A new approach to litter quality and performance in poultry nutrition

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The so called wet litter syndrome in poultry can cause significant commercial damage. According to Butchers & Miles (2009) litter quality is one of the key factors in poultry production. If litter is not kept at an acceptable level, very high bacterial loads and unsanitary growing conditions may result in odours (including ammonia), insect problems (particularly flies), soiled feathers, footpad lesions and breast blisters.

In a well managed broiler house litter moisture normally averages between 25-35%. In winter it is difficult to have sufficient ventilation due to the high energy cost.

Until now litter quality in Europe was just an issue in the broiler house, but very soon cages will be banned in Europe and then litter quality will be an issue for layers as well.

Beside disease, feed quality, animal bedding and the temperature, including ventilation in the house, the feed has a major impact on litter quality. The use of feed additives, for example NSP-enzymes, has been established already to address the wet litter syndrome. Another approach could be the use of raw fibre concentrates as a feed additive.

There is already evidence that raw fibre concentrates have a positive effect on litter quality and on the performance of the animals as well.

A potential solution?

Raw fibre concentrates describes raw fibres with at least 60% raw fibre content. This is mostly achieved by concentration processes, which can be of physical or thermo-mechanical nature.

Raw fibre concentrates are usually based on a lignocellulosic or a cellulotic fibre. The main differences of raw fibre concentrates to common fibre sources are:

- Raw fibre content >60%.
- Free of mycotoxins.
- Free of soluble fibres.
- Not binding nutrients.
- Stimulating the intestinal villi.
- Increasing enzyme activity.
- High swelling and water binding capacity (4-8g H2O/g raw fibre concentrate).

Not only its chemical composition

<table>
<thead>
<tr>
<th>Component (%)</th>
<th>Starter (day 1-14)</th>
<th>Grower (day 15-35)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Maize</td>
<td>16.00</td>
<td>16.00</td>
</tr>
<tr>
<td>Wheat</td>
<td>48.83</td>
<td>48.83</td>
</tr>
<tr>
<td>Extracted soya</td>
<td>22.60</td>
<td>22.60</td>
</tr>
<tr>
<td>Fat (vegetable)</td>
<td>3.800</td>
<td>3.800</td>
</tr>
<tr>
<td>Oil (vegetable)</td>
<td>3.800</td>
<td>3.800</td>
</tr>
<tr>
<td>Extracted rapseed</td>
<td>2.010</td>
<td>2.010</td>
</tr>
<tr>
<td>Amino acid premix</td>
<td>1.250</td>
<td>1.250</td>
</tr>
<tr>
<td>CaCO3</td>
<td>1.060</td>
<td>1.060</td>
</tr>
<tr>
<td>Na-Carbonate</td>
<td>0.120</td>
<td>0.120</td>
</tr>
<tr>
<td>Premix</td>
<td>0.970</td>
<td>0.970</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>1.200</td>
<td>0.900</td>
</tr>
<tr>
<td>Arboceol</td>
<td>---</td>
<td>0.300</td>
</tr>
</tbody>
</table>

Growth promoter

There is evidence that the raw fibre concentrate Arbocel, from J. Rettenmaier and Sons, can improve the digestibility of fat and protein in sows, piglets and other species. Additionally the use of insoluble cellulosic fibre is recommended from ISA (2007). They argue in their paper that ‘the presence of insoluble fibre appears indispensable, causing an increase in gizzard size, improving starch digestibility and limiting feather pecking by reducing the need to ingest fibres’. The positive effect of raw fibre concentrates on digestion of fat and protein as well as the effect on performance has not been evaluated in broilers until now.

The raw fibre concentrate Arbocel is a natural, pure and fibrillated lignocellulose which is free of mycotoxins and bark. It is produced with a special milling technology called HPC-fibrillation. The difference to the above mentioned raw fibre concentrate Vicatel is the lignin content. Arbocel delivers about 25% lignin. Both products are based on cellulosic fibre. The aim of the trial described below was to evaluate the effect of a HPC-fibrillated lignocellulose on broiler performance.

Material and methods

The experiment was carried out in the trial station at the University of Applied Science in Bingen, Germany. Some 200 three day old pouls with an average weight of 85g were kept in 100 cages (two birds per cage).

The broilers were weighed and distributed to five treatments (40 animals per treatment). Commercial formulations have been used as experimental diets. All animals received the same diet apart from the Arbocel, which was used with up to 1.2% instead of wheat bran (details in Table 1). The trial period was 35 days until an average of 2.2-2.3kg live weight. The analysis of the components was done according to the Weenders method in the laboratory of the University of Applied Science.

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Wheat bran (50x magnification).

Raw fibre concentrate Vitacel (50x magnification).

Table 1. Composition of the feed (main components of starter and grower feed). Groups: A = commercial broiler feed without additives, B = commercial broiler feed + 0.3% Arbocel, C = commercial broiler feed + 0.6% Arbocel, D = commercial broiler feed + 0.9% Arbocel, E = commercial broiler feed + 1.2% Arbocel.
Table 5. Feed conversion ratio (FCR) for the trial groups in g of feed consumed per g of live weight gain (20 cages per group).

<table>
<thead>
<tr>
<th>FCR (g/g)</th>
<th>Week</th>
<th>Control</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Statistics</th>
<th>SEM</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCR 1-3</td>
<td></td>
<td>1.79±0.13</td>
<td>1.70±0.09</td>
<td>1.74±0.08</td>
<td>1.70±0.09</td>
<td>1.765±0.13</td>
<td>0.01</td>
<td>0.056</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCR 4-5</td>
<td></td>
<td>2.01±0.32</td>
<td>1.95±0.22</td>
<td>1.91±0.18</td>
<td>1.90±0.16</td>
<td>1.98±0.20</td>
<td>0.023</td>
<td>0.591</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCR 1-5</td>
<td></td>
<td>1.83±0.13</td>
<td>1.77±0.08</td>
<td>1.79±0.09</td>
<td>1.74±0.07</td>
<td>1.80±0.09</td>
<td>0.011</td>
<td>0.129</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary and conclusion

The inclusion of lignocellulose in the feed in this trial caused an improvement in weight gain and FCR. Feed intake as well as the fibre network is potentially the reason for the positive impact of Arbocel on these performance parameters.

Further studies are required to understand the mode of action. The insoluble fibre could improve the intestinal peristalsis and therefore reduce the transit period. Due to the faster transit period there would be consequently less colonisation of pathogenic bacteria. Therefore lignocelluloses could contribute to the intestinal health.

Improved litter quality

The impact of crude fibre on the litter quality has been discussed in detail in other studies.

Table 6. Vitacel, corn hull and sand level in the different groups.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Corn hulls (%)</th>
<th>Vitacel (%)</th>
<th>Sand (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
</tr>
<tr>
<td>Corn hulls 1</td>
<td>0.3</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>Corn hulls 2</td>
<td>0.4</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Corn hulls 3</td>
<td>0.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vitacel 1</td>
<td>-</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Vitacel 2</td>
<td>-</td>
<td>0.4</td>
<td>-</td>
</tr>
<tr>
<td>Vitacel 3</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 7. Impact of different fibre sources on the litter humidity (%).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>29.2</td>
<td>26.9</td>
<td>25.5</td>
<td>19.9</td>
<td>24.9</td>
<td>22.8</td>
<td>24.3</td>
</tr>
<tr>
<td>Corn hulls 1</td>
<td>26.4</td>
<td>25.0</td>
<td>23.1</td>
<td>25.0</td>
<td>26.0</td>
<td>29.2</td>
<td>30.2</td>
</tr>
<tr>
<td>Corn hulls 2</td>
<td>24.6</td>
<td>23.1</td>
<td>19.1</td>
<td>24.1</td>
<td>27.7</td>
<td>44.1</td>
<td>45.0</td>
</tr>
<tr>
<td>Corn hulls 3</td>
<td>23.0</td>
<td>23.3</td>
<td>21.8</td>
<td>35.3</td>
<td>46.5</td>
<td>42.3</td>
<td>43.2</td>
</tr>
<tr>
<td>Vitacel 1</td>
<td>30.7</td>
<td>35.5</td>
<td>24.0</td>
<td>22.5</td>
<td>23.4</td>
<td>22.7</td>
<td>23.1</td>
</tr>
<tr>
<td>Vitacel 2</td>
<td>30.0</td>
<td>25.2</td>
<td>26.1</td>
<td>19.4</td>
<td>20.0</td>
<td>17.8</td>
<td>18.2</td>
</tr>
<tr>
<td>Vitacel 3</td>
<td>27.0</td>
<td>23.8</td>
<td>20.0</td>
<td>15.9</td>
<td>16.7</td>
<td>17.1</td>
<td>17.5</td>
</tr>
</tbody>
</table>

Conclusion and perspective

It has been demonstrated in two separate and independent trials that crude fibre concentrates have a positive impact on performance and on litter quality as well.

The wet litter problem in poultry is a serious problem that causes real damage in terms of economical output. Having realised this, raw fibre concentrates could offer a solution, especially as the raw fibre concentrates have a positive impact on the performance as well. Further studies are required to understand the mode of action better.