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Research Article

Comparative Effect of Light Emitting Diode Versus Traditional Light Source on Performance, Slaughter Characteristics, Immunity and Gland's Weight of Broiler

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A B S T R A C T

In the present study, we addressed effect of different light sources on performance of chicken. Two hundred fifty day old broiler were purchased from which one hundred sixty chicks of middle weight range were selected and distributed randomly into different light treatment groups: A, Fluorescent (FC); B, Light Emitting Diode (LED); C, Incandescent (INC) and D, Compact Fluorescent (CF). Each treatment received four replicates having ten chicks per replicate. Feed intake, weight gain, feed conversion ratio (FCR), dressed meat weight, thigh weight, liver weight, gizzard weight, heart weight, intestinal weight, bursa weight, thymus weight and immunity against ND and IBD were affected ($P<0.05$) by light sources whereas shank length, shank weight and keel length were not affected ($P>0.05$). Chicken received incandescent light showed higher mortality (13%) whilst those of received LED light showed only 3% mortality. These results indicated that LED has beneficial effect on welfare of broiler and also helpful in minimizing the production cost therefore must be used in the modern broiler husbandry.

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INTRODUCTION

Poultry is the second largest industry of Pakistan with annual growth rate of 8 to 10%. It contributes 25.8% of total meat production in Pakistan (Anonymous, 2011-12). Broiler farming contribute major share in poultry meat production. Most of the broiler farming has been shifted to environment controlled housing system. Light management and environment controlled house is a key factor which implicated in stimulating efficient production. Light affects many physiological processes of poultry (Karakaya *et al*., 2009). Effect of light sources varied from each other. Choice of best lighting source has been an issue for many decades and a lot of work has been done in this regard. A significant effect of compact

Table 1: Comparison of means for different performance of broiler birds

Parameters	Treatments			
	A	B	C	D
Initial body Weight (g)	48	46	48	45
Final body weight (g)	1739^{c}	2204.5^{a}	1542^{d}	1897.5^{b}
Weight gain(g / bird)	$\pm 47.01728^{c}$	$2193.5^{a} \pm 17.6$	$1530^{d} \pm 54.5$	$1886.7^{b} \pm 22.9$
Feed consumption (g/ bird)	$3506.4^{b} \pm 78.7$	$3943.6^{a} \pm 86.2$	$3388.4^{c} \pm 57.6$	$3591.7^{b} \pm 23.6$
FCR(g feed cons./g gain)	2.02 ± 0.027^{a}	1.79 ± 0.072^{b}	2.21 ± 0.059^{a}	1.90 ± 0.029^{b}

A = FC, B = LED, C = INC, D = CFL; Means sharing similar letters in a cell are statistically non-significant

Table 2: Weekly mortality record of broilers kept under different light sources

Weeks	A	B	C	D
W1	0	0	0	0
W2	1	0	0	0
W3	0	0	1	0
W4	1	0	1	1
W5	1	1	2	1

Fluorescent light on chicken has been reported by Scheideler, (1990); Prayitno *et al*. (1997); Rozenboim *et al*. (1998), Hajra *et al*. (2009) and Ahmad *et al*. (2011) whereas Boshouwers and Nicaise (1992); Lewis & Morris (1998) and Lewis *et al*. (2007) investigated no effect of compact fluorescent light on production performance of broiler. Hulan *et al*. (1987) compared two light sources (incandescent and fluorescent) on performance of broiler and reported an effect of light sources on body weight in broiler birds. Leighton *et al*. (1989) used incandescent (IN), daylight fluorescent (DF) and warm fluorescent (WF) lighting sources and found no effect of light sources on growth in turkeys. Rozenboim *et al*. (1999a) checked the effects of different light sources on the growth of broiler and envisaged that chicken reared on mini-fluorescent light bulbs were heavier than those kept under fluorescent tubes or incandescent bulbs. It is envisaged that LED lamps were found more energy efficient as compared to fluorescent tubes, compact fluorescent light, incandescent bulbs, fiber Angelica *et al*. (2012) reported better production performance in broilers reared under light emitting diodes light as compared to compact fluorescent light bulbs. No doubt scientists are still working to explore the most suitable source of artificial light which may be used in efficient broiler production and instead of its great work on effect of light sources on broiler production very least research has been conducted on Light emitting diode (LED) which is said to be very efficient and is an innovative technology, having better life span (50,000 hrs) than fluorescent (5000 hrs) and compact fluorescent (10,000 hrs) lights (Angelica *et al*., 2012).

Light emitting diode (LED) is a solid state device that converts electric energy directly into light through electroluminescence (Michael, 2008) and it seems to be imperative to compare it to traditional light sources. Therefore the objective of the present study was to examine whether the light emitting diode (LED) is an efficient alternative productive light source compared to those used in commercial rearing conditions or not.

MATERIALS AND METHODS

The experiment was carried out in the shed of Poultry Research Center, University of Agriculture, Faisalabad. From a local hatchery, two hundred and fifty day old broiler chicks (Hubbard) were purchased from a local hatchery. These chicks were individually weighed at 1st day and one hundred sixty chicks of middle weight range were selected for experimental purpose. These broiler chicks were randomly divided in to sixteen replicates, having ten chicks per replicate.

These replicates were randomly allotted to four treatments: A, Fluorescent (FC); B, Light Emitting Diode (LED); C, Incandescent (INC) and D, Compact Fluorescent (CF). Each treatment had four replicates. The chicks were reared for a period of five week in a room having sixteen pens. The chicks under different experimental treatments were kept in separate pens measuring 3x5 sq. ft. Strict biosecurity measures were followed throughout the experiment. All birds were provided homogeneous environmental conditions in every aspect with exception of light environment. Complete records of weekly feed consumed were maintained and at the end of every week average body weight of birds were calculated by an electrical weighing balance. Mean values of these records were calculated, separately from the data recorded. Antibodies against Newcastle disease and Infectious Bursal disease were measured by analyzing serum samples of two birds randomly selected from each replicate at weekly intervals after post vaccination as described by Buxton and Fraser (1977).

Table 3: Comparison of means for slaughter characteristics

Groups	Live Weight	Dressed meat	Heart	Liver	Gizzard	Intestine	Thigh	Breast	Dressing percentage
A	2067.0b±119.55	1353.8b±63.71	8.75b±1.01	54.16a±5.23	40.87c±6.02	107.58b±19.60	191.67b±17.49	321.67ab±18.50	65.58ab±3.56
B	2276.7a±105.34	1438.3a±118.99	10.33a±2.24	57.00a±5.96	50.33a±7.05	127.12a±21.57	218.33a±18.00	341.67a±27.90	63.22b±5.08
C	2029.2b±66.62	1399.2ab±108.07	8.11b±1.17	47.50b±5.19	42.91bc±8.43	97.91b±8.33	218.33a±28.86	327.50ab±36.12	68.97a±4.80
D	2042.9b±137.89	1380.0ab±47.48	7.94b±1.05	47.45b±3.03	47.37ab±4.09	104.17b±7.45	206.96ab±17.62	317.50b±16.58	67.58a±2.34

A = FC, B = LED, C = INC, D = CFL; Means sharing similar letters in a cell are statistically non-significant.

Table 4: Comparison of means for bursa weights (g) and thymus weights (g)

Groups	Bursa	Thymus
A	1.87±1.26b	10.33±3.15ab
B	2.70±0.98a	10.91±1.79a
C	1.12±0.51b	8.91±2.14bc
D	1.58±0.51b	7.83±0.93c

A = FC, B = LED, C = INC, D = CFL; Means sharing similar letters in a cell are statistically non-significant

Table 5: Comparison of means for Shank Weight (g), shank length and keel length

Groups	Shank Weight	Keel Length	Shank Length
A	47.07±3.88a	4.61±0.24a	2.48±0. 071a
B	41.80± 13.19a	4.64±0.17a	2.50±0.090a
C	43.29± 3.66a	4.47±0.23a	2.46±0.049a
D	45.20± 3.44a	4.67±0. 35a	2.49±0.090a

A = FC, B = LED, C = INC, D = CFL; Means sharing similar letters in a cell are statistically non-significant.

Table 6: Temporal distribution of antibody titers against Newcastle disease (ND) and Infectious Bursa Disease (IBD) in broilers at 32 days of age

Groups	ND	IBD
A	212±1.0484a	40±10.32a
B	268.75±1.7013a	84±38.56a
C	144±81.059a	31±12.47a
D	256.7±1.7456a	72±40.52a

A = FC, B = LED, C = INC, D = CFL
Means sharing similar letters in a cell are statistically non-significant.

At the end of experiment two birds from each replicate of each treatment were picked up randomly and data regarding dressed weight, dressing %age, Edible meat weight, relative kidney weight, relative liver weight, relative intestine weight, relative heart weight, relative gizzard weight, abdominal fat weight, bursa gland weight and thymus gland weight were recorded as described by Sagheer *et al*. (2004). Shank length and keel length were measured by measuring tape. The data so obtained were statistically analyzed by analysis of variance (ANOVA) technique using Completely Randomized Design (Steel *et al*., 1997). The differences in means of the treatments were compared by Duncan's Multiple Range (Duncan, 1955) test.

RESULTS AND DISCUSSION

Light sources revealed significant effect on weight gain, feed consumption and Feed Conversion Ratio ($P<0.05$). The mean values of weight gain of group A, B, C and D were1728g SE47.0, 2193g SE 17.6, 1530g SE 54.5 and 1886.7g SE 22.9, respectively, mean values of feed consumption of groups A, B, C and D were 3506.35g SE 78.7, 3943.64g SE 86.2, 3388.36g SE 57.6 and 3591.72g SE 23.6 respectively and mean values of groups A, B, C and D were 3506.35g SE 78.7, 3943.64g SE 86.2, 3388.36g SE 57.6 and 3591.72g SE 23.6 respectively (Table 1). Maximum weight gain was observed in group B (2193g SE 17.6) which were provided LED light, minimum fed consumption was observed in group C (3388.36g SE 57.6) which were provided INC light and birds kept under group B (LED) revealed better FCR (1.9 SE 0.029) as compared to other treatment groups. In present study birds provided LED light source gained more body weight as compared to all other groups. Different studies showed significant impact of light sources on body weight (Karakaya *et al*., 2009; Korde *et al*., 2007; Ghuffar *et al*., (2009). Whereas many other reports indicated no significant effects of different light sources on body weight in broilers (Leighton *et al*., 1989; Rodenburg and Middelkoop, 2003.

Until now very little research has been conducted on effect of LED on performance of chicken. Cao *et al*. (2008) reported significant effect of light emitting diode on growth of chicken. Similarly Karakaya *et al*., (2009) and Rozenboim *et al*., (2004) revealed the higher body weight of broiler kept under LED light source versus incandescent light. Significant effect of light sources on feed consumption was investigated by different scientists (Rozenboim *et al*., 1999! Korde *et al*., 2007;

Ghuffar *et al*., 2009) whereas many others found no significant effects of varying light sources on feed consumption in broilers (Hulan and Proudfoot, 1987; Rodenburg and Middelkoop, 2003; Rozenboim *et al*., 1999; Kristensen *et al*., 2006; Angelica *et al*., 2012). Rodenburg and Middelkoop (2003) reported that light source has no significant impact on FCR. Similar results are reported by Korde *et al*. (2007) whilst Ghuffar *et al*. (2009) investigated significant effect of light sources on FCR. Studies conducted on effect of LED on feed conversion ratio are very scant and study of Anglica *et al*. (2012) who observed better FCR under LED light source was background study in this regard.

The contradiction might be due to use of light sources of varying wavelength, differences in: types, strains, ages and sexes of birds or it might be due to variation in climatic conditions under which birds were reared. However it was first attempt to compare the efficacy of LED versus other commonly used light sources and we investigated significant productive effect of LED. It might be due that heat emission rate of LED is 3.4 BTU/hour which causes less stress to chicken (Khan and Abas, 2011); it is non sensitive to low temperature; its carbon dioxide emission rate is too low 451 pounds/year and it contains no toxic Mercury (Khan and Abas, 2011).

Mortality record was maintained throughout the research. The mortality was higher in the group C (13%) followed by group A (10%) and group D (6%) whilst group B showed only 3% mortality (Table 2). Highest mortality was seen kept under incandescent light source in present study whilst Rozenboim *et al*. (1999) reported significant less mortality in incandescent light group. Many researches revealed non significant effect of light sources on mortality (Rodenburg and Middel koop, 2003; Kristensen *et al*., 2006; Ahmad *et al*., 2011). However Leighton *et al*. (1989) observed greater mortality in birds under fluorescent light source. Most probable reason of greater mortality in traditional light group might be higher radiation flux from these light sources.

Light sources affected the dressed meat of broiler ($P>0.05$). Group B gained more dressed weight. Mean values of dressed meat weight of groups, A (FL), B (LED), C (INC) and D (CFL) were 1353.8, 1438.3, 1399.2 and 1380.0, respectively. Dressed meat weight was significantly higher in broiler received LED light. Thigh meat weight values of the birds kept under different treatments, A, B, C and D was 191.67, 218.33, 218.33 and 206.96, respectively. Apparently significantly maximum thigh meat was observed in treatment B ($P<0.05$). Light sources revealed an effect on liver weight, heart weight, gizzard weight and intestine weight ($P>0.05$) of the birds (Table 3).

Rodenburg and Middelkoop (2003) determined that lighting source had no significant effect on organ weights. Similarly Sagheer *et al*. (2004) found no differences in carcass weights, internal organs weights, head, neck, drumsticks, back, femurs, wings and abdominal fat deposition among different lighting programs. Petek *et al*. (2005) envisaged that intermittent light can decrease thigh disease incidence in chicken. Liu *et al*. (2010) investigated that monochromatic green or blue light may increases muscle growth of chicken whilst Cao *et al*. (2008) investigated better growth rate and productive performance when broilers were reared under green monochromatic light (LED) during the early life stage and blue monochromatic light (LED) during the later life stage. It was due to more effective stimulation of testosterone secretion.

Bursa weight and thymus weight was affected by light sources ($P<0.05$). The weight of the gland was high in the group B (Table 4). Victor *et al*. (1997) and, Rodenburg and Middelkoop (2003) found no significant effect of light sources on organ weights whereas Cao *et al*. (2008) reported significant effect of light sources on gland's function. Light imparts significant effect on the glandular system in birds (Blair *et al*., 2000). Bursa gland is responsible for maturation of B Lymphocytes and Thymus gland is responsible for maturation of T Lymphocytes. Improved weight of these glands under LED light might be cause of better immune response against ND and IBD.

Shank length, shank weight and keel length were not affected ($P>0.05$) by light sources (Table 5). Rozenboim *et al*. (1999) found that broilers from the INC group had less skin damage. Ingram *et al*. (2000) reported significant decrease in shank length by light restriction whilst keel length and tibiotarsal weight and strength were not affected.

Light sources revealed an effect on immunity against ND ($P<0.05$). The GMT values of antibody titer against Newcastle disease virus were found to be 139.59, 128, 90.51 and 107.63 in groups A, B, C and D respectively (Table 6). Group A gained more immunity titer than B, group B had more values of antibody titer as compared to group C and D. The GMT values of antibody titer against Gumboro disease virus were 34.89, 64, 20.75 and 45.25 in groups A, B, C and D respectively (Table 7). Group B (LED) gained highest titer ($P<0.05$) in the 5^{th} week post vaccination. Titer in the INC group was lowest. Recently many researchers have revealed significant effect on immunity against ND (Liu *et al*., 2010; Sadrzadeh *et al*., 2011); Jin *et al*.,

2011). Ahmad *et al*. (2011) concluded that melanin enhances immune response and melanin secretion depends on darkness. Skewed lighting can cause agitation, breeding problems, picking behaviors, weakness, and metabolic disorders (Lucio, 2000) Melatonin enhances cellular and humoral immune response in broilers and Japanese quail (Moore and Siopes, 2005). Light emiiting Diode might have some beneficial effect on immune system.

REFERENCES

Ahmad, F., A. U. Haq, M. Ashraf, G. Abbas and M. Z. Siddiqui, 2011. Effect of different light intensities on the production performance of broiler chickens. Pak. Vet. J. 31(3): 203-206.

Angelica, S. M., J. P. Sandro, R. Rasiel and M. Julieli. 2012. Performance and Preference of Broiler Chickens under Different Light Sources. ASABE, 12-1847.

Anonymous. 2011-2012. Economic survey of Pakistan, Govt. of Pakistan, Finance division, Economic Advisor's Wing, Islamabad Pakistan.

Blair, R., R.C. Newberry and E.E. Gardiner. 2000. Effects of lighting pattern: Broiler house lighting sources and photoperiods. Poult. Sci. 69: 1471-1479.

Boshouwers, F. M. G. and E. Nicaise. 1992. Responses of broiler chickens to high frequency and low frequency fluorescent light. J. Brit. Poult. Sci. 33: 711-717.

Buxton, A. and G. Fraser. 1977. Animal Microbiology. Blackwell Sci. Pub., Oxford. 1st Ed. 2:526-528.

Cao, J., W. Liu, Z. Wang, D. Xie, L. Jia, Y. Chen. 2008. Green and Blue Monochromatic Lights Promote Growth and Development of Broilers Via Stimulating Testosterone Secretion and Myofiber Growth. J. Appl. Poult. Res. 17(2): 211-218.

Duncan, B. D. 1955. Multiple range and multiple F-test. Biometrics, 11: 31-42.

Ghuffar, A., K. Rahman, M. Siddque, F. Ahmad and M. A. Khan. 2009. Impact of various lighting source incandescent, fluorescent, metal halide and high pressure sodium on the production performance of chicken broilers. J. Agri. Sci. 46:8-12.

Hajra, D. K., S. Kumar, J. P. Korde, A. K. Ghosh and D. Kumar. 2009. Effect of light source on growth and economics of commercial broiler production. J. Ind. Poult. Sci. 44:257-259.

Hulan, H.W. and Proudfoot, F.G. 1987. Effects of light source, ambient temperature, and dietary energy source on the general performance and incidence of leg abnormalities of roaster chickens. Poult. Sci. 66(4): 645-651.

Ingram, D. R. L. F. Hattens and B. N. McPherson. 2000. Effects of Light Restriction on Broiler Performance and Specific Body Structure Measurements. J. Appl. Poult. Res. Winter, 9 : 4 501-50.

Jin E, L Jia, J Li, G Yang, Z Wang, J Cao and Y Chen, 2011. Effect of Monochromatic Light on Melatonin Secretion and Arylalkylamine *N*-Acetyltransferase mRNA Expression in the Retina and Pineal Gland of Broilers the Anatomical Record: Adv. Integ. Ana. Evo. Bio. 294: 1233-1241.

Karakaya, M., S. Parlat, M. Yilmaz, I. Yildirim and B. Ozalp. 2009. Growth performance and quality properties of meat from broiler chickens reared under different monochromatic light sources. J. Br. Poult. Sci. 50:76-82.

Khan, N. and N. Abas. 2011. Comparative study of energy saving light sources. Ren. Sust. Ener. Rev. 296-309.

Korde, J. P., A. Kumar, M. Patel and S. K. Rastogi. 2007. Effect of light source and photoperiods on growth and health performance in broilers. Ind. J. Anim. Res. 41:21-25.

Kristensen, H. H., G. C. Perry and N. B. Prescott , J. Ladewig, A. K. Ersboll and C. M. Wathes. 2006. Leg health and performance of broiler chickens reared in different light environments. J. Br. Poult. Sci. 47:257-63.

Leighton, A.T., R. M. Hulet and D. M. Denbow. 1989. Effect of light sources and light intensity on growth performance and behavior of male turkeys. J. Brit. Poult. Sci. 30:563-574.

Lewis, P. D., L. Caston and S. Leeson. 2007. Green light during rearing does not significantly affect the performance of egg type pullets in the laying phase. J. Poult. Sci. 86:739-743.

Lewis, P.D. and T.R. Morris. 1998. Responses of domestic poultry to various light sources. J. World's Poult. Sci. 54:7-24.

Liu, W. J., Z. X. Wang, Y. X. Chen. 2010. Effects of Monochromatic Light on Developmental Changes in Satellite Cell Population of Pectoral Muscle in Broilers During Early Posthatch Period. Anat. Rec. Adv Integr. Anat. Evol. Biol. 293(8): 1315-1324.

Lucio, B. 2000. Cornell poultry pointers, held June 21, 2000, at the Ithaca Ramada Inn. 50. 3 July 2000.

Michael, J. O., 2008. LED poultry lighting: Energy and production efficiency. EVP, Once Innovations Inc.

Moore C B and T D Siopes, 2005. Enhancement of cellular and humoral immunity following embryonic exposure to melatonin in turkeys (Meleagris gallopavo). Gen Comp Endocrinol, 143:178-183.

Petek, M., G. S nmez, H. Yildiz, and H. Baspinar. 2005. Effects of different management factors on broiler performance and incidence of tibial dyschondroplasia. Br. Poult. Sci. 46:16-21.

Prayitno, D. S., C. J. C. Phillips and D. K. Stokes. 1997. The effects of color and intensity of light on behavior and leg disorders in broiler chickens. J. Poult. Sci. 76:1674-1681.

Rodenburg, J. van Harn and van Middelkoop, J.H. 2003. Effect of coloured light on production- and welfare traits in broilers. Applied Research, Animal Sciences Group, Wageningen UR, P.O.Box 2176, 8203 AD Lelystad, The Netherlands.

Rozenboim, I., Piestun, Y., Mobarkey, N., Barak, M., Hoyzman, A. and Halevy, O. 2004. Monochromatic light stimuli during embryogenesis enhance embryo development and posthatch growth. Poult. Sci. 83: 1413-1419.

Rozenboim, I., R. Huisinga, O. Halevy, and M. E. El Halawni. 2003. Effect of embryonic photostimulation on the posthatch growth of turkey poults. Poult. Sci. 82: 1181-1187.

Rozenboim, I., B. Robinzon and A. Rosenstrauch. 1999. Effect of light source and regimen on growing broilers. J. Brit. Poult. Sci. 40:452-457.

Rozenboim, I., Y. Zilberman and G. Gvaryahu. 1998. New monochromatic light source for laying hens. J. Poult. Sci. 77:1695-1698.

Sadrzadeh A, G N Brujeni, M Livi1, MJ Nazari1, M T Sharif1, H Hassanpour and N Haghighi, 2011. Cellular immune response of infectious bursal diseaseand Newcastle disease vaccinations in broilers exposed to monochromatic lights. Afri. J. Biotech 10: 9528-9532.

Sagheer, M., M. N. Makled and M. A.Mohammad, 2004. Effect of different lighting programmes on broiler performance. Egyp. Poult. Sci. J. 24:737-750.

Scheideler, S. E. 1990. Effect of various light sources on broiler performance and efficiency of production under commercial conditions. J. Poult. Sci. 69:1030-1033.

Steel, R. G. D., J.H. Torrie and D.A. Dickey. 1997. Principles and Procedure of Statistic. A biometrical approach (3rd edition), W. C. B. McGraw Hill. USA.

Victor G. Stanley, Jose Gutierrez, Alfred L. Parks, Samuel A. Rhoden, Hyginus Chukwu, Cassandra Gray, And Willie F. Krueger. (1997). Relationship between age of commercial broiler chickens and response to photo stimulation. Poult. Sci. 76:306-310.