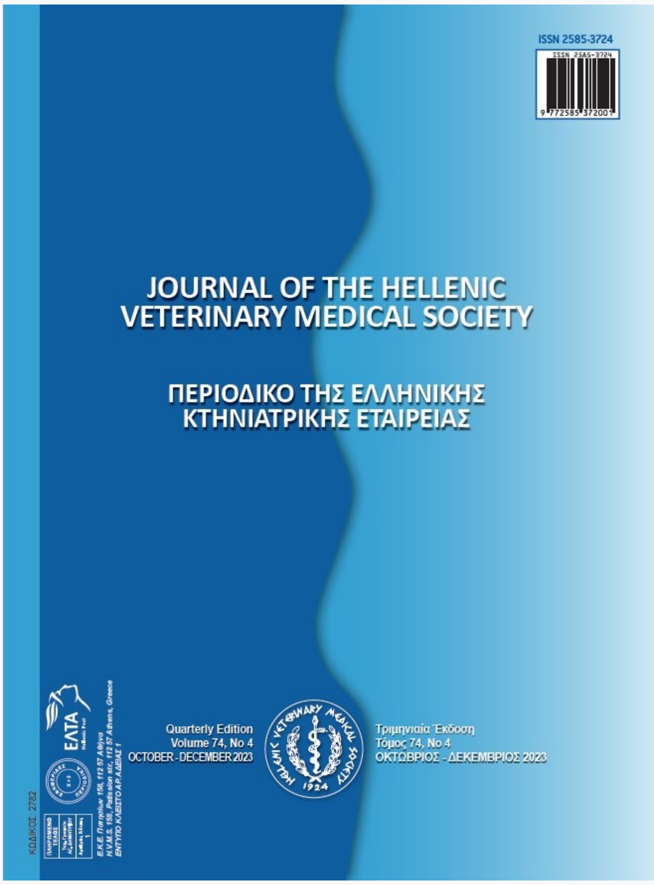
Journal of the Hellenic Veterinary Medical Society

Vol 75, No 1 (2024)



Study on Effect of Light Intensity and Perch on Welfare and Some Behavioral Traits in Broilers

EZ Okur, ED Fidan

doi: [10.12681/jhvms.31446](https://doi.org/10.12681/jhvms.31446)

To cite this article:

Okur, E., & Fidan, E. (2024). Study on Effect of Light Intensity and Perch on Welfare and Some Behavioral Traits in Broilers. *Journal of the Hellenic Veterinary Medical Society*, *75*(1). https://doi.org/10.12681/jhvms.31446

J HELLENIC VET MED SOC 2024, 75 (1): 6787-6796
ΠΕΚΕ 2024, 75 (1): 6787-6796

Research article
Ερευνητικό άρθρο

Study on Effect of Light Intensity and Perch on Welfare and Some Behavioral Traits in Broilers

E. Z. Okur*, **E. Dereli Fidan**

Department of Animal Science, Faculty of Veterinary Medicine, Aydın Adnan Menderes University, Turkey

ABSTRACT: The aim of this study was to investigate the effects of light intensity and perch use on welfare criteria and some behavioral traits in broilers. A total of 270, 1-day age male broiler chicks were randomly assigned to groups based on the light intensity (5, 20, and 80 lux) and perch use (perch and no perch) with three replicates. No cases of footpad dermatitis (FPD) were found in the groups exposed to different light intensities and perch conditions. Twenty and 80 lux light intensity tended (P<0.01) to decrease the incidence and severity of hock burn (HB) lesions. There was no effect of perch use on the gait score (GS) of broiler chickens. Eye weight was determined to be lowest (2.019 g) in the 80 lux light intensity group and highest (2.107 g) in the 5 lux group (P<0.05). In the study, it was observed that the presence of the perch reduced the standing behavior statistically (P<0.001). These results indicated that the obstacles created by placing perches between feeders and drinkers reduce the walking behavior of the broilers. However, perching behavior also represents an alternative form of increasing mobility. In conclusion, the use of 20 lux light intensity in broilers not only reduced the incidence of HB but also positively affected welfare by reducing eye weight. The findings suggest that optimizing light intensity levels can enhance the welfare of broilers.

Keywords**:** Behavior; Broiler; Light Intensity; Perch; Welfare

Corresponding Author:
E. Dereli Fidan, Department of Animal Science, Faculty of Veterinary Medicine, Aydın Adnan Menderes University, 09100, Aydın, TURKEY.
E-mail address: edereli@adu.edu.tr

Date of initial submission: 19-09-2022
Date of acceptance: 02-12-2023

INTRODUCTION

Broiler farming involves various managerial factors that contribute to the overall welfare of broiler chickens. Among these factors, light intensity and perch use stand out as important management tools that can positively impact broiler welfare. The effects of light intensity on the welfare of broiler chickens can be controlled physically and behaviorally. It has been observed that low light intensity generally has negative effects on poultry welfare (Rault et al., 2017). In this context, Blatchford et al. (2009), Alvino et al. (2009), Deep et al. (2010), and Rault et al. (2017) reported that low light intensity (dim light) has been shown to negatively affect broiler welfare as indicated by an increased incidence of skeletal system disorders, foot and leg lesions, preening, behavioral rhythms. Moreover, there are increased eye defects in broiler chickens reared under dim lighting (Rault et al., 2017). Some studies reported that broiler chickens reared at 1 lux have both larger eyes (Deep et al., 2010, comparing 1, 10, 20, and 40 lux; Blatchford et al., 2012, comparing 1 to 200 lux), and heavier eyes (Blatchford et al. (2009); Deep et al., 2010 comparing 5, 50 and 200 lux; Blatchford et al., 2012). Nonetheless, Blatchford et al. (2009) found no effect of 5 lux on eye diameter or the corneal radii that have been reported under lower intensities (Deep et al., 2013). Regardless, the welfare implications of these changes in eye morphology for broiler chicken's vision remain unclear.

In terms of behaviour, expression of comfort behaviours and alteration of circadian behavioural rhythms are noted to be affected by light intensity and are considered indicators of reduced welfare. Alvino et al. (2009) determined that behavioural rhythms were diminished at a light intensity of 5 and 1 lux during the day and night, respectively, with a more even distribution of behaviours over the 24-h photoperiod in broilers. In a choice study (Aldridge et al., 2022) report that broiler chickens exhibited a preference for being present in certain rooms or areas, and they showed an even stronger preference for drinking behaviour in rooms with an light intensity level of 20 lux compared to rooms with an light intensity level of 5 lux.

In terms of environmental enrichment, the presence of perches in broiler barns in various types and shapes is a factor that affects animal welfare. Providing greater environmental complexity with a possibility to perch is suggested to encourage increased physical activity of birds, which potentially leads to better leg health and animal welfare (Ventura et al., 2010; 2012; Hongchao et al., 2014; Bist et al., 2023). However, while perches may fulfill behavioral needs it may also threaten the birds' health by causing physical harm. Research have shown that perches may cause keel bone fractures (Gebhardt-Henrich et al., 2018) and breast blisters (Mens and van Emous, 2022). Furthermore, FPD is a serious welfare issue for broilers with as much as 64 % of the birds showing severe lesions at slaughter (Bist et al., 2023). Besides, HB is one of the most obvious indicators for determining animal welfare in broiler farming (Saraiva et al., 2016). The presence of perches may help reduce FPD and HB in broilers (Zhao et al., 2012; Gebhardt-Henrich et al., 2017), possibly through reducing the time spent in contact with the litter and slatted areas. Therefore, more information on the incidence of FPD and HB in broiler chickens with access to perches is needed. Skeletal health or mobility, as demonstrated by levels of mortality and culling due to leg weakness and GS. Lameness in broilers is usually assessed by examining the gait of individual birds using, for example, the gait scoring system, which scores from 0 (normal) to 5 (unable to walk) (Kestin et al., 1992). There is increasing evidence that broilers with a GS ≥ 3 suffer from pain when they walk. It was determined that 14% to 50% of broilers suffer from lameness as stated by GS of 4 or 5 (Kestin et al., 1992; Sorensen et al., 2000). Lameness is associated with pain, therefore representing an important welfare concern. Moreover, lame birds may struggle to access resources in the barn, such as food and water, due to compromised movement (Granquist, 2019).

The use of perches is an application that has a significant effect on the frequency of behaviors such as jumping and flying while perching to the routine behaviors of poultry. In addition, the use of perches is a cheap and simple strategy to increase broiler chickens' activity and reduce the incidence of leg problems such as lameness, improving broiler chickens' health and welfare (Ventura et al., 2012; Bailie and O'Connell, 2015).

This study aims to investigate the effects of light intensity and perch use on specific welfare parameters (incidence of FPD and HB, GS, eye dimensions) and behavioral traits (drinking, feeding, walking, running, perching, leg extension, sitting, dust bathing, standing, pecking, preening, wing stretching and flapping, and aggressiveness) in broiler chickens.

MATERIALS AND METHODS

All the experimental procedures involved in this study were performed after an ethical approval was taken from the Animal Care and Use Committee of Aydin Adnan Menderes University (no: 64583101/2019/075).

Animals and Experimental Design

This study was conducted at a fully controlled poultry house of Aydin Adnan Menderes University, Faculty of Veterinary Medicine Poultry Research Unit, Turkey. In the study, a total of two hundred and seventy 1-d-old Ross 308 male sex broiler chickens were purchased from a local commercial hatchery (EgeTav Agriculture and Livestock Industry Inc., Izmir, Turkey). The broiler chickens were randomly assigned to six treatment groups in a 3x2 factorial arrangement. The factors investigated were light intensity (5, 20, and 80 lux) and perch use (with perch and without perch). Each treatment group consisted of three replicate pens.

Management and Feeding

The broiler chicks were placed in individual floor pens measuring 1.1x1.5 meters (width x length). All replications and treatments were carried out at the same time and in the same barn. Day-old chicks were individually weighed and grouped based on their average body weights. Broiler chickens were reared for the first seven days with a maximum (23L:1D) photoperiod length and a light intensity of 30 lux. Current recommendations for light intensity must be followed, but a light intensity of minimum 30-40 lux (3-4 foot candles) from 0-7 days of age (the rearing period) and at least 5-10 lux (0.5-1.0 foot candles) thereafter will improve feeding activity and growth performance (Aviagen, 2018). The photoperiod length in all groups is carried out under the applications of 5, 20, and 80 lux light intensity, while restricted lighting replicates were provided 18 h light: 6 h dark (18L:6D) from 8 to 36 days, followed by 23 h light (23L:1D) onwards until the end of the experiment (EU, 2007).

The lighting in the rooms was controlled by yellow halogen bulbs, an automatic timer, and a rheostat. Light intensity was monitored at the chick-head level using a digital illuminometer (Extech HD Inst., USA 450, USA) thrice weekly. Walls and ceilings in the rooms were painted white color to ensure light intensity was permanent.

The ambient temperature of the trial rooms was maintained at 33°C for the first three days and gradually reduced by 3°C per week until reaching 22°C. Birds were held at a relative humidity of 50-60% in trial rooms. The chickens were fed a starter diet (0-10 days; 3050 kcal ME kg^{-1}, 23.0% crude protein), grower diet (11-24 days; 3150 kcal ME kg^{-1}, 22% crude protein), and finisher diet (25-42 days; 3200 kcal ME kg^{-1}, 20% crude protein) (NRC, 1994). Feed and water were ensured *ad libitum* throughout the study. Perches are placed between the waterer and the feeder. In the study, the perches made of flat metal pipes with an outer diameter of 3 cm were placed at a height of 5 cm (on days 0-21.) and 10 cm (on days 22-42.) starting just above the base.

Obtaining Data

At 41 days of age, seven broilers from each pen (21 birds per group), a total of 126 broilers, were randomly picked to evaluate some welfare criteria (FPD, HB, and GS). To calculate the severity of FPD, the size of the discoloration is set concerning the size of the footpad and then allocated to one of three scoring levels. The FPD was determined to 0 of 2 scores: footpads with no visible lesions; score 0 (good), footpads with mild superficial lesions; score 1 (fair), footpads with severe ulcerative lesions; score 2 (poor) (Welfare Quality Project, 2009). HB was assigned to 0 of 2 scores: mild superficial lesions (score 1) were judged to not be a trouble or disorder and they were combined with score 0 (not affected). The ulcerative lesions (score 2) were assigned as a painful condition (Welfare Quality Project, 2009). Right and left feet were scored separately because different feet often displayed lesions of different severity for FPD and HB. The decrease in the incidence of FPD and HB in broilers is positive in terms of animal welfare. Categories were later averaged to attain one score per bird for statistical analysis. The GS was determined by using the 0-to-5 scale (0: excellent gait and 5: deficiency stand) (Kestin et al., 1992). At d 42, seven broilers from each replicate pen (21 birds per group) were selected and slaughtered by severing the jugular vein and carotid artery, and eye dimensions measuring were carried out. The right eyes were collected from a total of 126 birds and eye dimensions (eye weight, corneal diameters, mediolateral, dorsoventral and anteroposterior size) were noted immediately after extirpation, using a digital caliper.

To determine the natural behavior characteristics, after the broiler chickens reached the age of 21 days, three broiler chickens from each age group were marked with a non-toxic dye, so that the broiler chickens were not affected by colors, and after seven days of the adaptation period, at the ages of 28, 35 and 42 days each chick was monitored by remote observation of 1 meter for 5 minutes. Behaviors recorded included drinking, feeding, walking, running, perching, leg extension, sitting, dust bathing, standing, pecking, preening, wing stretching and flapping, and aggressiveness. The duration of individual behaviours was expressed as the percentage of total time observed and the frequencies of the behaviours were expressed as frequency per min. (Fortomaris et al., 2007).

Statistical Analysis

Data analysis was performed statistically using SPSS 22.0 software. Data were tested for distribution normality and homogeneity of variance. The General Linear Model (GLM) method was used to reveal the effect of the states of light intensity and the use of perch on the eye morphological measurements and behavioral characteristics. The Duncan test was used to check the significance of the differences between the groups dec (Snedecor and Cochran, 1989). Behavior characteristics data were subjected to arc sine transformation, which showed a similar statistical trend. A non-parametric test (Kruskal Wallis test and Mann-Whitney U test) was used to analyze for HB and GS. No statistical analysis was performed for FPD scoring, as all groups had a score of “0”.

RESULTS

In this study, FPD was not seen in either light intensity and perch groups (FPD score: 0). The light intensity had a statistically significant effect on HB (P<0.01), while perches use had a statistically nonsignificant effect on HB (Table 1). There was no statistical difference between the light intensity group and the perch group in terms of GS (Table 1). Eye weights were 2.107, 2.090 and 2.019 g in broilers reared in 5, 20, and 80 lux groups, respectively (P<0.05). Perch use significantly related weight of the eye (P<0.001) (Table 2). The light intensity did affect walking and standing behavior (P<0.01; P<0.05). The walking (0.51) and standing behaviors (0.76) of broilers in the 20 lux light intensity group were higher compared with those in the 80 lux light intensity group (0.20 and 0.42, respectively). As a behavior parameter, the walking and standing behaviors were reduced in the perch group. Wing flapping behavior was 0.04 in broilers reared in no perch group, while there was no wing flapping in the perch group (P<0.01) (Table 3, 4).

Table 1. Effect of light intensity and perch on the hock burn and gait score in broilers

Factors	Number of animals				Median	The lowest value	The highest value	Rank average	Rank Sum	X^2	Sig.
	Hock Burn										
	n	S:0	S:1	S:2							
Light intensity											
5 lux	42	42	0	0	0	0	0	58.00^{b}			
20 lux	42	39	3	0	0	0	1	62.50^{ab}		9.684	**
80 lux	42	34	8	0	0	0	1	70.00^{a}			
										U	
Perch use											
Perch	63	57	6	0	0	0	1	64.00	4032.00	1953.00	-
No perch	63	58	5	0	0	0	1	63.00	3969.00		

Factors	Number of animals						Median	The lowest value	The highest value	Rank average	Rank Sum	X^2	Sig.
	Gait Score												
	n	S:0	S:1	S:2	S:3	S:4-5							
Light intensity													
5 lux	42	24	12	5	1	0	0	0	3	62.26			
20 lux	42	21	17	4	0	0	0.5	0	2	64.86		0.134	-
80 lux	42	20	22	0	0	0	1	0	1	63.38			
												U	
Perch use													
Perch	63	31	25	7	0	0	1	0	2	65.79	4145.00	1840.00	-
No perch	63	34	26	2	1	0	0	0	3	61.21	3856.00		

n: Total number of broilers, S: Score, a, b: Means with different superscript letters in the same column differ (P<0.05). -: non-significant, **: P<0.01

Table 2. Least square means (± SE) for eye dimensions in treatment groups

Factors	Eye weight (g)		Corneal DV dia. (mm)		Corneal ML dia. (mm)		Eye ML dia. (mm)		Eye DV dia. (mm)		Eye AP size (mm)	
	$\bar{X}$	$S^{\bar{x}}$	$\bar{X}$	$S^{\bar{x}}$	$\bar{X}$	$S^{\bar{x}}$	$\bar{X}$	$S^{\bar{x}}$	$\bar{X}$	$S^{\bar{x}}$	$\bar{X}$	$S^{\bar{x}}$
Expected Mean (µ)	2.072	0.015	7.276	0.022	7.503	0.021	17.077	0.045	17.359	0.088	13.190	0.051
Light intensity												
5 lux	2.107^{a}	0.027	7.335	0.038	7.538	0.037	17.132^{ab}	0.077	17.464	0.152	13.515^{a}	0.088
20 lux	2.090^{ab}	0.027	7.250	0.038	7.538	0.037	17.185^{a}	0.077	17.221	0.152	13.218^{a}	0.088
80 lux	2.019^{b}	0.027	7.243	0.038	7.434	0.037	16.914^{b}	0.077	17.393	0.152	12.835^{b}	0.088
Perch treatment												
Perch	2.129^{a}	0.022	7.250	0.031	7.424^{b}	0.030	17.198^{a}	0.063	17.295	0.124	13.396^{a}	0.072
No Perch	2.016^{b}	0.022	7.302	0.031	7.583^{a}	0.030	16.957^{b}	0.063	17.423	0.124	12.983^{b}	0.072
ANOVA	Significant											
Light intensity (L)	*		-		-		*		-		***	
Perch (P)	***		-		***		**		-		***	
L x P	**		-		-		-		-		***	

dia: diameter, a, b: Means with different superscript letters in the same column differ (P<0.05). -: non-significant, *: P<0.05, **: P<0.01, **: P<0.001. DV: Dorsoventral, ML: Mediolateral, AP: Anterioposterior.

Table 3. Effect of light intensity and perch on the behaviors in broilers at 6 wks of age

Factors	Behavioral patterns								
	Drinking	Feeding	Walking	Running	Perching	Leg extension	Sitting	Dust Bathing	Standing
Expected Mean (µ)	0.05	0.10	0.38	0.02	0.01	0.00	0.55	0.00	0.63
Light intensity									
5 lux	0.07	0.06	0.42^{ab}	0.03	0.01	0.00	0.00	0.00	0.70^{ab}
20 lux	0.03	0.10	0.51^{a}	0.00	0.01	0.01	0.00	0.00	0.76^{a}
80 lux	0.06	0.13	0.20^{b}	0.03	0.01	0.00	0.00	0.00	0.42^{b}
Perch treatment									
Perch	0.04	0.07	0.24^{b}	0.00	0.02	0.00	0.00	0.00	0.40^{b}
No perch	0.06	0.12	0.52^{a}	0.04	0.00	0.01	0.00	0.00	0.85^{a}
SEM[1]	0.01	0.02	0.04	0.01	0.001	0.00	0.00	0.00	0.06
ANOVA	Significant								
Light intensity (L)	-	-	**	-	-	-	-	-	*
Perch (P)	-	-	***	-	-	-	-	-	***
L x P	-	-	-	-	-	-	-	-	-

a, b: Means with different superscript letters in the same column differ (P<0.05).
-: non-significant, *: P<0.05, **: P<0.01, **: P<0.001, [1] Standard Error of the Mean

Table 4. Effect of light intensity and perch on the behaviors in broilers at 6 wks of age

Factors	Behavioral patterns					
	Pecking at litter	Pecking at objects	Preening	Wing stretching	Wing flapping	Aggressiveness
Expected Mean (µ)	0.13	0.00	0.15	0.07	0.02	0.02
Light intensity						
5 lux	0.10	0.00	0.12	0.07	0.01	0.01
20 lux	0.09	0.00	0.13	0.13	0.02	0.00
80 lux	0.20	0.00	0.20	0.00	0.03	0.06
Perch treatment						
Perch	0.15	0.00	0.09	0.09	0.00^{b}	0.01
No perch	0.11	0.00	0.22	0.04	0.04^{a}	0.04
SEM[1]	0.03	0.00	0.03	0.02	0.01	0.01
ANOVA	Significant					
Light intensity (L)	-	-	-	-	-	-
Perch (P)	-	-	-	-	**	-
L x P	-	-	-	*	-	-

a, b: Means with different superscript letters in the same column differ (P<0.05). -: non-significant, *: P<0.05, **: P<0.01, **: P<0.001, [1] Standard Error of the Mean

DISCUSSION

In poultry, one important animal welfare parameter is FPD, defined as discoloration, inflammation, and necrosis on the plantar surface of birds' feet. In the present study, incidence of FPD was not seen in light intensity groups (FPD score: 0). Research has shown that light intensity have an unstable effect on the development of FPD. Deep et al. (2010) found an increased incidence of FPD with dim light. On the other hand, Olanrewaju et al. (2015) discovered that broilers exposed to light intensities ranging from 0.5 to 5 and 10 lux had a similar incidence of FPD. Several studies have previously reported that access to perches did not affect the incidence of FPD (Ventura et al., 2010; Bailie and O'Connell, 2015; Bench et al., 2017; Bailie et al., 2018), as seen in the current study (FPD score: 0). Conversely to such results, Zhao et al. (2012) and Kiyma et al. (2016) reported that supplying perch did affect incidence of FPD, which was showed that be higher in the presence of perch by Zhao et al. (2012) and the absence of perch by Kiyma et al. (2016). These differences in results may have been caused by the use of different perch designs or combination of other management factors, such as placement. Currently, there is no literature available that includes the effects of light intensity and perch use on the incidence of FPD.

HB lesions which may be summarised under the expression contact dermatitis, have been increased in broiler flocks during the last decades. They are characterised by hyperkeratosis and necrosis of the epidermis of the affected sites. In an advanced area there are inflammations of the subcutis with degeneration of tissue. There is evidence that the contact dermatitis cause pain and thus is a matter of welfare (De Jong et al., 2012). In the current study, the broilers reared in 5 lux light intensity had a lower incidence of HB lesions compared to their corresponding 80 lux intensity group (P<0.01). This result can be explained by the fact that the decrease in mobility along with the decrease in walking behavior of broilers in the 80 lux intensity group. Parallel to this study, Blatchford et al. (2009) found that very bright lighting resulted in increased severity of hock condition. In addition, in another study, Blatchford et al. (2009) reported that the 200 lux birds had more bruising on hocks, but fewer erosions on their hocks, than those reared with 5 or 50 lux (P<0.05). However, Sherlock et al. (2010) found that broilers exposed to the light intensity of 10 or 200 lux have a similar incidence of HB. In the present study, HB lesions were unaffected by perch use. This result confirms the findings of previous many studies (Su et al., 2000; Ventura et al., 2010; Hongchao et al., 2014), in which the HB lesions were not affected by perch use. The light intensity did not significantly affect the GS of broilers. The results of this study are consistent with those reported by Blatchford et al. (2009), Deep et al (2010). However, Blatchford et al. (2012) determined that broilers reared under bright light (200 lux) had better overall GS than birds kept under dim light (1 lux). These results can be derived from the variations in light sources and light intensity applied in these studies. Previous studies have indicated that most of the broilers with a GS 4 or 5 are atypical of the bulk of lame birds (Sorensen et al., 2000) and may have infections in their joints or bones (pathological changes) (Kestin et al., 1994). It can be said that at 6 wk of age, the birds had good walking ability, no broilers had a GS 4 or 5 in the light intensity group. The results of this study showed that GS was not affected by perch use. Parallel to the study, some authors reported that there were no significant effects of perch use on the GS (Su et al., 2000; Tablente et al., 2003; Hongchao et al., 2014).

Perception of light depends on its intensity. Light with higher intensities (>4 lux) are suggested to be more capable of penetrating the skull tissue and having a direct effect on the pineal gland and hypothalamus, in contrast to dim light (<4 lux) perceived through the eyes (Benoit, 1964; Lewis and Morris, 2006). In the present study indicated that the eye weights of broilers kept under 5 lux light intensity were higher than those of broilers reared under 80 lux light intensity (P<0.05). Similar to our results, Deep et al. (2010) reported that rearing chicken under dim light resulted in ocular enlargement characterised by heavier and bigger eyes. Likewise, turkeys exposed to 1.1 lux had bigger and heavier eyes as compared to those given 11, 110 or 220 lux (Siopes et al., 1984). Blatchford et al. (2009) reported heavier eyes with dim light (5 lux) in contrast to bright light (50 and 200 lux). A larger eye can potentially exert pressure on the optic nerve, which runs along the caudal aspect of the eyeball, and that this pressure could lead to nerve damage (Morrison et al., 2005). This concept is related to the anatomy of the eye and the potential consequences of increased pressure within the eye. The pressure-induced damage to the optic nerve, as might occur in the case of increased eye size and dimensions, can lead to a painful condition. This pain may be accompanied by the release of inflammatory mediators, such as eicosanoids, which are responsible for hyperalgesia (heightened sensitivity to pain) (Tracey and Walker, 1995). It can be said that in broilers reared under 5 lux light intensity (dim light), which can lead to ocular enlargement and potential inflammatory changes, may experience poor welfare due to this painful condition.

In this study, light intensity had significant affect, except for corneal diameters and eye dorsoventral diameter, on all eye size parameters. The use of dim light (5 lux) in the present study caused a change in the anatomical structure of the broiler chicken's eyes. The lowest mediolateral and anteroposterior diameter of the eye was found in 5 lux light intensity ($P<0.05$, $P<0.001$). These findings are in agreement with those reported by Morrison et al. (2005), Blatchford et al. (2009; 2012), Deep et al. (2010; 2013), Olanrewaju et al. (2015) and Rault et al. (2017). A decrease in the ability to see with an increase in the mediolateral and dorsoventral diameter of the eye can lead to permanent eye defects such as myopia, retinal degeneration, and glaucoma that occur with an increase in the posterior diameter of the anterior (Li et al., 1995; Buyse et al., 1996; Blatchford et al., 2009). It was suggested that increased eye size (eye medio-lateral diameter and anterio-posterior size) may lead to myopia and reduced refractive power, thus affecting visual acuity (Siopes et al., 1984). Dim light was found to induce buphthalmia, altered retina (peripheral darkened areas and nonpigmented white bands), choroiditis, lens damage, inflammation, and increased eye size and weight (Siopes et al., 1984; Thompson and Forbes, 1999; Blatchford et al., 2009; Deep et al., 2010). All or some of these changes might impair the bird's vision and therefore compromise its welfare. According to these results, despite having prominent biological rhythms, broilers exposed to 5 lux demonstrated reduced welfare as indicated by increased eye size and dimensions.

It was found that the use of perch significantly increases the eye weight and anteroposterior diameter, while reducing the corneal mediolateral diameter. This is the first report of a study that investigates the effect of perch on the eye weight and size of broilers reared under different light intensities. This can be explained by the fact that the higher the chicks on the perch, the greater the light intensity of the broilers at eye level, which may have affected the morphometric measurements of the eye. As indicated, previous studies (Bizeray et al., 2002a, b) suggest that barrier perches may be a promising strategy to improve broiler health and welfare. Provision of simple barrier perches appeared to have some beneficial effect on health of broilers, which was evidenced by the trend of a lower proportion of birds with poor health scores in the simple barrier treatment compared with the control treatment. In contrast, complex barriers appeared to have had a damaging effect on health compared with the control pens (Ventura et al., 2010). Such a result may override any positive effects that the complex barrier perches had on health and welfare of broiler (Berg, 1998). The importance of unexpected findings in research and emphasizes the significance of carefully assessing the impact of enrichment items, such as perches, on animal welfare in commercial systems. It's crucial to recognize that even minor variations in the design of these items can lead to significant effects on the welfare of the animals involved.

It was determined that the walking (0.51) and standing (0.76) behaviors of the broilers in the 20 lux light intensity group were higher than those in the 80 lux light intensity group (0.20 and 0.42, respectively) ($P<0.01$, $P<0.05$). Newberry et al. (1988) determined that the walking and standing behavior of broilers reared at a light intensity of 180 lux was higher than that of those under a light intensity of 6 lux. Deep et al. (2012) found the effect of light intensity on walking and standing behavior to be statistically not significant. The differences between the findings can be explained based on the use of brighter and dimmer light as opposed to 80 lux in the studies mentioned. Sitting/lying behavior (0.50-0.58) was found to be lower than the study result (Weeks et al., 2000), which stated that broilers spent 76% of the day with sitting/lying behavior. The foraging behavior of broilers was not affected by the light intensity in accordance with other studies (Downs et al., 2006; Blackford et al., 2009; Deep et al., 2010; 2012). Similarly, Alvino et al. (2009) found no difference in feeding behavior depending on the light intensity, but found that broilers exposed to 5 lux light intensity spent more time drinking water as opposed to those exposed to 200 lux. Depending on the fact that growth-oriented broilers in broiler production have a high motivation to eat feed, it can be said that the intensity of light does not affect the behavior of feeding. It has been determined that preening behavior, which is a comfort behavior, is performed more in broilers kept under 80 lux light intensity, although it is not statistically significant. Similarly, Appleby et al (2004) determined that preening behavior was performed more in broilers housed in high light intensity compared to those in low light intensity.

In the current study, it has been observed that the use of perches eliminates the flapping behavior of wings. There are varied reports on the effect of perch use on wing flapping behavior. Chen et al. (2014) demonstrated that perch characteristics had significant effect on wing flapping behaviour. Newberry and Blair (1993) observed that the provision of perches can reduce vigorous wing flapping in broilers when they are handled. This behavior is important in the context of catching and transporting broiler chickens. Reducing vigorous wing flapping can help minimize the risk of injury to the birds during these processes. Perches give broilers a stable platform to stand on and can reduce their instinctual response to flap their wings vigorously when lifted or handled. This condition can be explained by the fact that the perches placed in the pen may have been an barrier, reducing the desire of the broilers to flap their wings.

Results showed that feeding behaviour was not significantly affected by using perch. In accordance with the results of the study, Bizeray et al. (2002a), and Ventura et al. (2012) found the differences between perch groups not significant in terms of feeding behavior in broilers. It was determined that the water drinking behavior (0.04) was lower in the perch group than in the non-perch group (0.06), and the difference between the groups was not significant. The result obtained in terms of water drinking behavior is in accordance with the results of the research conducted with a similar approach (Hongchao et al., 2014; Rault et al., 2017). It was found that walking behavior was lower in the perch group (0.24) than in the non-perch group (0.52). In parallel with the study findings, Hongchao et al (2014) reported that the use of perches reduced the frequency of walking ($P<0.001$). This situation can be explained by the fact that the obstacles presented by the perches disrupt the movement of broilers. Although the differences between the perch groups in terms of sitting behavior turned out to be statistically not significant, it was found that the lowest sitting behavior was in the perch group (0.53). This result is in line with the research result (Hongchao et al., 2014), which reported that broilers showed less sitting behavior (59.3%) in the presence of perches.

CONCLUSION

In conclusion, there was not seen FPD in the light intensity and perch groups. Treatment using 80 lux of light intensity resulted in increased incidence of HB lesions in contrast to 5 lux intensity. Light intensity and perch has no effect on GS in broiler chickens. Increased eye weight and anterioposterior size with the 5 lux light intensity indicate a reduction in broiler welfare. A comprehensive assessment revealed that keeping broilers at 20 lux light intensity stimulated walking and standing behavioral activities compared to keeping broilers at 80 lux. While the presence of perches between feeders and drinkers may initially reduce the walking behavior of the broilers, it may encourage them to engage in perching, which can be a beneficial activity for their welfare.

Additionally, our results may contribute to the ongoing search for light intensity and perch use. It can be stated that continuing the research will be an appropriate approach in terms of recording the results of different applications in terms of the factors studied.

CONFLICT OF INTEREST

None of the authors of this article has any conflict of interest.

ACKNOWLEDGEMENTS

Data of this article were taken from a Master Thesis supported by Scientific Researh Projects Unit (Project No: VTF-19035) of Aydın Adnan Menderes University, Turkey; Aydın Adnan Menderes University [VTF-19035].

REFERENCES

Aldridge DJ, Owens, CM, Maynard C, Kidd MT, Scanes CG (2022) Impact of light intensity or choice of intensity on broiler performance and behavior. J Appl Poult Res 31: 100216

Alvino GM, Archer GS, Mench JA (2009) Behavioural time budgets of broiler chickens reared in varying light ıntensities. Appl Anim Behav Sci 118(1-2): 54-61.

Appleby MC, Mench JA, Hughes BO (2004) Poultry behaviour and welfare. Wallington, United Kingdom: CABI Publishing.

Aviagen. 2018. Ross Broiler Management Handbook. Aviagen. Huntsville, AL.

Bailie CL, Baxter M, O'Connell NE (2018) Exploring perch provision options for commercial broiler chickens. Appl Anim Behav Sci 200: 114-122.

Bailie CL, O'Connell NE (2015) The influence of providing perches and string on activity levels, fearfulness and leg health in commercial broiler chickens. Animal 9(4): 660-668.

Bench CJ, Oryschak MA, Korver DR, Beltranena E (2017) Behaviour, growth performance, foot pad quality, bone density, and carcass traits of broiler chickens reared with barrier perches and fed different dietary crude protein levels. Can J Anim Sci 97(2): 268-280.

Benoit J (1964) The role of the eye and of the hypothalamus in the photostimulation of gonads in the duck. Ann N Y Acad Sci 117(1): 204-215.

Berg CC 1998. Foot-pad dermatitis in broilers and turkeys-Prevalence, risk factors and prevention. PhD Diss. Swedish Univ Agric Sci, Uppsala, Sweden.

Bist RB, Subedi S, Chai L, Regmi P, Ritz CW, Kim WK, Yang X (2023) Effects of perching on poultry welfare and production: A Review. Poultry 2: 134-157.

Bizeray D, Estevez I, Leterrier C, Faure JM (2002a) Effects of increasing environmental complexity on the physical activity of broiler chickens. Appl Anim Behav Sci 79(1): 27-41.

Bizeray D, Estevez I, Leterrier C, Faure JM. 2002b. Influence of increased environmental complexity on leg condition, performance, and level of fearfulness in broilers. Poult Sci 81:767-773.

Blatchford RA, Archer GS, Mench JA (2012) Contrast in light intensity, rather than day length, influences the behavior and health of broiler chickens. Poult Sci 91(8): 1768-1774.

Blatchford RA, Klasing KC, Shivaprasad HL, Wakenell PS, Archer GS, Mench JA (2009) The effect of light intensity on the behavior, eye and leg health and immune function of broiler chickens. Poult Sci 88(1): 20-28.

Buyse JPCM, Simons PCM, Boshouwers FMG, Decuypere E (1996) Effect of intermittent lighting, light intensity and source on the performance and welfare of broilers. World's Poult Sci J 52(2): 121-130.

Chen DH, Bao J, Meng FY, Wei CB (2014). Choice of perch characteristics by laying hens in cages with different group size and perching behaviours. Appl Anim Behav Sci 150: 37-43.

De Jong I, Berg C, Butterworth A, Estevéz I (2012) Scientific report updating the EFSA opinions on the welfare of broilers and broiler breeders. EFSA Support Publ 9(6): 116.

Deep A, Raginski C, Schwean-Lardner K, Fancher BI, Classen HL (2013) Minimum light intensity threshold to prevent negative effects on broiler production and welfare. Br Poult Sci 54(6): 686-694.

Deep A, Schwean-Lardner K, Crowe TG (2012) Effect of light intensity on broiler behavior and diurnal rhythms. Appl Anim Behav Sci 136(1): 50-56.

Deep A, Schwean-Lardner K, Crowe TG, Fancher BI, Classen HL (2010) Effect of light intensity on broiler production, processing characteristics and welfare. Poult Sci 89(11): 2326-2333.

Downs KM, Lien RJ, Hess JB, Bilgili SF, Dozier III 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(3): 406-416.

EU (2007) Council of the European Communities, 2007/43/EC, Council Directive. Laying Down Minimum Rules for the Protection of Chickens Kept for Meat Production, Off. J.L., 182, 19-28.

Fortomaris P, Arsenos G, Tserveni-Gousi A, Yannakopoulos A (2007) Performance and behaviour of broiler chickens as affected by the housing system. Arch Fur Geflugelkunde 71(3): 97-104.

Gebhardt-Henrich SG, Toscano MJ, Würbel H (2017) Perch use by broiler breeders and its implication on health and production. Poult Sci 96: 3539-3549.

Gebhardt-Henrich SG, Toscano MJ, Würbel H (2018) Use of areal perches and perches on aviary tiers by broiler breeders. Appl Anim Behav Sci 203: 24-33.

Granquist EG, Vasdal G, de Jong IC, Moe RO (2019) Lameness and its relationship with health and production measures in broiler chickens. Animal 13(10): 2365-2372.

Hongchao J, Jiang Y, Song Z, Zhao J, Wang X, Lin H (2014) Effect of perch type and stocking density on the behaviour and growth of broilers. Anim Prod Sci 54(7): 930-941.

Kestin SC, Adams SJM, Gregory NG (1994). Leg weakness in broiler chickens, a review of studies using gait scoring. In: Proceedings of the 9th European Poultry Conference. Vol 1., United Kingdom Branch of the WPSA, Glasgow, Scotland: pp 203-206.

Kestin SC, Knowles TG, Tinch AE, Gregory NG (1992) Prevalence of leg weakness in broiler chickens and its relationship with genotype. Vet Rec 131(9): 190-194.

Kiyma Z, Küçükyılmaz K, Orojpour A (2016) Effects of perch availability on performance, carcass characteristics, and footpad lesions in broilers. Arch Anim Breed 59(1): 19-25.

Lewis P, Morris T (2006) Poultry lighting, the theory and practice, Andover-Hampshire: Northcot.

Li T, Troilo D, Glasser A, Howland HC (1995) Constant light produces severe corneal flattening and hyperopia in chickens. Vision Res 35(9): 1203-1209.

Lien RJ, Hess JB, Mckee SR, Bilgili SF, Townsend JC (2007). Effect of light intensity and photoperiod on live performance, heterophil-to-lymphocyte ratio, and processing yields of broilers. Poult Sci 86(7): 1287-1293.

Mens A, van Emous R (2022). Broiler breeders roosted more on slats than on perches during the laying period. Appl Anim Behav Sci 246: 105531.

Morrison JC, Johnson EC, Cepurna W, Jia L (2005) Understanding mechanisms of pressure-induced optic nerve damage. Prog Retin Eye Res 24(2): 217-240.

Newberry RC, Blair R (1993). Perches ease handling of broiler chickens. In: Proceedings of the Fourth European Symposium on Poultry Welfare. CJ Savory and BO Hughes, ed. Universities Federation for Animal Welfare, Potters Bar, U.K: pp 270-271.

Newberry RC, Hunt JR, Gardiner EE (1988) Influence of light intensity on behavior and performance of broiler chickens. Poult Sci 67(7): 1020-1025.

NRC (1994) National Research Council. Nutrient requirements of poultry. 9th Edition, National Academy Press, Washington DC.

Olanrewaju HA, Miller WW, Maslin WR, Collier SD, Purswell JL, Branton SL (2015) Influence of photoperiod, light intensity and their interaction on health indices of modern broilers grown to heavy weights. Int J Poult Sci 14(4): 183-190.

Rault JL, Clark K, Groves PJ, Cronin GM (2017) Light intensity of 5 or 20 lux on broiler behavior, welfare and productivity. Poult Sci 96(4): 779-787.

Saraiva S, Saraiva C, Stilwell G (2016) Feather conditions and clinical scores as indicators of broilers welfare at the slaughterhouse. Res Vet Sci 107: 75-79.

Siopes TD, Timmons MB, Baughman GR, Parkhurst CR (1984) The effects of light intensity on turkey poult performance, eye morphology, and adrenal weight. Poult Sci 63(5): 904-909.

Snedecor GW, Cochran WG (1989) Statistical Methods, Eight edition. Ames, Iowa: Iowa state University press.
Sorensen P, Su G, Kestin S.C. (2000) Effects of age and stocking density on leg weakness in broiler chickens. Poult Sci 79(6): 864-870.
Su G, Sorensen P, Kestin SC (2000) A note on the effects of perches and litter substrate on leg weakness in broiler chickens. Poult Sci 79(9): 1259-1263.
Tablante NL, Estevez I, Russek-Cohen E (2003) Effect of perches and stocking density on tibial dyschondroplasia and bone mineralization as measured by bone ash in broiler chickens. J Appl Poult Res 12(1): 53-59.
Thompson CE, Forbes JM (1999) Morphology of eyes of turkeys reared under commercial lighting regimens at different light intensities. Br Poult Sci 40(S1): 5-6.
Tracey DJ, Walker JS (1995) Pain due to nerve damage: are inflammatory mediators involved. Inflamm Res 44: 407-411.
Ventura BA, Siewerdt F, Estevez I (2010) Effects of barrier perches and density on broiler leg health, fear and performance. Poult Sci 89(8): 1574-1583.
Ventura BA, Siewerdt F, Estevez I (2012) Access to barrier perches improves behavior repertoire in broilers. Plos One 7(1): e29826.
Weeks CA, Danbury TD, Davies HC, Hunt P, Kestin SC (2000) The behaviour of broiler chickens and its modification by lameness. Appl Anim Behav Sci 67(1-2): 111-125.
Welfare Quality (2009). Welfare Quality® Assessment Protocol for Poultry (Broilers, Laying hens). Welfare Quality® Consortium. Lelystad, the Netherlands.
Zhao JP, Jiao HC, Jiang YB, Song ZG, Wang XJ, Lin H (2012) Cool perch availability improves the performance and welfare status of broiler chickens in hot weather. Poult Sci 91(8):1775-1784.