RESEARCH ARTICLE

Effect of Lighting Schedule on the Performance of Broilers

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Abstract

Day-old commercial broiler chicks (n = 240) were randomly distributed into four treatments, each having 60 birds. Each treatment was further subdivided into three replicates of 20 birds each. All the groups were provided near-continuous light (23L:1D) during the initial seven days. Group A continued with near-continuous light (23L:1D) till six weeks, while Groups B, C and D were subjected to 18L:6D, 16L:8D and 14L:10D lighting schedule, respectively, from the second week to the fifth week and subsequently provided near-continuous light in the sixth week. The parameters studied were body weight (b.wt), weight gain (WG), feed intake (FI), feed conversion ratio (FCR), mortality, eviscerated yield (EVSY), giblet yield (GY), ready-to-cook yield (R-to-C), breast meat yield (BY), abdominal fat weight, weight of thymus, spleen, bursa of Fabricius, H/L ratio, and leg disorder (Gait score). The results of the study indicated that different lighting schedules do not significantly influence b.wt, WG, FI, FCR, EVSY, GY, R-to-C, BY, H/L ratio, abdominal fat. Mortality was higher in Group A provided with near-continuous light than Group B, C, and D. The 10 hours darkness schedule significantly improved the weight of the thymus. The incidence of birds falling in painfully gait and welfare issues were less in 6, 8, or 10 hours darkness schedule. However, its differences were non-significant.

Keywords: Broilers, Gait score, Growth, Leg disorder, Lighting schedule.

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Introduction

Traditionally, broilers have been subjected to continuous (24L:0D) or near continuous (23L:1D) light from placement to market age (Downs *et al*., 2006). Different photoperiodic regimes have been used and studied over the years. Results to date suggest an absolute minimum uninterrupted dark period of 4 hours, but the requirements for sleep may be higher at certain points of the growing period. Lighting programs such as light and dark phases may encourage the development of bone. The movement of birds increases during the light period, which stimulates the development of bone by increasing the mechanical strength due to an increase of genes transcription (Bradshaw *et al*., 2002). Melatonin hormone is higher during the dark period which stimulates the development of bone directly (Cardinali *et al.,* 2003) or indirectly due to hormones such as parathyroid hormone, estradiol or growth hormones, and factors which involved in bone development (Ostrowska *et al*., 2002). The provision of sufficient dark period reduces the health-related problems such as sudden death syndrome and spiking mortality, which are reported more in the continuous light program (Downs *et al.,* 2006). Hence, the present study was aimed to evaluate the effect of lighting schedules on growth, carcass parameters, immune-organ weight, and gait score of broiler chickens.

Materials and Methods

The experimental trial was conducted on straight-run commercial broiler chicks for six weeks. The birds (n = 240) were allotted randomly into four equal groups each of 60 birds. Each group was subdivided into three replicates of 20 birds each. Open-sided deep litter broiler house was divided into four independent pens with black-out curtains to ensure that the light will not pass into other pens. Four treatment groups were, Group A (Control) - near-continuous light from 1st day to 42 days (23 h light + 1 hr darkness); Group B - 1 to 7 days (23 h light + 1 h darkness), 8 to 35 days (18 h light + 6 h darkness) and 36 to 42 days (23 h light + 1 h darkness);

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Group C - 1 to 7 days (23 h light + 1 h darkness), 8 to 35 days (16 h light + 8 h darkness) and 36 to 42 days (23 h light + 1 h darkness); Group D - 1 to 7 days (23 h light + 1 h darkness), 8 to 35 days (14 h light + 10 h darkness) and 36 to 42 days (23 h light + 1 h darkness). Experimental birds were offered *ad libitum* pre-starter, starter and finisher diet as per industry standards. The performance parameters studied included body weight (b.wt), weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) at weekly intervals. The mortality was recorded as and when occurred. Dressing parameters, *viz.,* percent eviscerated yield (EVSY) Giblet yield (GY), breast meat yield (BY) and ready-to-cook (R-to-C) yield, and abdominal fat weight, and the percent weight of immune organs, *viz.,* thymus, bursa of Fabricius and spleen based on live weight were recorded at the end of the sixth week by randomly selecting one male and one female from each replicate. The blood smears were prepared from two birds from each replicate to calculate the heterophil lymphocyte ratio on the 42nd day. Gait score was recorded on a zero to five scale as described by Garner *et al.* (2002) on all the birds on the 42nd day. The data were analyzed using a completely randomized design and one-way ANOVA (Snedecor and Cochran, 1994).

Results and Discussion

Performance Paramters

The data on overall live body weight, gain in weight, feed intake, and FCR are presented in Table 1. The data indicate that different lighting schedules studied did not significantly influence the overall live weight, gain in weight, feed intake and feed conversion ratio at the end of six weeks. These results were in accordance with the results of Zhao *et al.* (2019), Coban *et al.* (2014), and Das and Lacin (2014). The present observations however contradicted the results of Ingram *et al.* (2000) and Abbas *et al.* (2008). They reported that feed conversion ratio was significantly improved in broiler birds subjected to restricted light program than continuous light regimen.

Mortality

The percentage mortality of birds in groups A, B, C, and D was 5.00%, 1.66%, 3.33%, and 1.66%, respectively. The overall mortality recorded was 2.91%. Near continuous light schedule in control group A, contributed 42.85% mortality out of the overall mortality of broiler birds. The overall result indicated that near-continuous light has an adverse effect on the mortality of broilers. The result of the experiment was in accordance with the report of Rozenboim *et al.* (1999), who reported higher mortality in broilers reared in 23L:1D lighting schedule than the intermittent increasing lighting schedule and continuous increasing lighting schedule from 8L:16D to 16L:8D. Schwean-Lardner *et al.* (2013) also reported that total mortality, as well as mortality due to metabolic and skeletal disease, decreased linearly with increasing inclusion of darkness.

Carcass Parameters and Abdominal Fat

The statistical analysis of the data indicated that groups A, B, C, and D were statistically comparable for these parameters (Table 1) Overall result of the dressing parameter indicated that photoperiod programs do not affect EVSY, GY, R- to- C, BY and abdominal fat percentage. These results correlated well with Downs *et al.* (2006), Erol and Cantekin (2007), Coban *et al.* (2014), Fidan *et al.* (2016) and Kalaba *et al.* (2016).

Table 1: Effect of lighting schedule on various parameters at the end of six weeks

	Groups of photoperiod						
Parameter	*A*	*B*	*C*	*D*	*CV*	*P-value*	*CD*
Body weight (g/bird)	2588.40 ± 26.47	2641.23 ± 16.12	2580.53 ± 37.67	2511.97 ± 63.14	2.945	0.23	NS
Body weight gain (g/bird)	2539.68 ± 26.2	2593.68 ± 15.88	2531.50 ± 37.68	2464.50 ± 63.38	3.001	0.23	NS
Feed intake (g/bird)	4222.35 ± 13.70	4197.16 ± 66.38	4249.87 ± 71.06	4115.68 ± 49.15	2.3	0.4	NS
FCR	1.66 ± 0.01	1.62 ± 0.04	1.68 ± 0.02	1.66 ± 0.02	2.633	0.4	NS
Mortality (%)	5.00	1.66	3.33	1.66	-	-	-
Eviscerated yield (%)	65.40 ± 0.49	66.64 ± 0.59	66.44 ± 0.43	65.71 ± 0.39	1.846	0.25	NS
Giblet yield (%)	3.72 ± 0.13	3.68 ± 0.16	3.48 ± 0.17	3.63 ± 0.09	9.291	0.65	NS
Ready to cook yield (%)	69.12 ± 0.41	70.32 ± 0.47	69.92 ± 0.58	69.33 ± 0.38	1.883	0.28	NS
Breast meat yield (%)	27.13 ± 0.69	27.88 ± 0.46	28.10 ± 0.36	27.70 ± 0.41	4.314	0.56	NS
Abdominal fat (%)	1.93 ± 0.17	1.94 ± 0.15	1.90 ± 0.16	1.86 ± 0.09	17.302	0.98	NS
Thymus (%)	0.33 ± 0.04^{a}	0.34 ± 0.04^{a}	0.40 ± 0.04^{ab}	0.50 ± 0.05^{b}	32.583	0.05	0.16
Bursa of Fabricius (%)	0.06 ± 0.01	0.05 ± 0.00	0.06 ± 0.02	0.06 ± 0.00	38.720	0.83	NS
Spleen (%)	0.11 ± 0.02	0.15 ± 0.02	0.13 ± 0.01	0.14 ± 0.02	29.172	0.22	NS
H/L ratio	0.26 ± 0.02	0.31 ± 0.03	0.27 ± 0.02	0.23 ± 0.01	22.22	0.10	NS

NS-Non-significant, CV- Coefficient of variance, CD- Critical difference

Table 2: Effect of lighting schedule on percent birds in various gait score (% birds) at the end of six weeks

	% birds in photoperiod groups					
Gait score	*A*	*B*	*C*	*D*	*P-Value*	*CD*
Zero	55.96 ± 0.96	62.81 ± 4.03	65.61 ± 6.70	74.39 ± 8.05	0.22	NS
One	35.61 ± 0.61	35.53 ± 4.76	30.89 ± 5.47	25.61 ± 8.05	0.55	NS
Two	5.09 ± 0.09	1.67 ± 1.67	3.51 ± 3.51	0.00 ± 0.00	0.34	NS
Three	1.67 ± 1.67	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.44	NS
Four	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	-	NS
Five	1.67 ± 1.67	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.44	NS

NS-Non-significant, CD- Critical difference

Immune Organ Weights

The percent thymus weight of broilers from 10 h darkness group D was significantly higher ($p < 0.05$) than group A and B (Table 1). There were no significant differences in percent weight of bursa Fabricius and spleen between treatment groups. Dark periods stimulate melatonin secretion and melatonin has a positive effect on the immune organ weight (Zheng *et al.,* 2013). The present findings are in accordance with Zheng *et al.* (2013), who reported significantly higher thymus weight under intermittent lighting schedule at 21 days.

Heterophil: Lymphocyte Ratio

There were no significant differences in H/L ratio among different treatment groups. The H:L ratio in many cases is an indication of circulating corticosterone and stress. In stress H:L ratio increases. In this study, no significant differences were seen in H:L ratio among different groups. Thus different lighting schedules do not have effect on the H:L ratio and also the level of stress. This result correlated with the observations of Lien *et al.* (2007), and Erol and Cantekin (2007). They reported that light intensity and photoperiod schedule do not affect the heterophil: lymphocyte ratio of broilers.

Leg Disorder- Gait Score

The zero scores indicate the normal walking ability of birds. Birds with normal walking ability increased with increasing dark hours in groups B, C, and D (Table 2), however, differences were non-significant. The gait score of three is an obvious gait defect, which affects the ability to move (e.g., limp, jerky, unsteady stride, splaying of a leg) and score five complete lameness was found in group A only. Birds with gait score of 3 and above face difficulty in getting resources like feed and water ultimately affecting growth rate. Such lame birds need to be culled in the early stage of market weight leading to decreased farm profitability (Granquist *et al*., 2019). The lighting schedule of 6 hrs, 8 hrs, and 10 hrs darkness was more beneficial for reducing painful gait score and concerns of broiler welfare. The present observations are in accordance with Schwean-lardner and Classen *et al.* (2010). They observed that levels of leg weakness increased linearly with decreasing the darkness schedule.

Conclusion

Overall results conclude that providing six hours of darkness during 8 to 35 days of rearing is beneficial to reduce the broiler welfare issues and mortality.

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ANNOUNCEMENT: SVSBT-NS-2022

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