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Supplementation of L-carnitine under varying photoperiod regimes improved production performance of broiler chickens

Jay P. Picardal

Biology Department, Cebu Normal University, Osmeña Boulevard, Cebu City, Philippines

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Abstract

The role of photoperiod in support of specific nutrient supplementation has been investigated to maximize growth, improve net gain and better feed conversion ratio in broiler chickens. Despite some advances, the relationship between restricted photoperiod and fat-burning feed supplements has not been fully explored in recent years. This study investigated the effects of 200 ppm L-carnitine and photoperiod on the production performance of broilers (12-day old, n=60). A 2×2 factorial design in RCBD was carried out to produce four treatment groups (15 replicates / group); T_1 = 16 hours light:8 hours dark without L-carnitine, T_2 = 16L:8D with L-carnitine, T_3 = 8L:16D with L-carnitine and T_4 = 8L:16D without L-carnitine. At 42 days, the highest weight was observed in T_2 (2.090kg), while the lowest FCR was reported in T_1 (2.40). Overall, there were slight differences between treatments in terms of body weight and feed conversion ratio (FCR) but were insignificant ($p<0.05$) to be attributed to interaction effects of L-carnitine and photoperiod. The study concluded that supplementation of L-carnitine improved production performance as evidenced by higher body weight and low FCR while % abdominal fat was lower than the unsupplemented group. It can also be deduced that the photoperiod of 16L:8D was the better regime, as evidenced by the better production performance of broiler chickens. Farmers may supplement feeds with 200 ppm or 0.02% (200 mg/L drinking water) of L-carnitine and adopt a photoperiod regime of 16 hours light and 8 hours dark period to hasten optimum productivity.

* **Corresponding Author:** Jay P. Picardal ✉ picardalj@cnu.edu.ph

Introduction

Photoperiod is the length of time to which birds are exposed to light each day (Abbas *et al.,* 2008). It is usually the sum of their exposure to sunlight and artificial light (Schneider, 1989). Among the three components of light, i.e., intensity, duration/photoperiod and wavelength, it is this second factor that received much emphasis in broiler production research in recent years. Anent this, different photoperiodic regimes have been applied and tested over the years, where almost all of them have been shown to improve broiler welfare (Gordon, 1994). Scientific studies and researches in the past claimed that livability, average body weight, feed efficiency and percent condemnations were enhanced in broilers exposed to restricted photoperiod (16L:8D or 8D:16L) over broilers that were adjusted to continuous lighting, i.e., 23L:1D or 24L:0D (Robbins *et al.*, 1984). Similarly, broilers exposed to restricted photoperiods also have an improved immune response to disease challenges which could be due to the rest period that is provided during dark periods, to the production of melatonin, or both (Apeldoorn *et al.*, 1991).

Some scientific findings have also indicated that the improvement in body weights and feed conversion resulting from reduced photoperiod were due to a combination of less energy expenditure on physical activity and better feed utilization or metabolizability of the diet (Apeldoorn *et al.*, 1999). Unfortunately, not all necessary nutrients with significant roles in metabolism are included in the nutrient content of commercial feeds due to their exorbitant prices in the market. Thus, only the most essential macronutrients and micronutrients are included in feed formulations. In view of these observations, it can be noticed that L-carnitine is rarely added as a supplement, probably due to the fact that it can be synthesized *de novo* in the liver and kidneys (Olson *et al.*, 1989) in the presence of lysine and methionine, two precursor amino acids normally present in commercial feeds necessary for the synthesis of L-carnitine in the body.

L-carnitine is a nutrient responsible for the transport of long-chain fatty acids into the mitochondria. It helps the body convert fatty acids into energy, which is used primarily for muscular activities throughout the body. The body produces L-carnitine in the liver and kidneys and stores it in the skeletal muscles, heart, brain and sperm. L-carnitine's primary job is in the regulation of cellular metabolism, and it closely interacts with coenzyme A as an obligatory cofactor in a variety of chemical reactions (Tolson, 2006; Sahelian, 2017). It is also required for fatty acid oxidation; the main theoretical reason why it improves exercise performance evident in improved fatty acid oxidation that preserves muscle glycogen and improves ATP production (Brass and Hiatt, 1988; Brass, 2000). It was also confirmed that supplemental L-carnitine increases long-chain fatty acid oxidation in healthy individuals without L-carnitine deficiency (Muller *et al.*, 2002), providing more evidence for an ergogenic benefit. Enhanced fatty acid oxidation and cellular metabolism is also the proposed mechanism of action for the nutrient partitioning benefits (Iossa *et al.*, 2002). L-carnitine is a potent antioxidant, especially in combination with alanine (Hagen *et al.*, 2002) and evidence provides that it increases exercise performance for this reason (Tolson, 2006). A Russian study, for instance, found that L-carnitine increased running speed and endurance in trained animals and that the increase was proportional to their antioxidative activity (Seifulla *et al.*, 1993). L-carnitine has also been shown to increase melatonin levels, another strong antioxidant secreted by the pineal gland (Esposti *et al.*, 1994). Since light duration is largely dependent upon the age of chickens involved and the type of housing in use, scientists came to the conclusion that the optimal photoperiod regime is indeed relative, depending on the age and housing where these chickens live. Since chicken's age varies according to the specific category of the flock that the owner likes to produce (i.e., commercial layers, breeder, broilers/roasters and others), different photoperiod regimes have been followed and practiced as the owner see it fit and applicable to the age of the flock being reared. Thaxton and Povadolpirod (2000) and Buckland *et al.* (1974) discovered in their respective experiments that some photoperiodic regimes

exhibited less stress while others could induce physical stress to the poultry animal where plasma corticosterone was elevated to a significant level. This increase in corticosterone elevation is considered an indication of a stressed broiler (Olanrewaju *et al.*, 2006). Similarly, broilers reared under continuous light had a higher heterophil to lymphocyte ratio (both indicators of stress in poultry) and experienced greater fear response as indicated by increased tonic immobility time than birds reared under a 12L:12D photoperiod (Siegel,1995; Zulkifli *et al.*,1998). Susceptibility to metabolic diseases such as ascites associated with pulmonary hypertension syndrome, tibial dyschondroplasia and other skeletal disorders are just a few among the possible diseases attributed to unsuitable photoperiodic regimes (Classen and Ridell, 1989; Renden *et al.*,1991; Classen, 2004; Petek *et al.*, 2005). These related research results show that an unsuitable photoperiodic regime produces a deleterious impact on the poultry production processes resulting in low performance, decreased egg production and reduced meat quality due to physical stress (Koelkebeck, 2001). Similarly, when stress becomes chronic and lasts longer, it affects the immune and reproductive system, in addition to the impact on a bird's metabolism and energy balance (Elrom, 2000). The abovementioned consequences of physical stress contributed by unsuitable photoperiod regimes will not only affect the income of small poultry raisers but severely affect commercial poultry entrepreneurs' profit as well. Similarly, such problems associated with physical stress attributed to variation in light duration could still be prevented using appropriate lighting duration. On a similar note, deficiency of L-carnitine in the diet can either be acquired as a result of malnutrition or as a result of inborn errors of metabolism (Kelly, 2006).

The benefits of both restricted photoperiod and L-carnitine show that these two factors are essential for growth and normal metabolism in broiler chickens. Since no published study was produced yet in any scientific journal on the effects of L-carnitine and restricted photoperiod on the production performance of broiler chickens, it is just appropriate and timely that this was focused in this research. This study answered the following questions: (1) Is there a significant effect of L-carnitine on the production performance of broilers exposed to varying photoperiods? (2) Is there an effective photoperiod on the production performance of broiler with or without L-carnitine? and (3) Are there interaction effects of L-carnitine and photoperiod on production performance of broiler?

Materials and methods

Experimental design

The study employed a 2-factor factorial experiment in a randomized complete block design (RCBD), resulting in 4 treatment groups receiving both factors A & B (photoperiod and L-carnitine, respectively) randomly distributed per treatment as follows: T_1 = 16 hours light:8 hours dark without L-carnitine, T_2 = 16L:8D with L-carnitine, T_3 = 8L:16D with L-carnitine and T_4 = 8L:16D without L-carnitine. There were 15 experimental broiler chicks per treatment group, replicated thrice with 5 chickens per replicate.

Experimental animals

One day-old, healthy, straight-run commercial broiler chicks (n=60, Starbro®) were utilized in the current study and were kept for 6 weeks. Chicks were housed on the meshed wire floor and given water *ad libitum*. For this experiment, two identical broiler houses were made, each having a floor area of 2.6 m^2 (2.6m × 1 m) where the first house covers cages named T1 and T2 while the second house covers cages T3 and T4, respectively.

Actual broiler management practices

Brooding: Brooding (day 1-12) started after hatching, where all chickens received 24h lighting for the first 3 days with a brooding temperature of 33°C. Upon arrival to the site, animals were provided with 25% sugar solution, and feeding was administered *ad libitum* (chick booster crumble, Purina Bio1®).

These feeds were given at 7:00 AM, 12 noon and 7:00 PM, respectively, taking into account the total amount of feeds consumed by the 60 chicks daily (Table 1).

Table 1. Proximate analysis of the commercial feeds given to all experimental broiler chicken (n=60).

Chick booster crumble (Bio 100 Purina Feeds)	Broiler starter crumble (Bio 200 Purina Feeds)	Broiler finisher crumble (Bio 300 Purina feeds)
1st and 2nd week	3rd and 4th week	5th and 6th week
Crude protein – 21.5 %	Crude protein – 19.5 %	Crude protein - 17.0 %
Crude fat - 3.0 %	Crude fat - 4.0 %	Crude fat - 4.0 %
Crude fiber - 5.0 %	Crude fiber - 5.0 %	Crude fiber - 2.0 %
Moisture -13.0 %	Moisture - 13.0 %	Moisture - 13.0 %

*Source: Proximate Analysis, Purina Feeds Corporation, Philippines

On days 4-12, the brooder cage was exposed to 23 hours of light and 1 hr dark period (lights were off from 8:00 AM to 9:00 AM daily). This preliminary photoperiod (Gillespe, 1995) is necessary to provide the young chicks a longer time to feed and adjust to the source of water. Likewise, 10 watts incandescent bulb hanged 18 inches (47.5 cm) from the litter was utilized in the entire experimental period. On days 5-9 and 10-12, the lamp was raised from 18 to 20 inches and 18 to 22 inches off the littered floor, respectively, to reduce light intensity. Brooder guards, as suggested by Gillespe (1995), made of corrugated cardboard (i.e., 30 cm tall and 78 cm diameter), were used. Contrary to the growing period, L-carnitine was not yet added to the drinking water since half of the broiler chicken (n=30) belonged to the L-carnitine untreated group T1 and T4, respectively).

All the broiler chickens were given a clean tap water *ad libitum* during the 12-day brooding period.

Table 2. Bodyweight and FCR (Mean±SEM) of chickens reared in two photoperiod conditions with and without L-carnitine (n = 60).

Photo-period	Treatments (w/ & w/o L-carnitine)	Production performance	
		BW (g)	FCR
A_1 (16 L: 8 D)			
	T_1 - No L-Carnitine	1,786.77±239^{a}	2.40±0.32^{a}
	T_2 - 0.02% (200 mg/L) L-carnitine	2,090.00±241^{b}	1.84±0.47^{b}
A_2 (8 L: 16 D)			
	T_3 - 0.02% (200 mg/L) L-carnitine	1,990.00±252^{a,b}	1.91±0.20^{a,b}
	T_4 - No L-Carnitine	1,920.00±226^{a,b}	1.94±0.26^{a,b}
Interaction Effects ($p \leq 0.05$)	L-carnitine vs Photoperiod	ns	ns

Different letter superscripts within columns indicate a significant difference ($p \leq 0.05$).
BW – Body Weight (grams); FCR – Feed Conversion Ratio; FI – Feed Intake (grams) 16L: 8D- 16 hours with light and 8 hours dark period (lights off).
*ns- not significant ($p < 0.05$).

Growth period (day 13 to day 42): The brooder guard was removed and the 10 watts bulb was raised from 22 inches to 24 inches off the floor. During the segregation of the 60 chicks into 4 treatment groups, the farm assistant randomly assigned a replication number written on the left leg using a permanent marker. This was necessary for easy tracking of samples. Feeds and drinking water were given *ad libitum* except for the extra water supplemented with L-carnitine where only cages T2 and T3 could utilize. Carniking (www.lonza.com), a company that manufactures L-carnitine stressed that poultry should not exceed 0.02% (200 ppm) of L-carnitine in feed. Thus, instead of mixing the encapsulated

commercially-available L-carnitine, the researcher decided to mix it with drinking water to achieve the homogeneous solution. Each capsule (300 mg/capsule @ 30 capsules/bottle) was dissolved in 1.66 liters of water (200 ppm = 200 mg L-carnitine in 1 L of water), mixed thoroughly and divided the solution into 2 equal parts (0.83 L each), one given to T2 and the other part was given to T3 daily.

Table 3. Abdominal Fat (Mean±SEM) of chickens reared in two photoperiod conditions with and without L-carnitine (n = 60).

Photo-period	Treatments (w/ & w/o L-carnitine)	Production performance Abdominal Fat (g)		
		Mean body weight (g)	Weight (g) of abdominal fat	% abdominal fat in total body weight
A_1 (16 L: 8 D)				
	T_1 - No L-Carnitine	1,580	64.30	4.07±0.12[a]
	T_2 - 0.02% (200 mg/L) L-carnitine	2,180	53.00	2.41±0.46[b]
A_2 (8 L: 16 D)				
	T_3 - 0.02% (200 mg/L) L-carnitine	2,080	48.33	2.30±0.31[b]
	T_4 - No L-Carnitine	2,000	76.00	3.81±0.18[a]
Interaction effect ($p \leq 0.05$)	L-carnitine vs Photoperiod	ns	ns	ns

Different letter superscripts within columns indicate significant difference ($p \leq 0.05$).

Like in the brooding stage, feeds were administered at 7:00 AM (0700), 12 noon (1200) and 7:00 PM (1700). The same schedule of measuring feeds left was followed. Photoperiod specified as factor A, like L-carnitine, was adjusted at day 13. T1 and T2 received 16 light and 8 dark periods daily where lights were turned on from 7:00 AM to 11:00 PM and off from 11:01 PM to 6:59 AM the next day. On the contrary, T3 and T4 followed the reverse photoperiod of 8 hours light and 16 hours dark period where lights were on from 7:00 AM to 3:00 PM and turned off from 3:01 to 6:59 AM in the next day. The schedule for measurement of weight weekly was the following: day 8, day 15, day 22, day 29, day 36 and day 43, representing weeks 1, 2, 3, 4, 5 and 6, respectively.

Data gathering procedure

Production performance parameters: Body weight was measured using a loading machine at the end of every week for the whole 6 weeks experiment period. Bodyweight gain, on the other hand, was measured by subtracting the present weight from the preceding weight for each replicate in each treatment weekly. Feed intake or feed consumption is the amount of feeds taken by each bird (measured in grams/bird). This was taken by subtracting the consumed feeds from the original weight of feeds given to the whole treatment divided by the number of heads/replicate animals in each treatment (mean feed intake). Feed conversion ratio (FCR) is a derived quantity taken from the feed intake over the weight gain of each treatment group weekly. In this recent experiment where all the 15 broilers per treatment group were housed in the same cage and fed altogether in the same type of feed, FCR was computed as by cage basis (mean FCR) since the weekly weight and weight gain was also taken as the average or mean (n=15).

Feed intake is the amount of feeds taken by each bird (measured in grams/bird). This was derived by subtracting the consumed feeds from the original weight of feeds given to the whole treatment group divided by 15 (since there were 15 replicate broilers in each treatment). This value is measured every after feeding (7:00 AM, 12:00nn and 7:00 PM, respectively) daily. Abdominal fat content was quantified by taking the adipose tissues surrounding the gizzard and intestine, including those that extend to the ischium and those surrounding the cloaca, bursa of Fabricius and adjacent abdominal muscles.

This was collected and weighed in a loading machine. Three broiler chickens per treatment group were randomly selected, euthanized and eviscerated as the source of abdominal fat. Abdominal fat content was derived by dividing the weight of the abdominal fat collected by the carcass weight (x100%).

Analysis of data

Data were encoded in the Windows Microsoft Excel® and were transferred to the data file of the Statistical Package for the Social Sciences (SPSS) software, Version 20. Data were labeled for identity and were analyzed using the SPSS Analysis of Variance program for the 2-factor experiment (2-way ANOVA). The main effects between subjects/factors were compared by Tukey's honestly significance test, which is a component program of SPSS.

Results and discussion

Bodyweight

The effect of restricted lighting programs (i.e., 16L:8D and 8L:16D) with or without L-carnitine supplementation on final body weight, FCR and abdominal fat content are summarized in Tables 2 and 3, respectively. In terms of body weight (grams), chickens (T1 and T2) exposed to similar light duration (16L:8D) varied significantly ($p<0.05$) where T1 (1,786.77±239) and T2 (2,090.00±241) had a difference of 304 grams after 42 days. On the other photoperiod regime (8L:16D), T3 (1,990.00±252) was higher than T4 (1,920.00±226) by 70 grams and appeared to be significantly comparable. Across the four treatments, the highest final weight (T2) was found to be significantly higher compared to T1 but neither to T3 or T4 ($p<0.05$). Similarly, T1 is neither significantly different from T3 and T4, respectively.

The significant difference between T1 and T2 is attributed to the presence of L-carnitine as a supplement in the drinking water in T2 compared to unsupplemented drinking water in T1. This presumption is supported by related research by Kita *et al.* (2002), where body weight was significantly improved in birds when 500 mg/kg of L-carnitine was added to the diet. Lettner *et al.* (1992) showed that dietary supplementation with L-carnitine from 20 to 60 mg/kg tended to improve the growth performance of broiler chickens, while Rabie *et al.* (1997b) indicated that the supplementation of dietary L-carnitine at 3 levels (30, 100 or 150 mg/kg) to a basal diet significantly increased body weight gain of broiler chickens compared with those of broilers fed the basal diet.

Apeldoorn *et al.* (1999) reported that broilers reared under longer periods of darkness are reported to experience better health than counterparts under long daylight conditions. One of the physiological explanations for this phenomenon has something to do with melatonin released by the pineal gland. This is a hormone involved in establishing circadian rhythms of body temperature and maintaining several essential metabolic functions that influence feed/ water intake patterns, digestion and secretion of several hormones that are integral to normal immune functions. Pairwise comparison in the two-way ANOVA shows that body weight and FCR attributed to photoperiod on L-carnitine or L-carnitine on photoperiod was all insignificant at $p<0.05$. This goes to show that body weight in any of the 4 treatments was not attributed to interaction effects of L-carnitine and photoperiod regimen in all treatments. Although not statistically significant, the result mentioned in Table 2 showed T2 (16L:8D photoperiod) produced higher weight (g) compared to either T3 or T4 with 8L:16D photoperiod.

This result is congruent to the outcome of the study by Classen *et al.*, (1991) and Classen (1991) that if photoperiod is taken as the only independent variable, a restricted photoperiod could improve body weight significantly in comparison with continuous light (24L:OD) duration. Rozenboim *et al.* (1999), in a different study, reported that broilers under 16L:8D photoperiod were heavier than those under 23 L:1D after 49 days. Reduced photoperiod was noted by researchers to improve body weight due to a combination of less energy on physical activity and better feed utilization or metabolizability of the diet (Apeldoorn *et al.,* 1999).

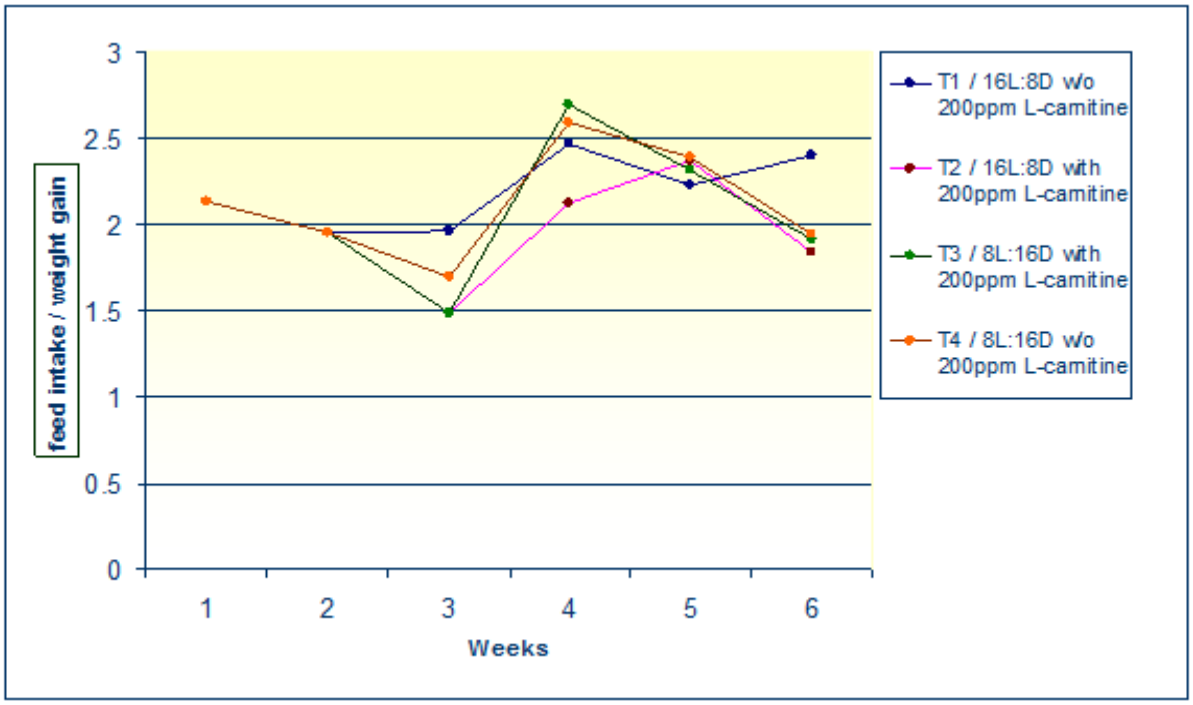

Fig. 1. Feed conversion ratio (FCR) of broiler chickens from the four treatment groups from the 1st week to the 6th week of broiler production.

Treatment 2 has the highest final body weight (after day 42), followed by T3. This result is the reverse with the result on abdominal fat % where T2 and T3 have the lowest abdominal fat content (Table 3). The L-carnitine molecule as a cofactor in lipid metabolism could be the reason why these treatment groups (T2 and T3) still weighed heavier than L-carnitine unsupplemented T1 or T4 despite having a low abdominal fat. In related research by Sarica *et al.*, (2005), they showed that supplementation with L-carnitine could improve the use of dietary nitrogen, either directly through sparing its precursors for protein biosynthesis and other cellular functions or indirectly by optimizing the balance between essential and nonessential amino acids within the cell. Thus, this mechanism improved protein and muscle deposition instead of fat deposition.

It is assumed in this study that L-carnitine did not actually function as the main fat burner rather as a cofactor that could have played an important metabolic role in the absorption and metabolism of the feeds taken by the animal. In the presence of this cofactor, it would be more efficient for the animal to oxidize feed nutrients into forms that can be used to produce ATP as the source of energy. Campbell (1996) noted that cofactors bind tightly to the active site of the enzyme, for example, lipase, which will convert lipids into component fatty acid and glycerol. In the presence of this cofactor, catalytic reactions may proceed at a faster rate and thus enhance the metabolism of different substances present in the feeds.

Feed Conversion Ratio (FCR)

Feed conversion ratio (FCR) is the ratio of the amount of feed (g) taken by the animal to the amount of weight gained after consuming such amount. In analyzing FCR, the lower the FCR, the more efficient is the feeding of the animals because a lesser amount of feed is necessary to produce a kilogram of meat. The FCR during the whole experimental period (42 days) differs significantly ($p<0.05$) between T1 and T2. The highest FCR was observed in T1 (2.40±0.32), which indicated low feed conversion efficiency. This goes to show that it takes 2.40 kilograms of feeds to produce 1 kilogram of body mass per chicken in T1. This is statistically different from T2 (1.84±0.47) and significant at $p<0.05$. FCR of T2, T3 (1.91±0.20) and T4 (1.94±0.26) did not differ significantly (Table 2).

The interaction effect of L-carnitine and photoperiod is not significant for FCR ($p<0.05$).

The two lowest FCR values at the end of the production period were those of T2 and T3 (Table 2), which were the two treatments supplemented with 200 ppm L-carnitine. In a different study, de Beer and Coon (2006) observed that carnitine supplementation improved feed efficiency during rearing; carnitine supplemented hens produced more eggs than unsupplemented hens and consequently increased mean egg size. As noticed, either T2 or T3, though exposed to a different type of photoperiod, still indicated a low FCR. This result is incongruent with the outcomes observed by Classen *et al.*, (1991) and Classen (2004), where FCR was improved in broilers exposed to restricted photoperiod (either 16L: 8D or 8L: 16D), as compared to broilers subjected to continuous light duration (24L:0D). Similar to the result on the body weight in Table 2, Rozenboim *et al.*, (1999) revealed that broilers reared under 16D:8L & 16L:8D regimens were heavier than those under 23L:1D at 49 days.

Fig. 1 above shows 4 line graphs, each colored graph representing one treatment group. The graph shows a decrease in FCR for all treatments from the 1st week to the 2nd week except T1, which increased slightly (by 0.01 in the 2nd week). In the third week, all FCR increased abruptly, but all went down on the 4th week except T2. In the last week (6th), all FCR except T1 decreased from the 5th week, an indication that the broilers from these three treatments (T2, T3 and T4) were all converting the feeds consumed into body mass efficiently. In understanding FCR further, it is understood that the lower the FCR, the more efficient the feeding since a lesser amount of feed is necessary to accumulate a specific amount of body mass.

Abdominal fat content

With regards to the %, abdominal fat relative to the bodyweight of the animal considered as sample per treatment (Table 3), only T2 and T3 manifested the two lowest mean (n=3 per treatment) abdominal fat (2.41±0.46% and 2.30±0.31%), respectively. These are the treatment groups that were supplemented with 200 ppm L-carnitine. Broilers in T1 (4.07±0.12%) exhibited the highest % of abdominal fat, whereas T4 ranks second with a value of 3.81±0.18%. These results imply that broilers exposed to the same light photoperiod could vary in abdominal fat if supplemented with 200 ppm L-carnitine. For instance, T1 (4.07%) vs. T2 (2.41%) has a difference of 1.66% abdominal fat while T4 (3.81%) vs. T3 (2.30%) has a difference of 1.51% abdominal fat. This is similar to the outcome of the study of Buyse *et al.*, (2001), where dietary L-carnitine supplementation had a significant reduction in the abdominal fat content of female chickens exposed to normal temperature (28°C). The interaction effect of the two factors (photoperiod vs. L-carnitine), however, was found to be insignificant, an indication that the abdominal fat content in the broilers is not attributed to the combination of both factors.

In independent research by Lien and Horng (2001) and Sarica *et al.*, (2005), they found that supplementary L-carnitine facilitated fatty acid transportation across the mitochondrial membrane for β-oxidation to generate ATP, thereby decreasing their availability for esterification to triacylglycerols and storage in adipose tissues. Rabie (1998) found that 50 mg of L-carnitine per kg of feed reduced abdominal fat significantly in broilers. The results of the present study are in agreement with those reported by Lettner *et al.*, (1992), who found that the composition of the abdominal fat was significantly affected by the addition of L-carnitine to the diet. Rabie and Szilagyi (1998) and Xu *et al.*, (2003) also reported that the abdominal fat percentage of body weight was significantly reduced by adding L-carnitine to diets.

With respect to photoperiod effects on abdominal fat, it was observed in a study by Oyedeji and Atteh (2005) that abdominal fat content of broilers was significantly reduced from 34.5 g to 21.4 g by reduction of photoperiod to 6 hours daily, thus, improving carcass quality. Elrom (2000) also emphasized that at the onset of a stressful event (i.e.,

exposure to extreme temperature and high heat), the synthesis of fatty acids increases. Carcass data, muscle depletion and fat accretion confirm that muscle protein declines and fat deposition occurs.

Conclusion

Based on the findings of the study, the study concluded that supplementation of L-carnitine improved production performance as evidenced by higher body weight, low FCR and less abdominal fat percentage. It is also deduced that photoperiod of 16L:8D was a better regime than 8L:16D as evidenced by a better production performance. The findings of this paper encourage farmers who are into broiler production to supplement 200 ppm or 0.02% (200 mg/L drinking water) of L-carnitine to broilers to hasten their productivity. Similarly, it would be advantageous to adopt a photoperiod regime of 16 hours light and 8 hours dark period per 24 hours cycle in broiler farms to attain maximum productivity.

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