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EFFECTS OF LIGHTING COLORS AND LITTER TYPE ON GROWTH PERFORMANCE AND PHYSIOLOGICAL PERFORMANCE STATUS OF BROILERS

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ABSTRACT : This study was performed to study the effects of lighting colors and litter type on growth performance, blood parameters and digestive enzyme activity of broiler chickens. A total number of 336 unsexed hatched chicks (broilers, Indian River IR) were used for 5 weeks. Chicks were allocated in four lighting color: White (WC), Blue (BC), Green (GC), Mixed (BC × GC) light colors. Each color group was further divided in two litter type (sand (SL) and wood shavings (WL)). Chicks of each group were distributed into three replicates. The obtained results revealed that the lighting colors and litter type significantly affected on final body weight and weight gain. Highly significant ($P<0.01$) increase in body weight and body weight gain were observed in chicks reared under W color WC and SL litter type. Chicks reared on SL litter type showed significantly the highest average of FC, but the lowest values were recorded in WL litter type**.** Mortality rate during all period (1-35 day) was not significantly affected by lighting colors**.** The highest value of digestive enzymes activity (DEA) were observed in GC light group while; the lowest values were recorded in group of WC light. Significant interaction effects ($P<0.001$) were found in plasma lipid profile. It can be concluded that using white and green light color with sand litter could improve growth performance, blood parameters and digestive enzyme activity in broilers chickens.

Keywords: Broiler, light colors, litter type, growth performance, digestive enzyme.

INTRODUCTION

Birds have active extra-retinal photoreceptors in their brains, which receive light energy and transport it through their tissues and skull. According to Bowmaker and Knowles (1977), the chicken retina is made up of four different types of single cones and a double cone that respond most strongly to violet, blue, green, and red light. Consequently, throughout the past three decades, coloured lighting has been examined in relation to poultry, and its use has recently risen.

For modulating a variety of physiological and behavioural processes in birds, light is a crucial external component. Numerous studies on the impact of light spectrum on grill development performance have recently been reported. Early muscle development is accelerated by green light, while mature bird growth is stimulated by blue light (Rozenboim et al., 1999, 2004). However, there are also contradictory studies regarding how monochromatic light affects the growth of birds. When raised under green and blue light, mature female Japanese quail weighed less than when raised under red or white light (Elkomy et al., 2019).

Litter quality is crucial in today's grill manufacture. The health and welfare of broilers, the quality of the carcass, and the condition of the birds' skin are all directly impacted by litter quality. Controlling the environment of the birds is therefore essential to ensuring their welfare, especially with regard to indoor humidity, ammonia, and litter moisture. Wood shavings, which have a high water-holding capacity, are thought to produce better-quality litter than straw, which has a lower water-holding capacity (North and Bell, 1990). Torok et al. (2009) shown that, particularly in the absence of in-feed antibiotics, litter choice may play a significant impact on poultry intestinal health. In order to lessen the negative effects of high stocking density, it is important to promote favourable growing conditions (Petek et al., 2010). This might be achieved by employing the best possible bedding material and utilising more litter per area under high stocking density conditions. The bedding or litter material must also be reasonably priced and easily accessible in adequate amounts (Butcher and Miles, 1995).

Therefore, determining the effects of light colors on growth performance, blood biochemical parameters and immunity in broiler chickens housed in two litter type was the aim of this study.

MATERIALS AND METHODS

Ethical approval

The experimental design and procedures were in compliance with the ethical standards of your relevant national and institutional committee on animal experimentation approved (BUAPD 202110) by the Scientific Ethics Committee, Animal Production Department, Faculty of Agriculture, Benha University, Egypt.

Experimental animals and design:

Birds and Housing Management

A total number of 336 one day old unsexed Indian River (IR) broiler chicks of nearly live body weight were used in this study randomly assigned into 4×2 factorial arrangement according to lighting colors (4 groups) and 2 litter type (42 Chicks/group) in 3 replicates (14 chicks/each) (Table 1). Chicks were kept under similar, standard hygienic and environmental conditions in separate group with 10 birds/m2 stocking density until the end of the experimental period. Floor brooders with gas heaters were used for brooding chicks. All chicks were brooded and reared at 32-33 °C from hatch to 7 d of age, 28-30°C from 8 to 14 d of age, 24-26°C from 15 to 21 d of age, and 21-24°C from 22 day of age to the end of the experiment. Mean relative humidity was maintained at 60- 65% throughout the experiment. All birds had ad libitum access to feed and water. Chicks received vaccinations for Newcastle, Infectious Bronchitis and Gumboro diseases ones for each.

The lighting program was 24-hrs light at the first 5 days of age, and then decreased from 6 to 35 days of age (the end of the experiment) to 23-hrs light and 1 hour dark was applied. Lighting intensity was set at 2.5 foot/candle from the 1st to the 6 days and reduced to 1 foot/candle (10 lux) from the 7 day to the end of the experiment. All 10-watt light multicolor LED bulbs used were purchased from Venus electric instruments, Cairo, Egypt.

The day-old chicks were randomly assigned in 4 light-controlled rooms (n=126). Light treatments were 1) control white at 400:700 nm [mini incandescent light bulbs, 8 pens in each experimental room, (WL)], 2) green light (GC) at 560 nm (peak wavelength of 560 nm, half band width between 552 and 565 nm) provided by LED (12 pens), 3) blue light (BC) at 480 nm (peak wavelength of 480 nm, half-band width between 470 and 490 nm) provided by light-emitting diode lamps (LED) (12 pens), and 4) mixed monochromatic between green and blue light (GC×BC), respectively, with an LED system (Rozenboim *et al*., 1999; Er et al., 2007) for seven weeks. The LED lamps were placed 15 cm above the heads of birds by using plastic crosses attached to the ceiling of the room. Each lighting colors were further divided into two housing systems [ground system with two type of litter (sand and wood shavings). Chicks in the each light colors x litter type treatment groups were randomized into three replicates (Table 1).

Birds in all treatments received the same diets, and they had ad libitum access to feed and water for the duration of the rearing period. Standard commercial broiler diets consisted of a crumbled starter (232 g/kg crude protein and 3,000 kcal metabolisable energy/kg diet from 1 to 14 d of age, pelleted grower (211 g/kg crude protein and 3,100 kcal metabolisable energy/kg diet from 15 to 28 d of age and pelleted finisher (195 g/kg crude protein and 3,219 kcal metabolisable energy/kg diet from 29 to 35 d of age. Feed and water were offered ad-libitum.

Measurements

Initial body weight and final body weight were recorded, and body weight gain (BWG) was calculated from the difference between the initial and final body weight (FBW) and feed consumption in each group was measured weekly. Daily supplied and refused feed were noted, and feed consumption (FC) was measured between the supplied and refused feed. Feed conversion ratio was calculated by total feed consumed by the birds/total weight gain. Mortality rate was recorded daily.

At the end of the experimental period 6 birds from each group were randomly selected. Blood samples were collected using a marked Falcon tube and instantly centrifuged at 3,500 rpm for 10 min at 4°C, and then transferred to a marked Eppendorf tube using a micropipette and stored at −20°C until analysis. Biochemical blood parameters, including, total protein (TP, g/dL), albumin (ALB, g/dL), Globuline (Glob, g/dL) ; total cholesterol (CLO, mg/dL), triglycerides

(TG, mg/dL), low density lipoprotein (LDL, mg/dl); high density lipoprotein (HDL, mg/dL).

Statistical Analysis

All data were analyzed by two-way analysis of variance using the GLM procedure in SAS (9.1., Cary, NC, 2004). Duncan's new multiple-range test was performed to identify differences (Steel and Torrie, 1980). A P-value ＜0.05 was considered significant. According to the following linear model:

$X_{ijk} = \mu + C_i + L_j + CL_{ij} + e_{ijk}$

Whereas: μ = Overall mean; C_i = Effect of the i^{th} lighting color. (i, 1-4); L_j = Effect of the j^{th} litter type. (j, 1-2); CL_{ij}= Interaction between i^{th} lighting color and j^{th} litter type. (4× 2); e_{ijk} = Experimental error, accordingly zero mean and variance = $\sigma^2 e$.

RESULTS AND DISCUSSION

Production performance of broilers

Body weight and daily gain are presented in Table 2. Highly significant (P<0.01) increase in BW and BWG were observed in birds reared under white light (WC) color as BW at 35 day age compared with all other light treatment groups.

According to Nelson and Demas (1997) and Reiter and Kutritz (2003), the pattern, colour, and intensity of lighting can influence many aspects of avian physiology and behaviour, including skeletal and ocular development and behavioural rhythms. The results obtained agree with those reported by Maurya *et al.* (2016). Soliman and Hassan (2019) reported that BL color group revealed a highly significant increase (P<0.01) in BW compared to RL and WL color in all tested lighting regimens.

The litter type had significant (P<0.05) effect on the BW and BWG of broiler, birds reared on sand litter type (S) had significantly (P<0.05) the highest average of BW and BWG of chicks age compared with wood shavings litter type. According to several studies (Atencio et al., 2010; Bilal et al., 2014; Simeon., 2015; Darwish et al., 2017), the comfort of birds on deep litter systems, which is important for relieving cage stress and enhancing physiological and metabolic functions, may be the cause of the increase in BW and BWG in broilers kept on litter floor as compared to those in batteries.

It was observed significant lighting color x litter type interactions for the traits related with the growth performance (P<0.05). Interaction between each of sand with WC, BC and MIX color had significantly the highest averages of BW and BWG compared with different interactions applied (Table, 2). The results obtained agree with those reported by Petek *et al*. (2014) and Maurya *et al.* (2016).

Feed consumption, Feed conversion ratio and mortality rate:

Results obtained in Table.3 showed highly significant (P<0.05) variations were found in FC and FCR during the period from 0-35 d due to the effect of lighting color and litter type.

The highest FC was recorded during the whole period 1-35 day of age in the group which exposed to mix light (GC×BC) and whit light (WC) compared with those of GC and BC, respectively, which showed the lowest average of FI at the end of the experimental period. The results obtained agree with those reported by soliman and Hassan, 2019; Mohamed *et al.*, 2014). On the other hand, the best FCR was observed during the whole period 0-5 wks of age in the groups which exposed to mix light (GC×BC) and white light), compared with birds exposed to blue light

(BC) and green light (GC) at the end of the experimental period. This result obtained agreed with those reported by (Assaf *et al*., 2015 and Balabel *et al*., 2017).

Chicks reared on sand litter type (SL) showed significantly the highest average of FC, but the lowest values were recorded in wood shavings (WL). For the feed conversion ratio, there were no appreciable variations between litter type groups (P>0.05). According to Bilal et al. (2014) and Darwish *et al*. (2017**),** broilers raised on the litter floor consumed more feed than those raised in cage batteries because the latter had more space for the birds to move around in, allowing them to respond to their environment normally in terms of physiology and metabolism. Okasha (2021) observed that broiler chicks raised on sand (S) and wood shaving (WSH) as a litter type were found to be significantly (P ≤0.01) increased average of (FC) compared chicks with chicks reared on plastic litter type. Chicks reared on floor housing as sand litter type showed significantly the best FCR, followed by chicks reared on wood shavings. The results obtained agree with those reported by Santos *et al.* (2008); Simsek *et al.,* 2014; Mendes *et al.* (2013)

Interaction effect between lighting color and housing systems showed highly significant effect on average FC and FCR during the whole period (1-35 day). The highest averages of FC were observed for the interactions between WC×SL, and GC×SL and MIX×WL, respectively. However, the interactions between WL with WC, GC nd BC color showed the lowest averages of feed intake respectively compared with the other interactions applied. The best FCR during the whole period (1-35 day) were observed from the interactions between BC×SL and GC×WL respectively. However, the interactions between GC × SL showed the worst FCR compared with the other interactions.

Results obtained showed that mortality rate during the all periods (1-35) days of birds age was not significantly affected by lighting color applied (Table, 3). The lowest mortality rate (%) is observed in group which exposed to GC (4.13%), then by those of BC (5.05%). However, the control group exposed to WC and GC×BC showed the same highest mortality rate (5.83%). The results of our findings are in accordance with the study of Prayitno et al. (1997) and Senaratna et al. (2016) who recorded that green or blue light is preferable to red or white light for broilers because it keeps the birds calmer and is chosen by the birds themselves. Balabel et al. (2017) stated that the lowest mortality rate was recorded in the intermittent Gl-BL group (1.2%) in comparison to BL (1.8%) and GL (1.8%) group. On the other hand, the chicks kept under WL recorded the highest values of mortality rate (3%). However, these results disagree with those reported by Rozenboim et al. (2004) showed that mortality rate did not differ between green and blue monochromatic light combination.

Chicks reared on wood shavings litter type showed the same lowest mortality rate (3.30%), while chicks reared on sand litter type showed the highest mortality rate which mounted (6.60%). The results obtained disagree with those reported by Şimşek *et al.* (2014) they showed that mortality rate was found to be similar between groups (P>0.05).

Interaction effect between lighting color and litter type showed high significant (P<0.01) effect on average mortality rate. The lowest mortality rate was recorded in GC×WL (2.40%) and BC×WC (2.60%) group. On contrast, the higher mortality rate percentage was recorded WC with SL and WL, GC with SL, BC with SL, MIX with SL and WL which showed the same average (7.50%).

Digestive enzymes activity of broilers

Results obtained in Table.4 showed highly significant (P<0.001) variation were found in digestive enzymes activity (DEA) (Protease, Lipase and Amylase) due to lighting color, litter type and the interaction between them.

Significant (P≤0.05) differences in DEA values between different light color treatment in the study. The highest values of DEA were observed in green light (GL) group while, the lowest values were recorded in group of white light (WC). Hassan *et al.* (2016) who showed that the variation in light color did not affect serum enzyme activities.

Chicks reared on wood shavings (WL) litter type showed significantly the highest values of DEA (Protease, Lipase and Amylase), followed by chicks reared on sand (SL) litter type, respectively. Özhan *et al*. (2016) found that there were not any significant differences at enzyme activities of alkaline phosphatase and creatine kinase (P>0.05) floor and cages.

Effects between lighting color and litter type interaction showed highly significant (P<0.001) in values of DEA (Table, 4). The highest averages of DEA were observed from the interactions between GC with SL and WL, respectively. However, the interactions between WC×SL and WC×WL showed the lowest averages of DEA compared with the other interactions.

Blood biochemical parameters

Protein fractions

The influence of lighting color, litter type and the interaction between them on plasma total protein, albumin, globulin and Alb /Glob ratio are summarized in Table 5.

Concerning to lighting color, the obtained results revealed that the highest averages of plasma TP, Alb and Glob were found in the group exposed to GC (6.40, 3.79 and 2.61 g/dl, respectively), followed by chicks exposed to BC (5.89, 3.60 and 2.29 g/dl, respectively), then by those of mix light (GC×BC) (5.51, 3.43 and 2.08 g/dl, respectively) compared with WL which showed the lowest average of plasma TP, Alb and Glob (4.93, 3.07 and 1.86 g/dl, respectively). However, chicks in the control group (WC) had significantly the highest average of A/G ratio, then by those of mix light, BL and GL, respectively. The results obtained agree with those reported by Hassan *et al.* (2016) and Mohamed *et al. (*2020).

Chicks reared on wood shavings litter had significantly (P<0.01) the highest averages of TP, Alb and Glob, respectively. However, chicks reared on floor housing as sand litter type showed the highest plasma Alb/Glob ratio. Abdel-Azeem *et al.* (2020) reported that there were insignificant differences in most blood parameters including TP, Alb and Glob due to housing systems.

Interaction effects showed highly significant (P<0.001) variations on plasma protein fractions. The interaction between GC×WL had the higher averages of TP, Alb and Glob, respectively. However, the interaction between WL×S had significantly the higher average of plasma Alb/Glob ratio, respectively (Table, 5).

Plasma lipid profile:

Plasma lipid profile; triglycerides, cholesterol, LDL-C and HDL-C are presented in table 6.

Concerning to lighting colors, chicks exposed to GL and BL showed significant (P<0.05) decreased of plasma triglycerides, cholesterol, LDL-C and HDL-C. However, chicks exposed to WC and GC×BC showed significant (P<0.05) increase of high density lipoprotein (HDL). This may be due to the serum glucose, cholesterol and triglyceride levels are as indicators of stress and birds under stress condition have elevated these three serum parameters (Thaxton and Puvadolpirod, 2000). The results obtained agree with those reported by Firouzi *et al.* (2014) reported that chicks reared in cage, floor as WL had significantly the lowest averages of plasma triglycerides, cholesterol and LDL-C. However, chicks reared on SL and WL had significantly the highest average of HDL-C. The results obtained disagree with those reported by Özhan *et al.* (2016) found that there were not any significant differences between both cage and floor at serum total cholesterol and triglycerides (P < 0.05).

Interaction effects showed highly significant (P<0.001) differences on plasma lipid profile between lighting system and litter type. The interaction between each of GL×WSH and GC×SL had the lower averages of plasma triglycerides, cholesterol and LDL-C, respectively. However, the interaction between WC×SL and WC×WL had significantly (P<0.001) the higher average of HDL-C compared with different interactions (Table, 6).

CONCLUSION

It is clear from the above discussion that lighting color and litter type has an utmost role in poultry production as well as physiology. White and green light was able to improve significantly growth performance, some biochemical parameters. A good light can improve the production traits like feed consumption, body weight and feed conversion ratio and also poultry well-being which will result in more production with profit.

Table (1): The bird number in each replicate in the treatment groups

Treatment groups (light color × litter type)	**Number of replicate**	**Bird Number in Each Replicate**
WC × Wood Shaving	3	42
WC × Sand	3	42
GC × Wood Shaving	3	42
GC × Sand	3	42
BC × Wood Shaving	3	42
BC × Sand	3	42
MIX(GC*BC) × Wood Shaving	3	42
MIX (GC*BC) × Sand	3	42

Table (2): Effects of various lighting color and Litter type on body weight and weight gain in broiler chickens

Items		**Body weight and weight gain(g)**		
		BW at 1 day	**BW at 35 day**	**BWG at 1-35 day**
Lighting color	White	41.6±0.56	2032.3±30.6[a]	1990.4±29.5[a]
	Green	39.3±0.56	1984.3±30.2[ab]	1945.1±29.1[ab]
	Blue	41.4±0.56	1979.3±30.2[ab]	1938.0±29.1[ab]
	Mix (green × blue)	42.3±0.56	1936.6±30.6[b]	1894.1±28.4[b]
p-Value		0.0013	0.0325	0.0270
Litter type	Sand	41.3±0.41	2029.3±21.4[a]	1987.8±19.5[a]
	Wood shaving	41.0±0.41	1938.1±21.1[b]	1897.1±19.2[b]
p-Value		0.5548	0.0027	0.0029
Lighting color × Litter type				
White (WC)	Sand	41.8±0.80	2089.2±42.7[a]	2047.3±41.3[a]
	Wood shaving	41.5±0.80	1975.4±42.7[abc]	1933.5±40.4[abc]
Green (GC)	Sand	39.2±0.80	1991.8±42.7[ab]	1952.5±40.5[ab]
	Wood shaving	39.3±0.80	1977.2±41.6[abc]	1938.0±40.2[abc]
Blue (BC)	Sand	42.2±0.80	2017.1±42.7[ab]	1975.0±40.5[ab]
	Wood shaving	40.6±0.80	1943.4±41.6[bc]	1902.9±40.1[bc]
Mix (GC × BC)	Sand	42.1±0.80	2019.1±42.7[ab]	1976.6±40.2[ab]
	Wood shaving	42.6±0.80	1854.0±42.7[c]	1811.6±39.6[c]
p-Value		0.1118	0.0158	0.0159

a-c: within column, values with different superscript letters differ significantly ($P<0.05$); BW, body weight; BWG, body weight gain.

Table (3): Effects of various lighting color and Litter type on feed intake, feed conversion ratio and mortality rate in broiler chickens.

Items		FI (g / bird) during 1-35 day	FCR (g feed/ g gain) during 1-35 day	Mortality rate (%) during 1-35day
Lighting color	White	3094.1±26.8ab	1.55±0.01	5.83±0.84
	Green	3031.0±26.8bc	1.55±0.01	4.13±0.84
	Blue	3005.1±26.8c	1.54±0.01	5.05±0.92
	Mix (green × blue)	3116.6.±26.8a	1.57±0.01	5.83±0.84
p-value		0.0265	0.5467	0.4497
Litter type	Sand	3094.7±20.3[a]	1.55±0.01	6.60±0.53[a]
	Wood shaving	3028.7±20.3[b]	1.56±0.01	3.30±0.30[b]
p-value		0.0321	0.7096	0.0001
Lighting color × Litter type				
White (WC)	Sand	3166.0±20.42[a]	1.54±0.009[bc]	7.50±0.96[a]
	Wood shaving	3022.3±20.42[c]	1.56±0.009[ab]	7.50±0.96[a]
Green (GC)	Sand	3105.6±20.42[ab]	1.59±0.009[a]	7.50±0.96a
	Wood shaving	2956.3±20.42[c]	1.52±0.009[c]	2.40±0.25[c]
Blue (BC)	Sand	3009.3±20.42c	1.52±0.009[c]	7.50±0.96[a]
	Wood shaving	3001.0±20.42c	1.57±0.009[ab]	2.60±0.25[b]
Mix (GC×BC)	Sand	3098.0±20.42[b]	1.56±0.009[ab]	7.50±0.96[a]
	Wood shaving	3135.3±20.42[ab]	1.57±0.009[ab]	7.50±0.96[a]
P-**value**		0.0001	0.0012	0.0012

a-c within column, values with different superscript letters differ significantly ($P<0.05$); FC, feed consumption; FCR, feed conversion ratio.

Table (4): Effects of various lighting color and Litter type on digestive enzymes in broiler chickens.

Items		Digestive enzymes (U)		
		Protease	Lipase	Amylase
Lighting color	White	42.05±0.28^{d}	9.70±0.13^{d}	90.85±0.82^{c}
	Green	62.50±0.28^{a}	13.50±0.13^{a}	96.90±0.82^{a}
	Blue	54.20±0.28^{b}	12.95±0.13^{b}	94.30±0.82^{b}
	Mix (green × blue)	50.50±0.28^{c}	11.60±0.13^{c}	93.40±0.82^{b}
P-value		0.0001	0.0001	0.0005
Litter type	Sand	51.70±2.2	11.67±0.44	92.07±0.66^{b}
	Wood shaving	52.92±2.2	12.20±0.44	95.65±0.66^{a}
P-value		0.6996	0.4123	0.0010
Lighting color × Litter type				
White (WC)	Sand	41.40±0.05^{h}	9.60±0.05^{g}	89.10±0.21^{f}
	Wood shaving	42.70±0.05^{g}	9.80±0.05^{f}	92.60±0.21^{d}
Green (GC)	Sand	62.1±0.05^{b}	13.30±0.05^{b}	94.50±0.21^{c}
	Wood shaving	62.90±0.05^{a}	13.70±0.05^{a}	99.30±0.21^{a}
Blue (BC)	Sand	53.50±0.05^{d}	12.50±0.05^{c}	92.90±0.21^{d}
	Wood shaving	54.90±0.05^{c}	13.40±0.05^{b}	95.70±0.21^{b}
Mix (GC × BC)	Sand	49.80±0.05^{f}	11.30±0.05^{e}	91.80±0.21^{e}
	Wood shaving	51.20±0.05^{e}	11.90±0.05^{d}	95.00±0.21^{c}
P-value		0.0001	0.0001	0.0001

a-h within column, values with different superscript letters differ significantly ($P < 0.05$)

Table (5): Effects of various lighting color and Litter type on Plasma protein fractions in broiler chickens.

Items		Plasma protein fractions (g/dl)			
		TP (g/dl)	**Alb (g/dl)**	**Glob (g/dl)**	**Alb/Glob ratio**
Lighting color	White	4.93±0.15[c]	3.07±0.11[c]	1.86±0.79[c]	1.68±0.07
	Green	6.40±0.15[a]	3.79±0.11[a]	2.61±0.79[a]	1.46±0.07
	Blue	5.89±0.15[b]	3.60±0.11[ab]	2.29±0.79[b]	1.58±0.07
	Mix (green × blue)	5.51±0.15[b]	3.43±0.11[b]	2.08±0.79[bc]	1.66±0.07
P-value		0.0001	0.0007	0.0001	0.1933
Litter type	Sand	5.47±0.15	3.41±0.09	2.06±0.07b	1.68±0.05[a]
	Wood shaving	5.89±0.15	3.53±0.09	2.35±0.07a	1.51±0.05[b]
P-value		0.0637	0.3761	0.0114	0.0244
Lighting color × Litter type					
White (WC)	Sand	4.74±0.19[d]	3.06±0.16[b]	1.68±0.09[e]	1.84±0.10[a]
	Wood shaving	5.12±0.19[cd]	3.08±0.16[b]	2.04±0.09[d]	1.51±010[ab]
Green (GC)	Sand	6.20±0.19[ab]	3.72±0.16[ab]	2.48±0.09[ab]	1.51±010[ab]
	Wood shaving	6.60±0.19[a]	3.86±0.16[a]	2.74±0.09[a]	1.41±0.10[b]
Blue (BC)	Sand	5.66±0.19[bc]	3.50±0.16[ab]	2.16±0.09[cd]	1.64±0.10[ab]
	Wood shaving	6.12±0.19[ab]	3.70±0.16[a]	2.42±0.09[bc]	1.53±0.10[ab]
Mix (GC ×BC)	Sand	5.30±0.19[cd]	3.36±0.16[ab]	1.94±0.09[ed]	1.75±0.10[ab]
	Wood shaving	5.72±0.19[bc]	3.50±0.16[ab]	2.22±0.09[bcd]	1.57±0.10[ab]
P-value		0.0001	0.0149	0.0001	0.0325

a-d: within column, values with different superscript letters differ significantly ($P<0.05$); TP, total protein; ALB, albumin; Glob, Globulin

Table (6): Effects of various lighting color and Litter type on Plasma lipid profile in broiler chickens

Items		Plasma lipid profile (mg/dl)			
		TG	CHOL	HDL	LDL
Lighting color	White	117.80±4.2[a]	139.4±4.6[a]	83.2±2.2[a]	56.1±3.8[a]
	Green	90.30±4.2[c]	107.4±4.6[c]	72.2±2.2[b]	35.1±3.8[c]
	Blue	99.00±4.2[bc]	115.8±4.6[bc]	74.0±2.2[b]	41.7±3.8[bc]
	Mix (green × blue)	106.6±4.2[ab]	125.2±4.6[b]	75.5±2.2[b]	49.6±3.8[ab]
P-value		0.0005	0.0002	0.0084	0.0024
Litter type	Sand	107.8±3.6	126.5±4.0	78.2±1.7	48.2±3.14
	Wood shaving	99.05±3.6	117.4±4.0	74.3±1.7	43.0±3.14
P-value		0.1252	0.0004	0.0014	0.0178
Lighting color × Litter type					
White (WC)	Sand	122.0±5.9[a]	143.4±6.6[a]	86.0±3.2[a]	57.4±5.5[a]
	Wood shaving	113.6±5.9[ab]	135.4±6.6[ab]	80.4±3.2[ab]	54.9±5.5[ab]
Green (GC)	Sand	95.4±5.9c[d]	111.0±6.6[cd]	74.7±3.2[bc]	36.2±5.5[c]
	Wood shaving	85.20±5.9[d]	103.8±6.6[d]	69.7±3.2[c]	34.0±5.5[c]
Blue (BC)	Sand	103.2±5.9[bcd]	120.8±6.6[bcd]	75.7±3.2[bc]	45.0±5.5[abc]
	Wood shaving	94.8±5.9[cd]	110.8±6.6[cd]	72.4±3.2[bc]	38.3±5.5[bc]
Mix (GC ×BC)	Sand	110.6±5.9[bc]	130.8±6.6[abc]	76.3±3.2[abc]	54.4±5.5[ab]
	Wood shaving	102.6±5.9[bcd]	119.6±6.6[bcd]	74.6±3.2[bc]	44.9±5.5[abc]
P-value		0.0939	0.0121	0.0252	0.2497

a-d: within column, values with different superscript letters differ significantly ($P<0.05$); TG, triacylglyceride; CHOL, cholesterol; HDL, high density lipoprotein; LDL, low density lipoprotein.

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الملخص العربي

تأثير لون الإضاءة ونوع الفرشة على أداء النمو والحالة الفسيولوجية لدجاج التسمين

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أجريت هذه الدراسة لمعرفة تأثير لون الإضاءة ونوع الفرشة على كلا من: أداء النمو ، ومقاييس الدم ونشاط الإنزيمات الهضمية لدجاج التسمين. تم استخدام عدد 336 كتكوت من سلالة (Indian River IR). تم اختيار الكتاكيت عشوائياً وتوزيعها تحت اربع الوان إضاءة: أبيض ، أزرق ، أخضر ، مختلط (أزرق × أخضر) . تم تقسيم كل مجموعة لونيه إلى مجموعتين علي حسب نوعية الفرشة : الرمل و نشارة الخشب . تم توزيع الكتاكيت في كل مجموعة بصورة عشوائية إلى ثلاث مكررات عند عمر يوم. أظهرت النتائج التي تم الحصول عليها أن لون الإضاءة ونوعية الفرشة كان لهما تأثير معنوي على وزن الجسم النهائي. حيث لوحظ زيادة معنوية (P <0.01) في وزن الجسم ومعدل الزيادة الوزنية في الكتاكيت التي تمت تربيتها تحت اللون الابيض وفرشة الرمل. الكتاكيت التي تمت تربيتها علي فرشة ارضية رمل سجلت أعلى متوسط استهلاك للعلف ، ولكن تم تسجيل أقل القيم في فرشة نشارة الخشب. لم يتأثر معدل النفوق خلال كل فترة التجربة (1-35 يوم) معنويا بإستخدام لون الاضاءة. لوحظت أعلى قيم لنشاط الإنزيمات الهضمية (DEA) في المجموعة التي تعرضت للضوء الاخضر بينما سجلت أقل القيم في المجموعة التي تعرضت للضوء الأبيض. أظهرت تأثيرات التداخل بين كلا من لون الإضاءه ونوعية الفرشة اختلافات معنوية (P <0.001) على مستوى الدهون في البلازما. يمكن التوصية بان استخدام اللون االابيض والاخضر مع فرشة الارضية الرمل يمكن أن يحسن الأداء الإنتاجي ، مقاييس الدم ونشاط الإنزيمات الهضمية في دجاج التسمين.

الكلمات الدالة : دجاج اللحم - لون الإضاءة – نوعية الفرشة – اداء النمو – الانزيمات الهضمية