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The Effects of L-carnitine Supplementation into Drinking Water on Growth Performance and Immunologic Parameters in Broilers

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Abstract

The aim of this study is to investigate the effects of the L-carnitine supplementation as liquid form into drinking water on broiler growth performance and serum immunoglobulin levels. In the study, a total of 240 one-day old Ross 308 chicks were randomly classified into two experimental groups as the control and L-carnitine supplementation group. Each experimental group was consisted of 4 pens, each consisting 30 chicks per pen. The L-carnitine in liquid form was added into drinking water as daily with an amount of 0.2 l liquid product per 100 l drinking water, for 3 days in each week until 35 days of age. At 35 days of age, final body weight was found to be higher in broiler treated with L-carnitine compared to the control group (2183.7 g vs. 2051.7 g, $P<0.05$). On the other hand, any significant differences observed for body weight, cumulative feed consumption and feed conversion rate. The broilers treated with L-carnitine had higher levels IgA, IgG and IgM than the broilers in the control group at 35 days of age (34.4 vs. 28.9; 118.9 vs. 108.6; 5.9 vs. 5.0 mg/dl respectively, P<0.01). Regarding with observed current findings, L-carnitine could be recommended as immunomodulatory additive with providing higher body weight gain in broiler production.

Key Words: *Broiler, L-carnitine, body weight, immunity, immunoglobulin.*

Introduction

Due to the rapid growth of human population around the world, poultry meat has increasingly gained importance as a major source of animal protein. At that point, one of the most important production options is poultry, especially poultry meat that is obtained from broiler and turkey production. This increased demand requires more efficient production with a rapid growth, better of feed efficiency, a bigger size of breast muscle, a decline in abdominal fat, a strong immunity with a lower risk of diseases in broilers (Ghoreyshi et al., 2019), with aiming to reduce production cost (Golzae Adabi et al., 2011).

To achieve the best performance in broiler production, some feed alternatives have become a recent topic in nutrition field, due to the banning of antibiotics in 2006 as growth promoters in animal nutrition (Fonseca et al., 2010; Ganan et al., 2012). At that point, some feed additives have been largely investigated for their beneficial effects on production parameters, pathogen control and better of health status of the birds. Therefore, the most effective tool could be use the feed alternative which could act as immune modulators, to provide a strong and well-functional immune system.

In recent time, L-carnitine that is the biologically active form of the carnitine, is synthesized from L-carnitine precursors (Borum, 1983; Feller and Rudman, 1988) including lysine and methionine, in the liver, kidney an brain (Cave et al., 2008). It is known that it takes important roles in many of metabolic processes, for example, lipid metabolism, energy utilizing, stimulation of immunity, enhancing of health status, improving feed efficiency and so on (Khatibjoo et al., 2016; Mirzapor Sarab et al., 2016). Some previous reports clearly found beneficial effects of L-carnitine in broiler nutrition as decline in feed consumption (Khatibjoo et al., 2016; Mirzapor Sarab et al., 2016), an increment in final body weight and improvement in feed efficiency and carcass characteristics (Hrncar et al., 2015). The aim of this study to investigate the potential effects of L-carnitine in liquid form which was supplemented into drinking water, on production performance and immune status of broilers.

Materials and Methods

The experiment was conducted at the farm of the Bursa Uludağ University of Agriculture Faculty, in Bursa (Turkey). A total of 240 one-day old Ross 308 broiler chicks were randomly placed in 8 floor pens with a floor space of 2.0 × 2.0 m to provide 4 replicated with 30 broilers (15 male/15 females) per pen. The chicks were weighed using a balance at ± 0.1 g precision, and then randomly allocated to the pens.

The chicks were classified into two experimental groups as control (no supplementation of L-carnitine) and supplementation of L-carnitine into drinking water. The content of L-carnitine was showed in Table 1. The L-carnitine in liquid form was added into drinking water as daily with an amount of 0.2 l liquid product per 100 l drinking water, for 3 days in each week during experimental period, according to the recommendation of

producer's company. The broilers received a standard crumbled starter feed (22.0% CP and ME 12.9 MJ/kg of diet, from day 1 to day14) and a grower feed (20.0% CP and ME 13.5 MJ/kg of diet, from day 15 to day 35), based a corn-soybean meal. Water and feed were offered ad libitum throughout the experiment.
Under controlled environmental conditions, house temperature was maintained 33°C at 1 days of age, gradually decreased by 3°C per each week, and then maintained at 20°C. The relative humidity was 50–60% until the end of the experiment. As litter material, wood shavings were laid at a thickness of 7–8 cm on the floor. The lighting schedule was applied according to the recommendations explained in the company's management guides.

Table 1. The content of L-carnitine (g/l)

Content	Amount
Sorbitol	250 g
L-carnitine	50 g
Magnesium sulfate	125 g
Sodium chloride	1 g
Aromatic compounds	10 g

Growth performance
The body weight and feed consumption of each pen were measured by weekly basis until the end of the 35 days of age. According to the measurements, body weight gain and cumulative feed consumption were also recorded as weekly basis. Feed conversion rate (FCR) was given as ratio between body weight gains and feed consumption as weekly basis.

Plasma immunoglobulin levels
The level of plasma immunoglobulins (IgA, IgG, and IgM) was analyzed by using a commercial kit (Roche Cobas 6000 E601, Roche Diagnostics, North America) according to the method explained Mountzouris et al. (2010).

Statistical analysis
In the study, statistical analysis for significant differences was performed by the paired t-test in SAS program (SAS institute, 2002). The mean values of growth performance and serum immunoglobulin levels were compared between control and L-carnitine supplementation groups. For growth performance, each experimental pen was considered as a replicate, whereas each broiler was accepted as a replicate for serum immunoglobulin levels in the experiment. In all cases, a difference was considered significant at $P<0.05$.

Results and Discussion

The current results clearly showed that L-carnitine supplementation could enhance the final body weight and also show an immune-modulatory effect by increasing of serum immunoglobulin levels in broilers. The mean value of body weights of broilers was shown in Figure 1. The body was found to be similar at 1, 7, 14, and 21 days of age, whereas a higher body weight was observed in L-carnitine group than the control group at 21 (1015.0 g vs. 953.1 g) and 35 (2183.7 g vs. 2051.7 g) days of age ($P<0.05$).Similar findings for a higher final body weight were reported by Hrncar et al. (2015) and Kamal et al. (2019). Hrncar et al. (2015), the L-carnitine supplementation into drinking water with an amount of 1 ml per 1.2 l water caused an increment in the final weight, improvement in FCR. However, non-significant differences were observed feed consumption and FCR in this study. Contrarily to our results, other studies found a positive effect for reducing feed consumption and FCR (Ghoreyshi et al., 2019). Other performance parameters as body weight gain and feed consumption were given in Table 2. The body weight gain between 1-14 days and 14-35 days, cumulative feed consumption and FCR at 14 and 35 days of age was found to be similar for control and L-carnitine groups ($P>0.05$). Similar to our results, Parsaeimehr et al. (2014) found any effects for body weight during the 3 three weeks, but a significant effect for body weight between 21-42 days with L-carnitine supplementation (0, 150, 300, 450 and 600 mg/kg of L-carnitine). Besides, any significant effects were observed for feed consumption and FCR during the experimental period.
The serum immunoglobulin levels of broilers at 35 days of age were shown in Figure 2. As seen in the figure, L-carnitine supplementation was resulted in an increment for IgA, IgG, and IgM ($P<0.05$).
These results clearly showed that L-carnitine supplementation showed an immune-modulatory effect in broilers. Similarly, Azizi-Chekosari et al. (2021) investigated the different amounts (200 mg/kg and 400 mg/kg) of L-carnitine on immunoglobulin levels at 35 and 42 days of age in broilers. The broilers fed with 400 mg/kg L-carnitine has a higher level of total Ig and IgG at 42 days old compared to the broilers fed with 200 mg/kg L-carnitine. Similar results were also reported by Mast et al. (2000). The authors concluded that the dietary L-carnitine administration had an immune-modulatory effect on antigen-specific total Ig and IgG responses.

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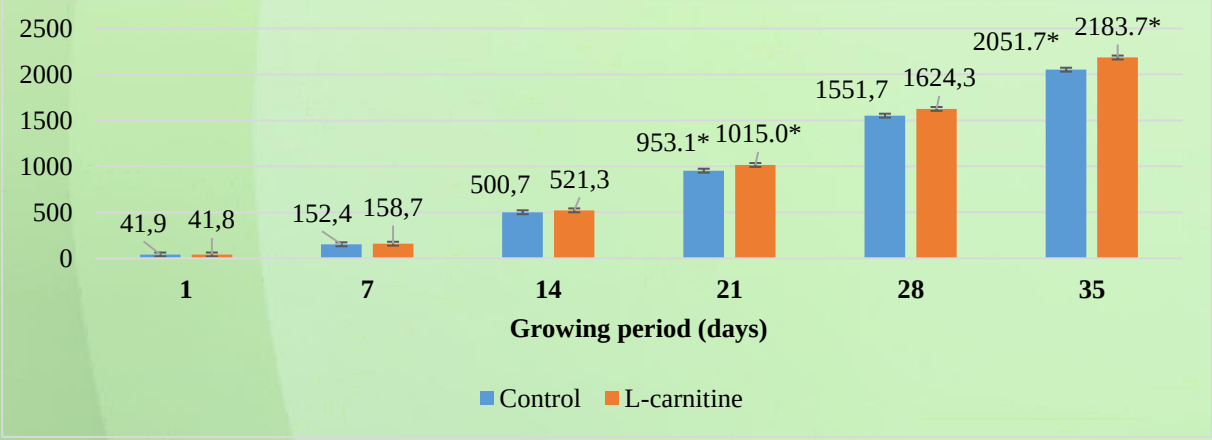

value of body weight (g) of experimental groups during growing period. Each bar represents Figure 1. Mean mean ± SEM; * indicate significant differences at P < 0.05.

Table 2. Body weight gain and cumulative feed consumption of experimental groups

Experimental groups	Body weight gain (g/bird)		Cumulative feed consumption (g/bird)		FCR	
	Day 1-14	Day 14-35	Day 14	Day 35	Day 14	Day 35
Control	458.8	1627.0	578.3	3298.3	1.17	1.83
L-carnitine	479.5	1662.3	604.0	3161.3	1.16	1.72
SEM	11.0	68.8	15.2	66.1	0.05	0.14
P value	0.083	0.563	0.107	0.064	0.890	0.381

n: 4 experimental pens/experimental group.

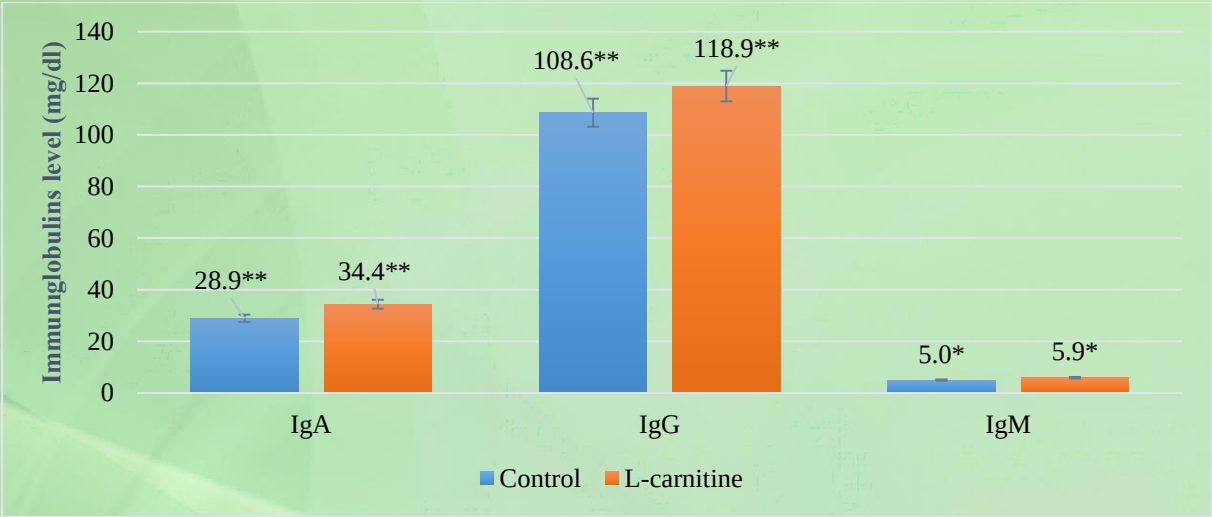

Figure 2. Mean value of immunoglobulin's of broilers at 35 days of age. Each bar represents mean ± SEM; *, ** indicate significant differences at P < 0.05, P < 0.01.

Conclusion

The L-carnitine supplementation into drinking water improved final body weight and immune status of broilers. The L-carnitine amount was applied as 0.2 l liquid product per 100 l drinking water, for 3 days in each week during experimental period. These evidences could be indicator for beneficial effects of L-carnitine supplementation for a strong immunity against diseases or stress factors under commercial production conditions.

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