Three topical areas of pig nutrition to improve profitability

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Margins are constantly under pressure in pig production and so cost reduction is an unrelenting priority. Commercial nutritionists use techniques including research to try and open up new ways of reducing costs alongside more routine desk based exercises for 'fine tuning' and exploiting dietary cost benefits.

Three examples are highlighted here. First, a recent breakthrough in piglet nutrition is followed by an exercise on fine tuning the energy density of grower/finisher diets. Thirdly, a brief comment is made on our work examining whether different genotypes require different starter diets.

A recent breakthrough

The negative effects that phytate can have as an anti-nutrient on trace mineral, protein, amino acids, sodium and energy utilisation are becoming clearer.

A new area of research, using high levels of phytase to break down dietary phytate, is emerging with the aim of establishing if there is a performance and economic response beyond that normally associated with the release of phosphorus.

It is proposed that phytate reduces the solubility of protein via a hydrating effect. Reduced protein solubility increases the production of HCl, pepsin, mucin, bile and $NaHCO_3$ resulting in increased energy, specific amino acid and sodium flow into the lumen, with the latter interfering with active transport.

Intact phytate strongly binds to zinc and calcium and with the latter reduces the efficacy of the calcium dependent pancreatic enzymes. There is also the suggestion that phytate competes for the structural calcium in mucin adversely affecting the unstirred water layer. This is detrimental to nutrient utilisation due to lower enzyme efficacy and increased endogenous amino acid loss from mucin fluidity. Increased mucin fluidity may also make the intestine more susceptible to health challenges.

The addition of phytase at high levels, termed 'superdosing', to quickly destroy as much phytate as possible would therefore be expected to have beneficial performance effects promoted through improved amino acids (specifically those associated with mucin and pancreatic secretions such as glycine, serine, threonine and proline) and mineral (zinc, iron, sodium, and magnesium) availability. In addition, there are likely to be energy benefits from direct (improved digestibility and solubility of dietary nutri-

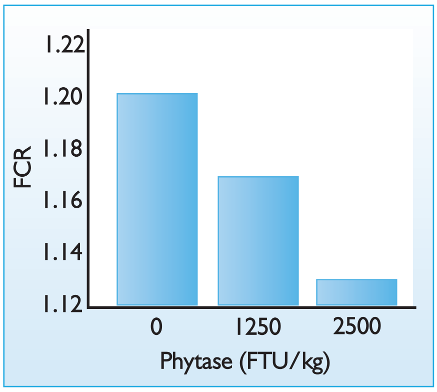

Fig. 1. Increasing phytase levels significantly (P<0.05) improves feed conversion ratio in newly weaned pigs (Toplis et al, 2011).

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ents), indirect (reduced endogenous losses) and net effects, whereby energy is utilised for growth rather than maintenance (mucin turnover and enzyme production).

Finally, the production of inositol indirectly from high levels of phytase may also play a role in improving the anti-oxidant status of the animal.

Low phytate nutrition

A recent series of post-weaning studies (from weaning at four weeks of age for three weeks post-weaning) in piglets conducted in the UK, tested phosphorus adequate diets with varying levels of phytase (0, 1250 and 2500 FTU/kg) in the presence of zinc oxide (3100mg/kg). Increasing levels of phytase significantly improved FCR (Fig. 1), with a numerical improvement in ADG. High levels of phytase also significantly reduced the level of post-weaning scour. The overall effect was that the margin per pig was improved ($0.58/pig) by the use of high levels of phytase showing the 'superdosing' application to be cost effective to the producer ($1540/100 sows or $5.5 million/year to the UK pig industry).

An additional study in the US compared piglets fed a 'superdosed' low digestible high phytate diet (negative control, NC), with piglets fed a high digestible, low phytate diet (positive control, PC). The 'superdosed' diet reduced cost/kg (-$0.06/kg gain) and improved the overall return per pig (+$0.35/pig).

In pigs the majority of the 'low phytate nutrition' research has been conducted in the nursery but a recent field evaluation in grower and finisher pigs in the UK was reassuring (unpublished).

Although the exact mechanism of 'low phytate nutrition' is not yet fully known the likelihood is that it will be made up of a number of factors such as improved nutrient utilisation and improved anti-oxidant status of the animal. Initial cost benefit data on 'low phytate nutrition' is very encouraging.

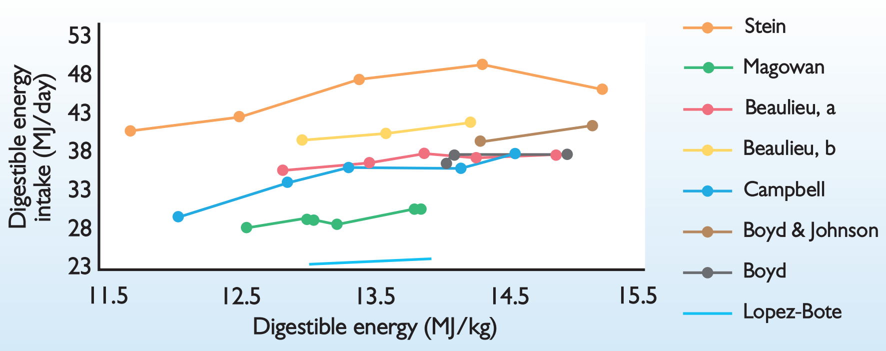

Fig. 2. Relationship between digestible energy concentration and feed intake (from M. Hazzledine, 2011).

Do pigs 'eat to energy'?

Two to three decades ago UK pig diets utilised a range of ingredients from all over the world. In the last decade far fewer, mainly home grown, ingredients have dominated UK pig diets; cereals and extracted rape meal along with imported soyabean.

Increased pressure on these raw materials, for example the increased demand for wheat from bioethanol plants is having a strong upward influence on prices and this has increased the cost of energy constraints in pig diets.

If pigs are able to regulate their feed intake to account for changes in dietary energy content, then it may be possible to adjust energy density to minimise feed cost.

Eight recent papers suggest that feed intake reduces with increasing energy concentration but often fails to prevent a small increase in energy consumption (Fig. 2). Pigs compensate, but not perfectly!

Ferguson et al., 1999, however, suggested accurate compensation (-0.0567kg d-1/MJ DEkg-1) having reviewed 10 papers published between 1967 and 1995. As energy

Table 1. Estimated growth and feed conversion of finishing pigs (65-105kg), showing full energy compensation (from M. Hazzledine, 2011).

	Digestible energy (MJ/kg)					
	12.75	13.00	13.25	13.50	13.75	14.00
Feed intake (kg/day)	2.75	2.70	2.65	2.60	2.55	2.51
DE intake (MJ/day)	35.1	35.1	35.1	35.1	35.1	35.1
Growth rate (g/day)	850	850	850	850	850	850
FCR	3.24	3.18	3.12	3.06	3.00	2.95

density increases, feed conversion improves (0.2 for each 1 MJ DE/kg in the feed).

An example is given for pigs from 65-105kg liveweight where it is assumed that pigs are accurately 'eating to energy' across a range of diet energy levels (Table 1).

To assess the cost benefit implications of performance outlined in Table 1, a series of diets were formulated using typical UK ingredient costs in 2010 (Table 2).

Two 'sensitivity' values, produced during feed formulation are helpful when assessing the economics of energy density, DE cost sensitivity and bulk (volume) sensitivity.

Where diets are formulated to fixed energy: nutrient ratios (AA/DE) removing the bulk density (volume) constraint is a rapid way of seeing if the diet is too dense or too dilute.

Feed cost per pig can be reduced by formulating diets to a higher (when too dilute volume <100%) or lower (when too dense volume >100%) energy level. In this example (Table 2) feed cost/kg gain is minimised at 13.6 MJ DE/kg when the energy sensitivity is about £11.50/MJ and the bulk sensitivity confirms this by changing from 'drop' to 'rise' between 13.6 and 13.75 MJ DE/kg.

In 2011 there were some unusual price differentials in UK ingredient costs with wheat at £205/t, but barley and wheatfeed relatively cheap at £175/t and £140/t.

Repeating the above exercise with 2011 ingredient costs results in feed cost/kg liveweight being minimised at a much lower 12.8 MJ DE/kg.

Formulating the 12.75 MJ DE/kg feed without a bulk constraint resulted in an optimum volume of 996kg (99.6%), suggesting it was already very close to the optimum nutrient density. The bulk constraint is a handy 'rapid test' to determine the optimum nutrient density when seeking potential savings in feed cost (on a liveweight basis).

It is important to question some of the existing nutrient constraints within the diet specification. Fibre constraints can become expensive and will limit nutrient density reductions unless increased. However, raising the fibre constraints is expected at some, ill-defined, point to limit feed intake.The above example assumes that pigs are able to fully compensate for any change in dietary energy content. However, the data in Fig. 2 suggests that, with younger pigs and at low energy concentrations, energy compensation is incomplete.

Where energy compensation is complete then growth rate and carcase fatness remains unaltered as energy concentration is changed (feeds with a lower energy concentration are likely to have a higher fibre content and consequently a lower carcase yield).

Where energy compensation is incomplete then as energy concentration falls energy intake also falls and pigs become leaner. The nutritionist must take into account carcase characteristics (including economic impact) as well as feed costs and growth rate along with other farm circumstances, when determining optimum nutrient density.

Table 2. Diet formulations at a range of dietary energy concentrations with key cost data (UK costs 2010) (from M. Hazzledine, 2011).

	£/t	Digestible energy (MJ/kg) 12.75	13.00	13.25	13.50	13.60	13.75	14.00
Wheat	205	18.3	25.2	45.2	50.0	50.0	50.0	50.0
Barley	198	35.0	35.0	15.0	16.5	19.8	22.8	25.5
Wheatfeed	190	21.8	13.8	14.0	6.3	2.5	0.0	0.0
Rape meal	190	12.5	12.5	12.5	12.5	12.5	9.6	0.9
Soya 48	290	9.7	10.8	11.1	12.1	12.7	14.9	20.5
Soya oil	850	0.5	0.5	0.5	0.7	0.8	0.9	1.1
Mins/vits/AA		to 100	to 100	to 100	to 100	to 100	to 100	to 100
RM cost (£/t)		214.6	216.5	218.9	221.66	222.81	225.81	232.43
Delivered feed cost (£/t)		239.6	241.5	243.9	246.66	247.81	250.81	257.43
Cost/kg gain (p/kg)		77.6	76.7	76.0	75.4	75.2	75.3	75.9
DE cost sensitivity (£/MJ)		0.00	7.93	10.95	11.51	11.51	26.22	26.8
Bulk sensitivity (£/unit)		200drop	82.8drop	32.3drop	27.1drop	27.1drop	26.2rise	153rise

Feeds for different breeds

New terminal sires are being favoured in the UK because of improved performance traits and apparent increased resistance to disease. Differences in the performance of discrete genotypes are expected to lead to differences in nutrient requirements.

The results of a large study carried out for Primary Diets by Professor Miller's group at the University of Leeds demonstrate that in the first three weeks after weaning the nutrient requirements are similar between the three different genotypes tested and that no significant savings are available from specific starter feeds for the breed.

The above three examples demonstrate research can still be used to bring significant savings to pig producers. In 2011 many producers will have saved $2.30/pig through a breakthrough in 'low phytate nutrition', a change in the nutrient density of their grower/finisher diet and by not using different starter diets for different breeds. ■