The positive effects of betaine on pig performance

by Dr Gustavo Cordero and Dr Tiago Santos, AB Vista Feed Ingredients, 3 Woodstock Court, Blenheim Road, Marlborough Business Park, Marlborough, Wiltshire SN8 4AN, UK.

Betaine is naturally present in animal, bacteria and plant materials. Due to its osmotic ability (ability to hold water molecules), it is usually accumulated in order to regulate variations in salt concentration and/or temperature.

As with choline and vitamins, supply to the animal is either from betaine present in feed ingredients, or from production by the gut microbiota and synthesis in the body.

Betaine is found at high levels in sugar beet and by-products such as beet molasses and condensed molasses solubles, but it is also present at significant levels in wheat, wheat by-products and lucerne meal.

Betaine supplementation of livestock diets has increased recently, particularly for swine. Betaine sources for swine diets can either be natural, a by-product of the sugar beet industry, or synthetic.

Due to its chemical structure, betaine (trimethyl-glycine) has a number of different functions both at the gastrointestinal and metabolic level. These include the osmolyte properties discussed above as well as methyl donation, allowing betaine to spare choline and methionine as well as acting as a lipotrope. The supplementation of swine feeds with betaine has been driven mostly by its ability to spare methionine, reducing the final cost of the diet. However, the benefits of betaine inclusion in pig diets go well beyond methionine sparing.

Effects on animal performance

Dietary betaine supplementation may affect animal performance and carcase characteristics. In some studies, the addition of betaine to pig diets improved weight gain and feed conversion, although other studies revealed a minimal effect of betaine.

However, dietary supplementation with betaine has been shown to improve pig weight gain and feed efficiency up to 15 and 8%, respectively.

	Betaine				p-value
Parameter	0.00kg/ton	0.75kg/ton	1.50kg/ton	2.25kg/ton	
Initial BW (kg)	5.77	5.82	5.79	5.80	1.00
Phase 1 (Day 0-7)					
BW (kg)	6.58	6.59	6.60	6.60	0.99
ADG (kg/d)	0.116	0.111	0.115	0.114	0.84
ADFI (kg/d)	0.127	0.117	0.122	0.117	0.32
F:G	1.11	1.10	1.07	1.06	0.79
Phase 2 (Day 7-21)					
BW (kg)	12.17	12.17	12.23	12.41	0.96
ADG (kg/d)	0.399	0.399	0.403	0.415	0.39
ADFI(kg/d)	0.421	0.417	0.421	0.416	0.91
F:G	1.07	1.05	1.04	1.03	0.04

Table 1. Effects of natural betaine (Vistabet) on the performance of piglets (0-21 days after weaning).

Moreover, betaine has been shown to improve feed efficiency of pigs housed under sub-optimal hygienic conditions.

Factors affecting efficacy

Inconsistent effects of betaine on animal performance and carcase composition have been frequently reported, and have been related to different factors such as dietary protein and energy levels.

Although betaine can improve energy availability, it is a nitrogen (N) containing substance which requires energy to be excreted. Consequently, increasing the dietary betaine level may reduce efficacy.

Age, sex and genetics all influence the capacity for lean accretion and fat deposition, and consequently might interfere with the mode of action of betaine.

An important factor for lipotropic agents is the initial degree of fatness of the animal. Barrows, which are associated with higher capacity for fat accretion than gilts, showed 18.1% reduction in backfat on betaine supplementation, while the reduction in gilts was only 10.8%.

According to Lawrence et al. (2002), dietary betaine supplementation decreased backfat in barrows only.

The improvement in average daily gain with dietary betaine was lower in weaned (8.7%) than in grower-finisher (13.3%) pigs. Feed conversion was also more improved in grower-finisher (7.9%) than in weaned pigs (2.2%). Schrama et al. (2003) showed that energy retention in pigs improves over time following the supplementation of betaine to the diet.

Betaine as an osmoprotectant

Osmoregulation is the ability of a cell to maintain its structure and function by regulating movement of water in and out of the cell. Changes in cell water volume are known to change intracellular ionic strength which may affect the conformation of proteins and enzymes in the cell.

The osmolytic property of betaine supports intestinal cell growth and survival, and enhances cell activity, thereby potentially influencing nutrient digestibility.

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These characteristics become more important for animals in transitory or adaptive situations, such as piglets, when the animals are adapting from a milk-based to a cereal-based diet.

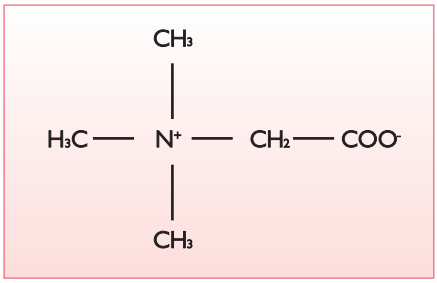
In weaned pigs, dry matter and crude protein digestibility was improved by 4.2 and 6.4%, respectively, when betaine was added to the diet.

Internal research from AB Vista has shown that betaine inclusion during the first three weeks post-weaning has improved piglet performance (Table 1).

Methyl group donor

Methionine, choline and betaine are the most important dietary methyl-group donors for pigs.

Fig. 1. Chemical structure of betaine.



However, methionine is essential for protein synthesis, whereas choline is essential for the formation of cell membranes (phosphatidylcholine) and neurotransmitters. Betaine supplementation to pig diets may allow methionine and choline to be used for these target functions and not to be wasted by donating their methyl groups.

Several papers have already been published describing the ability of betaine to spare both methionine and choline, but this is not the scope of the present article.

Effects on energy and nitrogen

The energy required for the breakdown and re-synthesis of body protein as well as for N excretion contributes to a great extent to the animal's energy requirement for maintenance.

Schrama et al. (2003) and Campbell et al. (1997) showed that the maintenance requirement for energy is reduced in pigs receiving betaine supplemented diets.

Provided that adequate dietary protein is available, a more efficient protein synthesis may be assumed, but if the correct protein level is not present, the extra energy provided by the reduction of the maintenance required may be retained as fat. This would reduce the quality of the carcase.

Fernandez-Figares et al. (2002) showed that the viscera weight in pigs is reduced when betaine is added to the diet. Since these organs are associated with the highest protein turnover rate in the body, reductions in the maintenance requirement for energy may be expected. However, improvements in energy availability can also be due to the osmolytic properties of betaine improving overall cell metabolism.

Conclusion

Betaine is a feed additive used in pig nutrition due to its osmoprotectant and methyl donor characteristics.

Betaine inclusion in piglet and growing and finisher pig diets will impact metabolism, which can have positive effects on growth performance and carcase characteristics of the animal, although these effects will depend on the composition of the diet.

Thus, the benefits of betaine inclusion in pig diets go beyond the ability to reduce diet costs through the partial sparing of methionine and choline, increasing the economic justification of betaine supplementation to piglet and grower-finisher diets. ■

References are available from the authors on request