A better start: a more productive and profitable finish

by Rafael Duran, Regional Technical Manager, EMEA, Danisco Animal Nutrition.

Despite a recent fall in feed costs and a rise in pig sales price the challenge of meeting increasing pork demand, while also making a sustainable profit, has intensified. Pork is already the world's most popular meat and is estimated to grow at a CAGR of 1.7% from 2012 to 2017.

Research in recent years has shown that certain feed additives can help ensure that piglets get off to a healthy start via their beneficial effects on diet digestibility and gut integrity, and can consequently reduce the number of days to produce a saleable animal. The benefits of applying feed additives to gilt rearer, gestation and lactation diets in terms of profitable herd performance and development have also been shown.

This article explores how the addition of specific feed additives – phytase, carbohydrase, betaine and essential oil compounds – to piglet, gilt and sow diets can help reduce production challenges and deliver considerable economic benefits.

Healthy profits

Thanks to continuous genetic advances over the years, gilts and sows are far more productive today than they were a few decades ago.

Digestibility (%)	Positive control	Negative control	NC + Buttiauxella			NC + E. coli
			250FTU/kg	500FTU/kg	1000FTU/kg	500FTU/kg
Phosphorus	50.0[d]	40.7[e]	55.5[c]	61.0[b]	64.9[a]	55.0[c]
Calcium	59.7[d]	49.4[e]	64.8[c]	69.4[ab]	73.1[a]	66.2[bc]

Table 1. The effect of a Buttiauxella spp. phytase on phosphorus and calcium digestibility in weaner pigs (12-19kg) in comparison to an E. coli phytase.

However, maximising sow longevity and productivity in the herd is still a complex challenge, influenced by many factors beyond genetics.

If we take into account the fact that the number of piglets per litter today is, on average, between 9.4 and 15, that since 2005 the total piglets born has increased by an average 1.41 pigs per litter and that an optimal economic lifespan for sows is five parities, it is clear that the nutritional drain on the sow over her productive life is going to be very high. Past research has shown that there is a direct relationship between prolificacy and energy and protein inputs.

Further research comparing the bone mineral reserves of sows over three parities with non reproducing gilts of a similar age demonstrated that most of the minerals, and in particular calcium and phosphorus, were reduced. The critical stage for mineral loss appeared to be during late gestation and lactation.

Lameness, leg and foot problems can be symptoms of depleted bone mineral reserves and lameness is the single most common reason for young sows being removed early from the herd. These effects reduce the potential number of piglets produced per sow, and consequently reduce producer profitability.

Clearly the effective utilisation of phosphorus and calcium is fundamental to many of these issues. Phytate, the form in which phosphorus is naturally stored in feed raw materials, reduces the availability of essential nutrients such as calcium, protein/amino acids, iron and zinc to the animal because it forms complexes with these nutrients in various parts of the digestive tract, a process which decreases the nutritional value of diet formulations. The strategic use of phytase to maximise

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a, b, c P<0.05	Control (C)	C + EO (g/tonne)		
		50	100	150
Final body weight (kg)	23.49[b]	25.36[a]	26.58[a]	26.76[a]
Average daily gain (kg)	0.37[c]	0.41[b]	0.45[a]	0.45[a]
Average daily feed intake (kg)	0.73[c]	0.78[bc]	0.87[a]	0.84[ab]
FCR	1.96[a]	1.90[ab]	1.93[a]	1.87[b]
Diarrhoea frequency (%)	7.50[a]	4.54[b]	3.13[b]	3.33[b]
Lactobacillus (cfu/g of faeces $\times 10^7$)	1.93[c]	2.23[c]	4.42[a]	2.42[b]
E. coli (cfu/g of faeces $\times 10^6$)	4.78[a]	2.72[b]	2.27[b]	2.15[b]

Table 2. Effect of essential oil compounds (EO) on performance, diarrhoea frequency and microbial counts in the faeces of piglets (Adapted from Li et al, 2012).

Fig. 1. Phosphorus and calcium digestibility in pregnant sows in response to an E. coli phytase at 500 FTU/kg feed (University of Manitoba, Canada 2007).

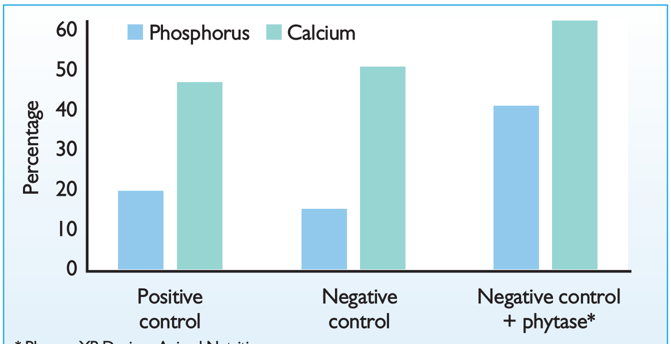

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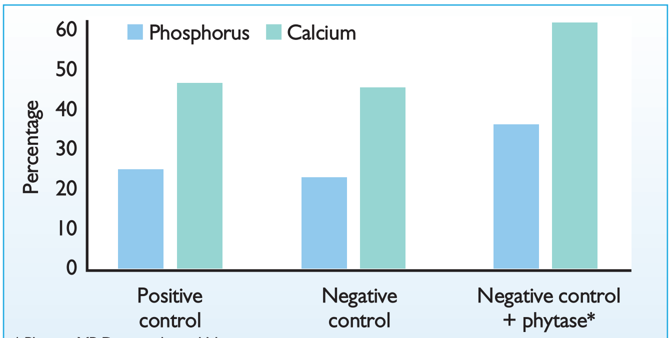
Fig. 2. Phosphorus and calcium digestibility in lactating sows in response to an E. coli phytase at 500 FTU/kg feed (Purdue University, 2007).



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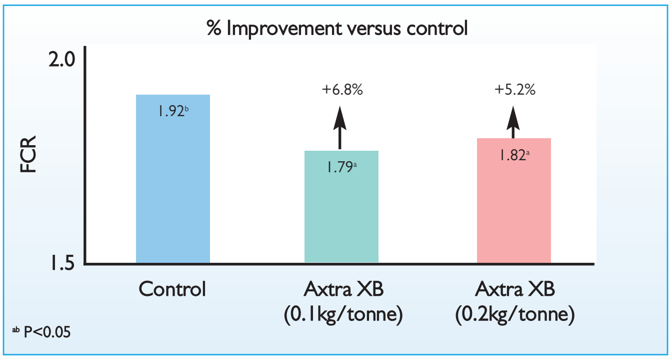

Fig. 3. Piglets (9-32kg) fed mixed grain diets with a xylanase and beta-glucanase combination (IRTA, Spain).

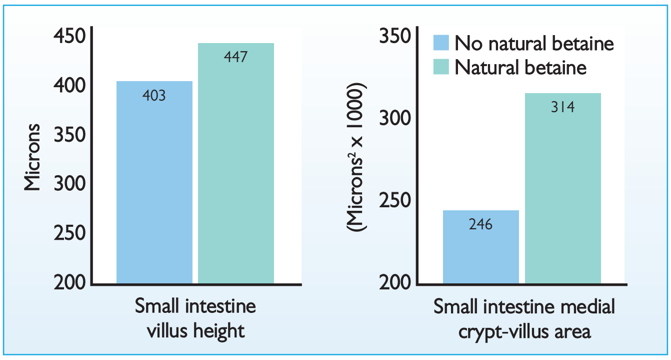

Fig. 4. Natural betaine significantly improved (P<0.05) villus height and associated absorptive area in the small intestine – means a more robust gut structure for improved digestion and absorption of nutrients after weaning (University of Leeds, UK – piglets fed 2kg/tonne of natural betaine to 20 days after weaning).

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destruction of phytate improves nutrient release thereby having a significant, positive impact on gilt and sow performance, as well as contributing substantially to feed costs savings.

Research has shown that phytase application in sow diets during the reproductive cycle significantly improves phytate destruction and therefore increases the digestibility of phosphorus and calcium in pregnant sows (Fig. 1). It is also very effective during lactation (Fig. 2), which is another critical time in terms of ensuring skeletal integrity not just for the sow, but also for its developing piglets. Research work with phytase addition in sows has also shown beneficial effects are not just confined to phosphorus and calcium, but also to energy and protein/amino acids.

Piglet diets tend to contain less phytate than grower-finisher or sow diets but piglets seem to be particularly sensitive to dietary phytate levels. Research by Woyengo et al, 2012 showed a significant reduction in growth performance (37%) when piglets were fed a synthetic diet based on casein-corn starch containing added phytate, versus a control diet with no phytate. Daily feed intake was also reduced by 18% and gain:feed by 25%. Similar negative effects of phytate level in the diet on energy and protein/amino acid digestibility in growing pigs have also been shown in earlier research studies. This data is of increasing significance at a time when some producers with concerns over Porcine Epidemic Diarrhoea virus (PEDv) have moved away from the use of pig plasma in weaner diets towards the use of more vegetable protein, resulting in more phytate in the diet for young animals.

It is also important to choose the right type of phytase to maximise phytate destruction. Research at Schothorst Feed Research, Netherlands has shown that the latest advanced phytase sources can offer even higher activity than best in class E. coli phytases under low pH conditions, ensuring more efficient breakdown of the phytate molecule early in the digestive process.

Table 1 shows the results from addition of a novel Buttiauxella spp. phytase in diets reduced in available phosphorus by 0.20%, calcium by 0.14% and with a dietary phytate P level of 0.21%.

Another critical factor is applying the right dose of phytase. The addition of other additives such as zinc oxide, which is used to reduce the incidence of post-weaning diarrhoea, also needs to be taken into account when considering the optimum phytase dose.

In vitro studies show that zinc can bind to phytate, rendering it less accessible to phytase and that the high zinc levels used in many post-weaning diets can compromise the efficacy of phytase at 'conventional' doses, for example 500 FTU/kg feed. Recent trials have shown that the use of phytase at 1000 FTU/kg feed (and higher) gave good growth and feed conversion responses in phosphorus-adequate piglet diets containing 2500 mg/kg of zinc oxide and with a phytate P level of 0.28%. The best performance in this trial was achieved with a dose of 2000 FTU/kg feed.

Minimising stress

The pre-weaning and post-weaning phases are particularly challenging times for pig producers, as they aim to minimise production stress in both the farrowing and follow-on facilities. It is also well known that young pigs can suffer considerable physiological stress during the weaning process. Dehydration is a common symptom at this time and a major challenge for producers as it increases the maintenance energy requirements of the animal, leaving less 'spare' metabolic energy available for productive processes, for example growth and lean gain. The newly-weaned piglet's immune and digestive systems are also still maturing, making them more susceptible to disease-causing organisms which can further disrupt gut integrity.

Producers have historically tried to overcome growth performance issues and disease challenges at weaning with the use of in-feed antibiotics but growing concerns about residues in meat products and potential bacterial resistance to antibiotics has led to increased research into practically feasible alternatives.

Studies with piglets suggest that essential oil compounds can support gut health status in the absence of antibiotics through modulation of the intestinal microflora and immune system, thereby improving growth performance, lowering the incidence of diarrhoea and reducing E. coli counts in the faeces (see Table 2).

Research has also shown how addition of xylanase and beta-glucanase combinations can support piglet gut health and growth by reducing fibrous anti-nutrients in the diet (Fig. 3).

Natural betaine supplementation in young pigs after weaning has also been shown to have positive effects on the animal's gut structure (Fig. 4).

Natural betaine has the ability to help protect against the dehydrating effects of, for example, coccidiosis or the proliferation of other undesirable micro-organisms in the gut, which can contribute to poor performance.

Another key benefit of natural betaine supplementation in pigs of all ages, but particularly during weaning, is that as an osmolyte it spares maintenance energy, leaving more metabolic energy for carcase lean gain.

For sows, having to cope with chronic or extreme heat stress can have a negative impact on reproductive performance. Natural betaine has been shown in trials to be particularly effective in boosting metabolic energy (through its effects on reducing maintenance energy requirements) and offsetting this negative impact of heat stress in sows.

In addition to its maintenance energy benefits, natural betaine's contribution to methylation requirements in sows can also add significant production value by potentially reducing conceptus loss, improving sub-optimal reproductive performance and consequently increasing litter size in the subsequent parity (Fig. 5).

Conclusion

Research clearly shows that many different feed additives (phytase and carbohydrase enzymes, betaine and essential oils) can help producers cope with the challenge of ensuring sow longevity and productivity, and maximising piglet performance. This will also help ensure that pig producers can run profitable operations to meet the demand for pork which is set to double by 2050. ■

References are available on request from monica.hart@dupont.com

Fig. 5. Summary of three trials at Rivalea (formerly QAF), Australia with natural betaine at 2kg/tonne in the preceding lactation period show improved subsequent numbers born alive to sows.