Contribution of phytase to prolific sow diets

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Mineral levels in gilt rearer, gestation and lactation diets must be managed carefully in order to maximise the health of sows and their retention in the sow herd. Phytase is an environmentally friendly, effective tool to manage dietary nutrient levels more efficiently in nutrition programs designed to feed for sow lifetime performance.

Pigs per sow per year and numbers weaned have always been the main performance criteria adopted by pig producers to judge the success of their business.

However, too much focus on pigs per sow per year means other indicators such as lifetime performance of the sow and feed efficiency, which are also important indicators for profitability in the sow herd, can become neglected.

Sow longevity is a critical factor for sow herd productivity and profitability, because of the high cost of gilt replacement. The cost of replacing gilts becomes even greater with increasing cost of feed.

Table 1 shows that high feed costs can increase the cost of replacement gilts entering the breeding herd by up to 29%. The optimal economic lifespan for sows is 4-5 parities, however on many commercial units 40-50% of sows are culled before reaching their third or fourth parity.

The two major reasons for culling sows early are reproductive failure and lameness. Therefore management practices reducing the incidence of these two factors are important to improve the productivity and profitability of the sow herd.

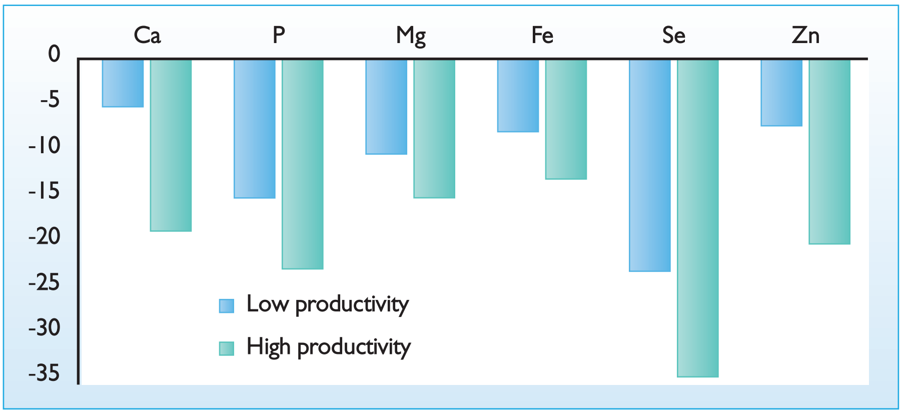

Fig. 1. Mobilisation of bone mineral reserves in sows with low productivity and prolific sows after three parities relative to non-gravid sows (Mahan and Newton 1995).

Dietary risk for lameness

With the top pig producing countries aiming for 35 piglets per sow per year, the nutritional demands on these sows are very high, including both macro- and micro-minerals.

Furthermore, increased prolificacy in sows is putting more pressure on a sow's skeleton, legs and claws. Pregnant prolific sows carry more weight, which results in more pressure on the legs and claws. During lactation the prolific sow has to cope with increased milk production to feed additional piglets, which can require greater mobilisation of calcium and phosphorus from the bones. It has been determined that reductions in sow body mineral reserves intensify with higher productivity (Fig. 1).

This can also affect the levels of trace elements such as copper and zinc which are important to maintain healthy claws. Bone mineralisation can be influenced by dietary mineral levels. This highlights the importance of adequate mineral nutrition in prolific breeding sows to prevent depletion of bone mineral reserves that could subsequently lead to feet and leg problems.

However, other risk factors for lameness such as housing conditions, floor type and genetics cannot be compensated for by nutrition.

Table 1. Associated costs to produce a replacement gilt entering the gilt development unit; gilt development feed costs and final cost of a gilt entering the breeding herd (adapted from Stalder 2009).

	Low feed cost	High feed cost
Feed costs ($ per tonne)	61.05	110.27
Final gilt cost entering the gilt development unit ($)	196.05	245.27
Gilt development feed costs ($)	28.06	49.00
Gilt cost plus development feed costs ($)	224.11	294.27
Placed gilts not entering the breeding herd (%)	10	10
Final replacement gilt cost entering the breeding herd ($)*	**250.33**	**321.80**

*Final gilt replacement cost assumes 10% of the gilts entering the gilt development unit will be sold at market value as non-breeders. Further other costs (breeding costs, vaccination, etc), in addition to gilt development, feed costs and non-breeders, were used to arrive at the final cost of gilts entering the breeding herd.

Managing dietary risks

Faced with the above challenges nutritionists frequently formulate sow diets with macro- and trace mineral levels which exceed National Research Council (NRC) recommendations. However, this is neither an efficient nor a healthy approach for the sow.

A more cost effective and healthier approach is to improve the utilisation of phosphorus and calcium in the raw materials used in sow diets.

Continued on page 17

	Positive control	Negative control	Phytase Phyzyme XP 500 FTU/kg
Dicalcium phosphate in diet (kg/tonne)	12.5	6.0	6.0
Limestone in diet (kg/tonne)	10.8	10.4	10.4
Calcium digestibility (kg/tonne)	47.1[a]	46.9[a]	59.1[b]
Phosphorus digestibility (kg/tonne)	25.1[ab]	23.3[a]	38.1[a]
Energy digestibility (kcal/kg)	3729[a]	3806[a]	3918[b]
Sow weight change (kg)	-13.8	-12.0	-5.3
Daily feed intake (kg)	4.38	3.96	4.65
Number of pigs born alive	10.6	9.8	9.6
Number of pigs weaned	9.2	8.6	8.6
Litter weight gain (kg)	33.2	26.4	33.2

Table 2. Nutrient digestibility, sow performance and body weight change over a 22 day lactation in response to a decrease in dietary phosphorus and calcium supplementation and phytase (University of Purdue, 2007).

Continued from page 15

The majority of phosphorus is present as phytate, which is unavailable to the pig. Phytate not only affects the availability of phosphorus, but also the availability of calcium, protein and trace elements through its anti-nutrient effects. The solution to this problem is phytase, a phytate degrading enzyme.

Adding phytase to the pig's diet will help to degrade phytate in the pig's stomach, releasing phosphorus and reducing the binding capacity of phytate to other nutrients.

This increases the availability of phosphorus, calcium, protein, energy and trace elements, resulting in better nutrient utilisation and potentially reduces overall feed costs.

Numerous trials in weaner and grower-finisher pigs have shown that phytase enables a reduction in dietary phosphorus and calcium in pig diets without detrimental effects on pig performance.

Furthermore, there is a linear response to phytase in fibula bone ash, which is an indicator for bone mineral reserves and bone strength in pigs.

A university trial carried out in the US showed that phytase increased the digestibility of phosphorus, calcium and energy in lactating sows and enabled a reduction in dietary phosphorus by 0.12% and calcium by 0.15% without compromising sow lactation performance (Table 2). Sows fed the phytase in the diet had lower weight loss compared to control sows.

Therefore, formulating with phytase in sow diets can help to reduce dietary calcium and phosphorus supplementation without compromising bone mineralisation and performance in the breeding animal.

Phytase in the sow

Preventing lameness starts with ensuring well developed gilts with a strong bone structure.

Skeletal development, leg structure and integrity in pigs are to a large extent associated with calcium and phosphorus reserves and are directly affected by dietary levels of calcium and phosphorus.

For example research has shown that the dietary level of calcium and phosphorus from weaning to 98kg influences skeletal development in gilts. Sufficient availability of these minerals over the growth period will have a carry-over effect on bone structure and consequent lameness in the first lactation.

More recent scientific research by Varley et al. (2010) shows that bone mineralisation in pigs at 100kg body weight can be influenced during the early stages of growth and development (i.e. from weaning to 30kg) through higher dietary phosphorus and calcium levels than those required for growth performance.

At high phosphate prices higher levels of supplemented dietary phosphorus can significantly increase the cost of piglet feed. Using higher levels of phytase in the weaner diet alleviates the need for high inclusion rates of inorganic phosphorus.

Therefore, adding phytase at higher inclusion rates into weaner diets, than required for growth, to maximise bone mineralisation will support skeletal strength for the later production stages at a reduced feed cost.

Lactation feed intakes are often insufficient in highly prolific sows to meet nutrient demands, resulting in the requirement for more nutrient dense diets.

Phytase increases the availability of phosphorus and reduces the anti-nutrient effect of phytate, which also increases the availability of dietary protein, energy and trace elements. As a result phytase can help to reduce the depletion of body mineral, protein and energy reserves in lactation and maintain better body condition and bone integrity in sows for greater sow lifetime performance.

Environmental benefits

Research carried out in Manitoba, Canada has shown that complying with P based manure regulations can significantly increase the cost of manure disposal in areas or on farms where there is not sufficient nearby land for manure application available.

For pig producers this represents decreased profitability. In the study carried out by Salvano et al (2006) negative impacts on farrowing operations were larger than on finishing operations.

Decreases in profitability averaged 5.6% for farrow to 5kg operations and 2.4% for finishing operations, when manure was applied on nearby land.

However, when manure had to be transported the decrease in profitability was more substantial, whereby profitability decreased by 70.6% on average for the farrow to 5kg and 14.8% for the finishing operations (Table 3).

Adding phytase to pig diets can help to reduce the excretion of phosphorus in manure and in this study was able to increase profitability by up to 14% when manure had to be transported.

Conclusions

Failure to maximise sow retention in the herd has a big negative impact on the economics of pig production.

Sow longevity in highly prolific sows could be compromised by increased risk of locomotor problems due to higher pressure on feet and legs and a danger of depleting their body mineral reserves over successive parities.

Phytase enables more cost efficient diet formulation to meet increased dietary mineral needs in highly prolific sows and maximise sow lifetime performance. ■

Table 3. Effects of P-based manure management strategies on long term average net returns for pig operations (adapted from Silvano et al 2006).

Strategy for compliance	Net returns ($/marketed pig)[1] Farrow to 5kg	Finishing	Finishing with phytase in the diet
Annual application on land	1.99	6.53	6.57
Multi-year land application	1.94	6.35	6.40
Transport with truck for 20km	0.15	4.98	5.69
Transport with truck for 40km	1.17	5.84	6.18
Transport with tank for 20km	0.52	5.29	5.87

[1] Loss and profitability compared to long term average net annual returns for N-base manure management strategies: $2.08 for farrow to 5kg and $6.62 for both finishing operations