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Effects of noise and light intensities on stress and fear reactions in broilers

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ABSTRACT

The study was conducted to investigate the effects of noise and light intensity on stress and fear reactions in broilers. Broiler chicks (288) were randomly allocated to nine environmentally controlled rooms containing 16 male and 16 female chicks. Commencing from day 15, the broilers were exposed to noise and light levels of 60, 80 and 100 dB and 50, 100 and 200 lx for 30 sec in every 2 h, respectively. There was no statistical difference between 60 and 80 dB noise level groups for heterophil to lymphocyte ratio (h/l) while it was determined that when noise level had increased to 100 dB, h/l reached to 0.82. The effect of light intensity had no statistical significance on stress. On the other hand, it was determined that fear response of broilers had not affected by either noise level or light intensity. It also revealed that live weights at 42 days of age were affected significantly by the noise and light levels while there were no differences in feed consumption, feed conversion ratios, and mortality rates.

Key words: Broiler, Light intensity, Noise level, Stress

Wavelength, intensity of noise and light and photoperiod are vital environmental factors for some physiological and behavioral functions in poultry. Any excessive change in these parameters causes stress and fear eventually resulting in decrease in productivity as well as animal welfare. Sound levels over 90 dB and wavelength between 2142–6300 Hz has detrimental effects on auditory epithels in poultry (Durham *et al*. 2002). Nijdam *et al*. (2005) reported that stress in poultry was getting higher during routine applications such as catching, crating, transporting, and stunning. On the contrary, McFarlane *et al.* (1989) reported that there was no significant difference in feed consumption and behavioral traits of chickens related to sudden sound stress. Heterophil to lymphocyte ratio is known as the main stress indicator in poultry. The number of heterophil cells increase while the number of lymphocytes decrease in case of stress in broilers. Siegel and Gross (2000), stated that average h/l should be 0.4 in chickens and h/l ratios ranging from 0.6 to 1.2 indicate higher level of stress.

North and Bell (1990) claimed that light intensity in a hen house should vary between 35 and 50 lx. In a different study, it was reported that broilers raised in 200 lx have more foot problems than those in 5 and 50 lx. Besides, as per an EU regulation, light intensity in a hen house must be at least 20 lx (Council Directive 2007). The aim of this study was to investigate the effects of different noise and light intensities on the basis of sex on stress and fear reactions in broilers.

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MATERIALS AND METHODS

This study was carried out in the Poultry Research Unit of the University with the approval of the Ethics Committee on Research Animal Care. Broilers (288) obtained commercially were weighed, wing tagged individually and regardless of sex were allocated into nine different environmentally controlled rooms each of which consisted of 32 chicks (16 male, 16 female). Chicks were fed with starter feed (3,060 kcal ME/kg; 23% crude protein) up to 14th day, and grower feed (3,200 kcal ME/kg; 22% crude protein) till the end of the experiment (NRC 1994). Lights were not turned off for 24 h and light intensity was set to 50 lx at the eye level of chicks (light meter). The ordinary noise level of the rooms was measured as 55–60 dB (sound meter). Stocking density was designed as 12 chicks/m^2. Standard ambient temperature and humidity were maintained during the study. No treatment was applied to chickens till the 13th day of age. Noise intensity was set to 60, 80 and 100 dB at their head level by 350 watts speakers hanged to the ceiling between 14–42 days. Chicks were exposed to truck, slaughter house and regular pen noise by means of an 800 watt sound amplifier (eight channel digital sound amplifier). Light was set to 50, 100 and 200 lx at chickens' eye level with dimmed projectors for 30s in every 2 h. Apart from these, ambient light and sound levels were maintained at 50 lx and 55 dB during the whole study, respectively.

Blood samples (1ml) from wing vein of 10 chickens (five male, five female) were taken in EDTA containing tubes

for heterophyl and lymphocyte counting (Zulkifli *et al*. 2002). After dying with May-Grünwald-Giemsa, 60 cells from each sample were counted for h/l (Gross and Siegel 1983). Tonic immobility test was performed on 12 chickens (six male, six female) from each group of animals which had not been used for blood sampling. TI was induced as soon as the chickens were carried to the test room by restraining them by hand on their right side for 15 sec. The experimenter retreated approximately 1m away from the test table and waited without noise. A chronometer was used to record latencies until the chicken righted itself. If the chicken righted itself in < 10 s, it was recaptured and the procedure was repeated. If TI was not induced after 3 trials, the TI duration was recorded as zero. Along with the TI duration, the numbers of TI inductions were also recorded. The maximum duration of TI allowed was 600 s (Benoff and Siegel 1976). As performance parameters, live weights at 42nd day, weekly feed consumption, and feed conversion ratio were recorded. Mortalities were recorded on daily basis. SPSS version 15.0 was used for analysis and a General Lineer Model (GLM) was designed to reveal the effects of the noise level, light intensity for each sex and their interactions on h/l, TI, no of TI inductions and live weight results. When a significant effect was noted ($P < 0.05$), means were compared by Duncan's multiple range test. Chi-square test was used for mortality.

RESULTS AND DISCUSSION

An increase in sound and light intensity resulted in an increase in h/l (Table 1); it was 0.49 in 60 dB sound group and 0.82 for 100 dB group ($P < 0.01$). There was no significant difference between 50 lx and other 2 light intensity groups (100 and 200 lx). It was determined that only noise had significant effect on stress while both TI duration and TI induction numbers were not affected by light intensity. It was also determined that females were more susceptible to stressors than male counterparts. In this context, h/l in 100 dB noise group was higher than 60 and 80 dB noise levels. Durham *et al.* (2002) reported that broilers were negatively affected by 90 dB noise level. Chloupek *et al.* (2009) reported that broilers exposed to 80 and 100 dB noise levels for 10 min have higher stress levels than control counterparts. In the study, as mentioned before, male broilers have lower stress and fear parameters than females as in the study of Wang *et al.* (2008), who had reported that average h/l in chronic stress in male and female broilers were 0.43 and 0.46, respectively. Results revealed that the effect of light intensity on stress in broilers was inconsistent. About this issue, Olenrewaju *et al.* (2010) reported that there was no statistical significance between different light intensity groups of 0.5, 1.0 and 20 lx. As parallel to this findings, in another study carried out by Lien *et al.* (2007) reported that light intensity had no effect on h/

Table 1. The effects of noise intensity, light intensity and sex on H:L ratio, TI, and live weights at 42nd days

		H:L ratio	TI duration (s) induction	No of TI		Live weight (g)	Mortality (%)
Overall means (μ±SEM)		0.64±0.01	212.7±19.5	1.39±0.07		2561.3±15.5	
Treatments	n	n			n		
Noise intensity (dB)							
60	30	0.49±0.06^{b} 36	155.8±33.8	1.57±0.12	91	2493.0±27.0^{b}	5.2
80	30	0.60±0.06^{b} 36	271.2±33.8	1.30±0.12	90	2633.4±27.1^{a}	6.2
100	30	0.82±0.06^{a} 36	211.1±33.8	1.30±0.12	93	2557.7±26.7^{b}	3.1
Light intensity (lx)							
50	30	0.58±0.06 36	183.1±33.8	1.30±0.12	89	2613.2±27.3	7.3
100	30	0.69±0.06 36	226.5±33.8	1.30±0.12	94	2529.1±26.5	2.1
200	30	0.63±0.06 36	228.5±33.8	1.57±0.12	91	2543.8±26.9	5.2
Sex							
Male	45	0.53±0.05 54	198.0±27.5	1.33±0.09	132	2764.7±22.4	7.7
Female	45	0.74±0.05 54	227.4±27.5	1.44±0.09	142	2357.2±21.6	2.7
Source of variation					Significance		
Noise intensity (dB)			**	-	-	***	X^2=1.05 -
Light intensity (lx)			-	-	-	-	X^2=2.86 -
Sex			**	-	-	***	X^2=3.60 *
Noise × light intensity			**	-	-	*	
Sex × light intensity			**	-	-	-	
Sex × noise intensity			*	-	-	-	
Noise × light × sex			**	-	-	-	

N, number of hen; -,non significant; *P < 0.05, **P < 0.01, ***P < 0.001. a, b, means within a column with different superscript are different (P < 0.05).

Table 2. Total feed consumption and feed conversion ratio (FCR) in groups

Groups	n	Feed consumption (g/bird/1–42 days)	Average live weight (g)	FCR
60 dB-50 lx	29	4493.2	2529.0	1.78
60 dB–100 lx	32	4365.9	2545.4	1.72
60 dB-200 lx	30	4166.6	2368.7	1.76
80 dB-50 lx	30	4659.7	2661.7	1.75
80 dB–100 lx	30	4486.5	2575.6	1.74
80 dB-200 lx	30	4876.8	2657.3	1.83
100 dB-50 lx	30	4542.0	2598.6	1.74
100 dB–100 lx	32	4256.8	2453.1	1.73
100 dB-200 lx	31	4412.2	2596.6	1.70
Total	274	4470.6	2553.5	1.75

n, number of hen.

l in broilers. Gross and Siegel (1983) stated that h/l in broilers under high stress condition ranged from 0.6 to 1.2. From these results, it can be said that noise intensity had more dominant effect on stress than light intensity in broilers. It was determined that different interactions between noise, light and sex had significant effects on h/l. Chloupek *et al*. (2009) reported that stress response in broilers could be triggered by noise above 80 dB. Similar results over stress were reported by many authors (Alvino *et al.* 2009, Lien *et al.* 2007, Wang *et al.* 2008).

TI results showed that different sound, light intensity and sex had no significant effects on fear in broilers. TI test revealed that different noise and light intensities had no effects on fear in broilers. Besides, it was determined that sex had also no effect on fear reaction. These findings were found parallel to the other studies (Chloupek *et al.,* 2009, Wang *et al.* 2008). A harmony was detected between fear and sound and light intensities. Similar case was determined in TI induction numbers (Table 1).

It was determined that the total feed consumption per bird between 1–42 days were ranged from 4166.6 g to 4876.8 g in different light and noise intensity groups. The best FCR (1.70) was calculated for 100 dB-200 lx group while the worst (1.83) was in 80 dB-200 lx group. Noise intensity and sex had statistical significant effects on 42nd day live weight. The highest and the lowest live weights were found as 2,633.4 g and 2,493.0 g in 60 dB and 80 dB noise groups, respectively. In this context, it can be said that noise intensity had more dominant effect on weight gain than light intensity. As parallel to this finding, some studies carried out by Lien *et al.* (2007), Deep *et al.* (2010) reported that light intensity had no significant effect on live weight gain. Additionally, Blatchford *et al.* (2009) stated that light intensities between 1–150 lx had no statistical significant effect on live weight gain, feed consumption, and feed conversion ratio. This finding can be derived from the differences in light intensity and light sources used in these studies. The other reason was lower stress levels of animals in these groups. No statistical significance was found about mortality as parallel to other studies. Lien *et al.* (2008; 2009) reported that one and 150 lx light intensity groups had no significant effect on mortality while Deep *et al.* (2010) claimed that 1, 10, 20 and 40 lx light intensity groups had also no significant effect on mortality.

Consequently, it was determined that noise intensity and the sex of birds both have significant effect on stress in broilers. It was also revealed that females were more susceptible to noise stress while noise and light have no negative effect on fear in broilers. It can be said that to avoid any stress in a pen, it is essential that noise level in the pen should not exceed 80 dB.

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