

Effect of Adding L-carnitine and Probiotic on Performance and Carcass Parameters of Broiler Chickens

Cyril Hrnčár*¹, Martin Gašparovič², Emília Hanusová³, Anton Hanus³, Veronika Pistová¹, Henrieta Arpášová¹, Martin Fik¹, Jozef Bujko³, Jozef Gašparík¹

¹Department of Poultry Science and Small Animal Husbandry, Faculty of Agrobiological and Food Resources, Slovak University of Agriculture, Nitra, Slovakia

²Department of Animal Nutrition, Faculty of Agrobiological and Food Resources, Slovak University of Agriculture, Nitra, Slovakia

³National Agriculture and Food Centre - Research Institute of Animal Production Nitra, Slovak Republic

⁴Department of Genetics and Breeding Biology, Faculty of Agrobiological and Food Resources, Slovak University of Agriculture, Nitra, Slovakia

Abstract

The study was realised to investigate the effects of adding L-carnitine and probiotic on performance and carcass parameters of broiler chickens. Totally 240 one-day old broiler Ross 308 chickens randomly divided into four groups. Control group with basal diet without supplementation, experimental group 1 with probiotic in feed mixture in dose of 7.5 g/kg; experimental group 2 with L-carnitine in dose of 1ml/1.2 l in drinking water and experimental group 3 with probiotic in feed mixture in dose of 7.5 g/kg + L-carnitine in drinking water in dose of 1 ml/1.2 l in drinking water. The results of this study indicated that supplementation with L-carnitine and probiotic statistically increased ($P < 0.05$) final body weight of broiler chickens in comparison to other groups. The other results showed no significant differences ($P > 0.05$) in feed consumption among groups in 42 days of age and broiler chickens receiving L-carnitine + probiotic had lowest mortality compared to the other groups. Furthermore, diet supplementation with L-carnitine and probiotic slightly increased ($P > 0.05$) breast proportion of broiler chickens at the expense of a slight reduction ($P > 0.05$) of thighs proportion in recognized statistically no significant differences ($P > 0.05$). Further result showed statistically decreased weight of abdominal fat in broiler chickens with L-carnitine and probiotic and no significant effect in weight of giblets and carcass yield between control and other groups.

Key words: body conformation, body weight, carcass yield, chicken, fattening.

1. Introduction

In the poultry industry, antibiotics are used worldwide to prevent poultry pathogens and disease so as to improve meat and egg production. However, the use of dietary antibiotics resulted in common problems such as development of drug resistant bacteria, drug residues in the body of the birds and imbalance of normal micro flora [1].

Many types of microorganisms have been used as probiotics. Lactic acid bacteria are predominating in probiotic preparations particularly *Lactobacillus* spp., *Streptococcus thermophilus*, *Streptococcus thermophilus*, *Enterococcus faecalis*, *Bifidobacterium* spp. are yoghurt starter organisms while other organisms are prevailing in the intestines [2].

There are many genera of lactic acid bacteria these include *Lactobacillus*, *Enterococcus*, *Bifidobacterium*, *Lactococcus*, *Lactosphaera*, *Leuconostoc*, *Melissococcus* and *Streptococcus*. These are gram-positive, non-spore forming, anaerobic but aero-tolerant, acid-tolerant and

* Corresponding author: Cyril Hrnčár, + 421 37 6414744, cyril.hrnacar@uniag.sk

produce no catalase enzyme. They cause fermentation of sugar and secrete lactic acid as end product [3-5].

One such alternative is the addition of yeast and yeast products to poultry diets. The inclusion of yeast *Saccharomyces cerevisiae*, in the diet has been shown to improve bird performance and decrease mortality [6-9].

L-carnitine is a water-soluble quaternary amine with a low molecular weight, and occurs naturally in microorganisms, plants and animals. L-carnitine is synthesized in vivo from lysine and methionine, and it is formed with contributions from vitamins B₃, B₆, B₁₂, C and folic acid, as well as iron [10-13].

It has been reported that L-carnitine has two major functions. The best known is to facilitate the transport of long-chain fatty acids across the inner mitochondrial membrane. L-carnitine also facilitates the removal of short and medium-chain fatty acids from the mitochondria that accumulate as a result of normal and abnormal metabolism [14,15].

Dietary L-carnitine supplementation promotes the β -oxidation of these fatty acids in order to generate adenosine triphosphate (ATP) energy and improve energy utilization [16-18]. Consequently, L-carnitine reduces the amount of long-chain fatty acids availability for esterification to triacylglycerols and storage in the adipose tissue [15,19]. L-carnitine has secondary functions, including the containment, buffering and removal of potentially toxic acyl groups from cells, equilibrating the ratio of free CoA and acetyl-CoA between the mitochondria and cytoplasm, participating in biological processes such as regulation of gluconeogenesis, stimulating fatty acid and the metabolism of ketones, branched-chain amino acids, triglycerides and cholesterol [18].

Finally, L-carnitine supplementation in diet or in drinking water would be useful for poultry [20-22]. The objective of this study was to determine the effect of probiotic and L-carnitine preparations on productive parameters and carcass characteristics of Ross 308 broiler chickens.

2. Materials and methods

Chickens were housed in pens with deep litter with housing density 30kg.m⁻². During the experiment, 24-h continuous illumination was

provided, used the 40 watt bulbs. Ambient temperature was maintained at 34°C between days 1 and 3, at 30°C between days 4 and 14, and at 27°C between days 15 and 42. Feeds were provided by using round plastic feeders with the capacity of 3kg during brooding and others carrying 7kg were used after brooding period. Water was provided in round plastic drinkers that carry 3l during brooding and 10l after brooding period.

Broiler chickens were fed commercial feed mixtures (PD Prašice, Slovak Republic): starter (days 1 to 21), grower (days 22 to 35) and finisher (days 36 to 42). Feed and water were given to the chickens *ad libitum*. The nutritive values of the feed mixtures are presented in Table 1.

Broiler chickens in the control (C) and three experimental groups (E) received a feed of the same nutritional value.

Chickens from experimental group 1 were supplemented drinking water by probiotic preparate (PHU EKO-AGROTECH, Poland) with strains *Lactobacillus casei* CCM 3775 (3.86x10⁶ CFU.g⁻¹), *Lactobacillus plantarum* 24001 (3.86x10⁶ CFU.g⁻¹), *Saccharomyces cerevisiae* MUCL 39885 (7.00x10³ CFU.g⁻¹) and molasses from sugar cane (48 g.100 g⁻¹) in dose of 7.5 g in 1 kg of feed mixture. Chickens from experimental group 2 were supplemented drinking water by feed additive (Biofaktor, Sp. z.o.o., Skierniewice, Poland) on the base L-carnitine (30.00 %), arginin chloride (19.33 %), taurine (13.33 %), magnesium gluconate (6.67 %), N-acetylcysteine (6.67 %), biotine (0.00667 %), sorbitol (0.30 %), aromatic additives (5.28 %) and vehiculum (wheat feed flour ad 1000 g). in dose of 1ml in 1.2 l drinking water and experimental group 3 with probiotic in feed mixture in dose of 7.5 g in 1 kg of feed mixture + L-carnitine in dose of 1 ml in 1.2 l of drinking water.

During the experiment broiler chickens were weighted for individual body weight at 1, 7, 14, 21, 28, 35 and 42 days of age, feed consumption and mortality were recorded at the end of fattening period.

In 42 day of fattening, 5 male and 5 females with body weight similar to the mean were chosen from each group for slaughter weighed and subjected to a 12-hours feed withdrawal. After slaughter, carcasses were chilled, weighed and subjected to simplified dissection. Abdominal

fat, edible giblets and breast and leg muscles were collected and weighed. The results obtained were used to calculate dressing percentage and the percentage of carcass components.

Data were analyzed using analysis of variance [23]. Significant difference was used at 0.05 probability level and differences between groups were tested using the Duncan's Multiple Range Test [24].

Table 1. Nutritional value in 1 kg complete feed mixture

| Nutrient | Unit | Starter | Grower | Finisher |
|------------------------|------|-------------|------------|-------------|
| Crude protein | % | min. 20.00 | min. 18.30 | min. 17.00 |
| Fat | % | min. 4.80 | min. 4.00 | min. 6.00 |
| Fibre | % | max. 4.00 | max. 5.00 | max. 5.00 |
| Methionine | % | min. 1.20 | min. 1.10 | min. 0.90 |
| Calcium | % | min. 0.52 | min. 0.48 | min. 0.45 |
| Phosphorus | % | min. 0.80 | min. 0.80 | min. 0.55 |
| Sodium | % | min. 0.55 | min. 0.55 | min. 0.50 |
| Cooper | mg | min. 0.12 | min. 0.12 | min. 0.12 |
| Zinc | mg | min. 15.00 | min. 15.00 | min. 15.00 |
| Manganese | mg | min. 80.00 | min. 80.00 | min. 80.00 |
| Iron | mg | min. 120.00 | min. 70.00 | min. 100.00 |
| Selenium | mg | min. 0.20 | min. 0.10 | min. 0.10 |
| Vitamin A | m.j. | min. 12000 | min. 10000 | min. 10000 |
| Vitamin D3 | m.j. | min. 5000 | min. 5000 | min. 5000 |
| Vitamin E | mg | min. 60.00 | min. 50.00 | min. 50.00 |
| Natrium salinomycinate | mg | 60.00 | 60.00 | - |
| Endox | mg | 125.00 | 125.00 | 125.00 |

3. Results and discussion

Table 2 provides body weights of broiler chickens of all groups during fattening period. Supplementation with L-carnitine and probiotic was most evident in combined addition of both additives, equally significantly increased ($P < 0.05$) final body weight we recorded in treatments with single addition of probiotic and L-carnitine in comparison with control treatment.

Our results agree with the work of [25-30] who observed improvement of final body weight of broiler chickens at addition of probiotics. In contrast, they are opposite to those of [31-36], who found that the use of probiotic products in the feed had no significant effect on body weight of broiler chickens.

Probiotic provides nutrients, effectively stimulates the growth of beneficial microflora in the small and large intestines resulting in the better balance of bacterium population [37-39].

Table 2. Effect of probiotic on body weight of broiler chickens in grams

| Day of fattening | Control | Probiotic | L-carnitine | Probiotic+L-carnitine |
|------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 1. | 45.86±4.29 | 46.25±5.11 | 46.74±4.88 | 46.05±4.22 |
| 7. | 116.51±17.07 | 122.68±18.21 | 123.98±19.45 | 124.38±17.86 |
| 14. | 284.11±38.58 | 312.61±39.25 | 31418±38.68 | 320.24±39.74 |
| 21. | 729.67±69.14 | 757.38±71.58 | 755.29±72.36 | 772.61±73.22 |
| 28. | 1141.73±128.69 ^b | 1228.65±128.11 ^a | 1231.13±126.69 ^a | 1239.55±128.87 ^a |
| 35. | 1652.64±149.37 ^b | 1769.54±151.57 ^a | 1778.39±153.39 ^a | 1789.27±154.69 ^a |
| 42. | 2147.29±184.18 ^b | 2271.08±191.36 ^a | 2288.69±194.14 ^a | 2296.34±193.65 ^a |

Values shown are mean±SD (standard deviation)

^{a,b} means in a row with different superscript differ significantly

The increased body weight gain of broiler chickens fed probiotic may be due to improvement in digestibility and availability of

many nutrients such as proteins, fats and carbohydrates, as well as, some mineral elements and vitamins [40]. Probiotic preparation with

addition of with *Saccharomyces cerevisiae* increased final body weight of broiler chickens. Equally, [41] recorded that addition of *Saccharomyces cerevisiae* significantly influenced body weight of broiler chickens. The beneficial effect of *Saccharomyces cerevisiae* is attributed to the fact that it is a naturally rich source of proteins, minerals and B-complex vitamins [42].

In our experiment, broiler chickens with supplementation of L-carnitine had higher final body weight. Similarly [43], who investigated the effect of L-carnitine supplementation in drinking water on the growth ability of broiler chickens, observed at 7 days of rearing that chickens from the control group had significantly lower body weight compared to the experimental groups receiving 30 and 60 mg of L-carnitine in 1 l of drinking water. A positive effect of L-carnitine on the body weight of chickens on the end of fattening period, however, not significant ($P < 0.05$) differences observed [14,44]. Other authors who studied the effect of L-carnitine on broiler performance found that it had no effect on body weight [45-47].

Totally feed consumption was not strongly affected by addition of probiotic and L-carnitine. We

noticed the lowest feed consumption in probiotic+L-carnitine (1.84 kg), followed by the treatments L-carnitine (1.86 kg) and probiotic (1.87 kg) and the highest consumption we found in control (1.89 kg). Some authors [48-50] found decrease of feed consumption while others suggest no such effect on feed utilization [51-53]. *Saccharomyces cerevisiae* is considered as one of the live microorganisms probiotic that, when administered through the digestive tract, have a positive impact on the hosts health through its direct nutritional effect [54].

Similar results were observed by other authors [44,55-57]. Our results are not supported by the studies of [14,58], according to these authors L-carnitine supplemented to chickens had no effect on feed conversion.

The mortality rate was improved in treatments probiotic+L-carnitine and L-carnitine (3.33%) in contrast with treatments probiotic and control (6.67%). Also [29,59] proved a reduction of mortality rate due to the addition of probiotic in feeding of broiler chicken. Decrease in mortality in broilers receiving dietary L-carnitine recorded [60,61].

Table 3. Effect of probiotic on body weight of broiler chickens

| Parameter | Control | Probiotic | L-carnitine | Probiotic+L-carnitine |
|-------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Breast (%) | 30.18±1.69 | 30.22±1.71 | 30.24±1.66 | 30.27±1.72 |
| Thighs (%) | 31.74±2.17 | 31.68±2.14 | 31.71±2.11 | 31.73±2.07 |
| Carcass yield (%) | 77.18±2.41 | 77.21±2.57 | 77.23±2.48 | 77.25±2.49 |
| Abdominal fat (g) | 43.89±6.12 ^b | 33.69±5.88 ^a | 35.19±5.39 ^a | 33.36±5.04 ^a |
| Edible (g) | 118.96±28.69 | 119.69±29.65 | 118.68±28.39 | 119.97±29.08 |

Values shown are mean±SD (standard deviation)

^{a,b} means in a row with different superscript differ significantly

Differences in breast and thighs of chicken from control and experimental treatments (Table 3) were not statistically significant ($P > 0.05$). Opposite tendency observed [62] who reported that addition of probiotic would increase efficiency of thigh and breast. The addition of acetyl-L-carnitine caused a non-significant increase [63] or significantly increases [15] in the proportion of breast muscle in the carcass. [61] reported that dietary L-carnitine supplementation no affected the proportion of breast muscle. Statistically non significant increase in the proportion of leg muscle recorded [64].

As shown in Table 3, there were no differences ($P > 0.05$) between groups on carcass yield of

broiler chickens. Similar values of carcass yields in broiler chickens supplemented or not with probiotics were found by [28,29,63]. Carcass yield of males and females was higher in the experimental group in both sexes that received L-carnitine compared to the control group (Table 4), but the differences were not significant ($P < 0.05$). Similar results were obtained by [61,64] that the carcass yield of which increased as a result of L-carnitine supplementation, but the differences were not significant. Different results were recorded by [67-69] who observed that supplementation of L-carnitine had no effect on carcass yield.

The experimental treatments fed with probiotic, L-carnitine and probiotic+L-carnitine had significantly lower weight of abdominal fat compared with control. Equally, [28,70] observed significant reduction of the supplementation of probiotic on abdominal fat content of the chicken. [15] found a decrease in the abdominal fat of carcasses from males. In the group supplemented with L-carnitine, the abdominal fat content decreased significantly in relation to the control group. Similar results were recorded by [66,67]. These authors recorded statistically significant decrease of fat content in the experimental broiler chickens supplemented with L-carnitine. Opposite results to those in the L-carnitine study were obtained by [14], who observed the proportion of abdominal fat to increase in the experimental group of males and to decrease in females.

The supplementation of probiotic and L-carnitine in broiler chickens from the experimental treatments had little effect ($P>0.05$) on weight edible (Table 3). Similarly, [21] showed a significant increase in edible weight in group with L-carnitine supplementation. In contrast, [15, 16, 67] observed edible weight to not significant increase by addition of L-carnitine and [58] recorded decrease of edible eight in broiler males with L-carnitine addition.

4. Conclusions

The results from this experiment show that supplementation of probiotic and L-carnitine positive affected final body weight and no strong affected feed consumption. Subsequently, we recorded partially beneficial effect on total mortality of broiler chickens. The probiotic and L-carnitine in single and combined addition had a no significant effect on percentage of breast and thighs from carcass body, weight of giblets and carcass yield. From carcass parameters we found only reduction of weight of abdominal fat in experimental treatments.

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