Effect of different methionine sources on growth performance and meat quality traits of broilers.

Trial: 07 INRA

1. Summary

The aim of this study was to compare the effects of several dietary synthetic methionine sources (DL-methionine (DLM), DL-methionine-hydroxy-analogue acid (DL-HMTBA) or a mix of both products DLM/HMTBA (50/50) on different quality traits of Pectoralis muscle and growth performance of broilers fed wheat-, corn- and soybean meal-based diets including soybean or palm oil. Broilers fed with DL-methionine diets showed an increase of feed intake during the finisher period and an improvement of daily weight gain during the overall rearing period. Indeed, at 28 and 42 days, birds had higher live bodyweight. On the other hand, methionine source did not affect feed conversion rate concluding to a strict feed intake effect. However, methionine source affected breast meat characteristics as ultimate pH which was higher for birds fed the 50% DLM / 50% HMTBA diet and consequently decreased drip losses.

2. Material and method

The evaluation of the effects between methionine hydroxyl-analogue and DL-methionine on oxidative stability of Pectoralis muscle and growth performance of broilers was evaluated according to the following design:

6 treatments x 7 replicates x 32 male Ross broilers per cage

Table 1. Experimental design

<table>
<thead>
<tr>
<th>Treatment</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil source</td>
<td>Palm oil</td>
<td>Soybean oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methionine source</td>
<td>DLM</td>
<td>HMTBA</td>
<td>DLM/HMTBA</td>
<td>DLM</td>
<td>HMTBA</td>
<td>DLM/HMTBA</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>100</td>
<td>100</td>
<td>50/50</td>
<td>100</td>
<td>100</td>
<td>50/50</td>
</tr>
</tbody>
</table>

Management and measurements:
The trial was performed at the Poultry Experimental Unit of INRA, Nouzilly (France). 672 broilers were distributed into six different treatments. Diets were based on wheat, corn and soybean meal. Birds received a starter diet from 0 to 14 days, a grower diet from 15 to 28 days and a finisher diet up to 42 days (Table 2).

Growth performance parameters (daily weight gain, feed intake, feed conversion rate) were measured during the three periods. Ultimately, 56 broilers per pen were sacrificed to follow technological quality of meat as ultimate pH (24 hours post-slaughter), breast meat drip loss and lipid oxidation during 10 days storage (TBARS index).
The effect of methionine sources had been compared using HMTBA to DLM performance ratio and results were expressed on a percentage basis of DLM performance (e.g. 100% means equal results between methionine sources on the considered parameter).

**Statistical analysis:**
Effect of methionine source has been tested using the ANOVA test with the UNIVARIATE procedure of SAS. Effects of treatments (methionine source + oil) and their possible interactions were analysed using the ANOVA test with the General Linear Models (GLM) procedure of SAS. For parameters measured along the time, effects of treatment and time have been tested using the ANOVA test with the UNIVARIATE procedure of SAS. When significant effect was detected, means comparison were tested by Least Squares Means procedure of Tukey.

**Table 2. Composition and characteristics of the basal diets**

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>Starter</th>
<th>Grower</th>
<th>Finisher</th>
<th>Calculated analyses</th>
<th>Starter</th>
<th>Grower</th>
<th>Finisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>Met. energy (kCal/kg)</td>
<td>3 000</td>
<td>3 100</td>
<td>3 200</td>
</tr>
<tr>
<td>Wheat</td>
<td>44.4</td>
<td>49.0</td>
<td>52.7</td>
<td>Crude Protein (%)</td>
<td>21.1</td>
<td>19.03</td>
<td>17.1</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>26.3</td>
<td>19.2</td>
<td>12.8</td>
<td>Methionine (%)</td>
<td>0.62</td>
<td>0.54</td>
<td>0.45</td>
</tr>
<tr>
<td>Extruded soybeans</td>
<td>7.0</td>
<td>9.0</td>
<td>11.0</td>
<td>Met + Cystine (%)</td>
<td>0.98</td>
<td>0.87</td>
<td>0.76</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>2.9</td>
<td>3.5</td>
<td>4.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limestone</td>
<td>1.20</td>
<td>1.10</td>
<td>1.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1.90</td>
<td>1.70</td>
<td>1.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Added methionine source</td>
<td>0.32</td>
<td>0.26</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vimain/mineral premix</td>
<td>0.68</td>
<td>0.94</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**3. Results and discussion**

Feed analysis revealed an inversion between T2 and T3 (Table 3) finisher diets for HMTBA incorporation (palm oil treatment). For this reason, meat quality traits on the three treatments (T1 to T3) were not assessed and the growth performances of the finishing periods were not considered in the following results.

**Table 3. Methionine contents in finisher experimental diets**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Oil source</th>
<th>Total methionine equivalent* (%)</th>
<th>Additional methionine (%)</th>
<th>HMTBA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Palm</td>
<td>0.43</td>
<td>0.19</td>
<td>-</td>
</tr>
<tr>
<td>T2</td>
<td>Palm</td>
<td>0.30</td>
<td>0.01</td>
<td>0.07</td>
</tr>
<tr>
<td>T3</td>
<td>Palm</td>
<td>0.49</td>
<td>0.10</td>
<td>0.17</td>
</tr>
<tr>
<td>T4</td>
<td>Soybean</td>
<td>0.43</td>
<td>0.19</td>
<td>-</td>
</tr>
<tr>
<td>T5</td>
<td>Soybean</td>
<td>0.39</td>
<td>-</td>
<td>0.17</td>
</tr>
<tr>
<td>T6</td>
<td>Soybean</td>
<td>0.43</td>
<td>0.09</td>
<td>0.10</td>
</tr>
</tbody>
</table>

*Total methionine equivalent was calculated by addition of total methionine level + HMTBA level on molecular basis in case of HMTBA addition.

**Growth performance:**

Due to the methionine incorporation issue during the finishing period and to the significant interaction observed on body weight gain during the grower period, results were compared by treatment instead of main effect factorial analysis.

During the starter period, no significant effect was observed between treatments for all growth parameters. From 15 to 28 days, daily feed intake and daily weight gain were significantly improved when broilers were fed the DL-methionine diets whatever oil source. During the finisher period, broilers fed DL-methionine diet including soybean oil had a significant higher feed intake.
compared to those fed HMTBA or DLM/HMTBA diets. The relation between feed intake and growth performances when methionine sources are compared has been previously underlined by Geraert and Mercier (2005).

Table 4. Effect of methionine source on growth performance parameters

<table>
<thead>
<tr>
<th>Treatments</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14 days</td>
<td>Daily feed intake (g)</td>
<td>38.6 ± 0.5</td>
<td>38.3 ± 1.0</td>
<td>38.1 ± 0.9</td>
<td>38.0 ± 1.3</td>
<td>37.8 ± 0.9</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>98.7%</td>
<td>98.7%</td>
<td>-</td>
<td>99.4%</td>
</tr>
<tr>
<td></td>
<td>Daily weight gain (g)</td>
<td>28.9 ± 0.5</td>
<td>28.7 ± 0.7</td>
<td>28.8 ± 1.0</td>
<td>29.1 ± 0.9</td>
<td>28.3 ± 0.6</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>99.5%</td>
<td>99.7%</td>
<td>-</td>
<td>97.4%</td>
</tr>
<tr>
<td></td>
<td>Feed conversion rate</td>
<td>1.34 ± 0.03</td>
<td>1.33 ± 0.02</td>
<td>1.33 ± 0.02</td>
<td>1.31 ± 0.01</td>
<td>1.3 ± 0.03</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>100.7%</td>
<td>100.7%</td>
<td>-</td>
<td>98.5%</td>
</tr>
<tr>
<td>15-28 days</td>
<td>Daily feed intake (g)</td>
<td>127.5 ± 2.1a</td>
<td>124.2 ± 3.2b</td>
<td>123.8 ± 1.4b</td>
<td>127.5 ± 2.7a</td>
<td>124.7 ± 2.3ab</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>97.4%</td>
<td>97.1%</td>
<td>-</td>
<td>97.8%</td>
</tr>
<tr>
<td></td>
<td>Daily weight gain (g)</td>
<td>78.6 ± 1.6ab</td>
<td>77.0 ± 2.2b</td>
<td>77.7 ± 1.4b</td>
<td>81.0 ± 0.8a</td>
<td>78.2 ± 1.8ab</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>97.9%</td>
<td>98.9%</td>
<td>-</td>
<td>96.6%</td>
</tr>
<tr>
<td></td>
<td>Feed conversion rate</td>
<td>1.62 ± 0.01</td>
<td>1.61 ± 0.03</td>
<td>1.60 ± 0.02</td>
<td>1.57 ± 0.03</td>
<td>1.60 ± 0.02</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>100.6%</td>
<td>101.3%</td>
<td>-</td>
<td>98.1%</td>
</tr>
<tr>
<td>29-42 days</td>
<td>Daily feed intake (g)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>209.7 ± 2.8a</td>
<td>202.4 ± 5.4b</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>96.5%</td>
</tr>
<tr>
<td></td>
<td>Daily weight gain (g)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>103.3 ± 3.7a</td>
<td>99.8 ± 2.6b</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>96.6%</td>
</tr>
<tr>
<td></td>
<td>Feed conversion rate</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.03 ± 0.05</td>
<td>2.03 ± 0.02</td>
</tr>
<tr>
<td></td>
<td>HMTBA ratio to DLM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100.0%</td>
</tr>
<tr>
<td>0-42 days</td>
<td>Daily feed intake (g)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>124.3 ± 2.3</td>
<td>121.4 ± 2.3</td>
</tr>
<tr>
<td></td>
<td>Daily weight gain (g)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>71.1 ± 1.4a</td>
<td>68.8 ± 1.4b</td>
</tr>
<tr>
<td></td>
<td>Feed conversion rate</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.75 ± 0.02</td>
<td>1.77 ± 0.01</td>
</tr>
</tbody>
</table>

* Results are expressed with mean ± standard deviation  
ab Means with different superscripts within a row differ (P<0.05)

In the overall growth period, broilers fed DL-methionine obtained significant higher daily weight gain than the others fed the other products. As feed conversion rate was not affected by methionine source, this weight gain improvement was due to a numerical increase of feed intake over the rearing period.

**Technological quality of breast meat:**
The results obtained on meat quality traits showed a significant effect of the combination of methionine sources on ultimate pH and drip loss compared to other treatments. Indeed the ultimate pH and drip loss had been clearly identified as meat quality parameters (Berri et al., 2005). Moreover, the effect of amino acid level (e.g. lysine) had been previously demonstrated by Berri et al. (2008). Interestingly HMTBA containing treatment resulted in significant lower lipid oxidation during storage as revealed through TBA-RS analyses. This effect of HMTBA on lipid oxidation can
be linked to the better ability of HMTBA to form Taurine and Cystine than DLM (Martin-Venegas et al., 2006), both involved in glutathione synthesis, well known as cellular antioxidant (Metayer et al. 2008).

Table 5. Effect of methionine source on breast meat muscle quality

<table>
<thead>
<tr>
<th>Treatment</th>
<th>DLM</th>
<th>HMTBA</th>
<th>50% DLM / 50% HMTBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate pH</td>
<td>5.96&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.98&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Drip loss (%)</td>
<td>0.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.75&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>TBARS index</td>
<td>0.180&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.144&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.143&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a,b</sup> Means with different superscripts within a row differ (P<0.05)

4. Conclusion

Growth results after a 42 day growth period showed a significant difference between treatments on body weight gain. However, this difference can be easily linked to feed intake resulting in lack of differences between treatments on feed conversion ratio. Moreover, breast meat ultimate pH of birds fed the 50% DL-methionine / 50% HMTBA diet were significantly higher, with also get lower drip loss. Interestingly, the HMTBA treatment decreased globally lipid oxidation during the 10 day refrigerated storage, pointing out a putative beneficial effect on oxidative process.

5. Literature cited


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