Fermented feed for organic layers

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The influence of fermented feed on egg production and egg quality was studied in an experiment with 480 layers (Babcock, 16 weeks old) housed in 16 floor pens (30 animals/pen, 8 replicates per treatment). From week 16 to week 38 during the laying period, the birds received a coarsely ground organic feed, which was either fed as dry mash (experimental group 1) or as wet feed (feed:water ratio, 1:1.4) following natural fermentation (experimental group 2). Fermented feed was characterised by high lactic acid concentration (260 mmol/kg feed) and moderate amounts of acetic acid (20-30 mmol/kg feed), high numbers of lactic acid bacteria (log 9-10 cfu/g feed) and a pH of approximately 4.5. During the experimental period, the body weight gain of hens receiving fermented feed was 80 g higher than of hens fed with the dry mash (P<0.001). Presumably due to an extended adaptation time to the feed, the onset of lay occurred somewhat later when hens were fed with fermented feed, resulting in a non-significant reduced total egg production (74.9% vs. 81.7%). There was no significant difference between the groups with respect to the total egg mass production (g/day/hen, 42.3 and 45.1 for fermented feed and dry mash, respectively). Throughout the experimental period, the feed dry matter intake of hens fed with fermented feed was lower than that of hens receiving the dry mash (110g vs. 125g, P= 0.002). From week 26 to 37, fermented feed improved the feed conversion as compared to the dry mash (g feed DM/g egg mass/d/hen, 2.28 vs. 2.53, P <0.05). The use of fermented feed increased the egg weight in the period from 34 to 37 weeks (61.4 vs. 60.0, P=0.003), and increased the shell weight (g/100 g egg weight, 10.24 vs. 9.92, P<0.05) and shell stiffness (N/mm, 161.3 vs. 149.6, P<0.001) of eggs collected at 37 weeks. The results indicate that feed fermentation generally improves nutrient availability including dietary phosphorous and calcium, which results in changes of the eggshell matrix. However, the use of fermented feed requires early adaptation already in the rearing period.

Keywords: Fermented feed; egg production; shell quality

Introduction

During recent years fermented liquid feed has been introduced with great success in pig nutrition, where it has shown to have some beneficial properties in particular considering animal health (Canibe and Jensen, 2003). The fermentation process results in the growth of a large number of lactic acid producing bacteria, leading to a reduction of the feed pH, which does not allow the growth of acid sensitive pathogenic or zoonotic bacteria, e.g. coliform bacteria and Salmonella. It has been shown that fermented feed protects broilers against infections with Campylobacter and Salmonella (Heres et al., 2003a; Heres et al., 2003b). With respect to nutrition, fermented feed may have some advantages in relation to the availability of minerals in particular phosphorous. During fermentation a microbial degradation of phytate and/or an activation of the plant phytase occur, leading to a liberation of phytate-bound phosphorous (Carlson and Poulsen, 2003). Until now the suitability of fermented feed for poultry especially for layers has not been investigated.

The aim of the present study was to investigate the use of fermented feed in the nutrition of layers taking production results and some egg quality parameters into consideration.
Materials and methods

A total of 240 beak-trimmed pullets (Babcock, 16 weeks old) were purchased from a commercial producer and were included in a feeding experiment over the period from wk 16 to wk 37. The experimental design consisted of two dietary treatments with 8 replicate floor pens of 30 hens. Each floor pen provided a floor area of 8.9m² covered with wood shavings as bedding material.

During the entire experimental period, the hens were fed with organic layer diets (phase 1 and phase 2), which were offered either in the form of coarsely ground mash feed or in the form of fermented liquid feed. Fermentation was initiated by adding water to the feed (feed: water, 1:1.2) and stirring for 72 h at 20 ºC. Fresh fermented feed was prepared daily in a closed 100 kg stainless steel container by adding 10 % of the feed residual from the day before to a new portion of feed and water. The pH in the feed was measured using a combined glass/reference electrode. Lactic acid bacteria in the feed were enumerated on MRS-agar after anaerobic incubation at 20 ºC for 3 days. The concentrations of lactic acid and acetic acid were measured using gas chromatography.

The hens were weighed individually at 16 wks of age (start of the experiment) and then at 19, 27 and at 38 wks (end of experiment). After an adaptation period of 2 weeks, the registrations of feed intake and collection of eggs was conducted from wk 18 to wk 37. The feed intake of birds receiving the dry mash was recorded weekly. The intake of fermented liquid feed was registered daily. Once a week, samples of the fermented feed and feed remnants collected during one week were analysed for dry matter contents by freeze-drying. All calculations regarding feed intake and feed conversion were done on dry matter basis. Eggs were collected and the number of eggs was recorded daily per pen, and a collection of one single day was weighed each week.

A total of 96 eggs (6 per pen) i.e. 48 eggs per treatment were collected at 37 wk of hen age. Egg weight was recorded individually before shell strength analysis. Shell strength was analysed by uniaxial compression at the equator of the egg on a TA-HDi Texture Analyzer (Stable Micro Systems Ltd., Surrey, England) with a 100 kg load cell, 0.001 N detection range, 75 mm diameter flat plate probe and a compression speed of 0.1 mm/s. Shell breaking was detected and recordings of force (N) and displacement (mm) were obtained and given as shell strength (N) and shell breaking point (mm). The shell stiffness (Modulus, N/mm) was calculated as the initial slope of the force-displacement curve. Afterwards, the eggshells were washed in demineralised water to remove remains of egg albumen while maintaining the shell membrane. The eggshells were dried at room temperature for 2 days followed by weighing the shell weight (g) and calculating the shell percentage (g/100 g egg weight).

Statistical analysis of results was performed using the General Linear Models procedure (GLM) of the SAS®.

Results and discussion

Fermented feed was characterised by high lactic acid concentration (up to 260 mmol/kg feed) and moderate amounts of acetic acid (20-30 mmol/kg feed), high numbers of lactic acid bacteria (log 9-10 cfu/g feed) and a pH of approximately 4.5.

During the entire experimental period, the body weight gain of hens receiving fermented feed was 80 g higher than that of hens fed with the dry mash (P<0.001).

The onset of lay occurred later when hens were fed with fermented feed as compared to hens fed with the dry mash (Figure 1), which resulted in a non-significant reduction in total egg mass production (74.9% vs. 81.7%, P=0.22). Throughout the entire experimental period the dietary DM intake of hens receiving fermented feed was lower (P<0.001) than that of hen receiving the dry mash (Figure 1). Up to 25 weeks of age, the produced egg mass was higher when hens were fed the dry mash (Figure 1). However, in the later experimental period no significant differences were observed between groups with respect to the produced egg mass (P>0.05).
Figure 1. Dry matter intake and produced egg mass of hens fed with an organic layer feed provided either as dry mash or as fermented feed

Due to the later onset of lay the feed conversion ratio (feed DM/g egg mass) was higher in the early experimental period (wk 18-21) when hens were fed fermented feed (Figure 2). However, from wk 26-37, the feed conversion ratio of hens fed with fermented feed was significantly better (P<0.001) as compared to the group receiving the dry mash (Figure 2).

Eggs collected in the period from 34-37 wk from birds receiving fermented feed were heavier than from birds fed the dry mash (Table 1).
Analyses of the shell quality revealed that the eggshell weight of eggs from hens receiving fermented feed was higher than that of hens fed the dry mash (Table 1). Further, the eggshell of eggs from birds fed fermented feed tended to have an increased strength at breaking ($P=0.173$) and a lower shell breaking point ($P=0.138$). The eggshell stiffness was markedly higher ($P=0.001$), which means that eggshells become less elastic following intake of fermented feed. These results indicate changes in the eggshell matrix, which might be related to an increased shell mineralization probably caused by an improved availability of dietary phosphorous and calcium following feed fermentation.

Table 1. Quality parameters of eggs collected from hens fed with an organic layer feed provided either as dry mash or as fermented feed

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dry mash</th>
<th>Fermented feed</th>
<th>SE</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg weight (wk 34-37)</td>
<td>60.0</td>
<td>61.4</td>
<td>0.271</td>
<td>0.003</td>
</tr>
<tr>
<td>Shell weight, g</td>
<td>6.08</td>
<td>6.37</td>
<td>0.050</td>
<td>0.003</td>
</tr>
<tr>
<td>Shell, g/100 g egg weight</td>
<td>9.92</td>
<td>10.24</td>
<td>0.058</td>
<td>0.006</td>
</tr>
<tr>
<td>Shell strength at breaking, N</td>
<td>32.03</td>
<td>33.29</td>
<td>0.461</td>
<td>0.173</td>
</tr>
<tr>
<td>Shell breaking point, mm</td>
<td>0.205</td>
<td>0.196</td>
<td>0.003</td>
<td>0.138</td>
</tr>
<tr>
<td>Shell stiffness (Modulus), N/mm</td>
<td>149.6</td>
<td>161.3</td>
<td>1.795</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

In conclusion, it can be stated that the fermentation of feed seems to improve nutrient availability including minerals as indicated by an improved feed conversion ratio and an improved eggshell quality, respectively. However, the use of fermented feed requires early adaptation already in the rearing period in order to ensure a sufficient dry matter uptake. Further investigations on the practical application of fermented feed considering feeding management should be carried out in the future.

References:


