

Research Article

Effect of Varying Light Intensity on Immunity Level, Dressed Weight, Minor Body Parts Weight, Fat Deposition and Serum Glucose Level in Broilers

Ghulam Abbas, Fawwad Ahmad, Sultan Mahmood, Muhammad Yousaf, Asif Iqbal¹, Muhammad Ijaz Saleem*², Ashar Mahfooz² and Faisal Siddique³

Department of Poultry Science; ¹Department of Parasitology; ²Department of Clinical Medicine and Surgery; ³Institute of Microbiology, University of Agriculture, Faisalabad-38040-Pakistan

*Corresponding author: drijazsaleem@gmail.com

ARTICLE HISTORY

Received: March 22, 2014

Revised: April 15, 2014

Accepted: May 27, 2014

Key words:

Broilers

Dressed weight

Immunity

Light intensity

Organ weight

ABSTRACT

This project was designed to explore the effects of varying light intensity on the immunity level, dressed weight, minor body parts weight, fat deposition and serum glucose level in broilers. Five light treatments T1 (20 lux at first week and 5 lux from 2-6 week), T2 (20 lux at first week and 10 lux from 2-6 week), T3 (20 lux at first week and 20 lux from 2-6 week), T4 (20 lux at first week and 30 lux from 2-6 week) and T5 (20 lux at first week and 40 lux from 2-6 week) were given to 150 birds equally divided in groups A, B, C, D and E respectively. The chicks were divided into fifteen replicates, allotted to five treatments group. The result of the study revealed that light intensity affected dressed weight, abdominal fat weight, head weight, neck weight, liver weight, bursa weight and immunity level against infectious bursa; disease (IBD) significantly ($P < 0.05$) whilst dressing percentage, carcass fat weight, heart weight, spleen weight, gizzard weight, drumstick weight, serum glucose level and immunity level against Newcastle disease (ND) were found to be un-affected.

All copyright reserve to Mr.Scholar

To Cite This Article: Abbas G, Ahmad F, Mahmood S, Yousaf M, Iqbal A, Saleem MI, Mahfooz A and Siddique F, 2014. Effect of varying light intensity on immunity level, dressed weight, minor body parts weight, fat deposition and serum glucose level in broilers. *Sch Adv Anim Vet Sci*, 1(1): 9-12.

INTRODUCTION

Light is an important exogenous factor for controlling many physiological and behavioral processes in birds (Ahmad *et al.*, 2011). Light intensity has influences on bird's immunity and antibody production in broilers (Onbailar *et al.*, 2007). Pineal gland regulates daily body rhythms and via its hormone melatonin, enhances immune function (Moore and Siopes, 2005). Lia *et al.* (2010) reported a short light duration may enhance the immune system. Onbailar *et al.* (2007) investigated that intermittent lighting has positive effects on antibody titers against anti-Newcastle disease virus. It was also investigated that green and white lights had strong effects ($P < 0.05$) on immunity in broilers (Sadrzadeh *et al.*, 2011). Stoianov and Georgiev, (1981) envisaged a higher amount of muscle glycogen in birds kept at low intensity. A low concentration of blood pyruvate was reported in birds kept at lower intensity light (Stoianov and Georgiev, 1981). Early investigations suggested that an increase in light intensity increased the fat pad yield, blood plasma

cholesterol, and whole body fat weight; while increased in incidence of skeletal muscles and foot pad health disorder and ocular defects in broilers subjected to dim light (Lien *et al.* 2008, Blatchford *et al.*, 2009, Deep *et al.*, 2010). However, no effect of light on fat pad weights or yield reported by (Downs *et al.*, 2006).

Yahav *et al.* (2000), found that light intensity affected heart muscle weight but not weight of breast muscle, abdominal fat or testis. Similarly, Rodenberg and Middlekoop (2003) reported no differences in body organ weight between different lighting systems. In contrast, Sagheer *et al.* (2004) investigated that the broilers reared under increasing light significantly has lower breast yield. In another investigation, Robinson (2004) explored that birds exposed to longer light duration had heavier carcass fat than those exposed to smaller light duration. Low light intensity could result in significantly heavier dressed weight, whilst high light intensity reduce leg abnormalities, drumstick weights and tibia weights (Hester *et al.*, 1986). Abdul Ghuffar *et al.* (2009) reported significantly higher weights of heart at 20 lux compared to 10 lux, but it had no effect on liver weight.

Table 1: Blood glucose level, abdominal fat weight and carcass fat weight in broilers kept under different light intensity treatment groups

Parameters	Light intensity treatment groups (duration 2-6 weeks)				
	A=5 lux	B=10 lux	C=20 lux	D=30 lux	E=40 lux
Blood glucose level	201.5 SE±3.25	203.7 SE±6.38	168.83 SE±5.05	182.16 SE±15.16	164.66 SE±28.16
Abdominal fat wt. (g)	75 ^b SE±3.81	76 ^b SE±1.04	81.3 ^{ab} SE±3.1	89.5 ^a SE±2	89.6 ^a SE±2.6
Caracas fat wt. (g)	96.61 SE±4.4	97 SE±4	98.3 SE±1.6	98 SE±1.52	101 SE±2

Same superscript with in rows shows non-significant differences

Table 2: Immune production in broilers against IBD and ND kept under various light intensity treatment groups

Light treatment group	Immunity titer against IBD	Immunity titer against ND
A	470 ^a SE±0.0	533.66 SE±4.5
B	446 ^b SE±0.19	545.5 SE±9.6
C	420 ^{bc} SE±7.63	480.8 SE±7.3
D	394 ^c SE±9.82	505.6 SE±7.7
E	357 ^d SE±16.64	487.16 SE±9.3

Same superscript with in columns shows non-significant differences

The present research was conducted to defuse the variance of previous investigations by using different intensity of light on broilers under controlled environment.

MATERIALS AND METHODS

Experimental design: The research was conducted at Poultry Research Center, University of Agriculture, Faisalabad. One hundred and fifty broiler chicks were randomly divided into 15 experimental units, comprising 10 chicks each, designated as replicates. Three replicates were randomly assigned to each of the five experimental groups A, B, C, D, and E. The light treatment T1 (20 lux at first week and 5 lux from 2-6 week) was given to birds of group A, T2 (20 lux at first week and 10 lux from 2-6 week) to group B, T3 (20 lux at first week and 20 lux from 2-6 week) to group C, T4 (20 lux at first week and 30 lux from 2-6 week) to group D, and T5 (20 lux at first week and 40 lux from 2-6 week) to group E birds. These birds were provided with commercial feed, according to recommended specifications (NRC, 1994), ad libitum.

Dressed weight and fat analysis: At the end of experiment two birds from each replicate of each treatment group were picked up randomly and their dressed weight, dressing %age, abdominal fat weight, carcass fat, and minor body parts weights were recorded, according to the procedure of Sagheer *et al.*, (2004).

Serum analysis: Humeral immune response was measured in two randomly selected bird's serum, from each replicate. Antibody titers against Newcastle disease and Infectious bursal disease, were determined by the procedure described by Hussain *et al.* (2003). Serum glucose level was determined by the method described by Barham and Trinder, (1972).

Statistical analysis: The data thus collected was subjected to statistical analysis for the interpretation of results using analysis of variance technique with completely randomized design. Treatment means were compared by Duncan Multiple Range test (Steel *et al.*, 1996).

RESULTS AND DISCUSSION

Abdominal fat and carcass fat weight: The results of present investigation revealed that broiler chicks exposed to high light intensity had significant more ($P<0.05$) abdominal fat deposition compared to low intensity light (Table 1), which is in accordance with the previous published reports (Lien *et al.* 2008 and Robinson, 2004). Also, in accordance to other scientific reports on decreased fat pad weights and whole body fat weight in broilers subjected to dim light (Charles *et al.*, 1992).

Analysis of Variance of the data revealed non-significant effects ($P>0.05$) of light intensity on carcass fat deposition in birds under investigation. Results are in contrast with previous exploration of Robinson (2004), who found that bird exposed to more light have heavier carcass fat than that of exposed to less light. In resemblance with Olanrewaju *et al.* (2011), who resulted that broilers at 56 days of age, reared less than 2.5 lux and 10 lux of light performed better and had significantly higher tender meat weight than those reared at 0.2 lux or 25 lux. The inconsistency observed might be due to management factors, e.g. space, density, and activity, in birds reared under different experimental environments.

Dressed weight of body organs and dressing percentage: Results of the present research showed that the light intensity had significant effect ($P<0.05$) on the dressed weight, with maximum dressing percentage noted was 71.7 in group B (Table 3). This indicated that with low intensity of light the average dressed weight gain was more than in birds exposed to higher intensity of light. This is in accordance with the previous reports (Charles *et al.*, 1992) indicating that in low intensity of light (6 lux) the bird activity decreased compared to higher light intensities (51 lux), which significant effected the dressing percentage. Hassanzada *et al.* (2000) also had reported similar results and expressed that with low light intensity the bird's metabolic rate is increased, which caused a significant increase in dressed weight percent. It was assumed that with lower light intensities, there was reduction in body activity and improvement in muscle growth, also supported by Charles *et al.* (1992).

Light intensity also affected the head and neck weights significantly ($P<0.05$). Birds of group A, gained more neck weight as compared to other groups. Similar report has been published (McKee *et al.*, 2009), indicating that birds subjected to dim light had greater live weights ($P<0.05$), post-chill weights and fillet weights than birds reared in bright light. In the current research findings, the light intensity had non-significant effect on drumstick weight, Table 4.

The liver weight gain, in the present study, indicated a significantly increase ($P<0.05$), whilst the heart weight,

Table 3: Post slaughter data of broilers kept under different light intensity treatment groups

Parameters	Light Treatment groups (duration 2-6 weeks)				
	A = 5 lux	B = 10 lux	C= 20 lux	D = 30 lux	E = 40 lux
Live weight (g)	2064.1 SE±42.93	1924.7 SE±62.1	1924.8 SE±25.4	1927.8 SE±51.7	1985.4 SE±47.1
Dressed weight (g)	1381.6 ^a SE±42.5	1381.6 ^a SE±57.7	1333.3 ^{ab} SE±49.1	1248.3 ^{ab} SE±18.3	1210 ^b SE±10
Dressing %	66.9	71.7	69.2	64.7	60.9

Same superscript with in rows shows non-significant differences

Table 4: Weight of minor body parts of broilers kept under different light treatment groups

Parameters	Light Treatment groups				
	A = 5 lux (2-6 weeks)	B = 10 lux (2-6 weeks)	C= 20 lux (2-6 weeks)	D = 30 lux (2-6 weeks)	E = 40 lux (2-6 weeks)
Liver weight (g)	65 ^a SE±1.115	63.4 ^a SE±0.90	59.1 ^b SE±0.945	59.7 ^b SE±1.241	59 ^b SE±1
Heart weight (g)	14.8 SE±0.61	14.5 SE±0.072	14.4 SE±0.34	14.6 SE±0.17	14.5 SE±0.24
Gizzard weight (g)	32.2 SE±0.55	30.9 SE±0.53	30.00 SE±0.57	29.2 SE±1.01	28.8 SE±1.02
Head weight (g)	57.7 ^a SE±0.6	56 ^a SE±4.09	51.16 ^{ab} SE±2.4	50.3 ^{ab} SE±0.33	46.8 ^b SE±1.48
Neck weight (g)	101.5 ^a SE±3	98.3 ^a ±2.12	96.3 ^{ab} SE±2.12	90.3 ^{bc} SE±1	85.7 ^c SE±2.68
Bursa weight (g)	3.23 ^a SE±.033	2.95 ^b SE±0	2.88 ^{bc} SE±0.044	2.75 ^c SE±0.0577	2.75 ^c SE±0.0763
Drumstick weight (g)	111.6 SE±1.66	107.6 SE±1.4	105 SE±2.8	103.3 SE±3.3	103.3 SE±1.66
Spleen weight	3.1 SE±0.05	3.11 SE±0.12	3.01 SE±0.066	2.9 SE±0.16	2.8 SE±0.028
Pancreas weight	5.997 SE±0.19	5.657 SE±0.19	5.760 SE±0.19	6.163 SE±0.19	5.833 SE±0.19

gizzard weight, spleen weight, and pancreas weight was non-significantly among broiler chick groups, using various light intensity (Table 4), and was in accordance with report of Lien *et al.* (2008) and Abdulguffar *et al.* (2009). In contrast with the experiment by Yahav *et al.* (2000), that indicated that light intensity significantly affected the heart weight but not breast muscle, abdominal fat and testis weight.

Bursa fabricius weight: The results of the present study had indicated that there was significant reduction ($P<0.05$) in bursa fabricius weight with increase in the light intensity (Table 4). Birds kept under lower light intensity showed maximum antibody titer (IBD) and weight of bursa fabricius, indicating strong interaction of light intensity and bursa fabricius growth. In contrast with the findings of Abdulguffar *et al.* (2009) and Rodenburg and Midlkoop (2003) and concluded that light had no significant effect on bursa fabricius weight.

Immunity against gumboro disease virus and newcastle disease virus at 6th week of age: The antibody titer against Gumboro disease virus revealed significant differences ($P<0.05$) with different light intensity. Group A developed more humoral immunity against Gumboro disease virus as compared to other groups, indicating that high light intensity had negative impact on immune production and it is in accordance with previous studies (Scot and Siopes, 1994 and Kirby and froman, 1991). The antibody titer against Newcastle disease virus revealed non-significant differences ($P>0.05$), in birds reared at different intensity of light. In contrast, previous research studies had indicated that green and blue monochromatic lights promoted myofibril growth and humoral immune response in the broilers (Liu *et al.*, 2010, and Sadrzadeh *et al.*, 2011). The light intensities used in the present experiment to excavate the effect on immune function were inordinately greater than that are used in the commercial broiler farms, which had no added effect in immune production.

Serum glucose: Analysis of variance for serum glucose level showed non-significant differences ($P>0.05$) among

birds in different groups, used in the present investigation (Table 1), which is similar to results reported earlier (Abdul Gaffar *et al.* 2009). It was in contrast with findings of Stoianove and Georgiev (1981), who had reported significant effects of light intensity on serum glucose levels.

Conclusion: It could be concluded from the data of the present research that there is good interaction between light intensity and weight gain in broilers. The vital evidences drawn from the current research specified that the light intensity of 5 lux if fitted at broiler farm houses, is good for maximum production as well as good in saving energy, and a higher light intensities sources are sheer wastage.

REFERENCES

- Gaffar A, Rehman K, Siddique M, Ahmad F and Khan MA, 2009. Impact of various lighting sources and regimens on the production performance of broilers. Pak J Agric Sci, 46: 40-45.
- Ahmad F, Haq AU, Ashraf M, Abbas G and Siddiqui MZ, 2011. Effect of different light intensities on the production performance of broiler chickens. Pak Vet J, 31: 203-206.
- Barham D and Trinder P, 1972. an improved color reagent for the determination of blood glucose by the oxidase system. Analyst, 97: 142-145.
- Blatchford RA, Klasing KC, Shivaprasad HL, Wakenell PS, Archer GS and Mench JA, 2009. The effect of light intensity on the behavior, eye and leg health, and immune function of broiler chickens. Poult Sci, 40: 8820-28.
- Charles RG, Robinson FE, Hardin RT, YU MW, Feddes J and Classen HL, 1992. Growth, body composition and plasma androgen concentration of male broiler chickens subjected to different regimens of photoperiod and light intensity. Poult Sci, 71: 1595-1605.
- Deep A, Schwan KL, Crowe TG, Fancher BI and Classen HL, 2010. Effect of light intensity on broiler

- production, processing characteristics and welfare. *Poult Sci*, 89: 2326-2333.
- Downs KM, Lien RJ, Hess JB, Bilgili SF and Dozier WA, 2006. The effects of photoperiod length, light intensity, and feed energy on growth responses and meat yield of broilers. *J Appl Poult Res*, 15: 406-416.
- Hassanzada M, Bozorgmerifard MH, Akbari AR, Buys J and Decuyper E, 2000. Effect of intermittent lighting schedule during the natural scotoperiod on T3- induced ascites in broiler chicken. *Avian Pathol*, 29: 433-439.
- Hester PY, Peng IC, Adams RL, Furumoto EJ, Larsen JE, Phyllis M, Klingensmith OA and Stadelman WJ, 1986. Comparison of two lighting regimens and drinker cleaning programs on the performance and incidence of leg abnormalities in Turkey males. *Brit Poult Sci*, 27: 63-73.
- Hussain I, Zahoor MA, Rasool MH, Mahmood MS, Mansoor MK and Riaz MN, 2003. Detection of serum antibody levels against infectious bursal disease (IBD) virus using indirect hemagglutination (IHA) test in commercial broilers. *Inter J Poult Sci*, 2: 442-445.
- Kirby JD and Froman DP, 1991. Evaluation of humoral and delayed hypersensitivity responses in cockerels reared under constant light or a twelve hour light: twelve hour dark photoperiod. *Poult Sci*, 70: 2375-2378.
- Lien RJ, Hess JB, Mckee SR, Bilgili SF and Townsend JC, 2007. Impact of light intensity and photoperiod on live performance, heterophile to lymphocyte ratio, and processing yields of broilers. *Poult Sci*, 86: 1287-1293.
- Lia WG, Yan LI, Ji-Lan C, Rong W, Yao H and Dong-Ge S, 2010. Influence of Lighting Schedule and Nutrient Density in Broiler Chickens: Effect on Growth Performance, Carcass Traits and Meat Quality. *Asian Aust J Anim Sci*, 11: 1510-1518.
- Lien RJ, Hess JB, Mckee SR and Bilgili SF, 2008. Effect of light intensity on line performance and processing characteristics of broilers. *Poult Sci*, 87: 853-857.
- Liu W, Wang Z and Chen Y, 2010. Effects of monochromatic light on developmental changes in satellite cell population of pectoral muscle in broilers during early post-hatch period. *Anat Rec*, 293: 1315-1324.
- Mckee NA, Lien RJ, Hess JB, Bilgili SF and Mckee SR, 2009. Effect of light intensity and handling during rearing on broiler breast meat characteristics. *Inter J Poult Sci*, 8: 1028-1033.
- Moore CB and Siopes TD, 2005. Enhancement of cellular and humoral immunity following embryonic exposure to melatonin in turkeys (*Meleagris gallopavo*). *Gen Compos Endocrinol*, 143: 178-183.
- Olanrewaju HA, Purswell JL, Collier SD and Branton SL, 2011. Effect of varying light intensity on growth performance and carcass characteristics of broiler chickens grown to heavy weights. *Inter J Poult Sci*, 10: 921-926.
- Olanrewaju HA, Purswell JL, Collier SD and Branton SL, 2012. Effect of Varying Light Intensity on Blood Physiological Reactions of Broiler Chickens Grown to Heavy Weights *Inter J Poult Sci*, 11: 81-87.
- Onbailar EE, Erol H, Cantekin Z and Kaya U, 2007. Influence of intermittent lighting on broiler performance, incidence of tibial dyschondroplasia, tonic immobility, some blood parameters and antibody production. *Asian-Austr Assoc Anim Soc*, 20: 550-555.
- Robinson K, 2004. Photoperiod and feed intake effects on ovarian morphology in broiler and breeder. Accessed at <http://www.poultryindustrycouncil.ca/factsheets/fact108>.
- Rodenburg J, Van H and Middelkoop JHV, 2003. Effect of colored light on production and welfare traits in broilers. Applied Research, Animal Sciences Group, Wageningen UR, P. O. Box 2176, 8203 AD Lelystad, The Netherland.
- Sadrzadeh A, Brujeni GN, Livi1 J, Nazari1 MJ, Sharif1 MT, Hassanpour H and Haghighi N, 2011. Cellular immune response of infectious bursal disease and Newcastle disease vaccinations in broilers exposed to monochromatic lights. *Afr J Biotechnology*, 10: 9528-9532.
- Sagheer M, Makled MN and Mohammad MA, 2004. Effect of different lighting programs on broiler performance. *Egypt Poult Sci J*, 24: 737-750.
- Scott P and Siopes TD, 1994. Light color: Effect on blood cells, immune function and stress status in turkey hens. *Compound Bioch Physiol*, 108: 161-168.
- Stainove P, 1980. Effect of lighting intensity on carbohydrate metabolic indices in broilers. *Vet Med Naukia*, 9: 59-64.
- Stoianov P and Georgiev GA, 1981. Effect of lighting intensity on protein metabolic indices in broilers. *Vet Med Naukia*, 18: 7-22.
- Steel RGD, Torrie JH and Dickey DA, 1996. Principle and Procedure of Statistics. A biometric approach (3rd. Ed). McGraw Hill Book Comp. Inc New York, USA. P. 666.
- Yahav S, Hurwitz S and Rozenboim I, 2000. The effect of light intensity on growth and development of turkey toms. *Brit Poult Sci*, 41: 101-106.