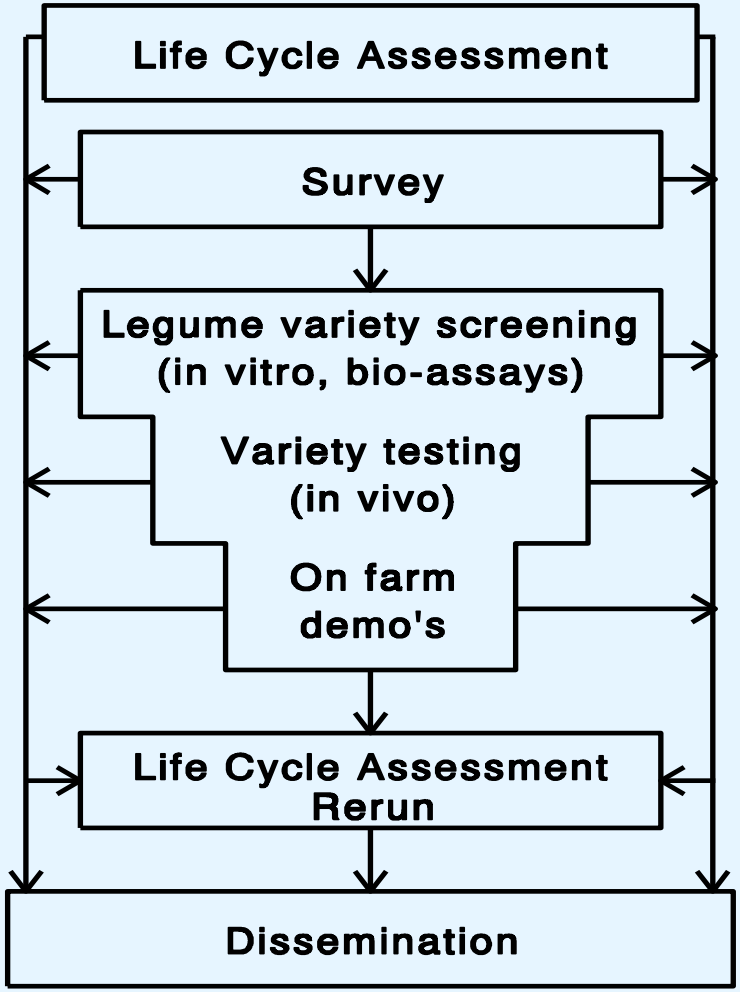
- Potential to use home grown pulses as an alternative.

Green Pig Aims

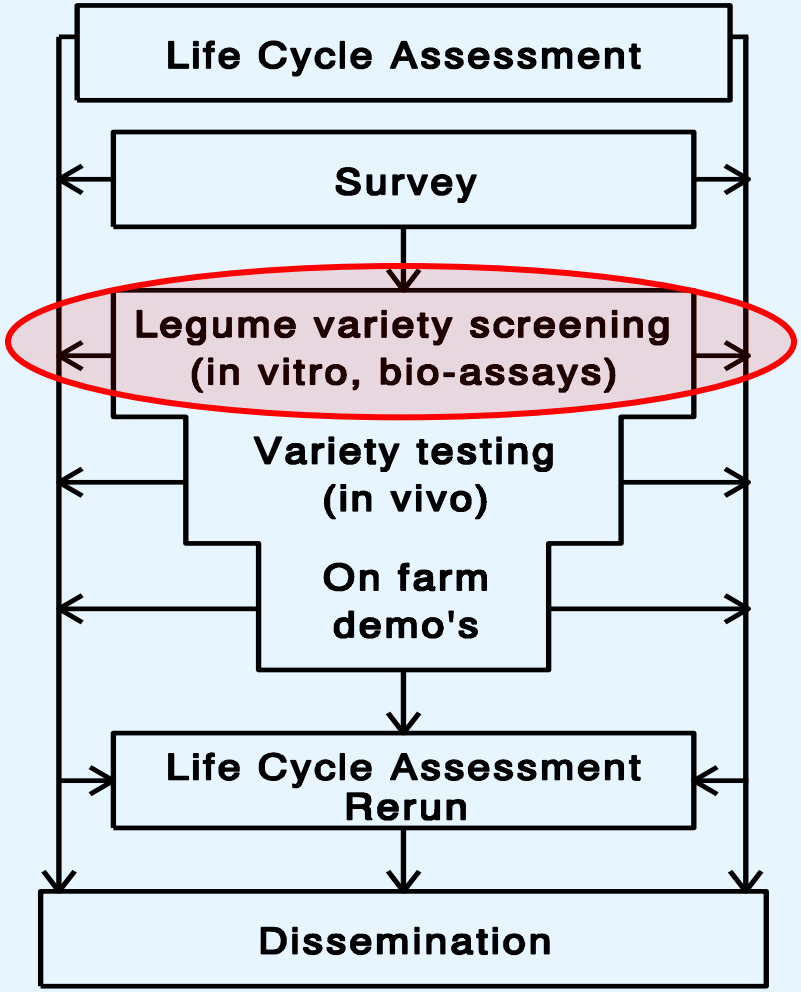
- The Green Pig project investigates the potential of using home grown peas and faba beans, in the diets of growing/finishing pigs.

- Emphasis will be placed on the consequences of pulse inclusion on pig performance and its potential environmental benefit.

Green Pig Approach



Green Pig Approach



AA profiles and digestibility of different varieties of UK grown peas and faba beans

AA profiles of selected pea and faba bean varieties

- Harvest 2008 and 2009
  - 33 varieties of peas
  - 8 varieties of winter beans
  - 12 varieties of spring beans
- Samples were collected from 5 trial locations per year.
- Analysed for CP content and AA composition
  - NIR (peas)
  - wet chemistry (beans)

Selected Peas

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
Nitouche	21.7	7.22	0.9	2.28	3.75	0.93	4.64
Gregor	21.6	7.20	0.89	2.24	3.74	0.94	4.61
Aviso	21.2	7.22	0.91	2.32	3.76	0.94	4.64
Ragtime	20.9	7.33	0.91	2.31	3.80	0.95	4.68
Bluemoon	20.7	7.32	0.92	2.33	3.79	0.95	4.66
Respect	20.2	7.33	0.94	2.36	3.83	0.96	4.69
Mascara	19.8	7.36	0.94	2.37	3.87	0.97	4.70
Prophet	19.8	7.39	0.96	2.44	3.87	0.95	4.75
Mean	20.74	7.30	0.92	2.33	3.80	0.95	4.67
s.e	0.3	0.12	0.01	0.03	0.04	0.02	0.06

Selected Peas

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
Nitouche	21.7	7.22	0.9	2.28	3.75	0.93	4.64
Gregor	21.6	7.20	0.89	2.24	3.74	0.94	4.61
Aviso	21.2	7.22	0.91	2.32	3.76	0.94	4.64
Ragtime	20.9	7.33	0.91	2.31	3.80	0.95	4.68
Bluemoon	20.7	7.32	0.92	2.33	3.79	0.95	4.66
Respect	20.2	7.33	0.94	2.36	3.83	0.96	4.69
Mascara	19.8	7.36	0.94	2.37	3.87	0.97	4.70
Prophet	19.8	7.39	0.96	2.44	3.87	0.95	4.75
Mean	20.74	7.30	0.92	2.33	3.80	0.95	4.67
s.e	0.3	0.12	0.01	0.03	0.04	0.02	0.06

Selected Spring faba beans

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
Tattoo	25.6	6.19	0.69	1.89	3.40	0.84	4.44
Betty	25.3	6.41	0.71	1.95	3.56	0.88	4.61
Fuego	25.1	6.22	0.70	1.88	3.45	0.86	4.43
Memphis	25	6.32	0.72	1.89	3.53	0.89	4.47
Ben	23.9	6.34	0.72	1.92	3.46	0.87	7.47
Mean	24.98	6.27	0.71	1.91	3.48	0.87	5.08
s.e	0.2	0.06	0.01	0.03	0.04	0.01	0.04

Selected Spring faba beans

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
Tattoo	25.6	6.19	0.69	1.89	3.40	0.84	4.44
Betty	25.3	6.41	0.71	1.95	3.56	0.88	4.61
Fuego	25.1	6.22	0.70	1.88	3.45	0.86	4.43
Memphis	25	6.32	0.72	1.89	3.53	0.89	4.47
Ben	23.9	6.34	0.72	1.92	3.46	0.87	7.47
Mean	24.98	6.27	0.71	1.91	3.48	0.87	5.08
s.e	0.2	0.06	0.01	0.03	0.04	0.01	0.04

Selected Winter faba beans

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
Husky	25.5	6.20	0.68	1.86	3.34	0.84	4.42
Wizard	24.4	6.37	0.73	1.99	3.43	0.83	4.50
Arthur	24.3	6.29	0.74	1.97	3.46	0.84	4.47
Clipper	23.6	6.42	0.75	1.90	3.46	0.85	4.56
Mean	24.45	6.32	0.73	1.93	3.42	0.84	4.49
s.e	0.4	0.09	0.01	0.02	0.05	0.02	0.08

Selected Winter faba beans

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
Husky	25.5	6.20	0.68	1.86	3.34	0.84	4.42
Wizard	24.4	6.37	0.73	1.99	3.43	0.83	4.50
Arthur	24.3	6.29	0.74	1.97	3.46	0.84	4.47
Clipper	23.6	6.42	0.75	1.90	3.46	0.85	4.56
Mean	24.45	6.32	0.73	1.93	3.42	0.84	4.49
s.e	0.4	0.09	0.01	0.02	0.05	0.02	0.08

Mean CP and AA profiles

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
SBM	47.78	6.11	1.35	2.83	3.90	1.36	4.75
Peas	20.74	7.30	0.92	2.33	3.80	0.95	4.67
Spring FB	24.98	6.27	0.71	1.91	3.48	0.87	5.08
Winter FB	24.45	6.32	0.73	1.93	3.42	0.84	4.49

Mean CP and AA profiles

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
SBM	47.78	6.11	1.35	2.83	3.90	1.36	4.75
Peas	20.74	7.30	0.92	2.33	3.80	0.95	4.67
Spring FB	24.98	6.27	0.71	1.91	3.48	0.87	5.08
Winter FB	24.45	6.32	0.73	1.93	3.42	0.84	4.49

Mean CP and AA profiles

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
SBM	47.78	6.11	1.35	2.83	3.90	1.36	4.75
Peas	20.74	7.30	0.92	2.33	3.80	0.95	4.67
Spring FB	24.98	6.27	0.71	1.91	3.48	0.87	5.08
Winter FB	24.45	6.32	0.73	1.93	3.42	0.84	4.49

Mean CP and AA profiles

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
SBM	47.78	6.11	1.35	2.83	3.90	1.36	4.75
Peas	20.74	7.30	0.92	2.33	3.80	0.95	4.67
Spring FB	24.98	6.27	0.71	1.91	3.48	0.87	5.08
Winter FB	24.45	6.32	0.73	1.93	3.42	0.84	4.49

Mean CP and AA profiles

	CP (%)	Lys (% in CP)	Met (% in CP)	M+C (% in CP)	Thr (% in CP)	Trp (% in CP)	Val (% in CP)
SBM	47.78	6.11	1.35	2.83	3.90	1.36	4.75
Peas	20.74	7.30	0.92	2.33	3.80	0.95	4.67
Spring FB	24.98	6.27	0.71	1.91	3.48	0.87	5.08
Winter FB	24.45	6.32	0.73	1.93	3.42	0.84	4.49

Raw material AA contents

	CP (%)	Lys (%)	Met (%)	M+C (%)	Thr (%)	Trp (%)	Val (%)
SBM	47.78	2.92	0.65	1.35	1.86	0.65	2.27
Peas	20.74	1.51	0.19	0.48	0.79	0.20	0.97
Spring FB	24.98	1.57	0.18	0.48	0.87	0.22	1.12
Winter FB	24.45	1.54	0.18	0.47	0.84	0.21	1.10

Raw material AA contents

	CP (%)	Lys (%)	Met (%)	M+C (%)	Thr (%)	Trp (%)	Val (%)
SBM	47.78	2.92	0.65	1.35	1.86	0.65	2.27
Peas	20.74	1.51	0.19	0.48	0.79	0.20	0.97
Spring FB	24.98	1.57	0.18	0.48	0.87	0.22	1.12
Winter FB	24.45	1.54	0.18	0.47	0.84	0.21	1.10

Raw material AA contents

	CP (%)	Lys (%)	Met (%)	M+C (%)	Thr (%)	Trp (%)	Val (%)
SBM	47.78	2.92	0.65	1.35	1.86	0.65	2.27
Peas	20.74	1.51	0.19	0.48	0.79	0.20	0.97
Spring FB	24.98	1.57	0.18	0.48	0.87	0.22	1.12
Winter FB	24.45	1.54	0.18	0.47	0.84	0.21	1.10

AA digestibility of selected pea and faba bean varieties

- Broiler assays were used to assess apparent ileal digestibility (AID).

- Differences in AA AID
  - between peas and faba beans
  - within pulse varieties
  - between peas/faba beans and SBM

Materials and Methods

- Legumes were added to a protein-free basal diet at a rate of 750 g/kg.
  - SBM at 500 g/kg in Exp. 2
- Diets were fed to Ross-type broilers for 7d.
  - 6 cages per diet, 2 birds per cage.
- Ileal digesta and diets were analysed for CP, AA and digestibility marker (titanium dioxide).

AID of Crude Protein (%)

	Exp. 1	Exp. 2
SBM	-	83[b]
Peas	79[a]	90[a]
Faba beans	72[b]	83[b]
sed	1.4	2.7

AID of Lysine (%)

	Exp. 1	Exp. 2
SBM	-	84
Peas	87[a]	87
Faba beans	78[b]	79
sed	1.1	4.7

AID of Methionine (%)

	Exp. 1	Exp. 2
SBM	-	86[a]
Peas	80[a]	79[a]
Faba beans	65[b]	59[b]
sed	1.7	2.7

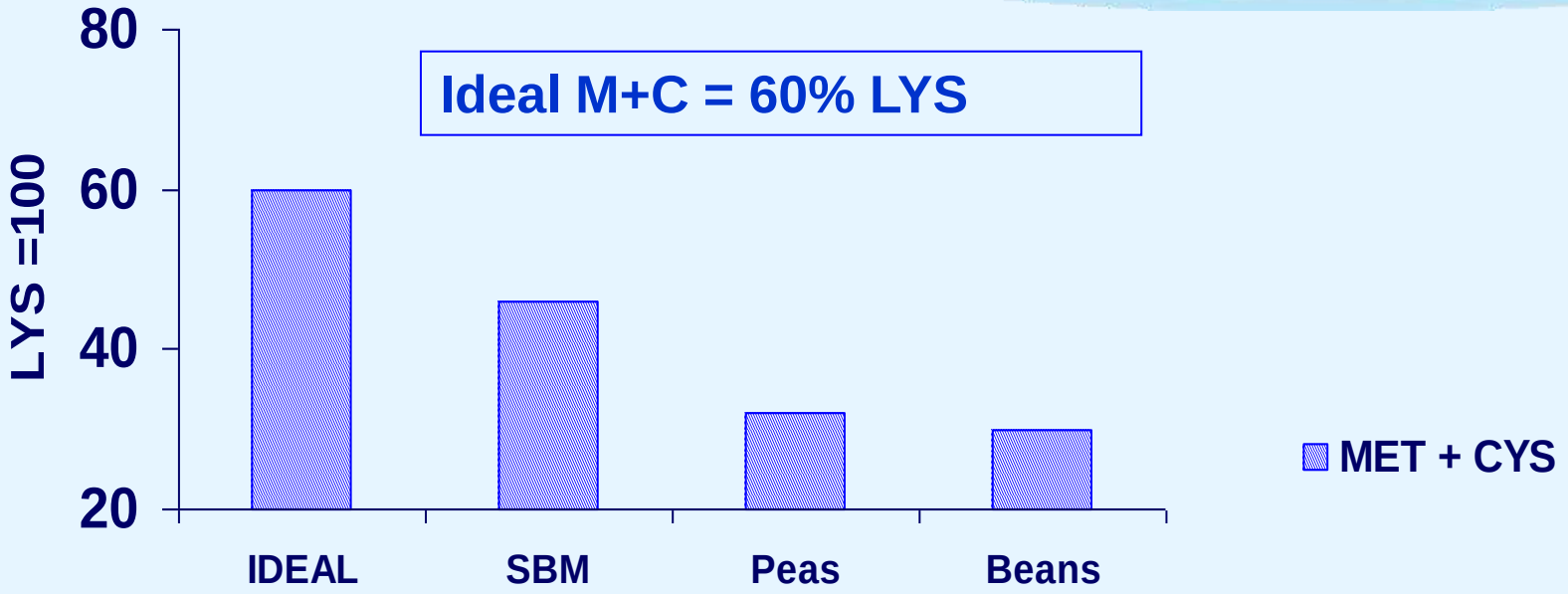
AID of Threonine (%)

	Exp. 1	Exp. 2
SBM	-	78[a]
Peas	79[a]	78[a]
Faba beans	71[b]	67[b]
sed	1.4	5.9

Variety effects on AA AID

- Peas:
  - Exp 1: Some varietal effects for Leucine only
  - Exp 2: No differences found
- Beans:
  - Exp 1&2: No differences found for any AA
  - Some varietal effects for AID of CP
- Overall, little varietal effects on digestibility

Ideal protein concept for pigs



- SBM more balanced for M+C than peas and faba beans.
- Pea and faba bean based diets require more AA from other sources to meet requirements

Conclusions

- AA profile of peas and field beans suggests its protein is of lower quality than that of SBM.
- Little difference in AA profiles, and CP and AA digestibility within pea and faba bean varieties.
- In general, CP and AA digestibility was greater in peas than in faba beans.

Conclusions

- Combined AA contents and digestibility suggests that additional AA are required from other dietary sources to meet AA requirements
  - remarkable similar between peas and faba beans.

- Within strategic feed formulations, peas and faba beans may be useful alternatives for SBM in monogastric diets.

Overall take home message

- The question was whether sufficient varietal differences within peas and beans exists to be exploited for feed formulation purposes

Overall take home message

- The question was whether sufficient varietal differences within peas and beans exists to be exploited for feed formulation purposes

- Our data suggests that from a feed formulation point of view this is unlikely the case

Overall take home message

Peas are peas

and beans are beans!


SAC
Success through Knowledge