



Original Research

Economic Evaluation of Broilers Performance under Coloured Light Emitting Diodes and Incandescent Supplemental Lighting

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Rec. Date:	Sep 06, 2018 02:44
Accept Date:	Nov 21, 2018 17:12
DOI	10.5455/ijlr.20180906024410

Abstract

The present study was designed to evaluate the broiler birds' performance using light emitting diodes (LEDs) and incandescent light. For this purpose 240 straight run commercial Cobb broiler chicks were procured and distributed in four different light treatment groups i.e. T_1 ; white (650nm), T_2 ; green (565nm) and T_3 ; blue (430nm) light LED (3 Watt each) and incandescent light bulbs (60 Watt each) as control (T_c) in 12 pens (4x3 factorial design). The data on growth performance indicated that final body weight, body weight gain and feed intake were higher in LED light treatment groups over the incandescent light bulbs. However, numerically lower FCR, higher PER and EER was found in LED light treatment groups. The data on economic benefits indicated that benefit cost ratio of LED light treatment groups (T_1 , T_2 and T_3) was higher (1:1.18, 1:1.18 and 1: 1.15) as compared to incandescent bulb treatment (T_c) i.e. 1:1.05. From the study, it can be concluded that birds under LED light treatment showed improved growth performance by increasing the overall body weight gain, reducing the FCR and by better benefit cost ratio.

Key words: LEDs, Incandescent Bulb, Supplemental Light, Broiler Birds, FCR, PER, EER, Benefit Cost Ratio

How to cite: Kumar, S., Gupta, R., Singh, Y., Sharma, A., & Kashyap, N. (2019). Economic Evaluation of Broilers Performance under Coloured Light Emitting Diodes and Incandescent Supplemental Lighting. International Journal of Livestock Research, 9(2), 18-24. doi: 10.5455/ijlr.20180906024410

Introduction

Poultry farming is an age old practice in India and to meet current higher demands of poultry, intensive poultry farming is the need of hour. In intensive poultry farming there is lot of environmental factors which plays a crucial and significant role and out of all factors light management has a significant impact on poultry production performance. The effect of coloured light emitting diodes bulbs (LEDs) on broilers growth performance (Guevara *et al.*, 2015; Rogers *et al.*, 2015; Olanrewaju and Maslin, 2016 and Seo *et al.*, 2016) is well documented. Therefore, birds under light emitting diode (LED) bulbs treatment groups



were better because of improved growth performance by increasing the overall body weight gain, reducing the FCR. Earlier a number of studies have been conducted for assessing economic returns in broiler birds reared under monochromatic lights (Ghuffar *et al.*, 2009 and Hajra *et al.*, 2009) thus, increasing the margin of profit and improving the overall benefit cost ratio. However, till now, use of coloured light emitting diodes bulbs (LEDs) in broiler sheds are not common in India due to higher initial procurement cost of coloured LEDs, but broilers can be raised under coloured LEDs (thus, improving growth performance and higher rate of return). Thus, the present study was planned with the following objectives-

- a) To compare the growth performance parameters of broiler chicks under different light treatments
- b) To work out economics under different light treatments on per bird and live weight basis.

Materials and Methods

Present experiment was conducted on 240 commercial Vencobb broiler chicks procured from M/s Venkey's India (Ltd.) at the Poultry Research Farm of the Department of Livestock Production Management, Guru Angad Dev Veterinary and Animal Science University, Ludhiana (Latitude: 30°54' North and Longitude : 75°48' East) in open sided broiler shed with monitor type asbestos sheet roofing.

Experiment Details

The shed comprised of 12 pens with 5 × 4 square feet area and the day old sexed chicks were randomly distributed to 4 treatment groups each having 3 replicates. Out of total 12 such pens, 9 pens were modified for installation of coloured light emitting diodes bulbs of 3 Watt each (3 pens for white T₁ coloured light emitting diodes bulbs, 3 pens for Green T₂ coloured light emitting diodes bulbs and 3 pens for blue T₃ coloured light emitting diodes bulbs) and remaining 3 pens were maintained as such under incandescent light bulbs (60 Watt each) which were taken as control (T_c). Broiler chicks were reared on deep litter with a provision of floor space of about 1 sq. ft. per chick from day old to 42 days of age under standard managerial conditions. The provision of natural day light was made available during 10:00 am to 04:00 pm by opening the side curtains of open sided house and rest of the time the shed remained closed under the artificial light to ensure round the clock light to broiler chicks. The entire experimental period was divided into 3 phases namely starter (0-2 weeks), grower (3-4 weeks) and finisher (5-6 weeks). The starter, grower and finisher rations were formulated containing 22, 20 and 18 % crude protein and 2896, 2932 and 2979 Kcal ME/Kg of feed, respectively. These rations (starter, grower and finisher) were offered to chicks in all treatment groups. Feed was made available *ad libitum* throughout the experimental period. A weighed quantity of feed was offered two times a day in morning and evening. Waterers were cleaned daily and first few days luke warm drinking water (temperature around 38-40 C) were provided two to three times daily and after that continuous supply of cool and fresh drinking water was ensured during the entire experimental

period. Light intensity was measured by light intensity meter (Lutron®PLX-111 light meter with range 0-20,000 LUX) and maintained at 25 Lux in first week and then reduces successively @ 5 Lux per week by increasing the height of bulbs from the bird eye level. The chicks were vaccinated against Marek, Ranikhet and Infectious Bursal diseases according to standard vaccination schedule.

Data Recording for Growth Performance

To assess the growth performance of broiler bird's body weight of individual chicks was recorded at weekly intervals with the help of digital weighing balance in early morning prior to feeding and average weekly body weight and average body weight gain were calculated for different treatments groups. Daily each replicate of all the treatment groups was offered a weighed quantity of feed and at the end of every week; feed consumption was calculated by subtracting the residual feed from total feed offered during different days of the week. The average feed intake for each group was calculated by dividing the total feed intake by the number of birds taking into account mortality, if any, in the particular pen. The feed conversion ratio (FCR) in each replicate was calculated by dividing the average feed intake by average weight gain for the week. The Protein efficiency ratio (PER) was calculated as grams of body weight gain per grams of protein consumed and Energy efficiency ratio (EER) was calculated as Kcal of metabolizable energy (ME) consumed per gram of body weight gain.

Data Recording for Economic Impact

The effect of different coloured light emitting diodes on economic gain in broiler chicken production was expressed as cost benefit ratio per bird. To assess the units of electricity consumption, different sub meters were installed for different treatment groups. The cost components were calculated as total working expenditure on purchase of chicks, feeding cost, fixed and operating cost of coloured light emitting diodes. However, labour cost was not included because care and management of broiler were performed by own. Net income was determined by subtracting working cost from gross income obtained from sale of live broiler. Data on various biochemical parameters and behavioural study in relation to different treatments were subjected to one way analysis of variance (ANOVA) utilizing GLM procedure of SAS (SAS® 9.3) software and the difference among various treatments were examined by tukey's test.

Results and Discussion

Growth Performance

The data on growth performance (Table1, 2 and 3) during different phases (starter, grower and finisher) indicated that average body weight (gm) and body weight gain (gm) were numerically higher in all coloured light emitting diodes (LEDs) treatment groups over incandescent light as control group (Tc) during all 3 phases (Starter, Grower and Finisher) and significantly ($p \leq 0.05$) higher average body weight (gm) in all

coloured light emitting diodes (LEDs) treatment groups over incandescent light as control group (T_c) during finisher phase. However within LEDs light treatment groups (T₁, T₂ and T₃) T₂ group were having maximum average body weight (1419.53±93.91) and differ significantly over T₁ (1417.68±105.46) and T₃ (1398.28±101.73) group. Similar to these findings, Rozenboim *et al.*, 1999; Rozenboim *et al.*, 2004; Cao *et al.*, 2008 and Kim *et al.*, 2013 also reported higher average body weight (gm) in broilers reared under coloured monochromatic lights.

Table 1: Growth performance of broiler chick during Starter phase (0-2 weeks) under different treatment groups

Treatment/Parameters	T _c	T ₁	T ₂	T ₃
Average body weight(gm)	138.68±26.64	140.41±24.99	138.07±24.85	134.83±24.83
Body weight gain(gm)	79.66±17.60	78.51±14.82	78.20±15.19	75.06±15.55
Feed intake(gm)	85.61±13.87	86.61±12.03	87.97±11.82	84.25±11.57
FCR	1.16±0.08	1.16±0.06	1.20±0.08	1.22±0.10
PER	3.98±0.28	3.95±0.22	3.83±0.26	3.86±0.33
EER	30.49±2.17	30.33±1.74	29.29±1.97	29.50±2.51

Feed intake (Table1, 2 and 3) was higher in LED groups as compared to incandescent group and the findings are in agreement with the findings of Mendes *et al.*, 2013; Assaf *et al.*, 2015 and Olanrewaju *et al.*, 2015 in which they found that coloured LEDs (green and blue) did not significantly ($p \leq 0.05$) affect the average feed consumption as compared to white incandescent light. Feed conversion ratio (Table1, 2 and 3) among different treatment groups did not differ significantly ($p \leq 0.05$) and it indicate that efficiency of feed utilization is better in all LED's groups as compared to incandescent group. PER and EER among different treatment groups did not differ significantly ($p \leq 0.05$) among various treatment groups and the higher PER and EER in the entire test LED groups may be due to better utilization of protein and energy.

Table 2: Growth performance of broiler chick during Grower phase (3-4 weeks) under different treatment groups

Treatment/Parameters	T _c	T ₁	T ₂	T ₃
Average body weight(gm)	571.84±61.51	593.53±66.18	593.68±72.02	581.26±64.25
Body weight gain(gm)	255.19±8.58	271.92±10.19	279.77±18.39	267.00±8.93
Feed intake(gm)	447.87±15.79	447.50±17.48	451.81±18.92	426.86±20.29
FCR	1.75±0.01	1.64±0.01	1.62±0.03	1.59±0.02
PER	2.85±0.01	3.03±0.01	3.08±0.07	3.13±0.04
EER	19.49±0.04	20.45±0.11	21.02±0.59	21.50±0.30

Table 3: Growth performance of broiler chick during Finisher phase (5-6 weeks) under different treatment groups

Treatment/Parameters	T _c	T ₁	T ₂	T ₃
Average body weight(gm)	1329.62 ^a ±93.44	1417.68 ^b ±105.46	1419.53 ^c ±93.91	1398.28 ^b ±101.73
Body weight gain(gm)	414.91±1.64	455.24±8.14	442.85±10.34	450.08±4.01
Feed intake(gm)	938.28±60.97	976.80±60.67	981.18±51.25	968.01±55.70
FCR	2.25±0.13	2.13±0.09	2.23±0.16	2.14±0.11
PER	2.48±0.15	2.61±0.11	2.50±0.17	2.62±0.13
EER	15.42±0.94	15.95±0.69	15.19±1.05	15.74±0.90

Means with different superscripts in a row differ significantly ($P < 0.05$)

Economics Impact

The data on economic analysis (Table 4) indicated that although, the initial cost and production life of LED bulbs was higher than incandescent bulbs and total installation cost of LED bulbs (Rs. 285) was highest in treatment groups over the control group, but overall profit as depicted by cost benefit ratio were on higher side under all coloured light emitting diode bulb treatment groups.

Table 4: Economic impact on broiler production subjected under different light treated groups

S. No.	Particulars	Treatments			
		T _c	T ₁	T ₂	T ₃
Input (Rs.)					
1	Total installation cost of electrical bulbs (Rs)	45	285	285	285
2	Total Fixed expenditure of electrical bulbs (Rs)	28.35	4.29	4.29	4.29
3	Fixed expenditure of electrical bulbs (Rs/bird)	0.47	0.07	0.07	0.07
4	Total operational cost of electrical bulbs (electrical units consumed x per unit price)	136.08x7.0 =952.56	8.36x7.0 =58.52	8.36x7.0 =58.52	8.36x7.0 =58.52
5	Operational cost (Rs/bird)	15.87	0.97	0.97	0.97
6	Expenditure on brooding (Rs/Bird)	6.3	12.6	12.6	12.6
7	Chick price (Rs./bird)	20.5	20.5	20.5	20.5
8	Medication and vaccination (Rs.5/bird)	5	5	5	5
9	Feeding cost (Rs/ bird)	54.19	58.63	56.84	58.96
10	Total working cost (Rs/bird) (3+5+6+7+8+9)	102.33	97.77	95.98	98.1
Output (Rs.)					
10	Average body weight/bird (g)	1538.2	1653.6	1629.86	1625.13
11	Market price (Rs/kg)	70	70	70	70
12	Gross return (Rs/ bird)	107.66	115.71	114.03	113.75
Income (Rs.)					
13	Net income(Rs/ bird)	5.33	17.94	18.05	15.65
14	Benefit – cost Ratio	1:1.05	1:1.18	1:1.18	1:1.15

The total operational cost of coloured light emitting diode bulb (Rs. 58.52) was lower than incandescent bulbs (Rs. 952.56) while the total fixed expenditure of electrical bulbs in T_c, T₁, T₂ and T₃ was Rs. 28.35, Rs. 4.29, Rs. 4.29 and Rs. 4.29, respectively. The total working cost per bird in T_c, T₁, T₂ and T₃ was Rs 102.33, Rs. 97.77, Rs. 95.98 and Rs. 98.10, respectively. Gross return per bird was highest Rs. 115.71 in T₁ followed by Rs. 114.03 in T₂, Rs. 113.75 in T₃ and Rs. 107.66 in T_c. Net income (Rs./ bird) was highest

Rs. 18.05 in T₂ followed by Rs. 17.94 in T₁, Rs. 15.65 in T₃ and Rs. 5.33 in T_C. The cost benefit ratio in T_C, T₁, T₂ and T₃ was 1:1.05, 1:1.18, 1:1.18 and 1: 1.15 respectively. Similar to these findings, Hajra *et al.*, 2009 and Khaliq *et al.*, 2017 also reported higher economic return in birds under coloured light treatment group (Rs.7.5/bird and Rs. 16.16/bird respectively) as compared to incandescent light (Rs. 2.8/bird) and Ghuffar *et al.*, 2009 also reported higher profit in birds under MH (Metal halide) light group and next to it was FC (Fluorescent light) group with profit of Rs.22.895 followed by INC (Incandescent light), no light and HPS (High pressure sodium) light groups having profit Rs. 17.02, Rs. 12.96 and Rs. 10.51 respectively. These results indicated that installation of coloured light emitting diode bulbs over incandescent bulbs in poultry industry improved economics of production and save a lot of electricity.

Conclusion

Thus, it may be summarized that broiler birds under light emitting diode (LED) bulbs treatment groups were better over incandescent bulbs in terms of growth performance by increasing the overall body weight gain, reducing the FCR and economically by having better benefit cost ratio under white and green light emitting diode (LED) bulbs treatment groups.

Acknowledgement

The authors are thankful to the worthy Vice-Chancellor, GADVASU, Ludhiana for extending necessary support to carry out this research work.

Ethical Permission

Permission to conduct experimental trial was granted by Institutional animal ethics committee vide letter no. GADVASU/2015/IAEC/27/013

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