



EFFECTS OF MELATONIN SUPPLEMENTATION ON CARCASS YIELD OF BROILER CHICKENS SUBJECTED TO DIFFERENT LIGHTING REGIMENS

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Abstract

The study aimed to determine the impact of continuous lighting on the carcass yield of broiler chickens, administered with melatonin. Broiler chicks were assigned randomly into three groups, comprising 100 chicks each. Group I was raised under natural photoperiod of 12-h light and 12-h darkness, without melatonin supplementation. Group II was kept under 24-h continuous lighting, without melatonin supplementation. Group III was raised under 24-h continuous lighting, with melatonin supplementation (0.5 mg/kg *per os*) via drinking water. Melatonin was administered once daily for 42 consecutive days at 17:00 h. At day 42, ten broilers per group that represented the average body weight were selected, slaughtered and processed to determine the yield of carcass parts. The data on carcass characteristics showed significant ($P < 0.001$) differences between the groups, especially in carcass, breast plate, thigh and live weights. The melatonin-treated group consistently ranked highest for each of the carcass parameters of broiler chicken. The liver weights of 38.70 ± 2.14 g and 42.40 ± 1.63 g obtained from groups III (CL + MEL) and II (CL), respectively were significantly ($P < 0.05$) higher than 32.90 ± 1.42 g, recorded in group I subjected to 12D:12L cycle. The highest dry feather weight of 37.10 ± 1.46 g was recorded in group III reared on CL and administered with melatonin. In conclusion, melatonin supplementation enhanced growth and carcass yield in broiler chickens.

Key words: Broiler chickens, melatonin, photoperiods, carcass and continuous lighting.

Introduction

Management of broiler chickens is unavoidably associated with the adverse effects of continuous lighting programme, inducing oxidative stress with the attendant production losses and mortality (Deep *et al.*, 2012; Archer and Byrd, 2018). Manipulation of lighting intended to enhance physiological processes of feed consumption and rapid growth (Sun *et al.*, 2017) induces oxidative stress in broiler chickens (Sinkalu *et al.*, 2016). Raising broiler chickens under unfavourable thermal environment conditions also induces oxidative stress, which may reduce carcass yield and quality. It has been shown that antioxidant supplementation provides beneficial effects against stress-induced tissue damages (Akinwande and Adebule, 2003; Tauler *et al.*, 2003; Lin *et al.*, 2006; Bhimaraj and Tang, 2012). Melatonin is a potent antioxidant and the major neurohormone secreted during the dark hours of the day by the vertebrate pineal gland (Korkmaz *et al.*, 2011, Bahrami *et al.*, 2018). Once formed, melatonin is released into the capillaries and in higher concentrations into the cerebro-spinal fluid, from where it is rapidly distributed to most body tissues (Cardinali and Pevet, 1998). The beneficial effects of melatonin on the respiratory chain open new perspectives for diminishing free-radical formation rather than administering antioxidants to eliminate radicals already formed in the body (Hardeland and Pandi-Perumal, 2005). It is conceivable that the results of this study may shed light to our current understanding of effects of different lighting regimens on carcass



yield of broiler chickens, and also the beneficial effects of the supplementation of exogenous melatonin on broiler chickens.

Materials and Methods

The experiment was performed in a poultry house in the Department of Veterinary Physiology, Ahmadu Bello University, Zaria (11° 10' N, 07° 38' E), located in the Northern Guinea Savannah zone of Nigeria. Three hundred (300) broiler chicks belonging to the Marshall breed were obtained at a day-old from Fidan Farms, a branch of Fidan Investments Nigeria Limited, Ibadan (07° 23' N, 03° 55' E), Nigeria. Complete routine vaccinations and appropriate medications were administered to the chicks from day-old up to the end of the experiment. The broilers were raised on deep litter system and maintained on commercial feed, obtained from Vital Feeds, Grand Cereals and Oil Mills Limited, Jos, Nigeria. Starter diets were fed to the chicks from day-old to 21 d of life, after which they were placed on finisher diet up to the end of the experiment. They were given access to feed and water *ad libitum*. Simple random sampling was used to select and assign the 300 broiler chicks into three groups, comprising hundred (100) chicks each. Group I was raised under natural photoperiod of about 12 h light and 12 h darkness cycle, without melatonin supplementation. Group II was kept under 24 h continuous lighting, without melatonin supplementation. Group III was raised under 24 h continuous lighting and administered daily with melatonin (ISI Brands, Inc. Utah, USA) at 0.5 mg/kg *per os* (Nisbet *et al.*, 2008), via drinking water. Melatonin was administered once daily at 17:00 h. At day 42, a total of 10 broilers per group that represented the average body weight were selected, slaughtered and processed as described by Veldkamp *et al.* (2000) to determine the yield of carcass parts. After dressing, carcasses were weighed and expressed as a percentage of live body weight and were cut into commercial-type of cut parts. Each part was weighed and expressed as a percentage of the carcass weight (Veldkamp *et al.*, 2000).

Results and Discussion

The data on carcass characteristics presented in Table 1 show significant ($P < 0.001$) differences between the groups, especially in carcass, breast plate, thigh and live weights. The melatonin-treated group consistently ranked highest for each of the key parameters of broiler chicken production. Table 2 reveals that the liver weights of 38.70 ± 2.14 g and 42.40 ± 1.63 g obtained from group III (CL + MEL) and group II (CL), respectively were significantly ($P < 0.05$) higher than 32.90 ± 1.42 g, recorded in group I, subjected to 12D:12L cycle. The highest dry feather weight (37.10 ± 1.46 g) was recorded in group III, reared on CL and administered with melatonin (Table 2). The results demonstrated clearly that melatonin administration to broiler chickens enhanced their growth and carcass yield. The marked increase in the overall carcass characteristics observed in group III may be attributed to the ability of melatonin to effectively counter the adverse effects of oxidative stress, induced by rapid growth, continuous lighting (CL) and high feed metabolism. This is because CL induces sleep deprivation and causes severe physiological stress responses (Campo and Davila, 2002). Continuous lighting (CL) improved overall performance of the broiler chickens compared to those raised on 12L:12D light cycle. This is because broiler chickens did not eat during darkness. The results contradicted the findings of Yang *et al.* (2015), who reported that feed conversion in broiler chickens raised in the 4L:4D photoperiod was significantly more efficient than in broiler chickens in CL. Restricting light regimens increased productivity of broiler chickens because of very low physical activity during darkness and considerable reduction in energy expenditure on body activities. Again, melatonin administration promoted feathering of the broiler chickens, which was purely whitish in colour. The massive whitish feathering of the broiler chickens treated with melatonin prevented heat absorption,



but enhanced heat reflection. The mechanism involved in reduction of heat load and free-radical generation in the melatonin-treated broiler chickens.

Table 1: Meat and Carcass Quality Parameters or Processing Yields (g) of Marshal Broiler Chickens administered with Melatonin as at day 42

Parameter	Group		
	12D:12L	CL	CL+MEL
Live weight	1740.00 ± 48.00 ^a	1970.00 ± 33.50 ^b	2430.00 ± 68.40 ^c
Carcass	1390.00 ± 18.00 ^a	1740.00 ± 34.00 ^b	1860.00 ± 61.80 ^b
Breast	259.00 ± 10.53 ^a	339.70 ± 16.43 ^b	364.30 ± 13.46 ^b
Thighs	306.50 ± 13.35 ^a	350.30 ± 10.06 ^b	368.10 ± 6.35 ^b
Wings	126.30 ± 3.75 ^a	138.80 ± 5.92 ^{ab}	141.80 ± 5.11 ^b
Neck	66.50 ± 3.52 ^a	73.40 ± 2.98 ^a	71.20 ± 4.40 ^a
Legs	67.60 ± 3.41 ^a	72.90 ± 2.82 ^a	70.70 ± 2.68 ^a
Head	34.30 ± 1.71 ^a	37.40 ± 1.75 ^a	38.80 ± 1.51 ^a

^{a, b, c}: Means within the same row and having different superscript letters are significantly ($P < 0.05$) different.

12D:12L = 12 h darkness 12 h light cycle (Group I); CL = Continuous lighting (Group II) and CL + MEL = CL + Melatonin (Group III).

Table 2: Organ Processing Weight (g) of Marshal Broiler Chickens at day 42 of melatonin administration

UP	Organ weight					Feather	
	Heart	Liver	Gizzard	Brain	Intestine	Wet	Dry
	17.10 ± 0.71 ^a	32.90 ± 1.42 ^a	66.60 ± 1.21 ^a	2.54 ± 0.12 ^a	152.90 ± 14.81 ^a	95.60 ± 5.74 ^a	31.20 ± 1.53 ^a
	19.10 ± 0.71 ^a	42.40 ± 1.63 ^b	72.30 ± 4.02 ^a	2.52 ± 0.11 ^a	146.30 ± 16.11 ^a	125.50 ± 7.20 ^b	36.40 ± 1.22 ^b
	17.40 ± 1.41 ^a	38.70 ± 2.14 ^b	74.00 ± 9.73 ^a	2.37 ± 0.10 ^a	121.40 ± 11.05 ^a	121.10 ± 5.24 ^b	37.10 ± 1.46 ^b

^{a, b}: Means within a column having different superscripts are significantly ($P < 0.05$) different. Group I = 12 h darkness and 12 h light cycle; Group II = Continuous lighting (CL), and Group III = CL + Melatonin.

Conclusion and Recommendation

In conclusion, CL enhanced the carcass yield of broiler chickens by 20.12 % compared to controls. Melatonin administration to broiler chickens quenched the pecking action of free radicals on the tissues and further increased the carcass yield by 6.45 %. It is recommended that melatonin be administered to CL broiler chickens to further increase carcass yield.

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