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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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 carcass quality, like lowering carcass fat content and increasing breast meat yield, are attributed to betaine. Natural betaine is obtained from partially desugared (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 osmeregulation. Under normal conditions, the saved energy can be used for increased animal performance and improved carcass 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 carcass 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 hence ingredient selection and formulations strategies to limit Cl⁻ should be considered. However, 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 Sirinongkote (animal research consultant).

The results underline the effect of Continued on page 17
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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

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

<table>
<thead>
<tr>
<th>Group</th>
<th>Breast meat (%)</th>
<th>Thigh meat (%)</th>
<th>Drumstick (%)</th>
<th>Abdominal fat (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet 1</td>
<td>2712</td>
<td>16.47</td>
<td>13.25</td>
<td>2.49</td>
</tr>
<tr>
<td>Diet 2</td>
<td>26.43</td>
<td>16.90</td>
<td>13.83</td>
<td>2.45</td>
</tr>
<tr>
<td>Diet 3</td>
<td>27.74</td>
<td>16.15</td>
<td>13.38</td>
<td>2.44</td>
</tr>
<tr>
<td>Diet 4</td>
<td>27.12</td>
<td>16.44</td>
<td>13.49</td>
<td>2.46</td>
</tr>
<tr>
<td>Diet 5</td>
<td>27.09</td>
<td>17.00</td>
<td>13.29</td>
<td>2.58</td>
</tr>
</tbody>
</table>

**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

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

**Table 2. Effect of different methyl donor products on litter of broilers
(38 days of age)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Litter score</th>
<th>Litter moisture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet 1</td>
<td>1.75</td>
<td>74.70</td>
</tr>
<tr>
<td>Diet 2</td>
<td>1.69</td>
<td>74.93</td>
</tr>
<tr>
<td>Diet 3</td>
<td>1.44</td>
<td>78.36</td>
</tr>
<tr>
<td>Diet 4</td>
<td>1.38</td>
<td>78.07</td>
</tr>
<tr>
<td>Diet 5</td>
<td>1.56</td>
<td>76.84</td>
</tr>
</tbody>
</table>

**P-value** 0.5359 0.5115 0.5175

**Pooled SEM** 0.178 1.874 1.871

**CV (%)** 32.20 6.92 22.57

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
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