S156 Effect of dietary sodium diformate on growth performance and nutrient utilization in broilers

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Sodium diformate in broilers

Summary
The use of formic acid and its salts in poultry diets have well documented effects on productivity. Acting against pathogens, they help decrease pressure on the immune system, making more nutrients available from the feed; they are also reported to improve nutrient digestibility. The double sodium salt of formic acid, having the same antimicrobial properties as formic acid, has become more prevalent in poultry diets, due to its improved handling properties. In a recent trial conducted at a research farm in Taiwan, sodium diformate (NaDF; 0.15% inclusion rate) was tested in a commercial broiler diet, against a control diet containing no acidifier. 120 day-old broiler chicks (male Arbor Acres) were randomly selected and divided into 2 treatment groups with 3 replicates each. Feed and water were available ad libitum. The effects of NaDF on performance (final weight, FCR, broiler index) and nutrient utilization (CP, CL) were examined after 39 days. Data were analysed using the t-test and a confidence level of 95% was defined for these analyses.

Performance was enhanced in the birds fed 0.15% NaDF. Treated birds were significantly heavier (2467 g vs. 2316 g; P<0.05), while the FCR improved only numerically (1.68 vs. 1.71). Nutrient utilization was also improved (numerically for CP: 63.5 vs. 61.6; significantly for crude fat: 91.6 vs. 90.5; P<0.05).

This study demonstrates that including NaDF in broiler diets is beneficial to performance and improves nutrient utilization.

Keywords: sodium diformate, broiler, growth performance, nutrient utilization

Introduction
Organic acids have long been used in animal nutrition, usually in order to stabilize compound feed, but also to enhance animal performance. While most of the early data on this group of additives were collected from studies in the pig production chain (Cole et al., 1968; covering sows, piglets and fatteners), the 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). Other researchers went on to study the dietary impact of this acid or its salts. Izat et al. (1990), for example, found significantly reduced levels of Salmonella spp. in carcass and caecal samples after including calcium formate in broiler diets. The use of pure formic acid in breeder feed was found to reduce contamination of tray liners and hatchery waste with S. enteritidis drastically (Humphrey et al., 1988).

Improvements in broiler performance or hygienic conditions with the aid of various organic acids have been reported by many sources, as reviewed by Desai et al. (2007). An important limitation, however, is that organic acids, including formic acid, are rapidly metabolised in the fore-gut (crop to gizzard) of birds, which will reduce their impact on growth performance. A newer formic acid salt (sodium 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 an improved gut microflora, leads to a state of eubiosis in treated chickens, suggests that inclusion of diformate in broiler diets will also result in improved bird performance. This hypothesis was confirmed statistically with a meta-analysis, using data from trials which had been carried out over the last half-decade world-wide (Lückstädt, 2013a; Lückstädt, 2013b). This study analyzed the average impact reported from all studies on the effect of the additive on the performance parameters weight gain, feed efficiency, mortality and productivity. However, the focus of all these trials was weight gain and feed conversion outputs. The present study aimed to investigate the effects of sodium diformate on both growth performance parameters and nutrient utilization in broilers.

**Material and methods**

The trial was conducted at the research farm of the National Pingtung University of Science and Technology in Pingtung, Taiwan. One hundred and twenty day-old male Arbor Acres broilers were randomly allotted into 2 treatment groups × 3 replications with 20 birds in each pen. The commercially-available feed in one group contained 0.15% sodium diformate (NaDF); this group was compared against a negative control. Feed and water were provided *ad libitum*. Birds were weighed individually after 14 days and 39 days; feed consumption was recorded per pen. The effects of NaDF on performance (final weight, feed conversion ratio, European Broiler Index EBI) and nutrient utilization (crude protein, crude fat) were examined after 39 days. The EBI is calculated as:

\[
\text{EBI} = \frac{\text{Daily weight gain (g) x Survival (\%)} \times 10}{\text{FCR}}
\]

Data were analysed using the t-test and a confidence level of 95% was defined for these analyses.

**Results and conclusion**

The inclusion of 0.15% NaDF into the diet of broilers for 39 days exerted significant effects on performance as well as nutrient utilization of birds.

The effect of the additive was already pronounced after only 14 days. At this stage, the body weight of the broilers receiving NaDF had increased significantly (P<0.05), by almost 15% (Table 1). At the end of the trial, treated birds were still significantly heavier (2467 g vs. 2316 g; P<0.05), while the FCR improved numerically (1.68 vs. 1.71). Furthermore, the mortality rate of birds was substantially reduced. As a result, the European Broiler Index, which includes the three most important parameters in animal husbandry – weight gain, survival and feed efficiency – improved markedly by almost 11%.

Table 1: Performance parameters of broilers fed with or without NaDF at 0.15% for 39 days

<table>
<thead>
<tr>
<th></th>
<th>Negative control</th>
<th>0.15% NaDF</th>
<th>Difference [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW-14 days [g]</td>
<td>320^b</td>
<td>367^a</td>
<td>+14.7</td>
</tr>
<tr>
<td>Final weight [kg]</td>
<td>2.316^b</td>
<td>2.467^a</td>
<td>+6.5</td>
</tr>
<tr>
<td>ADG [g]</td>
<td>58^b</td>
<td>62^a</td>
<td>+6.9</td>
</tr>
<tr>
<td>FCR</td>
<td>1.71</td>
<td>1.68</td>
<td>-1.8</td>
</tr>
<tr>
<td>Mortality [%]</td>
<td>3.33</td>
<td>1.67</td>
<td>-50.0</td>
</tr>
<tr>
<td>EBI</td>
<td>329</td>
<td>364</td>
<td>+10.6</td>
</tr>
</tbody>
</table>

Means with a different superscript differ significantly at P<0.05
Analysis of the nutrient utilization of the birds gave the following picture. The fat utilization improved significantly to 91.6% (P<0.05), whereas the protein utilization increased numerically from 61.6% to 63.5% in the NaDF fed birds. There were no pronounced differences in the utilization of dry matter and ash (Table 2).

Table 2: Effect of sodium diformate (0.15%) on nutrient utilization of broilers in percent

<table>
<thead>
<tr>
<th></th>
<th>Negative control</th>
<th>0.15% NaDF</th>
<th>Difference [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>72.4</td>
<td>73.0</td>
<td>+0.8</td>
</tr>
<tr>
<td>Crude fat</td>
<td>90.5*</td>
<td>91.6*</td>
<td>+1.2</td>
</tr>
<tr>
<td>Crude protein</td>
<td>61.6</td>
<td>63.5</td>
<td>+3.1</td>
</tr>
<tr>
<td>Ash</td>
<td>26.3</td>
<td>26.5</td>
<td>+0.8</td>
</tr>
</tbody>
</table>

Means with a different superscript differ significantly at P<0.05

Similar trends (improved performance parameters as well as nutrient utilization) were reported as a result of a holo-analysis of 59 published studies for potassium diformate in pig diets (Rosen, as reported by Lückstädt et al., 2011). In broilers, improved zootechnical performance is thought to stem both from improvements in the intestinal microflora, as a result of suppressing pathogenic bacterial species; and improved protein digestion. This was at least partly confirmed with the present study. As often seen with other additives, hygiene challenge also plays some role in the performance observed. The current study was conducted at the research farm of a university. Even under these rather “clean” conditions, NaDF was able to significantly improve performance of birds. It is expected that results under practical conditions with a higher anticipated “bacterial load” might weigh even more in favour of the additive effects measured, as this has been seen with other trials under commercial conditions. It can therefore be concluded that dietary sodium diformate can play an important role in improving broiler production, especially in times of high raw material prices.

References