Effect of dietary L-carnitine supplementation on overall performance, carcass traits, serum components and immune response in broiler chicken

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This study was conducted to evaluate the effects of three dietary L-carnitine inclusion levels on performance, carcass traits, blood cells, serum components and immune responses on broiler chickens. 240 one-day-old Cobb male broiler chicks were received from a commercial hatchery and reared under optimum growth conditions until 49 days of age. Upon their arrival, they were randomly distributed into 12 floor pens in a randomized block design (4 treatments × 3 replications, each replication included 20 chicks, totally 240 chicks). Four experimental diets were formulated by adding four levels of supplemental L-carnitine (0, 125, 250 and 375 mg/kg) to a basal diet and used until 49 days old. During the rearing, daily feed consumption and mortality, weekly weight gain and feed conversion rate (FCR), and also antibodies titers induced by Newcastle Disease and Avian Influenza vaccines at 35 and 49 days old were measured and recorded. At the end of the study, three birds per treatment (one bird per pen) were weighted and serum components (cholesterol and triglyceride), blood cells (white blood cell and red blood cell), carcass traits (abdominal fat weight and heart weight ratio), histopathological changes of hepatocytes were measured. Finally all items were compared and analyzed between 4 treatments statistically. The results showed that:

1) L-carnitine could improve significantly body weight gain only in 35-49 days old (P<0.05), but no in earlier ages (P>0.05). Also FCR, production index, antibody titers against ND and AI vaccines improved significantly (P<0.05).

2) L-carnitine had a little positive improvement on serum components, blood cells count and carcass traits, but they were not considerable and significant statistically (P>0.05).

Key words: L-carnitine; Performance; Nutrition; Broiler

Introduction

Production of broiler chickens containing excess body fat is a problem in the poultry industry. Several factors, such as nutrients and genetics, contribute to the tendency for broilers to accumulate excess body fat. Therefore, improving carcass composition with additives has become a main focus of nutrition research. L-Carnitine supplementation of diets could be used to augment carnitine supply for use in metabolism, thereby facilitating fatty acid oxidation and reducing the amount of long-chain fatty acids available for storage in adipose tissue. Results of research indicate that L-carnitine supplementation to diets alters fat metabolism and reduces body fat (Burtle et al., 1994, Kachura 1995, Kudo et al., 1995 and Owen 1994). Several studies have been done to determine whether dietary L-
carnitine influences the carcass composition of broiler chickens, but the results obtained are not in agreement (Cartwright 1986, Rabie et al., 1997, Rabie et al., 1998).

Until now, there has been no clear knowledge about the effect of dietary carnitine supplementation on lipid metabolism. Dietary L-carnitine supplementation tends to improve total meat output per amount of feed consumed by improving survivability. Also, dietary L-carnitine supplementation may have a beneficial effect on broiler nutrition status, presumably due to its sparing effect on its precursors lysine and methionine.

**Materials and methods**

1- Chicken and grouping: 240 one-day-old Cobb male broiler chicks were received from a commercial hatchery and reared under optimum growth conditions until 49 days of age. Upon their arrival, they were randomly distributed into 12 floor pens in a randomized block design (4 treatments × 3 replications, each replication included 20 chicks, totally 240 chicks). Four experimental diets were formulated by adding four levels of supplemental L-carnitine (0, 125, 250 and 375 mg/kg) to a basal diet and used until 49 days old.

2- Collection data and recording

2-1-Performance data: During the rearing, daily feed consumption and mortality, weekly weight gain and feed conversion rate (FCR) were recorded

2-2- Antibodies titers: For evaluation of effects of L-carnitine on humoral immunity status, antibodies titers induced by Newcastle Disease and Avian Influenza vaccines at 35 and 49 days old of 5 birds per pen (15 samples per treatment) were measured by Haemagglutination Inhibition (HI) test.

2-3- Blood cells & factors: At 49 days old, one sample per pen (3 samples per treatment) was collected and blood cells (RBC, WBC, and platelet) and factors (haematocrit, haemoglobin) were counted and measured.

2-4- Serum components: At 49 days old, one sample per pen (3 samples per treatment) was collected and serum components (cholesterol and triglycerides) were measured by CHOD/PAD and GPO/Trinder method respectively.

2-5- Carcass traits: At 49 days old, one sample per pen (3 samples per treatment) was killed and abdominal fat weight and heart weight ratio (heart weight/ body weight) were measured.

**Results & discussion**

1- Performance data: Comparison of body weight of 4 group at 1-7 weeks of age shows that only group 1 and 4 that received 0 and 375 mg/kg L-carnitine respectively, are significantly different at 6 and 7 weeks old. L-carnitine can improve body weight at end of rearing period maybe because of high metabolism activity and high demand of energy of chicken that it is obvious in high level (375 mg/kg) usage of L-carnitine more than lower levels (125, 250 mg/kg).
Table 1: Body weight at 1-7 weeks old in 4 treatments

<table>
<thead>
<tr>
<th>L. carnitine (mg/kg)</th>
<th>0</th>
<th>125</th>
<th>250</th>
<th>375</th>
<th>p&gt;0.05, NS $^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (wk)</td>
<td>1</td>
<td>133</td>
<td>132</td>
<td>137</td>
<td>132</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>255</td>
<td>252</td>
<td>252</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>552.6</td>
<td>553</td>
<td>569</td>
<td>563</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>890</td>
<td>890</td>
<td>916</td>
<td>936</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1183</td>
<td>1201</td>
<td>1234</td>
<td>1299</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1579 b</td>
<td>1677.3 ab</td>
<td>1660 ab</td>
<td>1417.6 a</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>2303.3 b$^3$</td>
<td>2306.6 ab</td>
<td>2293.3 ab</td>
<td>2393.3 a</td>
</tr>
</tbody>
</table>

$^1$ Non significant
$^2$ Significant
$^3$ Means within rows with no common superscript are significantly different (p<0.05)

2-Antibodies titers: Table 2 shows antibody (Ab) titers induced against Newcastle Disease (ND) and Avian Influenza (AI) vaccines at 35 and 49 days old that are significantly different at 35 days old for AI and ND. L. carnitine stimulated immune system to induce Ab at first exposure, but after Ab induction it couldn't effect on it more.

Table 2: Effect of three dietary L-carnitine inclusion levels on Ab production.

<table>
<thead>
<tr>
<th>L- carnitine (mg/kg)</th>
<th>Ab Titer</th>
<th>0</th>
<th>125</th>
<th>250</th>
<th>375</th>
<th>P&lt;0.05, S $^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AI (35 days)</td>
<td>3 b</td>
<td>4 b</td>
<td>3.8 ab</td>
<td>3.8 ab</td>
<td>P&lt;0.05, S $^2$</td>
</tr>
<tr>
<td></td>
<td>AI (49 days)</td>
<td>3.6</td>
<td>3.8</td>
<td>3.8</td>
<td>3.8</td>
<td>P&gt;0.05, NS $^1$</td>
</tr>
<tr>
<td></td>
<td>ND (35 days)</td>
<td>3 b</td>
<td>4.3 b$^3$</td>
<td>6 a</td>
<td>5.1 a</td>
<td>P&lt;0.05, S</td>
</tr>
<tr>
<td></td>
<td>ND (49 days)</td>
<td>6</td>
<td>6.6</td>
<td>6.8</td>
<td>6.8</td>
<td>P&lt;0.05, NS</td>
</tr>
</tbody>
</table>

$^1$ Non significant
$^2$ Significant
$^3$ Means within rows with no common superscript are significantly different (p<0.05)

3-Blood factors: L-carnitine had no effect on blood cells and factors at three dietary inclusion levels significantly (Table 3).
Table 3: Effect of L. carnitine on blood factors

<table>
<thead>
<tr>
<th>Blood Factors</th>
<th>L- carnitine (mg/kg)</th>
<th>0</th>
<th>125</th>
<th>250</th>
<th>375</th>
<th>p &gt; 0.05, NS^1</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td></td>
<td>1939a²</td>
<td>1440ab</td>
<td>1440ab</td>
<td>10850b</td>
<td>p &gt; 0.05, NS^1</td>
</tr>
<tr>
<td>RBC</td>
<td></td>
<td>2.376ab</td>
<td>2.65a</td>
<td>2.376ab</td>
<td>2.17b</td>
<td>p &gt; 0.05, NS^2</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td></td>
<td>8.9ab</td>
<td>10.1a</td>
<td>8.9ab</td>
<td>8.2b</td>
<td>p &gt; 0.05, NS^1</td>
</tr>
<tr>
<td>Haematocrit</td>
<td></td>
<td>27.2ab</td>
<td>30.1a</td>
<td>27.2ab</td>
<td>24.73b</td>
<td>p &gt; 0.05, NS^1</td>
</tr>
</tbody>
</table>

^1 Non significant
^2 Means within rows with no common superscript are significantly different (p < 0.05)

4-Serum components: L. carnitine had no effect on serum components (triglycerides and cholesterol) significantly (Table 4)

Table 4: effect of L. carnitine on serum components in 4 treatments

<table>
<thead>
<tr>
<th>Serum Components</th>
<th>L- carnitine (mg/kg)</th>
<th>0</th>
<th>125</th>
<th>250</th>
<th>375</th>
<th>p &gt; 0.05, NS^1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triglycerides</td>
<td></td>
<td>91.3b</td>
<td>147a</td>
<td>112.3ab</td>
<td>110.3ab</td>
<td>p &gt; 0.05, NS^1</td>
</tr>
<tr>
<td>Cholesterol</td>
<td></td>
<td>92.66</td>
<td>96.66</td>
<td>94</td>
<td>105</td>
<td>p &gt; 0.05, NS^1</td>
</tr>
</tbody>
</table>

^1 Non significant
^2 Means within rows with no common superscript are significantly different (p < 0.05)

5-Carcass traits: L- carnitine had no effect on abdominal fat weight and Heart weight ratio significantly (table 5). Abdominal fat weight is regulated by several factors and L-carnitine can not effect on it alone(ness). L- carnitine can prevent on enlargement of hear and so can use for prevention or controlling of ascites process, but it is not significantly different (Table 5).

Table 5: Effect of L- carnitin on carcass traits in 4 treatments

<table>
<thead>
<tr>
<th>Carcass traits</th>
<th>L- carnitine (mg/kg)</th>
<th>0</th>
<th>125</th>
<th>250</th>
<th>375</th>
<th>p &gt; 0.05, NS^1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal fat weight</td>
<td></td>
<td>0.29</td>
<td>0.48</td>
<td>0.96</td>
<td>0.63</td>
<td>p &gt; 0.05, NS^1</td>
</tr>
<tr>
<td>Heart weight ratio</td>
<td></td>
<td>0.74</td>
<td>0.60</td>
<td>0.61</td>
<td>0.57</td>
<td>p &gt; 0.05, NS^1</td>
</tr>
</tbody>
</table>

^1 Non significant
Conclusion

1- L-carnitin can improve body weight of chicken at end of rearing period significantly (6 and 7 weeks old) only at high inclusion level (375 mg/kg) (p<0.05).
2- L-carnitin can improve Ab induction against ND and AI vaccines at first exposure significantly (p<0.05).
3- L-carnitine had no effect on blood cells and factors at three dietary inclusion levels significantly (p>0.05).
4- L-carnitine had no effect on serum components (triglycerides and cholesterol) significantly (p>0.05)
5- L-carnitine had no effect on abdominal fats and heart weight ratio significantly (p>0.05)

References