Effects of dietary sodium diformate in broilers – a performance analysis

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Abstract
Dietary sodium diformate (NDF) has been tested in poultry production since 2006 and numerous publications and conference contributions on its use in broilers have been published. This study analyzed the average impact from all studies on the effect of the additive on the performance parameters weight gain, feed efficiency, mortality and productivity (EBI). The final data-set contained the results of 8 documented studies, comprising 17 trials with NDF-inclusion, which ranged from 0.1% to 0.6%. Results are expressed as percentage difference from the negative control. The average level of dietary NDF from the data-set in all treated broilers was 0.28%. Only a numerical increase of feed intake (1.1%) could be monitored (P=0.22). However, the performance of broilers based on daily gain was significantly increased by 5.2% (P<0.001). Furthermore, the FCR was also significantly improved (4.1%; P<0.01). Survival was increased on average by 2.3% (P<0.05). Finally, the EBI improved significantly due to the inclusion of NDF by 12.4% (P<0.001). It is therefore concluded that dietary sodium diformate can improve broiler production worldwide.

Objective
Organic acids have long been used in animal nutrition, usually in order to stabilize compound feed, but also to enhance animal performance. Most of the early studies on this group of additives however, were carried out within the pig production chain (COLE et al., 1968); covering sows, piglets and fatteners. Available data on organic acid use in poultry production indicate a later focus on such additives. One of the first reports of improved broiler performance when diets were supplemented with single acids was for formic acid (VOGT et al., 1981). Later, similar effects were noticed for fumaric acid (PATTEN et al, 1988; KIRCHGESSNER et al., 1991; SKINNER et al., 1991). IZAT et al. (1990a) found significantly reduced levels of Salmonella spp. in carcass and caecal samples after including calcium formate in broiler diets. In another trial from IZAT et al. (1990b), buffered propionic acid was used to counteract pathogenic microflora in the intestine and carcass of broiler chickens, and resulted in a significant reduction in E. coli and Salmonella spp. The use of pure formic acid in breeder feed reduced the contamination of tray liners and hatchery waste with S. enteritidis drastically (HUMPHREY et al., 1988). KIRCHGESSNER et al. (1992) found significantly better feed utilization in laying hens after adding fumaric acid, but only when the feed was low in protein and methionine and cysteine. Performance enhancement was influenced by both quantity and quality of the protein.

Although growth performance benefits of organic acids and their salts have been shown in numerous studies over the past half-century, though mainly in pigs, the ban on antimicrobial growth promoters (AGP) in the European Union in 2006, and subsequently in a couple of other countries (e.g. Japan, South Korea) resulted in an increased scientific and commercial focus on organic acids.

A particular status among organic acids salts is granted to potassium diformate (KDF). The potassium double-salt of formic acid (Formi LHS, ADDCON) was approved as the first non-antibiotic growth promoter in pig feed in the European Union (ØVERLAND, 2001; CHOWDHURY et al., 2008) in July 2001 under Council directive 70/524/EEC. Dietary KDF
has been shown to improve growth performance and feed efficiency of fattening pigs and KDF passed the standards in several efficacy trials with piglets, fatteners and sows. A holo-analysis of all published data on KDF (n=59) confirmed that the additive significantly improved feed intake (+3.52%), weight gain (+8.67%) and FCR (-4.20%) compared against negative controls in pig production (LÜCKSTÄDT et al., 2011).

Improving broiler performance or hygienic conditions with the aid of organic acids has been reported by many sources, as reviewed by DESAI et al. (2007). An important limitation, however, is that organic acids are rapidly metabolised in the fore-gut (crop to gizzard) of birds, which will reduce their impact on growth performance. A new molecule (sodium diformate, similar to potassium diformate) has been proven to be effective against pathogenic bacteria, including salmonella, along the whole gastro-intestinal tract (LÜCKSTÄDT et al., 2009). The reduced impact of pathogenic bacteria on the broiler, as well as the improved gut microflora, leading to a state of eubiosis in treated chickens, suggests that including diformate in broiler diets will also result in improved bird performance. Several trials have been also been carried out over the last half-decade world-wide that document positive effects on broiler performance.

It was therefore interesting to estimate the potential impact of sodium diformate (NDF) in poultry production, through an analysis of the results of such trials.

**Material and methods**

This study analyzed the average impact from all studies on the effect of the additive on the performance parameters weight gain, feed efficiency, mortality and productivity, as measured using the European Broiler Index, (EBI). EBI is calculated using the following equation:

$$\text{EBI} = \text{ADG [g]} \times \text{survival [%]} / (10 \times \text{FCR})$$

The final data-set contained the results of 8 documented, negatively controlled studies, comprising 17 trials with NDF-inclusion, which ranged from 0.1% to 0.6%. Those studies were carried out between 2006 and 2012 in China, France, Russia, Taiwan, Thailand and Vietnam under both commercial and institutional conditions and included more than 36,700 broilers from different breeds (Arbor Acres, Cobb, Hubbard) raised to between 35 and 44 days.

The above mentioned performance parameters are expressed as percentage difference from the negative control. The results are given as mean and were statistically analysed using the t-test. A confidence level of 95% was defined for these analyses.

**Results and conclusions**

The average level of dietary NDF from the data-set in all treated broilers was 0.28%. Typical dosage for NDF in broilers ranges from 1-3 kg/tonne feed, depending on age (dietary protein level) and hygienic status of the farm. As shown in Table 1, NDF inclusion resulted in a numerical increase in feed intake of 1.1% (P=0.22).

<table>
<thead>
<tr>
<th>Dosage</th>
<th>Feed intake</th>
<th>Weight gain</th>
<th>FCR</th>
<th>Survival</th>
<th>EBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.28</td>
<td>+1.1</td>
<td>+5.2</td>
<td>-4.1</td>
<td>+2.3</td>
<td>+12.4</td>
</tr>
<tr>
<td>P-value</td>
<td>0.22</td>
<td>0.0001</td>
<td>0.002</td>
<td>0.034</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

However, although feed intake was not improved significantly by NDF inclusion, the performance of broilers based on daily gain was significantly increased by 5.2% (P<0.001).
Furthermore, the FCR was also significantly improved (4.1%; P<0.01). Survival was increased on average by 2.3% (P<0.05). Finally, the EBI improved significantly due to the inclusion of NDF by 12.4% (P<0.001). Similar trends (no significant increase in feed intake, but significant improvements in weight gain and FCR) were reported as a result of a holistic analysis of 59 studies for KDF in pig diets (ROSEN, as reported by LÜCKSTÄDT et al., 2011). In broilers, improved zootechnical performance is thought to stem from both improvements in the intestinal microflora, as a result of suppressing pathogenic bacterial species; and improved protein digestion. As often seen with other additives, hygiene challenge also plays some role in the performance observed. In the present performance analysis, a range of hygiene conditions were included, representing both university and farm trials. The average impact of NDF inclusion on performance remained above that normally expected. It can therefore be concluded that dietary sodium diformate can play an important role in improving broiler production world-wide, especially in times of high raw material prices.

References