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# Effect of tallow (TAL) and crude soybean oil (CSBO) with or with out L-carnitine supplementation on carcass and serum lipid profile of male broiler chicken

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ABSTRACT

The present experiment was conducted to study the effect of tallow and crude soybean oil with or without L-carnitine supplementation on the carcass and lipid profile of male broiler chicks. Day old male broiler chicks (160) were divided into 4 treatments groups (T1, T2, T3 and T4) with eight replicates having five birds each. The T1 and T2 groups were fed with basal diets along with TAL and CSBO respectively without supplementation of carnitine, whereas T3 and T4 groups were fed with basal diets along with TAL and CSBO respectively with supplementation of carnitine @ 100 mg/kg diet. The fat sources with or without carnitine did not have significant effect on various carcass yields of broilers except for abdominal fat percentage, whereas interactions between fat sources and carnitine were significant. Abdominal fat content was significantly lower for crude soybean oil without carnitine. Carnitine supplementation had significantly increased moisture percentage of liver in case of fat source. Carnitine supplementation also significantly increased the fat content of liver, light and dark muscles. Serum triglycerides concentration was significantly lower for bird fed CSBO with 12 h fasting whereas, the concentration of triglycerides and cholesterol with 3 h fasting was significantly lower for birds fed with tallow diet. Serum triglyceride and cholesterol were significantly lower in carnitine supplementation groups.

**Key words**: Chicken, Cholesterol, Crude soybean oil, Dark muscle, L-carnitine, Liver fat, Tallow

Fats and oils can be used as alternative energy sources by replacing primary energy feed ingredients in broiler production. The cholesterol content of any food product especially from animal sources becomes the prime area of consumer's concern because of the increased awareness on higher dietary cholesterol and the incidence of coronary heart diseases. The composition of supplemental fat has direct impact on quantity and quality of carcass fat. L-carnitine (β-OH-g-N-trimethylaminobutyric acid) is a small molecular weight, water soluble quaternary amine, which occurs naturally in micro-organisms, plants and animals. Supplementation of L-carnitine reduces the serum triglycerides and cholesterol for storage in adipose tissues by β oxidation (Xu *et al.* 2003). Accordingly, this study was formulated to know the effects of fat sources with or without L-carnitine supplementation on carcass traits and serum lipid profile of male broilers.

## MATERIALS AND METHODS

A total of 160 day old male broiler chicks were divided into 4 treatments groups (T1, T2, T3 and T4) with eight replicates having five birds each. At day one, chicks were wing banded and housed under battery brooder with optimum brooding conditions. Standard management practices were followed during the entire experimental period up to 42 days.

The birds were fed with maize and soybean meal based diets presented in Table 1. The T1 and T2 groups were fed

Table 1. Ingredients composition

| Treatment | Starter diet (0–28 days) | | | | Ingredients (%) | |
|---|---|---|---|---|---|---|
| | Maize | Soya | Tallow | Crude soya oil | Constants* | L-Carnitine (mg/kg diet) |
| *Diets* | | | | | | |
| T1 | 53.84 | 39.15 | 3.28 | - | 3.73 | - |
| T2 | 53.00 | 40.40 | - | 2.87 | 3.73 | - |
| T3 | 53.84 | 39.15 | 3.28 | - | 3.73 | 100 |
| T4 | 53.00 | 40.40 | - | 2.87 | 3.73 | 100 |
| | Finisher diet (28–42 days) | | | | Ingredients (%) | |
| T1 | 62.46 | 29.20 | 4.60 | - | 3.74 | - |
| T2 | 62.06 | 30.60 | - | 2.87 | 3.74 | - |
| T3 | 62.46 | 29.20 | 4.60 | - | 3.74 | 100 |
| T4 | 62.06 | 30.60 | - | 2.87 | 3.74 | 100 |

*Dicalcium phosphate, calcite powder, common salt, DL-methionine, choline chloride, $AB_2D_3KB$-E mix, vitamin $B_{12}$, trace mineral mixture, L-Lysine HCl, Cygro, Auryomycine.

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with basal diets along with tallow (TAL) and crude soybean oil (CSBO) respectively without supplementation of carnitine, whereas T3 and T4 groups were fed with basal diets along with TAL and CSBO respectively with supplementation of L-carnitine (L-car) @ 100 mg/kg diet. At the end of experimental period (42 d), one bird from each replicate from all the treatment groups were sacrificed for recording carcass parameters such as ready to cook yield along with skin, giblets, breast yield including bone and skin and abdominal fat content. Approximately 20–25 g of dark and light muscle along with skin and liver samples were collected in a sealed polythene bag and preserved at 4°C and further analyzed for percentage of dry matter, crude fat to know the effect L-car on redistribution of fat from adipose tissue to liver and muscle. Serum triglyceride and cholesterol were also estimated by using mass spectrophotometer with commercially available kit (Qualigens) method. The data were analysed using General Linear Model procedure of SPSS 16th version and significance was considered at P<0.05.

## RESULTS AND DISCUSSION

Relative weights of dressing, R to C, giblet and breast percentage were unaffected by treatments employed (Table 2). Rondelli *et al.* (2004) reported that neither fat source nor the level of fat had any significant effect on dressing or carcass yields. Similar results were also reported by Nyebpor *et al.* (2007). L-car supplementation could not influence the carcass variables studied. Similarly, few authors reported lack of significant effect of L-car on dressing percentage (Abedpour *et al.* 2017).

The percentage of abdominal fat was not significantly (P>0.05) influenced by fat source and L-carnitine (Table 2). There was a significant interaction between fat source and L-car on abdominal fat deposition. There was significant (P<0.05) reduction in abdominal fat when carnitine was added to TAL based diet whereas a reverse trend was observed for CSBO. In the present experiment, the TAL fed birds deposited more fat compared to those fed CSBO, perhaps due to higher concentration of MUFA present in TAL compared to CSBO. Supplementation of carnitine to TAL based diet might have facilitated transportation of the MUFA for their subsequent oxidation in mitochondria and resulted in reduced fat deposition in abdominal area. These finding were in accordance with Mohammed and Horniakova (2011) and Duraisamy *et al.* (2013).

Table 2. Effect of TAL and CSBO with or without L-carnitine on carcass yields

| Treatment | L-car | % of Yield | | | | |
|---|---|---|---|---|---|---|
| | | Dressing[1] | R to C[1] | Giblet | Abdominal fat | Breast[2] |
| TAL | 0 | 85.73 | 77.56 | 4.05 | 2.25[a] | 21.28 |
| CSBO | 0 | 85.69 | 76.39 | 4.32 | 1.77[b] | 20.22 |
| TAL | 100 | 85.38 | 76.66 | 4.48 | 1.89[b] | 21.16 |
| CSBO | 100 | 85.60 | 76.73 | 4.44 | 2.19[a] | 20.71 |
| *Effect of fat source* | | | | | | |
| TAL | | 85.56 | 77.11 | 4.27 | 2.07 | 21.22 |
| CSBO | | 85.45 | 76.56 | 4.38 | 1.98 | 20.47 |
| *Effect of L-car (mg/kg)* | | | | | | |
| 0 | | 85.71 | 76.98 | 4.19 | 2.01 | 20.75 |
| 100 | | 85.49 | 76.70 | 4.46 | 2.04 | 20.93 |
| SEM | | 0.873 | 1.732 | 0.432 | 0.046 | 0.302 |
| *Source of variance* | (*p* value) | | | | | |
| Fat * L-car | | 0.683 | 0.326 | 0.290 | 0.001 | 0.618 |
| Fat source | | 0.783 | 0.383 | 0.442 | 0.133 | 0.231 |
| L-car | | 0.506 | 0.657 | 0.070 | 0.575 | 0.766 |

Values bearing different superscripts in a column differ significantly (P<0.05). [1]with skin, [2] with skin and bone.

Moisture percentage of liver reduced significantly (P<0.05) by feeding CSBO than those fed TAL and a reverse trend was seen in dark muscle (Table 3). However, the moisture percentage of light muscle was not significantly (P>0.05) influenced by the fat source. Similar finding was reported by Ozdogan and Aksit (2003), who stated that the moisture content of dark muscle was significantly (P<0.05) higher in broilers fed on diet containing soybean oil compared to broiler fed with tallow, whereas moisture content of light muscle was not influenced by the fat source.

Effect of L-carnitine supplementation on moisture percentage of liver was significantly (P<0.05) increased by adding 100 mg/kg in the diet, whereas a reverse trend was seen in moisture percentage of dark muscle. However, moisture percentage of light muscle was not significantly (P>0.05) influenced by L-car supplementation. Interaction between fat source and L-car was significant (P<0.05) for moisture percentage of liver, light and dark muscles. The data suggests that L-car supplementation significantly (P<0.05) increased moisture percentage of liver and light muscle for CSBO and TAL fed birds respectively. Whereas, moisture percentage of dark muscle was significantly reduced in CSBO fed birds but not in TAL fed birds. The interaction data thus indicated that the effect of carnitine supplementation depends on fat source and tissue. Similar finding was reported by Ozdogan and Aksit (2003).

The fat percentage of liver was significantly (P<0.05) higher for CSBO than TAL (Table 3) implying better absorption of soybean oil or it may be due to enhanced hepatic lipogenesis as reported by Crespo and Esteve-Garcia (2002c). Fat percentage of light muscle was significantly (P<0.05) lower for CSBO fed group than TAL fed birds whereas fat percentage of dark muscle was not significantly influenced by fat source. This lower fat deposition in light muscle of birds fed with CSBO might be attributed to enhance β-oxidation of fatty acids in light muscle. The effect of carnitine supplementation on fat percentage of liver, light and dark muscles was significantly (P<0.05) higher at 100 mg/kg L-car dietary level.

Interaction effect was not significant (P>0.05) for liver fat percentage, whereas interaction effect was significant (P<0.05) for fat percentage of light and dark muscles. In the present experiment, the CSBO fed birds deposited less fat in light and dark muscles which might be due to higher

Table 3. Effect of TAL and CSBO with or without L-carnitine on moisture and fat content of liver, light and dark muscle of broilers

| Treatment | L-car | Moisture percentage | | | Fat percentage | | |
|---|---|---|---|---|---|---|---|
| | | Liver | Light muscle | Dark muscle | Liver | Light muscle | Dark muscle |
| TAL | 0 | 69.17[a] | 65.21[b] | 68.47[c] | 9.62 | 12.75[a] | 13.43[b] |
| CSBO | 0 | 68.13[b] | 66.46[a] | 71.58[a] | 10.97 | 9.89[c] | 12.92[c] |
| TAL | 100 | 69.47[a] | 66.55[a] | 68.50[c] | 13.17 | 11.73[b] | 13.81[ab] |
| CSBO | 100 | 69.25[a] | 65.72[ab] | 69.27[b] | 14.94 | 11.46[b] | 14.30[a] |
| *Effect of fat source* | | | | | | | |
| TAL | | 69.32[a] | 65.88 | 68.49[b] | 11.40[b] | 12.24[a] | 13.62 |
| CSBO | | 68.69[b] | 66.09 | 70.42[a] | 12.96[a] | 10.68[b] | 13.61 |
| *Effect of L-car (mg/kg)* | | | | | | | |
| 0 | | 68.65[b] | 65.83 | 70.02[a] | 10.30[b] | 11.32[b] | 13.18[b] |
| 100 | | 69.36[a] | 66.14 | 68.89[b] | 14.06[a] | 11.60[a] | 14.06[a] |
| SEM | | 0.121 | 0.198 | 0.232 | 0.635 | 0.312 | 0.166 |
| *Source of variance (P value)* | | | | | | | |
| Fat * L-car | | 0.019 | 0.008 | 0.001 | 0.592 | 0.001 | 0.012 |
| Fat source | | 0.001 | 0.562 | 0.001 | 0.003 | 0.001 | 0.950 |
| L-car | | 0.001 | 0.406 | 0.001 | 0.001 | 0.032 | 0.001 |

Values bearing different superscripts in a column differ significantly (P<0.05).

concentration of polyunsaturated fatty acids present in CSBO when compared to TAL. Supplementation of L-car to CSBO based diet resulted in increased fat percentage of light and dark muscles. Similar results were also reported by Xu *et al.* (2003).

The effect of fat source on the concentration of serum triglycerides was significantly (P<0.05) lower for TAL than CSBO with 3 h fasting (Table 4). This might be due to saturated fatty acid having less ability to form micelles than unsaturated fatty acids (Wiseman 2003). However, opposite trend was observed by Sanz *et al.* (2000a). In case of 12 h fasting, significantly (P<0.05) lower concentrations of triglyceride were observed for CSBO diets, which might be due to increased lipoprotein activity in the mitochondria of muscle resulting in the enhanced rate of fatty acid oxidation and depression of serum triglycerides level. This higher level of serum triglycerides in TAL fed birds reflected in higher abdominal fat deposition. Supplementing 100 mg/kg L-car in diets resulted in the reduction of serum triglycerides. These findings were in accordance with Jalali *et al.* (2015) and Rezaei *et al.* (2007).

Table 4. Effect of TAL and CSBO with or without L-carnitine on blood parameters

| Treatment | L-car | Triglyceride (mg/dl) | | Cholesterol(mg/dl) |
|---|---|---|---|---|
| | | 3 h fasting | 12 h fasting | 3 h fasting |
| TAL | 0 | 85.93[a] | 23.10[a] | 167.50 |
| CSBO | 0 | 87.88[a] | 14.76[b] | 185.83 |
| TAL | 100 | 43.79[c] | 16.72[b] | 150.83 |
| CSBO | 100 | 55.04[b] | 14.74 [b] | 172.48 |
| *Effect of fat source* | | | | |
| TAL | | 64.86[b] | 19.91[a] | 159.16[b] |
| CSBO | | 71.46[a] | 14.75[b] | 179.16[a] |
| *Effect of L-car (mg/kg)* | | | | |
| 0 | | 86.90[a] | 18.93[a] | 176.66[a] |
| 100 | | 49.41[b] | 15.73[b] | 161.66[b] |
| SEM | | 4.9741 | 0.9461 | 3.3951 |
| *Source of variance (P value)* | | | | |
| Fat * L-car | | 0.001 | 0.001 | 0.487 |
| Fat source | | 0.001 | 0.001 | 0.001 |
| L-car | | 0.001 | 0.001 | 0.001 |

Values bearing different superscripts in a column differ significantly (P<0.05).

Significantly (P<0.05) lower serum cholesterol concentrations were observed in tallow fed diet compared to CSBO (Table 4). L-car supplementation significantly (P<0.05) reduced the serum cholesterol in both TAL and CSBO fed groups. These results were in agreement with Rezaei *et al.* (2007). Serum cholesterol was inversely proportional to abdominal fat deposition and when carnitine was added, abdominal fat deposition was directly proportional to serum cholesterol.

From the study, it may be concluded that supplementing carnitine in tallow based diets results in lean meat production in broilers. The same is not true for crude soybean oil, indicating long chain-monounsaturated fatty acids of tallow are better utilized by supplementing carnitine than oil which was evident by serum triglyceride levels at 12 h fasting.

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