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Original Article

Effect of different light intensities on performance, welfare and behavior of turkey poults

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ABSTRACT

Objective: Lighting requirements of birds have to be considered for choosing the optimal light intensity. Therefore, the experiment was carried out to study the effects of the different light intensities on performance, welfare and behavior of turkey poults.

Materials and Methods: A total of 81 turkey poults aging 3 weeks were randomly selected and divided into three equal groups. The birds were subjected for 3 different light intensities (5, 25 and 50 lux) with 12 h photoperiod in 3 separate rooms. The growth performance parameters of the poults were measured; the parameters were body weight (BW), average feed intake (FI), average body weight gain (ABWG), relative growth rate (RGR), and feed conversion ratio (FCR). Besides, blood parameters and behavioral characters were observed.

Results: Our results revealed that poults reared in low intensity (5 lux) had better performance (body weight gain, relative growth rate and feed intake). Also, final body weight was significantly higher in 5 lux. The cortisol level was lower in 5 lux than other 25 and 50 lux. Behavior of poults is affected by light intensities in our study, where feather preening, feather pecking and aggressive behaviors were significantly higher in birds housed in the highest intensity (50 lux). In the same way, drinking time was significantly higher in 25 lux. The poults tended to lay and rest on perches more under the lowest intensity (5 lux).

Conclusion: It was concluded that, it is better to use moderate light intensity to improve previous parameters with avoiding abnormal behavior.

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INTRODUCTION

Turkey is an aspect of the poultry industry and very popular in many parts of the world especially America and Europe, where they play an important role in the supply of eggs and meat. Turkeys (*Meleagris gallopavo*) were originally brought from North America to Europe by the Spaniards in the 16th century (Magdelaine et al., 2008). Turkey production, consumption and trade are much lower than for chicken, they have been affected by many of the same trends that have dominated the broiler industry. Furthermore, turkeys are adaptable to wide range of climatic conditions and can be raised successfully almost anywhere in the world if they are well fed and protected against diseases, predators and adverse weather conditions.

The well-being of poultry and stress largely influence the poultry production (Mohammed et al., 2014). There are many factors which can decrease the performance and increase abnormal behavior of poultry such as management and housing (Mohammed et al., 2010).

Lighting condition is the most important facet influence performance and welfare of animals. There is a need for suitable lighting condition to use best practice husbandry and management in turkey (Case et al., 2010). The knowledge on effects of duration of lighting and light intensity on bird's performance and behavior are well documented for hens (Er et al., 2007), whereas, influences of light source and wavelength spectrum are rarely investigated in laying hens. Here it has to be taken into account that birds cover a broader wave length spectrum (380 to 760 nm) than mammalians and that the resolution frequency of pictures is higher (up to 150 images /sec). Especially, birds are capable to see under ultraviolet lighting conditions and light intensity is felt differently by birds due to their different sensitivity to wave length (Mohammed et al., 2010). Thus, the objectives of the current study were to investigate the effect of light intensity on growth performance, cortisol level and behavior of turkey poult.

MATERIALS AND METHODS

Study location and ethical approval: The present study was conducted at the Faculty of Veterinary Medicine, Zagazig University, Egypt. The ethical approval was taken from the Zagazig University Animal Ethics Committee guidelines (ANWD-206).

Experimental animals and management: This experiment was performed on 81 turkey poults (Broad Breasted Bronze) aging 3 weeks with initial body weight of 290±5g. It was divided randomly into 3 equal groups of 27 poults (each group subdivided into 3 replicas) under 3 different light intensities (5, 25 and 50 lux) of incandescent bulb source with 12 h photoperiod in 3 separate rooms, where, all rooms had the same hygienic measurement. Each group was reared in room with a floor area of 4.5 m length×3.5 m width with 4 m height, providing each poult with 0.75 m^2 of floor space. Light intensities were calculated by lux meter (Conrad, Hirschau, Germany). The basal diet was formulated to meet the nutrient requirements of poults which fed grower ration ad-libitum twice daily (7 am and 5 pm) containing 23% of crude protein and 3060.88 Kcal/Kg of metabolized energy, according to standard procedures of the AOAC (2002). Birds were vaccinated by lasota vaccine at 30th day of age and periodically every month, while pox vaccine was at 2nd month of age.

Growth performance parameters: It was recorded according to Abdelaty (2016), where, the body weight (BW) of turkey poults were weighed at the beginning of experiment (3rd weeks age) and weekly until 13th weeks age, also feed residues and thus average feed intake (FI) were recorded weekly. Average body weight gain (ABWG) was calculated by subtracting body weight between two successive weeks. Relative growth rate (RGR) was calculated by (initial BW-final BW)/(initial BW-final BW) *0.5. Furthermore, feed conversion ratio (FCR) was calculated (feed intake/weight gain) over period of experiment.

Blood sampling and cortisol level: At the end of the experimental period (13th week of age), blood samples had been collected randomly from 10 birds/group, at morning to overcome the circadian variation in hormone level, through one minute for each poult. Blood samples were obtained from wing vein into heparinized tubes, centrifuged at 4000 rpm for 15 min to obtain blood plasma which stored at -80°C for evaluating the cortisol level, as one of stress indicating hormones (Abdel-Rahman, 2005).

Behavioral observation: Direct observations were conducted in the home pen to record different behavior for 12 h every 2 weeks by focal sample technique after identification of poults by using different colored wing bands. An observation sheet, a stop watch and photographing camera were used during the observation time for recording the behavioral pattern according to Shimmura et al. (2007). The observers stood inside the room 10 min before starting the direct observation to allow the poults to acclimatize. All experimental groups were observed directly for 3×10 minutes in the morning (8:00 am till 12:00 am) and for 3×10 minutes in the

Table 1. Direct behaviour observation of the poults

Observed behavior	Definition
Ingestive behavior	Feeding: mean time of feeding from troughs. Drinking: mean time of drinking from drinkers. Foraging (pecking and scratching in floor or other parts of pen).
Standing behavior	Standing not engaged in any activity.
Locomotion behavior	Walking: mean time of walking. Running: mean time of running.
Comfort behavior	Laying: sitting to remain dormant with the neck withdrawn Perching: roosting high of the ground (standing or sitting on a perch) Feather preening: clean and care their plumage with their beak using short and repeated action while standing or sitting.
Abnormal behavior	Aggression: the birds counter acts toward other birds. Feather pecking: only pecks to feathered parts of the body Beak pecking: only pecks the beak

afternoon (1:00 pm till 5:00 pm) with one minute interval for each random samples from each group. After observation, the total times of normal behavior and frequencies of abnormal behavior, as illustrated in **Table 1**, in all random samples were counted and calculatedthe total times and frequencies of activities.

Statistical analysis: Data was statistically analyzed using SAS statistical system Package (SAS, 2009). The data were examined for non-normality by the Kolmogorov-Smirnov test. The analysis of data distribution suggested that all traits analyzed followed a normal distribution (*P*>0.05). The Proc. general linear model (GLM) has been used with the intensities as a fiComment "1"Comment "1"xed effect, while, the dependent variables were the growth performance, cortisol level and behavioral observation. Data collection and observation had been conduction on continuous period regularly. Results were presented as mean±SE. Difference among treatment means were compared using Tukey's Honestly Significant Difference test (Tukey's HSD).

RESULTS

Means±standard error of performance and cortisol level at different light intensities (5, 25 and 50 lux) were shown in **Table 2**. It clearly showed that poults housed at 5 lux had the highest of final body weight and the lowest value of cortisol level, with significant differences. While, there were no significantly differences in average weight gain, relative growth rate, feed intake and feed conversion ratio. Normal and abnormal behavior of poults in different light intensities are presented in **Table 3**. As it was seen, the poults housed at 50 lux had significant decrease in the times of laying, perching and feather preening, while aggression and feather pecking were the highest with significant differences. Drinking time was significantly higher in poults housed at 25 lux than others. There were no significantly differences in other behavior (feeding, foraging, standing, walking, running and beak pecking) among the experimental groups.

DISCUSSION

Behavior, performance and hormonal changes are good indicators for the assessment of the well-being of poultry especially in turkey. In the present study (**Table 2**), light intensity did not really affect the most of performance parameters (ABWG, RGR and FI); although it was the highest in low intensity (5 lux), but there was no significance. However, final BW was significantly higher in 5 lux than other groups. The same results were described by Yahav et al. (2000); Kristensen et al. (2006), who found that low light intensity improves the growth performance. Nevertheless, Blatchford et al. (2009) mention that light intensity ranging from 1 to 150 lx did not affect BW, feed consumption, and feed: gain ratio. Improvement of performance under low intensity has been expected due to decrease the physical activity (walking and flightiness) of birds. Therefore, feed conversion ratio was the lowest in poults housed at 5 lux than other poults. This result differed from the findings of Downs et al. (2006) who stated that lower light intensity improved feed conversion in poultry and stimulated in better muscular growth. It is recognized that stress augments the activity of the hypothalamus-pituitary-adrenal axis and consequences in amplified corticosteroids secretion from the adrenal cortex (Gong et al., 2015). Therefore, cortisol and corticosterone are frequently used as stress and/or depressive disorders

Table 2. Performance parameters and cortisol levels of turkey under different light densities (Mean±SE)

Parameters	Light intensity			Significance
	5 lux	25 lux	50 lux	
Initial body weight (g)	293.6±13.4	292.3±13.9	294.7±8.4	N.S
Final body weight (g)	1952.8±76.6[a]	1584.3±79.6[b]	1475.6±43.7[b]	**
Average body weight gain (g/week)	185.07±31.09	150.43±10.84	136.93±45.52	N.S
Relative growth rate	0.26±0.04	0.19±0.8	0.17±0.06	N.S
Feed intake (g/bird/week)	674.1±73.4	615.8±72.2	593.5±50.9	N.S
FCR	3.60±0.09	4.05±0.20	4.30±0.33	NS
Cortisol level (μg/dL)	0.06±0.009[c]	0.10±0.012[b]	0.17±0.013[a]	*

[abc]*Means in the same row with different superscripts are significantly different at (P≤0.05). N.S = Non significant*

Table 3. Mean values (±SE) of normal and abnormal behaviour of turkeys under different light intensities

Behavioral patterns	Light intensity			Significance
	5 lux	25 lux	50 lux	
Feeding time (sec/12 h)	2656.0±429.4	2723.3±415.8	2657.3±599.7	N.S
Drinking time (sec/12 h)	246.5±53.7 [b]	332.8±83.6[a]	232.0±93.3[b]	*
Foraging time (sec/12 h)	2642.8±192.3	2985.6±147.7	2735.2±250.2	N.S
Standing time (sec/12 h)	23952.0±1666.0	26547.0±1953.0	27975.0±1875.0	N.S
Walking time (sec/12 h)	2622.0±214.6	2757.5±155.1	2846.3±418.5	N.S
Running time (sec/12 h)	8.66±4.0	9.1±4.9	9.0±4.4	N.S
Laying time (sec/12 h)	9582.0±131.6[a]	6875.7±383.8[b]	6037.8±353.4[b]	**
Perching time (sec/ 12 h)	1001.1±164.2[a]	369.6±71.7[b]	243.6±78.8[b]	**
Feather preening time (sec/12 h)	262.9±35.6[ab]	367.4±54.2[a]	222.8±24.4[b]	*
Aggression frequency/12 h	0.0±0.0[b]	0.2±0.2[b]	3.3±1.9[a]	**
Feather pecking frequency/12 h	8.0±1.5[b]	13.8±1.5[a]	16.66±1.6[a]	**
Beak pecking frequency/12 h	19.0±5.3	18.2±3.5	21.3±5.9	N.S

[abc]*Means in the same row with different superscripts are significantly different at (P≤0.05). N.S = Non significant*

biomarkers. Cortisol educes physiological modifications that allow animals to endure stressful environments. In the current study, the cortisol level was significantly increased with the increase of light intensity. The obtained values were approximately in accordance with the finding of Olanrewaju et al. (2006), who reported that light intensity had effect on bird activity, behavior, physiology, immune response and growth rate. Reduction in body weight with augmented corticosterone values are commonly used as a marker for chronic or repeated stress condition (Brennan et al., 2000).

The direct behavioral observation, as mentioned in **Table 3** revealed that light intensity did not really affect feeding, foraging, standing, walking and running activities of poults, as reported by Mohammed et al. (2010), who noted no significantly differences in behavior of layers under different light intensities. But, Alvino et al. (2009) found that the expression of exploratory and comfort behaviors have been found to be reduced with exposure to dim light (5 lx), and bright light improved welfare of broilers.

As well as, drinking time was significantly higher ($P<0.05$) in 25 lux than other groups. This result may be due to the increase feeding time in this group and positive relation between drinking and feeding. The comfort behavior patterns as indicator of animal welfare includes resting, perching and feather preening (Mohammed et al., 2014), where it was the lowest significantly in 50 lux. The results on resting and perching behavior were in agreement with observations of Barber et al. (2004), while the result on feather preening behavior was in disagreement with Vandenberg and Widowski (2000). A significant positive effect of the light intensities on abnormal behavior (aggression and feather pecking) was described in the present study. Light intensities have effects on plumage condition of poults through the effects on aggression and feather pecking, as described by Tauson (2005); Ostovic et al. (2009), who showed that low intensities commonly used to reduce injurious pecking, control of cannibalism and improve welfare. But, this result is not in agreement with Kjaer and Sørensen (2002) recorded that light intensity (10-15 lux) during rearing of poultry had no significant effect on the rate of feather pecking behavior or plumage condition due to reduced ability to identify environmental cues.

CONCLUSION

It is better to use moderate light intensity to improve previous parameters with avoiding abnormal behavior. Therefore, the light sources with low intensity (5 lux) should be used and that high light intensities (50 lux) should be avoided in turkey poults houses.

CONFLICT OF INTEREST

The authors declare that they have no competing interest.

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