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Effect of different light sources on the performance of broiler chicken reared under deep litter system of management

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Abstract
A study was conducted to investigate the effect of different light sources on the performance of broiler chicken during March- April, 2017. One hundred and sixty day old broiler chicks were brooded in battery cages for a week and then distributed randomly into four light treatment groups *viz.*, Natural light (T_1) as Control, Incandescent (T_2), CFL (T_3) and LED (T4) groups having 40 chicks in each which were again subdivided into four replicates of 10 chicks each. The highest body weight was recorded in LED (2180.42±28.57g) and lowest in CFL (2128.33±25.89g) gropus. The results indicated that light sources had no significant effect on the weekly body weight and body weight gain. However, average feed intake was found to be significantly ($P \leq 0.05$) higher in Control (3730.65±36.45g) and INC (3762.80±40.36g) groups compared to CFL (3364.28±45.08g) and LED (3323.73± 67.10g). Similarly, the overall FCR was found to be significantly ($P \leq 0.05$) better in LED (1.63±0.04) and CFL (1.68±0.01) groups compared to INC (1.84±0.02) and Control (1.86±0.006) groups. The mortality and leg weakness was also not influenced by light sources.

Keywords: Light sources, broiler, performance, FCR

1. Introduction
Broiler production and management has become highly specialized over the years to optimize bird performance. Improving broiler chicken performance through artificial lighting has been extensively studied over the past fifty years as producers have sought to increase broilers muscle gain, while maintaining an efficient feed conversion ratio and bird health [21]. The effect of lighting on poultry is a topic that has been studied for decades. Wavelength, intensity, photoperiod, type and placement of lighting all play an important part in bird development and performance [17]. Several types of lighting systems, such as incandescent, fluorescent, compact fluorescent, fluorescent tube lighting and high intensity discharge lighting have all been used in commercial poultry housing. Recently, light emitting diode (LED) lamps have been of growing interest in poultry operations because of their high energy efficiency [8], long operating life, availability in different wavelengths [3], low electricity consumption and low rearing cost [21]. Modern lights are much more energy efficient and still provides adequate illumination. This has required new research on the entire lighting management system for growing broilers. Artificial light is the only light source for chickens in environmentally controlled houses. Thus, source, spectra, intensity, and regimen of light supplementation have become major factors in modern broiler management [1]. Light affects many aspects of growth and must be taken into account when attempting to provide the most efficient controlled environment for poultry production. By selecting the optimum light source and taking advantage of the unique spectral requirements of poultry, it is possible to maximize growth and efficiency while reducing unnecessary stress and fostering ideal behavior [2]. In the light of above mentioned facts, the present study was designed to see the impact of various lighting sources on the production performance of broilers.

2. Materials and Methods
To check the impact of various lighting sources on production performance of broilers, the present study was conducted at Student's Poultry Instructional Farm, Faculty of Veterinary and Animal Sciences, SKUAST Kashmir, Jammu and Kashmir, during the months of March-April,

under deep litter system management. One hundred and sixty day old broiler chicks were obtained from a commercial hatchery and brooded in battery cages for a week. After one week the chicks were weighed by using an electronic balance and the chicks having similar body weights were distributed randomly into four light treatment groups *viz*, Natural light (T_1) as control, Incandescent (T_2), Fluorescent (T_3) and LED (T_4) having 40 chicks in each which were again subdivided into four replicates of 10 chicks each. Each treatment group was housed in a light proof enclosure. Continuous lighting was provided to the birds similar intensity in all treatment groups was maintained. The light intensity was kept similar in all the treatment groups and monitored regularly using a digital lux meter. The experimental barn was cleaned thoroughly and kept under similar housing and management conditions like floor space, temperature, ventilation, humidity, ad-libitum feed and fresh water except sources of light. Performance parameters in terms of measurement of weekly body weight, body weight gain, weekly feed consumption, feed conversion ratio (FCR), mortality and leg weakness was recorded. The experiment was carried for a period of six weeks. Chicks were weighed individually at the beginning of experiment and at weekly intervals in all the groups using a digital weighing balance before offering feed to the birds. Weighed quantity of feed was offered ad libitum to each group. Residual feed present in feeder was collected and weighed each week to calculate the weekly feed consumption. Weekly body weight gain and feed conversion ratio were calculated. The birds were continuously monitored and leg weakness if any was recorded accordingly during the trial. A complete record of mortality in each group was maintained throughout the experimental period.

3. Statistical Analysis

The data so obtained was statistically analyzed by analysis of variance (ANOVA) technique as per Snedecor and Cochran [25]. The differences in means of the treatments were compared by Duncan's Multiple Range Test [4].

4. Results and Discussion

The body weights at 6 weeks of age was recorded as 2129.75±33.80, 2174.28±15.33, 2128.33±25.89 and 2180.42±28.57 g respectively for birds reared under Natural (Control), Incandescent, CFL, and LED light groups. There were no significant differences found in the mean body weight and body weight gain of birds among the different treatment groups. The results of the present study are well supported by the findings of Hulan and Proudfoot [9], Schetdeler [24], Lewis and Morris [14], Rodenburg and Middelkoop [20] and Kristensen *et al.* [13] who reported that light sources has no significant effect on body weight. Olenrawaju *et al.* [18] also found no difference among Incandescent, CFL, and Neutral-LED light bulbs on body weight of broilers.

The cumulative feed consumption and FCR differed significantly ($P \leq 0.05$) among different treatment groups. The highest cumulative feed consumption was recorded in INC (3762.80±40.36g) and lowest in LED (3323.73±67.10g) groups. In the present study the birds under LED and CFL light were calm and cool due to the spectral characteristics of these light sources and resting behavior was more pronounced in these groups which could be one of the possible reasons for their less energy expenditure and therefore less feed consumption. Sultana *et al*. [26] also found that blue/green light caused birds to rest more than yellow/red light. The incandescent lamp emits long wavelength light (towards yellow to red end of spectrum) [7] therefore more long wavelength light would have reached the hypothalamus making the birds more active hence increasing the feed consumption and it has also been stated by Jones *et al.* [11] that feed consumption was maximum for hens subjected to red light. The birds of control group were found to be active and therefore the energy expenditure was more which could be the possible reason for higher feed intake. The results of the present study are in agreement with Hajra *et al.* [6] and Ghuffar *et al.* [5] who found significant effect of light source on feed consumption of broilers.

The cumulative FCR was lowest in LED group (1.63± 0.04) and highest in Control group (1.86± 0.006). The better FCR found in the birds reared under LED lamps might be due to the fact that the LED bulbs produce the spectrum that most closely matches the spectral sensitivity of bird [19], thereby the birds were more comfortable and performed better. The improved FCR in CFL light source might also be due to spectral characteristics of this light especially recognized by poultry birds [7], thereby the birds were comfortable under CFL light which could be the result for better FCR. The results of the present study are in agreement with the findings of Huth and Archer [10], Archer [2] and Kim *et al.* [12] who also reported better FCR in birds reared under LED lighting as compared to other light sources.

The mortality of the birds among the different treatment groups did not influenced by the sources of light. The results are in good agreement with the findings of Hulan and Proudfoot [9], Rodenburg and Middelkoop [20], Kristensen *et al.* [13], MacDonald and Gibb [15], Rozenboim *et al.* [23] Mendes *et al.* [16] and Ghuffar *et al*. [5] who found no effect of light source on the mortality of broiler birds. Olenrawaju *et al.* [18] also found no significant difference on mortality of broilers when reared under incandescent and fluorescent light sources.

The incidence of leg weakness was not observed among the treatment groups**.** In agreement with the present study, Kristensen *et al.* [13] also found no effect of light source on leg health. However, Hulan and Proudfoot [9] found that the incidence of angular deformities and total leg abnormalities was significantly ($P \leq 0.05$) lower for roasters reared under fluorescent light compared with those reared under incandescent light. Lewis and Morris [14] also found that the birds reared under fluorescent lighting showed lower incidence of leg problems as compared to birds under incandescent light.

Table 1: Comparison of means for body weight (g), feed consumption (g) and FCR of broilers reared under different light sources

Treatment groups	42d Body weight	42d Feed consumption	42d FCR
Control	2129.75±33.80	3730.65^{b} ±36.45	1.86^{b}±0.006
INC	2174.28±15.33	3762.80^{b}±40.36	1.84^{b} ±0.02
CFL	2128.33±25.89	3364.28^{a}±45.08	1.68^{a} ±0.01
LED	2180.42±28.57	3323.73^{a}±67.10	1.63^{a} ±0.04

Means across the rows with different superscripts differ significantly

5. Conclusion

The results indicated no significant difference in the body weight and body weight gain of broilers among different treatment groups. However, significant differences ($P \leq 0.05$) was found in the feed consumption and FCR of the birds with lower feed consumption and better FCR in LED and CFL groups. Therefore, Incandescent light sources could be replaced with modern energy efficient light sources (LED and

CFL) as indicated by overall performance of broilers for a profitable broiler production.

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