African Journal of Biotechnology Vol. 10(68), pp. 15450-15455, 2 November, 2011
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.1410
ISSN 1684–5315 © 2011 Academic Journals

*Full Length Research Paper*

# Effects of supplemental ractopamine and L-carnitine on growth performance, blood biochemical parameters and carcass traits of male broiler chicks

**Farshid Kheiri[1]*, Javad Pourreza[2], Yahya Ebrahimnezhad[1], Kambiz Nazeradl[1] and Sayed Mohammad Ali Jalali Haji-abadi[2]**

[1]Department of Animal Science, Shabestar Branch, Islamic Azad University, Shabestar, Iran.
[2]Department of Animal Science, Shahrekord Branch, Islamic Azad University, Sharekord, Iran.

Accepted 21 September, 2011

**This experiment was conducted to consider the effect of ractopamine and L-carnitine as lipolytic agent and growth promoter on broiler chicks. Nine experimental diets were fed to 675 broiler chicks at the growth periods (3 to 6 weeks of age). Three levels of ractopamine (0, 5 and 10 mg/kg) and L-carnitine (0, 60 and 120 mg/kg) were fed. A completely randomized design with a 3 × 3 factorial arrangement was used. Growth performance, blood biochemical parameters and carcass traits were measured. Results indicate that daily body weight gain (DBWG), feed intake (FI) and feed conversion ratio (FCR) were not affected significantly ($p>0.05$) by different levels of ractopamine and L-carnitine. Ractopamine (10 mg/kg) significantly ($p<0.05$) increased blood serum cholesterol and albumin levels. On the other hand, triglyceride, blood urea nitrogen and globulin were reduced ($p<0.05$) in 10 mg/kg of ractopamine. L-Carnitine (60 mg/kg) significantly ($p<0.05$) reduced triglyceride, blood urea nitrogen and albumin, but increased blood serum cholesterol and glucose levels. The lowest level of triglyceride was observed by diets 5 (5 and 60 mg/kg) and diet 8 (10 and 60 mg/kg), which contained with ractopamine and L-carnitine, respectively. Carcass traits, except thigh and liver fat percentage were not influenced by added ractopamine. A significant ($p<0.05$) reduction was observed in abdominal fat pad due to supplemental L-carnitine. Liver fat content was significantly ($p<0.05$) reduced by (10 mg/kg) ractopamine. Blood biochemical parameters and some carcass traits of broilers were responsive to supplemental ractopamine and L-carnitine.**

**Key words:** Ractopamine, L-carnitine, performance, carcass traits, broiler chicks.

## INTRODUCTION

One of the major concerns in the broiler industry is carcass fatness. Body fat of broiler chicks is the most important in the poultry industry. Although, a degree of fattening is desirable, there are undesirable, even wasteful fat depots like abdominal and crop fat. Processing yield can be reduced by high amount of abdominal fat pad and often removed from the carcass together with the intestine during mechanical dressing. The main factors determining production costs of broilers are growth rate and feed conversion ratio method, which alters fat deposition and also have a beneficial effect on growth rate or feed costs, or combination of these factors. Fat deposition can the influenced somewhat by environmental factors and to larger extent by nutritional and genetic factors. The influence of nutrition and genetic on fat deposition is large compared to the environmental factors (Lin et al., 1980). Involvement of genetic on fat deposition is mostly in the quantity of fat, while nutritional factors influence both quantity and quality of fat (Mcleod, 1982).

Fat metabolism can be manipulated by some feed additives. Ractopamine hydrochloride (RAC) and L-carnitine (L-C) are used to alter fat metabolism and deposition, due to their lipolytic and growth promoter properties. Since 1963, β-adrenergic (β-AR) agonist has

*Corresponding author. E-mail: farshid_kheiri@yahoo.com. Fax: + 98 3813361093.

**Table 1.** Ingredients and composition of the experimental diets.

| Diet | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Ractopamine (mg $kg^{-1}$) | 0 | 0 | 0 | 5 | 5 | 5 | 10 | 10 | 10 |
| L-Carnitine (mg $kg^{-1}$) | 0 | 60 | 120 | 0 | 60 | 120 | 0 | 60 | 120 |
| **Ingredient (%)** | | | | | | | | | |
| Basal Portion[1] | 99.959 | 99.959 | 99.959 | 99.959 | 99.959 | 99.959 | 99.959 | 99.959 | 99.959 |
| Ractopamine | 0 | 0 | 0 | 0.001 | 0.001 | 0.001 | 0.0005 | 0.0005 | 0.0005 |
| L-carnitine premix[2] | 0 | 0.015 | 0.03 | 0 | 0.015 | 0.03 | 0 | 0.015 | 0.03 |
| Premix free L-canitine[3] | 0.018 | 0.009 | 0 | 0.018 | 0.009 | 0 | 0.018 | 0.009 | 0 |
| Sand | 0.023 | 0.017 | 0.011 | 0.022 | 0.016 | 0.01 | 0.0225 | 0.0165 | 0.0105 |
| **Chemical analysis (%)** | | | | | | | | | |
| ME (kcal $kg^{-1}$) | 3100 | 3100 | 3100 | 3100 | 3100 | 3100 | 3100 | 3100 | 3100 |
| CP (%) | 19.375 | 19.375 | 19.375 | 19.375 | 19.375 | 19.375 | 19.375 | 19.375 | 19.375 |
| Ca (%) | 0.871 | 0.871 | 0.871 | 0.871 | 0.871 | 0.871 | 0.871 | 0.871 | 0.871 |
| P (%) | 0.339 | 0.339 | 0.339 | 0.339 | 0.339 | 0.339 | 0.339 | 0.339 | 0.339 |
| Met + Cys (%) | 0.6975 | 0.6975 | 0.6975 | 0.6975 | 0.6975 | 0.6975 | 0.6975 | 0.6975 | 0.6975 |

[1]Basal portion contained (%): 64.67 corn, 25.74 soybean meal (CP: 44%) , 4.21 fish meal (CP: 60.05), 2.737 soybean oil, 1.2 oyster shell, 0.51 dicalcium phosphate, 0.042 DL-methionine, 0.2 salt, 0.15 sodium bicarbonate, 0.25 mineral premix and 0.25 vitamin premix. [2]Content: 60% L-carnitine L-tartrate (40%pure L-carnitine). [3]Content: lactose, starch and cellulose microcrystal.

been used in broiler diets, due to it is effects on growth and carcass traits (Cunninghm, 1963). RAC is a β-AR agonist determined by Food and Drug Administration in 2003, for use in cattle and swine diets (Van de Haar, 2005). β-AR agonists modify effects on growth and fat metabolism (Mersmann, 1998). These drugs mediated protein turnover and muscle growth (Reeds and Mersmann, 1991). Glucose lactate and insulin in the blood serum were increased by β-AR agonists (Beermann et al., 1986; Beermann, 1987; Mersmann, 1987). L-C (β-hydroxy-γ-trimethylammonium butyrate), is a zwitter ionic compound (Bremer, 1983), which transports long chain fatty acids to across the mitochondrial membrane (Fritz, 1963 cites in Owen et al., 2001).

As indicated by previous research, L-C can reduce body fat in pigs (Newton and Haydon, 1989; Owen et al., 1994; Kachura et al., 1995; Kaudo et al., 1995). Results indicated the effect of L-C on chickens did not assign equal. Cartwright (1986) reported that L-C did not have affect on abdominal fat in broiler chicks during 5 to 7 weeks of age. Moreover, Rabie et al. (1997), Rabie and Szilagri (1998) and Xu et al. (2003) found that L-C increased breast muscle yield and leg meat yield and reduced abdominal fat content. The aim of this experiment was therefore to evaluate the effect of RAC and L-C on growth performance, carcass traits and blood biochemical parameters in male broiler chicks.

## MATERIALS AND METHODS

Six hundred seventy five (675) Ross male broiler chicks were randomly distributed into 45 pens, allocated to nine dietary treatment groups with 5 replicates for each treatment. The trail was conducted using 3 × 3 factorial arrangement for treatments (three replicates per treatment) in a completely randomized design with three levels of ractopamine and three levels of L-carnitine as the main effect and the interaction of ractopamine and L-carnitine supplementation. Diets were formulated to contain three levels of L-carnitine (0, 60 and 120 mg/kg) and three levels of ractopamine (0, 5 and 10 mg/kg). Ingredients and details of the designated diets are presented in Table 1. Experimental diets were fed from 3 to 6 weeks of age. Ractopamine hydrochloride (Sinoway International Jiangsu, china) and L-carnitine tartrate (Sigma Tau, Rome, Italy) were used. Feed intake, body weight and feed conversion ratio were evaluated at the end of experiment.

At the end of experiment (day 42), from each replicate two chickens were selected randomly and blood samples was taken from jugular vein, slaughtered and dressing percentage, abdominal fat (the fat around the cloaca and gizzard), gall bladder, liver, breast, breast muscle, thigh and heart were measured. Serum was separated (centrifuged 10 min; 5000 g) and stored at -20°C before analysis. Concentrations of albumin, total protein, glucose, triglyceride, cholesterol, uric acid and blood urea nitrogen (BUN) in the serum were measured by an enzymatic method based on Darman kave Diagnostics Kits (Res. Lab. Isfahan, Iran. 2002). Liver fat was mea-sured according to standard procedures (AOAC, 2000).

For statistical analysis, arcsine square transformation of data was carried out to achieve homogeneity of variance. Data processing was completed by the GLM procedure of the statistical program SAS (1993). Significant differences between main effects and their interactions were determined by least square means (LSMEANS) using a significant probability value ($P<0.05$).

## RESULTS AND DISCUSSION

The effect of RAC and L-C on DBWG, FI, FCR, live body weight and carcass yield are presented in Tables 2 and

**Table 2.** Effects of supplemental dietary ractopamine (R) and L-carnitine (L-C) on performance of male broiler chicks.

| Parameter /Treatment | | | ADG[1] ( g bird$^{-1}$ day$^{-1}$) | Feed intake ( g bird$^{-1}$ day$^{-1}$) | FCR[2] |
|---|---|---|---|---|---|
| Ractopamine (R, mg kg$^{-1}$) | 0 | | 73.112 $^{n.s}$ | 134.841 $^{n.s}$ | 1.846 $^{n.s}$ |
| | 5 | | 73.432 $^{n.s}$ | 137.855 $^{n.s}$ | 1.903 $^{n.s}$ |
| | 10 | | 71.780 $^{n.s}$ | 137.460 $^{n.s}$ | 1.915 $^{n.s}$ |
| L-Carnitine (L-C, mg kg$^{-1}$) | 0 | | 73.85$^{n.s}$ | 136.794$^{n.s}$ | 1.871$^{n.s}$ |
| | 60 | | 70. 359 | 134.004 | 1.905 |
| | 120 | | 71.031 | 139.356 | 1.886 |
| S.E[3] | | | 2.637 | 2.083 | 0.293 |
| **R × L-C** | | **Diet** | | | |
| 0 | 0 | 1 | 74.420$^{a}$ | 137.198$^{a}$ | 1.795 $^{n.s}$ |
| 0 | 60 | 2 | 68.129$^{b}$ | 126.436$^{b}$ | 1.86 |
| 0 | 120 | 3 | 74.787$^{a}$ | 140.889$^{a}$ | 1.884 |
| 5 | 0 | 4 | 68.775$^{b}$ | 132.733$^{ab}$ | 1.989 |
| 5 | 60 | 5 | 74.348$^{ab}$ | 142.732$^{a}$ | 1.92 |
| 5 | 120 | 6 | 77.173$^{a}$ | 138.092$^{a}$ | 1.8 |
| 10 | 0 | 7 | 76.400$^{a}$ | 140.451$^{a}$ | 1.84 |
| 10 | 60 | 8 | 68.599$^{b}$ | 132.843$^{ab}$ | 1.936 |
| 10 | 120 | 9 | 70.602$^{ab}$ | 139.086$^{a}$ | 1.97 |
| S.E | | | 4.567 | 3.607 | 0.507 |

Values in columns with same superscript or not superscript are not significantly different (P<0.05). [1]ADG, Average daily gain; [2]FCR, feed conversion ratio; [3]S.E, standard error; [#]Non significant.

3. RAC and L-C did not have any significant effect on a mentioned parameters. This result agreed with Buyse et al. (1991), who reported no significant effect of clenbuterol on weight gain and final body weight of broilers. Added cimaterol to the diet of broiler did not improve DBWG (Cartwright et al, 1988). In contrast, several researches have shown the positive effect of β-AR agonist on growth rate (Xiao et al., 1999; Moody et al., 2000; Tahmsabi et al., 2006; Gruber et al., 2007). Mersmann (2002) reported an improvement in DBWG and FI of broilers due to supplemental β-AR agonist. Difference in response of broilers to supplemental β-AR agonist can be attributed to differences in type and dose of β-AR agonist, broiler strain, age and also duration of β-AR agonist consumption (Mersmann, 2002, Buyse et al., 1991). Results of Baker and Sell (1994) and Xu et al. (2003) indicated that L-C at levels of 50, 70 or 100 mg/kg was not effective to improve DBWG and FI of broilers. In contrast, Owen et al. (1996) showed an improvement in DBWG and feed efficiency of pig, when L-C was added to diet at levels of 250 or 500 mg/kg. Difference in broiler strain, duration of experiment and diet compositions justifies differences in results obtained in our experiment with others.

Furthermore, interaction between RAC and L-C regarding daily gain, FI and FCR were significant ($p<0.05$). The best DBWG was obtained with 5 and 120 mg/kg RAC and L-C respectively (Table 2). The effects of RAC and L-C on carcass traits are presented in Table 3. Thigh and liver fat percentage were significantly ($p<0.05$) increased due to 10 mg/kg RAC (Table3). RAC mediated fat deposition in liver and the results obtained confirm this effect. Effect of RAC on muscle cell proliferation has also been reported by Grant et al. (1990) which in turn, cause an increase in muscle weight. L-C supplementation (120 mg/kg) significantly ($p<0.05$) reduced abdominal fat

**Table 3.** Effects of supplemental dietary L-carnitine (L-C) and ractopamine (R) on carcass traits analysis and fat content on liver of male broiler chicks.

| Parameter/ Treatment | Live body weight (g) | Carcass (%) | Abdomina fat (%) | Gall bladder (%) | Liver (%) | Breast muscle (%) | Breast (%) | Thigh (%) | Heart (%) | Liver fat (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ractopamine (R mgkg$^{-1}$)** | | | | | | | | | | |
| 0 | 2290.55$^{n.s}$ | 91.363$^{n.s}$ | 1.821$^{n.s}$ | 0.057$^{n.s}$ | 2.164$^{n.s}$ | 16.65$^{n.s}$ | 19.52$^{n.s}$ | 8.740$^{b}$ | 0.441 | 4.874$^{b}$ |
| 5 | 2270.55$^{n.s}$ | 91.467$^{n.s}$ | 2.001$^{n.s}$ | 0.068$^{n.s}$ | 2.349$^{n.s}$ | 16.636$^{n.s}$ | 19.818$^{n.s}$ | 8.782$^{b}$ | 0.472 | 3.898$^{c}$ |
| 10 | 2143.88$^{n.s}$ | 91.007$^{n.s}$ | 1.958$^{n.s}$ | 0.059$^{n.s}$ | 2.271$^{n.s}$ | 15.621$^{n.s}$ | 19.015$^{n.s}$ | 9.220a | 0.47 | 5.367$^{a}$ |
| **L-Carnitine (L-C, mg kg$^{-1}$)** | | | | | | | | | | |
| 0 | 2302.22$^{n.s}$ | 90.697$^{n.s}$ | 1.830$^{a}$ | 0.058$^{ab}$ | 2.167$^{n.s}$ | 16.865$^{n.s}$ | 19.911$^{n.s}$ | 9.191$^{a}$ | 0.474$^{n.s}$ | 3.634$^{c}$ |
| 60 | 2207.77 | 91.752 | 1.872$^{a}$ | 0.055$^{b}$ | 2.278 | 15.949 | 19.133 | 8.731$^{b}$ | 0.459 | 4.760$^{a}$ |
| 120 | 2195 | 91.387 | 1.168$^{b}$ | 0.069$^{a}$ | 2.34 | 16.094 | 19.315 | 8.821$^{ab}$ | 0.45 | 4.745$^{b}$ |
| **R × L-C Diet** | | | | | | | | | | |
| 0 0 1 | 2380$^{n.s}$ | 91.311$^{n.s}$ | 1.833$^{bc}$ | 0.064$^{ab}$ | 2.092$^{c}$ | 17.467$^{a}$ | 20.575$^{a}$ | 8.945$^{abc}$ | 0.455$^{ab}$ | 3.650$^{f}$ |
| 0 60 2 | 2223.33$^{n.s}$ | 91.405$^{n.s}$ | 1.615$^{be}$ | 0.055$^{b}$ | 2.123$^{c}$ | 15.564$^{ab}$ | 18.312$^{b}$ | 8.328$^{c}$ | 0.419$^{a}$ | 4.013$^{d}$ |
| 0 120 3 | 2268.33 | 91.371 | 2.017$^{cd}$ | 0.053$^{b}$ | 2.278$^{abc}$ | 16.920$^{ab}$ | 19.689$^{ab}$ | 8.949$^{abc}$ | 0.450$^{ab}$ | 4.960$^{b}$ |
| 5 0 4 | 2358.33 | 90.676 | 1.772$^{bce}$ | 0.067$^{ab}$ | 2.359$^{abc}$ | 17.302$^{a}$ | 20.544$^{a}$ | 9.130$^{a}$ | 0.512$^{b}$ | 3.403$^{g}$ |
| 5 60 5 | 2256.66 | 92.006 | 2.353$^{ad}$ | 0.057$^{b}$ | 2.146$^{c}$ | 16.107$^{ab}$ | 19.144$^{ab}$ | 8.842$^{abc}$ | 0.475$^{ab}$ | 4.166$^{c}$ |
| 5 120 6 | 2196.66 | 91.72 | 1.879$^{bc}$ | 0.076$^{ab}$ | 2.544$^{ab}$ | 16.500$^{ab}$ | 19.768$^{ab}$ | 8.497$^{bc}$ | 0.429$^{ab}$ | 4.126$^{c}$ |
| 10 0 7 | 2168.33 | 90.105 | 1.886$^{bc}$ | 0.044$^{b}$ | 2.051$^{c}$ | 15.826$^{ab}$ | 18.615$^{ab}$ | 9.497$^{a}$ | 0.456$^{ab}$ | 4.850$^{e}$ |
| 10 60 8 | 2143.33 | 91.845 | 1.378$^{e}$ | 0.053$^{b}$ | 2.564$^{a}$ | 16.175$^{ab}$ | 19.943$^{ab}$ | 9.023$^{ab}$ | 0.484$^{ab}$ | 6.100$^{a}$ |
| 10 120 9 | 2120 | 91.072 | 2.610$^{a}$ | 0.079$^{a}$ | 2.198$^{abc}$ | 14.863$^{b}$ | 18.489$^{ab}$ | 9.140$^{a}$ | 0.471$^{ab}$ | 5.150$^{c}$ |
| Pooled SE | 127.16 | 0.464 | 0.134 | 0.007 | 0.134 | 0.714 | 0.744 | 0.224 | 0.028 | 0.035 |

Values in columns with same superscript or not superscript are not significantly different ($p<0.05$).

(Table 3). Percentages of gall bladder, thigh and liver fat were significantly ($p<0.05$) increased due to 120 mg/kg L-C supplementation (Table 3). Reduced abdominal fat by L-C supplementation indicates the effect of L-C on enhancing mitochondrial permeability to fatty acids consequently more β-oxidation and catabolism of fat and fatty acids, therefore more energy availability to chicks for better growth. Higher dressing percentage and thigh might be the response of animal to added L-C. Reduction in abdominal fat was in agreement with finding of Rabie and Szilagyi (1998) and Xu et al. (2003), but was not consistent with the results of Sarica et al. (2005) who reported no response of abdominal fat to supplemental L-C in Japanese quail. However, abdominal fat was not influenced by RAC and hence not in agreement with the findings of Wellenreiter and Tonkinson (1990) who reported a reduction in abdominal fat due to RAC supplementation. Interactions bet-ween RAC and L-C on carcass traits except dressing percentage were significant ($p<0.05$), but the data had not a consistence trend and no explanation for these consistency.

The effect of RAC and L-C on blood parameter is presented in Table 4. Blood glucose was decreas-ed and cholesterol increased by added RAC ($p<0.05$). Also triglyceride was reduced ($p<0.05$). These results indicate that RAC alters

**Table 4.** Effects of supplemental dietary L-carnitine (L-C) and ractopamine (R) on blood biochemical parameters of male broiler chicks.

| Parameter | Glucose (mg dL$^{-1}$) | Cholesterol (mg dL$^{-1}$) | Triglyceride (mg dL$^{-1}$) | Uric acid (mg dL$^{-1}$) | Bun[1] (mg dL$^{-1}$) | Albumin (g dL$^{-1}$) | Total protein (g dL$^{-1}$) | Globulin (g dL$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| **Ractopamine (R mg kg$^{-1}$)** | | | | | | | | |
| 0 | 335.627$^{a}$ | 70.922$^{b}$ | 94.025$^{a}$ | 3.527$^{a}$ | 1.194$^{a}$ | 2.468$^{b}$ | 5.699n.s | 3.231$^{a}$ |
| 5 | 216.436$^{b}$ | 76.662$^{b}$ | 94.088$^{a}$ | 2.961$^{b}$ | 1.407$^{a}$ | 2.915$^{b}$ | 5.459 $^{n.s}$ | 2.544$^{ab}$ |
| 10 | 339.303$^{a}$ | 93.572$^{a}$ | 77.128$^{b}$ | 3.527$^{a}$ | 0.887$^{b}$ | 4.094$^{a}$ | 5.807 $^{n.s}$ | 1.713$^{b}$ |
| **L-Carnitine (L-C mg kg$^{-1}$)** | | | | | | | | |
| 0 | 275.447$^{b}$ | 74.131$^{b}$ | 88.986$^{b}$ | 3.225$^{b}$ | 1.263$^{a}$ | 3.529$^{n.s}$ | 5.725$^{n.s}$ | 2.196$^{n.s}$ |
| 60 | 373.370$^{a}$ | 87.691$^{a}$ | 68.591$^{c}$ | 3.335$^{ab}$ | 0.917$^{b}$ | 2.829$^{n.s}$ | 5.822$^{n.s}$ | 2.993$^{n.s}$ |
| 120 | 242.579$^{c}$ | 79.334$^{b}$ | 107.664$^{a}$ | 3.455$^{a}$ | 1.309$^{a}$ | 3.12$^{n.s}$ | 5.418$^{n.s}$ | 2.299$^{n.s}$ |
| **R × L-C Diet** | | | | | | | | |
| 0 0 1 | 250.680$^{ef}$ | 47.363$^{c}$ | 89.592$^{c}$ | 3.058$^{de}$ | 1.974$^{a}$ | 4.049$^{ab}$ | 5.487$^{n.s}$ | 1.437$^{d}$ |
| 0 60 2 | 473.365$^{a}$ | 91.742$^{a}$ | 78.096$^{d}$ | 3.773$^{b}$ | 0.337$^{d}$ | 2.640$^{c}$ | 5.304$^{n.s}$ | 2.664$^{bc}$ |
| 0 120 3 | 282.926$^{ed}$ | 73.661$^{b}$ | 114.388$^{ab}$ | 3.750$^{b}$ | 1.274$^{bc}$ | 3.467$^{b}$ | 5.009$^{n.s}$ | 1.542$^{d}$ |
| 5 0 4 | 240.054$^{f}$ | 74.950$^{b}$ | 97.122$^{bc}$ | 3.687$^{bc}$ | 1.332$^{bc}$ | 2.676$^{c}$ | 5.586$^{n.s}$ | 2.910$^{bc}$ |
| 5 60 5 | 260.975$^{def}$ | 75.710$^{b}$ | 62.149$^{d}$ | 1.919$^{f}$ | 1.798$^{a}$ | 4.273$^{a}$ | 4.779$^{n.s}$ | 0.506$^{d}$ |
| 5 120 6 | 148.282$^{g}$ | 79.326$^{b}$ | 122.994$^{a}$ | 3.279$^{de}$ | 1.091$^{c}$ | 3.616$^{ab}$ | 5.37$^{n.s}$ | 1.753$^{c}$ |
| 10 0 7 | 335.609$^{c}$ | 100.080$^{a}$ | 80.244$^{d}$ | 2.930$^{e}$ | 0.484$^{d}$ | 3.233$^{c}$ | 5.284 | 2.054$^{c}$ |
| 10 60 8 | 385.772$^{b}$ | 95.621$^{a}$ | 65.530$^{d}$ | 4.313$^{a}$ | 0.616$^{d}$ | 1.496$^{d}$ | 4.952 | 3.456$^{a}$ |
| 10 120 9 | 296.530$^{cd}$ | 85.017$^{b}$ | 85.612$^{c}$ | 3.338$^{cd}$ | 1.563$^{ab}$ | 2.765$^{c}$ | 5.58 | 2.818$^{bc}$ |
| Pooled SE | 13.48 | 4.143 | 6.205 | 0.121 | 0.13 | 0.25 | 0.317 | 0.354 |

Values in columns with same superscript or not superscript are not significantly different ($p<0.05$). [1]Blood urea nitrogen.

the trend of fat metabolism and also shift glucose toward fat biosynthesis. Changes in blood uric acid, BUN, albumin and globulin suggest an involvement of RAC in protein metabolism (Table 4). The results of RAC in increasing blood protein and also percentage of thigh confirm the finding of Liu et al. (1994), who reported simulative effect of RAC in protein synthesis. Our results are in agreements with the report of Vandenberg et al. (1998), regarding simulative effect of RAC on protein synthesis. Significant ($p<0.05$) effect of L-C on glucose, cholesterol and triglyceride was obser-ved, which indicate effectiveness of L-C in changing fat metabolism due to its involvement in fatty acid movement into mitochondria for β-oxidation and production of acetyl CoA. Acetyl CoA can be used for cholesterol and triglyceride biosynthesis which alter liver triglyceride and blood cholesterol. More cholesterol and triglyceride turnover leads to increase in bile production and turnover. Higher gall ball bladder weight in L-C treated chicken could be explain and justified for higher cholesterol and triglyceride turnover. Effect of L-C on uric acid and BUN was significant ($p<0.05$). It therefore seems that L-C can be effective in protein metabolism, compared to RAC. Interactions between L-C and RAC were significant ($p<0.05$)regarding blood parameter, but the changes showed no consistence trend and there is no explanation for inconsistency.

## Conclusion

L-C causes reduction in abdominal fat and also alter fat metabolism. On the other hand, RAC stimulate protein synthesis and changes trend of fat metabolism. It is also more effective in protein synthesis than L-C. There is some interaction between RAC and L-C regarding carcass trait and blood parameters.

### REFERENCES


AOAC (2000). Official Methods of Analysis,17th edn. Assoc. official anal. Chem. Gaithersburg MA USA.

Baker DL, Sell JL (1994). Dietary carnitine did not influence performance and carcass composition of broiler chickens and young turkeys fed low-or high-fat diets. Poult. Sci. 73: 281-287.

Beerman DH, Butler WR, Hogue DE, Fishell VK, Darlymple RH, Ricks CA, Scanes CG (1987). Cimaterol induced muscle hypertrophy and altered endocrine status in lambs. J. Anim. Sci. 65: 1514-1524.

Beerman DH, Hogue, DE, Fishell V K, Dalrymple RH, Ricks CA (1986). Effects of cimaterol and fishmeal on performance, carcass characteristics and skeletal muscle growth in lambs. J. Anim. Sci. 62: 370-380.

Bremer J (1983). Carnitine metabolism and functions. Physiol. Rev. 63: 1420-1480.

Buyse J, Decuypere E, Huyghebaert G, Herremans M (1991). The effect of clenbuterol supplementation on growth performance and on plasma hormone levels of broilers. Poult. Sci., 70: 933-1002.

Cartwright AL (1986). Effect of carnitine and dietary energy concentration on body weight and body lipid of growing broilers. Poult. Sci. 65(1): 21. (Abst.)

Cartwright AL, Marks HL, Campoin DR (1988). Adipose cellularity in nonselected and selected broiler stocks: measurements at equal weight and age. Poult. Sci. 67: 1338-1344.

Cunninghm HM (1963). Effects of epinephrine, norepinephrine and nicotine on growth and carcass composition of chicks. Poult. Sci. 42, 1197.

Fritz IB, Yeu KTN (1963). Long-chain carnitine acyltransferase and the role of acylcarnitine derivatives in the catalytic increase of fatty acid oxidation induced by carnitine. J. Lipid. Res. 4:279-288.

Grant AL, Helferich WG, Merkel RA, Bergen WG (1990). Effects of phenethanolamines and propanolol on the proliferation of cultured chick breast muscle satellite cells. J. Anim. Sci. 68: 652–658.

Gruber SL, Tatum JD, Engle TE, Mitchell MA, Laudert SB, Schroeder AL, Platter WJ (2007). Effects of ractopamine supplementation on growth performance and carcass characteristics of feedlot steers differing in biological type. J. Anim. Sci. 85: 1809-1815.

Kachura SA (1995). Influence of carnitine and dietary energy level on the productivity of early weaned piglets. Byulleten'-Vsesoyuznogo-Nauchno-issledovatel' skogo-Instituta-Viziologii,-Biokhimii-i-Pitaniya-Sel' skokhozyaistvennykh- Zhivotnykh. 96: 39–43.

Kaudo N, Barr AJ, Barr RL, Desai S, Lopaschuk GD (1995). High rates of fatty acid oxidation during reperfusion of ischemic hearts are associates with a decrease in malonyl-CoA levels due to an increase in 5' P-AMP- activated protein kinase inhibition of acetyl-CoA carboxylase. J. Biol. Chem. 270: 17513-17520.

Lin CY, Frias GW, Moran EJ (1980). Genetic and environmental aspects of obesity in broilers. World Poult. Sci. J. 36: 103-111.

Mcleod JA (1982). Nutritional Factors Influencing Carcase Fat in Broilers-A Review. World Poult. Sci. J. 38: 194-200.

Mersmann HJ (2002). Beta-adrenergic receptor modulation of adipocyte metabolism and growth. J. Anim. Sci. 80: E24-E29.

Mersmann HJ (1998). Overview of the effects of β-adrenergic agonists on animal growth including mechanisms of action. J. Anim. Sci. 76: 160-172.

Mersmann HJ (1987). Acute metabolic effects of adrenergic agents in swine. Am. J. Physiol. 252: E85-E95.

Moody DE, Hancock DL and Anderson DB (2000). Phenethenolamine repartitioning agents. In farm animal metabolism and nutrition. Edited by J. P. D Mello. CABI publishing, New York, pp. 65-96.

Newton GL, Haydon KD (1989). Carnitine supplementation for finishing pigs. J. Anim. Sci. 67(1): 267 (Abstr.).

Owen KQ, Nelssen JL, Goodband RD, Tokach MD, Friesen KG (2001). Effects of dietary L-carnitine on growth performance and body composition in nursery and growing-finishing pigs. J. Anim. Sci. 79: 1509-1515.

Owen KQ, Nelssen JL, Goodband, RD, Weeden TL, Blum SA (1996). Effect of L-carnitine and soybean oil on growth performance and body composition of early weaned
pigs. J. Anim. Sci. 74: 1612-1619.

Owen KQ (1994). The effect of L-catinite additions on performance and carcass characteristics of growing-finishing swine. J. Anim. Sci. 71(1): 62. (Abstr.).

Rabie MH, Szilagyi M, Gippert T (1997). Effects of dietary L-carnitine supplementation and protein level on performance and degree of meatiness and fatness of broilers. Acta Biol. Hung. 48(2): 221-229.

Rabie MH, Szilagyi M (1998). Effects of L-carnitine supplementation of diets differing in energy levels on performance, abdominal fat content, and yield and composition of edible meat of broilers. Br. J. Nutr. 80 (4): 221-229.

Reeds PJ, Mersmann HJ (1991). Protein and energy requirements of animals treated with β-adrenergic agonists: a discussion. J. Anim. Sci. 69: 1532-1550.

Sarica S, Corduk M, Kilinc K (2005). The effect of dietary L-carnitine supplementation on growth performance, carcass traits, and composition of edible meat in japanese quail (Coturnix coturnix japonica). J. Appl. Poult. Res. 14: 709-715.

SAS (1993). Statistical Analysis System User's Guide. SAS Inst. Cary NC USA, Version 6.03.

Tahmsabi AM, Kashefi E, Moghadam GH, Taghizadeh A, Ghasemi HA (2006). Influence of 5-Adernergic agonist (Metaproterenol) and lysine and growth, carcass quality in broiler chickens. Inter. J. Poult. Sci. 5(11): 1082-1086.

Wellenreiter RH, Tonkinson LV (1990). Effects of ractopamine hydrochloride on growth performance of turkeys. Poult. Sci. Suppl. 69(1): 142.

Van de Harr MJ (2005). Regulation of nutrient partitioning: and overview of the hormones that are affected by nutrition or that directly alter metabolism. In: Basic Anim. Nutr. feeding Pond WG, Church DC, Pond KR, Schoknecht PA(ed). John Wiley and Sons, Hoboken, NY, USA. pp. 275-289.

Vandenberg GW, Moccia RD (1998). Growth performance and carcass composition of rainbow trout, Oncorhynchus mykiss (walbaum), fed the β-agonist rectopamine. Aqua. Res. 29: 469-479.

Xiao R, Xu Z, Chen H (1999). Effects of ractopamine at different dietary protein levels on growth performance and carcass characteristics in finishing pigs. Anim. Feed Sci. Tech. 79: 119-127.

Xu ZR, Wang MQ, Mao HX, Zhan XA, Hu CH (2003). Effects of L-carntine on growth performance, carcass composition, and metabolism of lipids in male broilers. Poult. Sci. 82: 408-413.