Effects of L-Carnitine administration on growth performance, carcass traits and some serum components of Japanese quail (Coturnix cot. japonica)

Einfluss einer L-Carnitin-Zulage zum Futter auf Wachstumsleistung, Schlachtkörpermerkmale und einige Serum-Parameter bei der japanischen Wachtel

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Introduction

L-Carnitine (β-hydroxy-γ-N-trimethylamino butyrate) is a water-soluble quaternary amine which exists naturally in micro-organisms, plants and animals (Bremer, 1983). L-Carnitine is synthesised in vivo from lysine and methionine in the kidney (feline) and liver (Rebouche and Paulson 1986, Feller and Rudman 1988).

L-Carnitine plays an important role in energy metabolism. Its major role appears to be the transport of long-chain fatty acid into mitochondria for β-oxidation (Bremer, 1983; Borum, 1987; Rabie et al., 1997; Novotny, 1998; Díaz et al., 2000). Thus, dietary L-Carnitine supplementation could improve fatty acid and energy utilisation and by this live weight gain and feed conversion efficiency (Gropp et al., 1994). Also this compound has secondary functions including, buffering and removing potentially toxic acyl groups from cells, equilibrating ratios of free CoA and acetyl-CoA between mitochondria and cytoplasm and participating in biological processes such as regulation of gluconeogenesis, stimulation of fatty acid synthesis and ketone, branched chain amino acid, triglyceride and cholesterol metabolism (Novotny, 1998). Additionally, several researchers (Bell et al., 1987; Seccombe et al., 1987; Díaz et al., 2000) have reported that L-Carnitine as a hypolipidemic drug is capable of reducing the circulating levels of cholesterol of high, low, very low density lipoproteins. Furthermore, L-Carnitine has been found to exhibit immunomodulatory effects (Mast et al., 2000).

There is not any study available on the use of L-Carnitine in quail diet and its effect. Studies have shown that L-Carnitine supplementation increased body weight gain, reduced carcass fat and improved feed conversion in broiler chickens (Rabie et al., 1997a; Rabie and Szilagyi, 1998; Kita et al., 2002). However, there exist contradictory studies in which supplementary dietary L-Carnitine did not effect growth performance, abdominal fat content and some internal organ weights (Barker and Sell, 1994; Leibetseder, 1995; Buyse et al., 2001) or increased heart weight (Buyse et al., 2001) in broiler chickens.

In several researches conducted on rats (Mondola et al., 1992), rabbits (Bell et al., 1987) and hens (Seiwald, 1993) it was established that L-Carnitine supplementation in diet decreased serum cholesterol and triglyceride levels. Lieu and Horng (2001) reported that 160 ppm L-Carnitine supplementation in diet did not effect growth performance, carcass traits, serum cholesterol, phospholipid and lipoprotein levels in broiler chickens.

The aim of the study was to investigate the effects of administration of carnitine chlorhydrate by drinking water on growth performance, carcass traits and some blood parameters in Japanese quail (Coturnix coturnix japonica).

Materials and Methods

Animal, Treatment, and Management

Two hundred, one-day-old chicks were randomly assigned to two groups. The experimental unit was a pen of 20 birds and each treatment was tested on 5 replicates (first group was allocated as control second group was allocated as carnitine). Both groups were fed to meet the National Research Council recommendations for quails (NRC, 1984). Additionally, 100 mg/l carnitine chlorhydrate (He-pabal Carnitine, SOGEVAL Laboratoire, FRANCE) was given via drinking water to the second group. As carnitine chlorhydrate used in this study was in liquid form, it was offered via drinking water. Experimental period was conducted for 6 weeks, first 3 weeks as starter period and the last 3 weeks as grower period. Diets were offered to animals ad libitum in mash form and water was available at all times during the experimental period. It is worth to state that amount of L-Carnitine offered in the water was known but intake by animals could not be estimated because of undefined water intake.

It is well known that growing chicken drinks approximately twice as much water as the feed it consumes (NRC, 1984). L-Carnitine intake by quails might be estimated with weekly feed intake in this study. Additionally, studies have already shown that L-Carnitine supplementation did not affect water intake in broilers (Çelik and Öztürkcan, 2003).

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Data collection

Individual live weights of quails were recorded weekly. Feed consumption was determined per subgroup per week, feed conversion efficiency was also calculated on group basis. At the end of the trial, 5 randomly separated quails from each subgroup were slaughtered. Blood samples were taken at the time of slaughter and sera were separated and stored at -20 °C until analyses. The carcasses were cut into parts according to JONES (1984).

Analytical procedure

Dry matter, crude protein, crude fibre, ether extract, and ash content of diets were determined according to AOAC (1984) procedures. Because of known relationship between L-Carnitine and lipid-energy metabolism, concentration of glucose, cholesterol, total lipid and triglycerid were analysed. In addition total protein and albumin were also analysed. The concentration of glucose, total cholesterol, total lipid, triglycerid, total protein and albumin were analysed by an autoanalyser (Abbot Alcyon 300i, Illinois, USA), using commercial kits Abbot Labourites (USA).

Statistics

Data were subjected to statistical analysis using “t test” in SPSS (SPSS, 1993). Statistical differences were set up at P < 0.05.

Results and Discussion

Live weight of quails at the beginning of the experiment was similar across the groups and averaged 7.36 g both in control and carnitine group. There were no statistical differences between the groups in terms of live weight, daily feed consumption and feed conversion efficiency between the groups in whole experimental period (P > 0.05). Throughout the experimental period cumulative feed consumption by quails in the control and in the carnitine groups were 761.6 and 881.3 g, respectively (P > 0.05). Due to the higher feed intake and similar live weight gain in the carnitine group, feed conversion efficiency was found to be worse than in the control group, but there were no statistical differences between the groups. These findings are consistent with the observations of other research (BARKER and SELG, 1994; MAST et al., 2000; LIEN and HORN, 2001) on broilers. However, LETTNER et al., (1992) indicated that L-Carnitine supplementation up to

Table 1. Composition and analysed nutrient contents of diets (%)*

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Starter period</th>
<th>Grower period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>58.20</td>
<td>49.90</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>32.10</td>
<td>25.00</td>
</tr>
<tr>
<td>Fish meal</td>
<td>7.50</td>
<td>4.00</td>
</tr>
<tr>
<td>Barley</td>
<td>...</td>
<td>18.70</td>
</tr>
<tr>
<td>Lime stone</td>
<td>1.10</td>
<td>1.20</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>0.50</td>
<td>0.60</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Vit. Min. premixes**</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>Chemical analysis</td>
<td>92.40</td>
<td>91.45</td>
</tr>
</tbody>
</table>

* L-Carnitine administered in drinking water as 100 mg/l carnitine group.
** Provided per kg concentrate: Vitamin A, 21,000 IU; Vitamin D3, 4200 IU; Vitamin E, 25.5 mg; Vitamin K1, 2.5 mg; Vitamin B2, 2.55 mg; Vitamin B6, 12.25 mg; Vitamin B12, 7 mg; Vitamin B13, 0.03 mg; Folic acid, 1.75 mg; D-Biotin, 0.08 mg; Vitamin C, 175 mg; Niacin, 70 mg; CaD-Pantothenat, 14 mg; Choline chloride 2.5 mg; Fe, 140 mg; Zn, 105 mg; Cu, 35 mg; Co, 0.35 mg; I, 1.75 mg; Se, 0.26 mg; Mn, 140 mg.
*** Metabolisable energy, provided by calculation (NRC, 1984).

Table 2. Live weight, feed consumption and feed conversion efficiency of experimental groups [Mean ± Sx] Lebendgewicht, Futterverbrauch und Futterverwertung der Versuchsgruppen [Mittelwert ± Sx]

<table>
<thead>
<tr>
<th>Groups</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Live weight, g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>18.9 ± 0.9</td>
<td>41.3 ± 1.7</td>
<td>73.1 ± 3.5</td>
<td>108.2 ± 4.4</td>
<td>147.3 ± 12.4</td>
<td>176.6 ± 10.1</td>
</tr>
<tr>
<td>Carnitine</td>
<td>18.1 ± 0.6</td>
<td>39.9 ± 0.9</td>
<td>78.8 ± 2.1</td>
<td>117.8 ± 3.0</td>
<td>153.6 ± 7.0</td>
<td>176.3 ± 6.0</td>
</tr>
<tr>
<td></td>
<td>Daily feed consumption, g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>3.1 ± 0.2</td>
<td>8.4 ± 0.4</td>
<td>13.6 ± 0.7</td>
<td>16.4 ± 0.9</td>
<td>33.1 ± 2.9</td>
<td>34.2 ± 3.3</td>
</tr>
<tr>
<td>Carnitine</td>
<td>2.5 ± 0.2</td>
<td>7.8 ± 0.3</td>
<td>18.3 ± 0.4</td>
<td>25.4 ± 0.8</td>
<td>36.3 ± 2.6</td>
<td>35.6 ± 2.0</td>
</tr>
<tr>
<td></td>
<td>Feed conversion efficiency g/g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.9 ± 0.1</td>
<td>2.6 ± 0.1</td>
<td>3.0 ± 0.1</td>
<td>3.3 ± 0.1</td>
<td>6.0 ± 0.9</td>
<td>8.2 ± 1.3</td>
</tr>
<tr>
<td>Carnitine</td>
<td>1.6 ± 0.1</td>
<td>2.5 ± 0.1</td>
<td>3.3 ± 0.1</td>
<td>4.6 ± 0.2</td>
<td>7.1 ± 0.6</td>
<td>11.3 ± 1.7</td>
</tr>
</tbody>
</table>

Table 3. Carcass quality of experimental groups [n = 25; Mean ± Sx] Schlachtkörperqualität der Versuchsgruppen [n = 25; Mittelwert ± Sx]

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Carnitine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight, g</td>
<td>180.3 ± 15.9</td>
<td>175.7 ± 15.7</td>
</tr>
<tr>
<td>Carcass yield, %</td>
<td>69.2 ± 1.3</td>
<td>68.2 ± 2.1</td>
</tr>
<tr>
<td>Breast*</td>
<td>40.8 ± 2.9b</td>
<td>42.4 ± 1.3a</td>
</tr>
<tr>
<td>Leg*</td>
<td>28.8 ± 3.3</td>
<td>24.7 ± 3.0</td>
</tr>
<tr>
<td>Wing*</td>
<td>8.7 ± 0.6</td>
<td>8.5 ± 0.7</td>
</tr>
<tr>
<td>Liver*</td>
<td>4.2 ± 0.6</td>
<td>4.0 ± 1.1</td>
</tr>
<tr>
<td>Heart*</td>
<td>1.2 ± 0.1</td>
<td>1.2 ± 0.1</td>
</tr>
<tr>
<td>Gizzard*</td>
<td>3.1 ± 0.4</td>
<td>3.3 ± 0.4</td>
</tr>
<tr>
<td>Abdominal fat*</td>
<td>0.6 ± 0.4</td>
<td>0.8 ± 0.5</td>
</tr>
</tbody>
</table>

*; Different superscripts within the row differ (P < 0.05).
* The percent of the carcass weight.
60 mg/kg in feed tended to improve growth performance of broiler chickens. Differences in dosage level of L-Carnitine, metabolisable energy levels of diets, ingredient of diets and physiological status of the animals may be responsible for the discrepancies between studies.

The natural L-Carnitine content of starter and grower diets used in this study calculated as 18.99 and 13.55 mg/kg, respectively (BAUMGARTNER and BLUM, 1997a). Although, the carnitine group had taken up more L-Carnitine than the control group, there was no positive effect on growth performance. This status might be explained that, in the way that in the present study calculated amounts of L-Carnitine, L-Carnitine precursors and of methyl donors such as choline and folic acid were adequate in the experimental diets according to the nutrient requirements for quails outlined by the NRC (1984). Moreover, unchanged live weight gain and feed conversion efficiency argue against a marginal deficiency of L-Carnitine sparing nutrients (BAUMGARTNER and BLUM, 1997b). Also, they suggested on the basis that normal broiler rations contain approximately 10 mg L-Carnitine/kg to increase the content to 30–50 mg/kg diet if a high growth performance is desired.

Results indicated that L-Carnitine administration via drinking water did not affect carcass traits, abdominal fat and edible internal organs except for breast muscle (Table 3). Findings in the study are consistent with the observations of other researchers (LEIBETSEDER, 1995; RICHTER 1999; LIEN and HORNG, 2001).

L-Carnitine administration via drinking water statistically increased serum glucose level but did not affect other serum parameters (Table 4). The significant increase in the glucose level in carcass group is probably related to the gluconeogenetic effect of L-Carnitine. Concentration of serum cholesterol, total lipid and triglycerid levels were 30.1, 44.5 and 11.9% lower in the carcass group than in the control group, respectively. The decreases in cholesterol, total lipid and triglycerid levels might be attributed to acceleration of β-oxidation of the long chain fatty acids under the effect of L-Carnitine. Similar results were found for both animals (BELL et al. 1987; MONDOLA et al. 1992; SEIWALD, 1993) and human (REBOUCHE and PAULSON (1986)). LIEN and HORNG (2001) determined that the activity of carnitine palmitoyl transferase, which is a fatty acid β-oxidation enzyme, was significantly increased by supplemental L-Carnitine in broiler chickens. Very close results in both groups in terms of total protein and albumin level, reflect that L-Carnitine has no effect on protein metabolism.

Consequently, carnitine chlorhydrate administration via drinking water had no beneficial effect on growth performance and carcass traits in quails. In the serum parameters, glucose significantly increased, cholesterol, total lipid and triglycerid numerically decreased, total protein and albumin levels did not show any positive or negative trend.

**Abstract**

The present study was conducted to examine the effects of 100 mg carnitine chlorhydrate/l administration via drinking water on growth performance, carcass traits and blood serum components in Japanese quails. Two hundred a-day-old chicks were divided into two groups, allocated to 5 replicates, each consisting of 20 chicks. At the end of the 6 weeks experimental period, results indicated that administration of L-Carnitine did not significantly influence growth performance and carcass traits in quails. Administration of L-Carnitine did not significantly affect serum cholesterol, total lipid, triglycerid, total protein and albumin levels (P > 0.05) but increased the glucose level (P < 0.05).

**Keywords**

Quail, L-Carnitine, growth performance, carcass traits, blood parameters

**Zusammenfassung**

Einfluss einer L-Carnitin-Zulage zum Futter auf Wachstumslie­stung, Schlachtkörperformenke und einige Serum-Para­meter bei der japanischen Wachtel

In der vorliegenden Studie wurde der Einfluss einer Gabe von L-Carnitin über das Trinkwasser (100 mg/l) auf die Wachstumsleistung, Schlachtkörperformenke und einiger Parameter des Blutserums von japanischen Wachteln untersucht. Zweihundert Eintags­küken wurde in zwei Gruppen aufgeteilt. Jeweils 20 Tiere bildeten eine Wiederholung. In der einen Behandlung wurde L-Carnitin dem Trinkwasser zugegeben, die andere Behandlung ohne Zugabe fungierte als Kontrolle. Am Ende der Versuchsperi­ode von 6 Wochen zeigte sich, dass die L-Carnitin-Zugabe keinen signifikanten Einfluss auf die Wachstumsleistung und die Schlachtkörperformenke hatte. In ähnlicher Weise beeinflusste die L-Carnitin-Zugabe nicht die Cholesterol-, Gesamtlipid-, Triglyzerid-, Gesamtprotein- und Albuminspiegel im Blutserum (P > 0.05). Dagegenüber waren die Serum-Glucosespiegel bei L-Carnitin-Zugabe signifikant erhöht (P < 0.05).

**Stichworte**

Wachtel, L-Carnitin, Wachstum, Schlachtkörperformenke, Blutpara­meter

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