Growing potential for betaine in poultry feed

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Betaine has been used for many years in poultry feeds. It basically has two important metabolic functions, it can serve as a methyl donor and it helps in maintaining cellular osmolarity. Betaine can be used as an alternative donor of methyl groups for choline and methionine. Both betaine and choline can be used to replace part of the methionine in feeds that is used for methyl donation.

The amount of methionine that can be replaced seems to be dependent on the cysteine level in the diet and hence on the amount of methionine that has to be used for the formation of cysteine. As a methyl donor, betaine seems to be more efficient than choline, which makes betaine an attractive methyl donor source in poultry feeds.

Besides the use of betaine as a methyl donor as a potential substitute for choline and methionine, there is also evidence that betaine has other functional properties in poultry, making it a more valuable nutrient in poultry feeds. Based on literature data, this might be particularly true under stressful conditions and at high performance levels.

Betaine and gut health

Intestinal cells use betaine as an osmolyte to prevent dehydration due to a high solute concentration of intestinal contents. This is important to maintain the metabolic activities of intestinal cells. Loss of cell water for example will bring cells in a more catabolic state. Macrophages in the intestinal wall change the level of intracellular betaine depending on the extracellular solute concentration. This might indicate that betaine can affect phagocytosis and the release of inflammatory cytokine release.

These indications were partly confirmed by Klasing et al. (2001), who reported improved intestinal cell functions in coccidiosis challenged broiler chickens. This was indicated by increased betaine levels in intestinal epithelium, a less severe shortening of duodenal villi and in more leukocytes in the epithelium and in the lamina propria.

Klasing et al. (2001) hypothesised that the latter could be associated with a more effective clearance of sporozoites. Additional work showed that betaine enhanced phagocytosis of E. acervulina and NO release, which are important functions in the defence against parasites.

Tiihonen et al. (1997) found that the effect of betaine in feeds on bird performance seemed to be more pronounced in coccidiosis challenged birds than in non-challenged ones. This might be related to the positive effects of betaine in intestinal cell osmolarity and cell function.

The effect of adding betaine to poultry feeds on cell osmolarity and cell function might not only be positive when metabolic activities are disturbed by coccidiosis.

Zulkifli et al. (2004) found under heat stress conditions, which can push body cells into a more hypertonic environment, a reduction in heterophil to lymphocyte ratio and body temperature when feeds were supplemented with betaine. This indicates betaine helps to maintain its metabolic functions when cells are under different situations of osmolaric pressure.

Direct cellular effect

The effect of betaine on osmolaric properties of intestinal cells and cell function appears to be a general characteristic that results in effects in different animal species.

For instance, in a recently performed study at the Nutreco Swine Research Centre, the inclusion of 2g/kg betaine (™betain96, Trouw Nutrition International) in methionine and choline adequate feeds tended to reduce the incidence of diarrhoea in weaned piglets subjected to poor hygiene conditions.

Besides effects of betaine in intestinal cell properties the effects might also be due to positive effects of betaine on nutrient digestibility. Eklund et al. (2005) suggested that this might be due to effects of betaine on intestinal microbial fermentation.

Another characteristic of betaine that can make it a more essential nutrient in poultry production is its effect on carcase yield.

In several experiments, positive effects of betaine on carcase characteristics have been reported. McDevitt et al. (1999) and Esteve-Garcia and Mack (2000) found an increase in carcase yield when feeds were supplemented with betaine. An improved breast meat yield was observed in turkeys by Noll et al. (2002) and in ducks by YiZhen (2000).

The addition of betaine to feeds also resulted in less abdominal fat in ducks.

Consistent carcase quality

The effect of betaine on carcase quality is not only limited to poultry and, therefore, seems to be consistent. Betaine increased protein deposition and reduced backfat in pigs. Findings of Campbell et al. (1997) and Fernandez-Figares et al. (2002) suggest that the improvement in carcase quality is most pronounced when protein deposition is limited by energy intake.

The earlier mentioned effect of betaine on nutrient digestibility might explain partly this improvement. Moreover, Schrama et al. (2003) found a reduction in maintenance requirement for energy when betaine was included in pig feeds, indicating that more energy is available for protein deposition. The results obtained with poultry and pigs suggest an improved utilisation of energy when betaine is included in the feeds.

In conclusion, betaine can be included in poultry feeds as an efficient donor of methyl groups. Choline and methionine can also be used for this, but betaine has additional metabolic effects.

Due to its effect as osmoregulator in cells, betaine improves metabolic functions when cells are under osmolaric pressure as in coccidiosis challenged or heat stressed birds. Moreover, betaine improves carcase quality, which might be related to an improved utilisation of energy in feeds. Therefore, betaine becomes a more valuable essential nutrient in poultry nutrition. ■