Clean Environment Commission Hog Production Industry Review

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Nutrient management

- For successful feed formulation we need an accurate definition of
  - Nutrient requirements
  - Nutrients in feedstuffs
- We can then formulate feeds, and ration pigs, to meet nutrient requirements accurately whilst minimising environmental impact.
- Fortunately the science is strong and in the public domain
- Is the science reaching the farm?

Digestible Phosphorus

- Digestibility of P in plant sources limited by phytic acid.
- The enzyme phytase degrades phytic acid and increases P digestibility (and reduces cost)
- Routinely used in EU for 7-10 years.
- Digestibility of P in mineral sources variable
  - Move from dicalcium to monocalcium P

Digestible Phosphorus

Raw Material	Digestibility (%)
Skim Milk	92
Mono cal P	90
Mono dical	80
Fish	77
Dical	72
Wheat	46
Peas	45
Soya	39
Barley	39
Mill-run	30
Canola ext	27
Suns extr	15

Digestible P or Available P?

- Confusion reigns!!
  - Available P is an old system and has largely been replaced by digestible P
  - Available P less accurate and has higher numbers
  - Some nutritionists using available P on feed ingredients but digestible P requirements
    - Result – excess P in feed

Digestible phosphorus requirements

Example for UK conditions

(Derived from C Jondreville, C; Dourmad, J.-Y INRA Prod. Anim., (2005), 18 (3), 183-192)

Weight (kg)	Growth rate (kg/day)	DP required (g/day)	True intake (kg/day)	DP required (%)
10	0.4	2.2	0.55	0.4
20	0.5	2.9	0.96	0.30
30	0.6	3.4	1.32	0.26
50	0.75	4.4	1.86	0.24
70	0.85	5.0	2.24	0.22
100	0.9	5.4	2.59	0.21
115	0.85	5.2	2.63	0.2

DP requirement as INRA; Feed intake midway BSAS guideline and BSAS minus. DP requirement for maintenance 10mg/kg BW.
DP requirement for growth (-2*-002857*BW+5.4199)*DLWG kg/day

Digestible phosphorus requirements

C Jondreville, C; Dourmad, J.-Y INRA Prod. Anim., (2005), 18 (3), 183-192

Litter growth rate (g/day)	1750	2000	2250	2500	2750	3000
DP requirement (g/day)	11.5	12.8	14.2	15.5	16.9	18.2
Av. feed intake (kg/day)	DP requirement (%)					
4.0	0.29	0.32	0.35	0.39	0.42	0.46
5.0	0.23	0.26	0.28	0.31	0.34	0.36
6.0	0.19	0.21	0.24	0.26	0.28	0.30
7.0	0.16	0.18	0.2	0.22	0.24	0.26

Digestible phosphorus requirements

- As we reduce the digestible P in feeds we reduce the “safety margin”
- Where problems have been encountered (and there have been few) then
  - Check phytase recovery
  - Check P recovery and variability
    - Separation, particle size and mixer efficiency.
  - Gilts in lactation where feeds specification is based on “average” sow.
  - Feed intake lower than anticipated.

Example phosphorus balance

Start weight (kg)	End weight (kg)	P (%)	P with phytase (%)	Phosphorus intake (kg/pig)	Phosphorus intake phytase(kg/pig)
7	12	0.68	0.58	0.04	0.03
12	30	0.65	0.55	0.21	0.18
30	65	0.60	0.50	0.51	0.43
65	100	0.57	0.47	0.63	0.52
			Total intakes (kg)	**1.39**	**1.15**
30	100		**Retention (kg)**	**0.50**	**0.50**
			Excreted (kg)	**0.76**	**0.64**
			% retained	**0.36**	**0.43**

1. Phytase reduces P excretion by 16% in this example
2. P excretion particularly at the higher weights – more feeds?

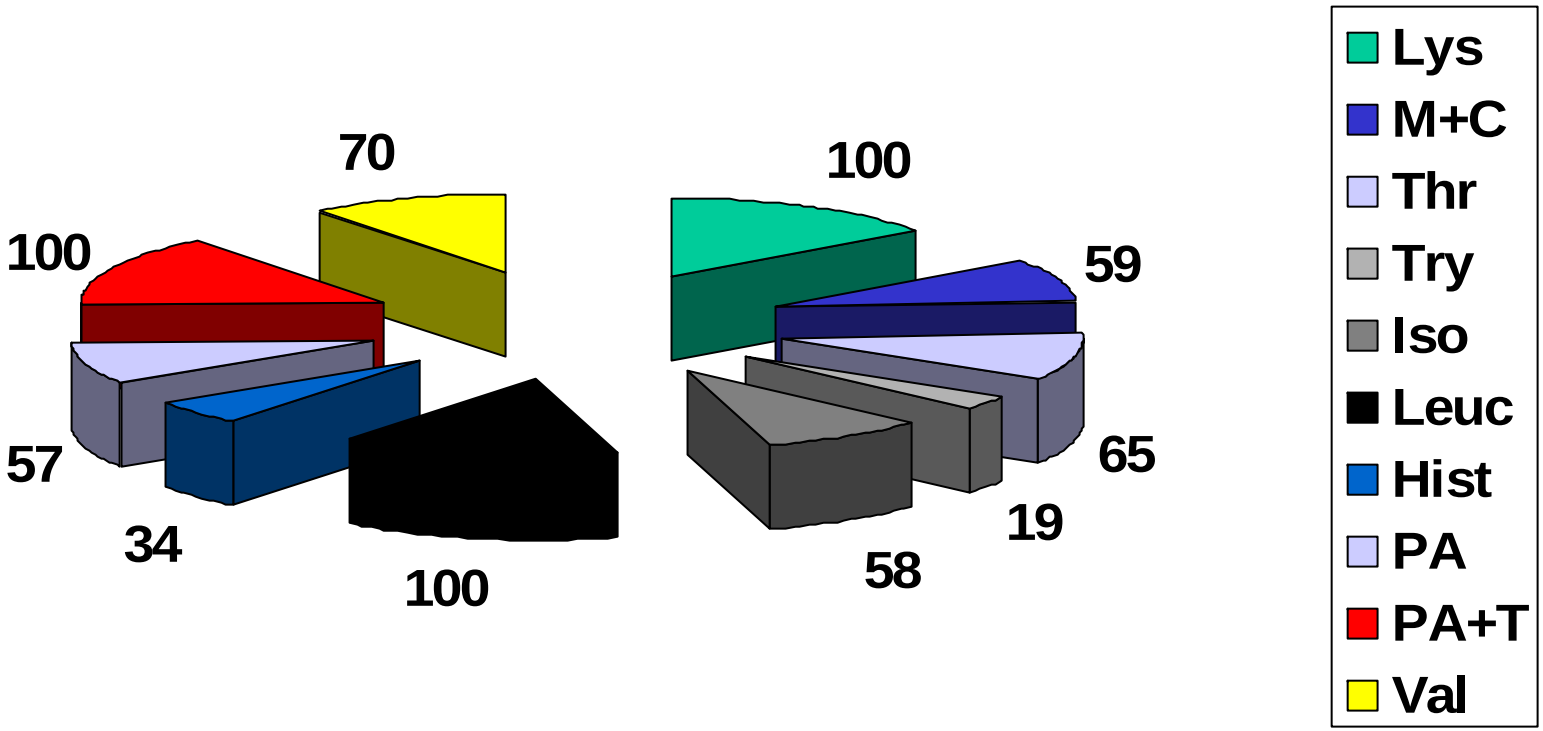
*Jongbloed et al (1999)

Nitrogen

- Feed protein is taken as N*6.25
- Pigs have a requirement for essential amino acids in a certain balance (as in pork, sows milk etc) known as ideal protein
- Some protein is indigestible and thus appears in the dung
- Some is digested but is in excess of requirements/imbalanced and is broken down in the liver and the N excreted in the urine.
- To minimise N output
  - Feeds should be formulated to the lowest crude protein possible commensurate with the daily supply of balanced digestible amino acids for the productive purpose.

“Ideal” protein

Digestible amino acid balance for growing pigs



Amino acids in feeds formulation

- The amino acids lysine, methionine, threonine and tryptophan are available commercially
- They can be added to feed to improve amino acid balance and thus reduce crude protein (typically soya inclusion is reduced)
- A 1% reduction in CP reduces N excretion by about 10%.

Cost impact of formulating low protein feeds

- Cereals plus amino acids replace soya
- Energy
  - Most feeds are formulated to metabolisable or digestible energy both of which *overestimate* the energy value of protein to the pig ie protein is seen to have a bigger $ value than is the case
  - Canada is now adopting Net energy which prevents this overestimation and reduces the cost of low protein feeds
- Generally in the last 3 years it has saved money to reduce protein of feed by 1-2% points against historic norms

Example nitrogen balance

Start weight (kg)	End weight (kg)	CP (%)	Nitrogen intake (kg/pig)
7	12	22	0.21
12	30	20	1.02
30	65	18.5	2.52
65	100	17	2.99
		Total intakes (kg)	**6.74**
	100	**Retention (kg)**	**2.72**
		Excreted (kg)	**3.75**
		% retained	**0.40**

Assumes 17% protein in final pig.
Some of the N excreted is lost as ammonia although this can reduced using benzoic acid (Vevovital, DSM)

New feed formulation techniques – digestible P, amino acids and net energy

Ingredients	Old	New
Wheat	397.0	413.0
Barley	126.0	193.0
Millrun pellets	125.0	125.0
Peas	100.0	100.0
Soya	214.0	133.0
Lysine	0.6	3.0
Methionine	-	0.7
Threonine	-	1.1
Canola Oil	10.0	10.0
Phytase	-	0.1
Limestone	16.0	13.0
Mono Cal	6.4	2.4
Salt	4.3	4.3

Nutrients	Old	New
Oil	3.3	3.4
Crude Protein	19.9	17.2
Crude Fibre	4.0	4.0
ME (Kcal/kg)	3120	3120
NE (Kcal/kg)	2275	2318
Dig. Lysine	0.93	0.93
Less N output		-27%
Less P output		-30%
Price ration		
/tonne	$182.89	$180.97
/2300 Kcal NE	$184.90	$179.56

Nutrient management

Conclusions

- The science for reducing both N and P output is published, and has been adopted in northern Europe for a number of years
- Costs depend upon commodity prices and the target N & P excretion targets
- N and P output from hog farms can be modelled from a knowledge of feed delivery/manufacture and hog sales
- The heavier the pig the lower the efficiency of N and P retention. Changing feed formulation more frequently allows requirements to be more accurately met reducing excretion.
- A publication giving “best nutritional practice” might be useful