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Research Article

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

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A B S T R A C T

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 results 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.

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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

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

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 effects 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). 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 bursl 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

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

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; 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 depicted, Table 4. The liver weight gain, in the present study, indicated a significantly increase (P<0.05), whilst the heart weight, 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 Abdulghuffar *et al.* (2009) Rodenburg and Midlkoop (2003) 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 that the data of the present research, 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.

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