Natural betaine to support efficient broiler production

Gut health management and heat stress are two of the major concerns in livestock production. Maintaining the optimal balance of the gut microflora is key for promoting growth performance, especially without antibiotic growth promoters (AGPs), as well as generating higher profitability.

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Litter quality not only has economic implications but is also relevant to bird welfare. Left, dry litter and, right, wet litter.

A trial in Thailand showed the strength of betaine, and naturally sourced betaine in particular, as a nutritional aid to manage gut health and litter quality in broilers, in heat stress conditions.

Physiological functions of betaine

Several potential benefits on broiler carcase quality, like lowering carcase fat content and increasing breast meat yield, are attributed to betaine. Natural betaine is obtained from partially desugarised (sugar) beet molasses via ion exclusion (a chromatographic separation process), which enables the separation of the molasses into three different fractions, one of which is a natural, betaine rich fraction.

Courtesy of its formula, (CH3)3N+CH2COO with three methyl groups and its bipolar structure, betaine is a multi-functional nutrient, acting as the most efficient methyl group donor and as an organic osmolyte, with direct influence on the gastrointestinal tract (GIT) functionality and health.

Methyl groups are vital, as they are involved in a variety of metabolic processes including protein synthesis, hormonal signalling, neurotransmission, cell growth and membrane integrity – with the latter two playing a major role in gut integrity and functionality.

Since vertebrates are unable to synthesise methyl groups, these need to be provided via the diet. Potential dietary sources of methyl groups: betaine, choline, methionine and folic acid are not equally available for use in methylation reactions. Most of dietary methionine is needed for protein synthesis, while choline is used predominantly in cell membranes and neurotransmitters.

Both functions of betaine play a key role, especially when animals are under challenged conditions including dietary changes, heat stress, temperature stress (the fluctuation between the day and night temperatures) and pathogenic challenges (mainly coccidiosis), often with wet litter as a consequence.

This, in turn, can lead to further severe complications like respiratory disease or pododermatitis (footpad dermatitis). The fact is, the higher the challenges, the higher the demand is on methyl groups. In such conditions, the mineral and water balance might be disturbed and the cell wall integrity potentially damaged.

Energy is one of the major dietary cost factors in poultry production and osmoregulatory responses are highly energy-consuming processes. Betaine, being involved in energy metabolism, can reduce the energy required for osmoregulation. Under normal conditions, the saved energy can be used for increased animal performance and improved carcase quality.

Whilst in challenged conditions, it may alleviate consequences by leading to fewer digestive disorders and lower mortality, thereby better production efficiency.

Choosing the right source

Recently, the use of betaine in animal feed diets has moved from selective utilisation to that of a core ingredient in key feed formulations for poultry, swine and even ruminants. The increased use of betaine in animal diets has been driven by producer demands to counter performance challenges encountered under heat stress conditions that may be exacerbated by higher stocking densities especially in poultry; as a methionine/choline sparing tool, and to improve carcase quality and yield in broilers.

Nowadays, there are many products to choose from, both natural and synthetic. Thus, the question for many producers is how to proceed, by choosing a naturally sourced product or a chemical, synthetic product. However, nutritionists may need to consider the impact of the chloride (Cl^-) on the DEB (Dietary Electrolyte Balance) especially in heat stress conditions. Higher temperatures require higher DEB values hence ingredient selection and formulations strategies to limit Cl^- should be considered. Synthetic betaine sources, including betaine hydrochloride and choline chloride, can impact the DEB values of the diet.

Besides the content on inorganic ions, the synthetic products contain higher trimethylamine (TMA) levels (up to 10-50 times higher than naturally sourced betaine). TMA can have a negative influence on the quality of end-products, for example fishy eggs or fishy tainted meat.

Furthermore, EFSA recognised high TMA levels as being corrosive to the eye, to the skin, and irritant to the respiratory tract (published in the EFSA Journal 2012). This can lead to discomfort which can directly affect production efficiency.

Natural sources of betaine are available on the market in either powder or liquid forms.

Agrana, a basic manufacturer of natural betaine, converts agricultural raw materials into high-quality foods and numerous industrial intermediate products and has been extracting betaine sourced from sugar beet for many years.

In 2015 the company decided to upgrade and expand their production processes to increase the quantities and purity of the betaine extracted from GMO-free sugar beets.

Thailand broiler trial

To confirm the efficacy of Agrana's natural source of betaine, a trial was conducted in Thailand, in cooperation with Saksit Srinongkote (animal research consultant).

The results underline the effect of

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natural betaine on the carcase quality of broilers in challenged conditions and the effect on the litter quality in broiler production.

Trial design

Some 400 newly hatched male broiler chicks of commercial strain Ross 308 were randomly allocated to five treatments with eight replications using 10 male birds in a pen as an experimental unit.

A practical corn-soybean meal diet was formulated as the positive control (PC) diet for each growing phase.

A negative control (NC) diet, with 100 kcal ME/kg lower than that of the PC diet, was formulated for each growing phase.

The test methyl group donor products were supplemented in the NC diet, at the same level of activity: 1,000mg/kg of complete feed, as shown in the following treatment design:

- **Diet 1:** Positive control (PC) practical corn-SBM diet, according to Ross 308 nutritional guideline.
- **Diet 2:** Negative control (NC) as diet 1, but with lower ME by 100 kcal/kg
- **Diet 3**: NC + test betaine product 1 BET1 - ActiBeet L 40% (liquid, natural source of betaine).
- **Diet 4:** NC + test betaine product 2 BET2 - crystallised natural betaine product 96%.
- **Diet 5:** NC + test product 3 CHOL3 - choline chloride 50%, synthetic product.

The test products were added to the experimental feed before pelletising. All diets were pelletised under conditioning temperature of 80°C. The trial was conducted during a period of the year when higher ambient temperatures above 35°C were experienced. Unclean conditions were also provided by using 50%/50% used/new litter.

Dirty litter should facilitate mild gastrointestinal tract (GIT) disorders in order to observe the effect of betaine under such conditions.

Per pen, bodyweight and feed consumption were measured for growth, feed intake and feed conversion ratio (FCR) calculation. The trial was conducted over 38 days. On day 38, after body weight measurement, two birds from each pen were selected and slaughtered for carcase measurements (breast meat yield, thigh yield, drumstick and abdominal fat). On day 38, the litter in each pen was assessed by visual scoring. Additionally, a litter sample of about 1kg was also collected from each pen for litter moisture content evaluation (80°C for 24 hours).

The data was subjected to analysis of variance as a randomised complete block design.

Table 1. Effect of different methyl donor products on carcase traits of broilers (38 day of age).

Group	Breast meat (%)	Thigh meat (%)	Drum stick (%)	Abdominal fat (%)
Diet 1	27.12	16.47	13.25	2.49
Diet 2	26.43	16.90	13.83	2.45
Diet 3	27.74	16.15	13.38	2.44
Diet 4	27.12	16.44	13.49	2.46
Diet 5	27.09	17.00	13.29	2.58
P-value	0.5359	0.2536	0.1236	0.9948
Pooled SEM	0.520	0.295	0.163	0.046
CV (%)	5.42	5.03	3.42	7.04

Group	Litter score[1]	Litter DM (%)	Litter moisture (%)
Diet 1	1.75	74.70	25.30
Diet 2	1.69	74.93	25.07
Diet 3	1.44	78.36	21.64
Diet 4	1.38	78.07	21.93
Diet 5	1.56	76.84	23.16
P-value	0.5339	0.5115	0.5175
Pooled SEM	0.178	1.874	1.871
CV (%)	32.20	6.92	22.57

Table 2. Effect of different methyl donor products on litter of broilers (38 days of age). [1]Litter samples collected from the middle of the pen using a 20cm diameter sampling ring. Visual scoring on the scale of 1-3, where 1 = Good (light brown colour and quite dry), 2 = Fair (brown colour and quite wet) and 3 = Poor (dark brown colour and wet).

Strong results even in challenging conditions

Results found that supplementation of methyl donor products did not significantly affect all of the carcase traits. A numerical improvement in breast meat yield and lower abdominal fat content were observed by supplementing natural betaine products (Table 1).

All methyl donor products improved the litter quality by reducing the score of visual litter assessment and the litter's moisture content; better results were recorded by supplementation of the natural betaine test products (Table 2). It is important to mention that considering the overall period (0-38 days), birds fed NC diet had significantly lower BWG and higher FCR than those fed PC diet. The supplementation of all test products improved BWG and FCR of birds fed the NC diet.

Conclusion

Gut health and litter quality are directly linked. Any challenge to the gut can often cause diarrhoea, resulting in increased nutrient and moisture excretion into the litter.

Litter quality not only has economic implications, but it is also relevant to bird welfare.

The fact that the growing global livestock production is moving away from antibiotic growth promoters and coccidiostats means that the industry will therefore face new challenges impacting gut health.

Based on litter score data, the positive effect of natural betaine in managing gut health and related problems caused by wet litter including footpad lesions is evident, even in challenged conditions.

As a multi-functional nutrient, betaine is a trusted nutritional aid in managing gut health, litter quality and for optimising feed efficiency in broiler production. ■

References are available from the author on request

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