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Cage position and density effect on some welfare criteria in Denizli chicken

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ABSTRACT

In this experiment, the effect of cage position (tier level) and cage density on some welfare criteria in Denizli Chickens were investigated. In the experiment, 252 hens were allocated to California type battery cages per partition (48×41×46 cm) systematically to from cage density (3, 4 and 5 hen/cage partition) and cage position (top, middle and bottom tier level) groups. The birds were housed 3, 4 and 5 birds / cage partition which resulted in 656.0, 492.0 and 393.6 cm^2 of cage floor surface area/hen, respectively. Feed and water were provided ad lib. As a result of this study, Denizli fowls, differences between foot health and claw length values among cage density groups were found statistically significant. Feather degree was the highest in 3 bird density group (16.59 score) and the lowest in 5 bird density group (8.40 score). In the experiment, it was observed that the effects of cage density and cage position on heterophil lymphocyte ratio (h/l) were not significant.

Key words: Claw length, Denizli chicken, Feather formation, Foot health, Heterophil lymphocyte ratio

Battery cage systems are the most economical for commercial layer industry, but have negative effects on hen welfare. Hen welfare is based on health, production traits, behaviour, and physiology. Factors causing stress include physiological factors, such as climate, environment, nutrition, and diseases, and physical conditions, such as cage density, cage sections and the position of cages in the pen and transport (Onbasilar and Aksoy 2005, Onbaþilar *et al*. 2009, Dereli Fidan and Nazligül 2012). It is reported that h/l ratio is a reliable stress indicator and an increase in h/l ratio should be considered as chronic stress in poultry (Gross and Siegel 1983, Bedanova *et al*. 2007, Azis 2012). The effect of cage density on h/l ratio in commercial layers is reported as non-significant by some studies (Spinu *et al.* 2003, Bishop 2009) while some others reported that cage density has significant effect on h/l ratio (Onbasilar 2003, Onbasilar *et al*. 2009). Onbasilar (2003) is reported that h/l ratios in 1, 3 and 5 cage density groups are 0.61, 0.57 and 0.95, respectively. In another similar study, Onbasilar *et al*. (2009) were found h/l ratios as 0.89 and 1.16 for 4 and 8 cage density groups, respectively. Onbasilar (2003) and Onbasilar and Aksoy (2005) are reported that cage position (top, middle and bottom) has no statistically significant effects on h/l ratio in commercial layers. Besides the biochemical and physiological measurements of stress level, external appearance (pale comb, weak feather formation, bruises at foot and neck and claw length) and general behavior patterns are both can be used as welfare indicators in commercial layers. In different studies on cage density was reported that decreasing the cage density has positive effects on feather formation (Yener 2004, Sarica *et al*. 2008, Bishop 2009), foot health (Onbaþilar 2003 Dozier *et al.* 2006, Onbaþýlar *et al.* 2008) and claw length (Onbasilar 2003, Lay *et al.* 2011). Yener (2004) found that there was no statistically significance between position groups for general feather formation and similarly density and position of the cages had no significant effects on foot health and neck skin bruises in Denizli and commercial layer flocks. Onbasilar (2003) reported that cage position had statistically significant effects on claw length but not on foot health and feather formation. Lay *et al.* (2011) also reported depending on cage design, overgrown claws increase the risk of hens becoming increased in cage fixtures.

This study was carried out to reveal the effects of cage position and density on h/l ratio that is considered as a welfare criteria and external appearance characteristics in Denizli hens, a native Turkish chicken race.

MATERIALS AND METHODS

This study was carried out in the Poultry Research Unit of Faculty of Veterinary Medicine in Adnan Menderes University. This study was approved by Animal Ethic Committee of University of Adnan Menderes. A total of 252

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Denizli hens were used in the study. Birds were reared in a pen with deep litter all together to the end of the growing period (18th week) and routine commercial layer feeding management and health care procedures were applied. Birds were fed with a before laying diet from 18 to 20 week of age (ME=12.12 MJ/kg, 170 g/kg crude protein) and laying diet from 20 to 44 week (ME=11.08 MJ/kg, 150 g/kg crude protein). Feed was available *ad lib*. during the experiment. After finishing the growing period, 252 Denizli breed hens were taken to the California type battery cages (Dimensions: 48 × 41× 46 cm) which have 3 floors and the study was ended at the 44th week of age. Birds (bird initial and final body weight average respectively 1241.50±9.76 and 2293.40±24.24 g) were allocated to the battery cages with 3 × 3 experimental design according to 3 cage positions (top, middle and bottom tier level; 84, 84 and 84 hen, respectively, total 252 hen) and 3 cage densities (3, 4 and 5 bird/cage; 63, 84 and 105 hen, respectively, total 252 hen) and 7 density sub groups were formed for each cage position group. Floor spaces for 3, 4 and 5 hen/cage groups were allocated as 656.0, 492.0 and 393.6 cm^2, respectively. Lighting program designed as 16 h light/day, temperature and humidity were measured daily with min-max thermometers and hygrometers. Nipple drinkers were used for water supply.

In the determination of the h/l ratio, 63 (7 hens from each group) blood samples with EDTA from hens at 30 and 44 weeks of age in different position and density groups were used. For this purpose, blood films were prepared from the samples and painted with May-Grunwald and Giemsa dyes (Gross and Siegel 1983). After 100 leucocytes were counted in light microscope with (×100) magnification, h/l ratio was calculated by dividing heterophil count to lymphocyte count. All chickens one by one were taken to the out of the cages for external appearance (feather formation, neck skin bruises, foot health and claw length) evaluation at the 44th week of the study.

To determine the feathering status and feather losses, foot health, claw length and neck skin bruises 4 scored evaluation method was used (Tauson 1984, Onbasilar *et al.* 2008, Lay *et al.* 2011). For this purpose body of the hen was parted to 5 as neck, breast, back, wings and tail. Each part was scored as 1 to 4 points (1: feathers only in small area, 2: non-feathering area > feathering area, 3: feathering area > non-feathering area and 4: fully feathered). Feathering degree that varied from 5 to 20 for each hen was calculated by adding five partial scores. According to the bruises on the neck, 1–4 scale was used to evaluate the neck skin status (1: a few big bruises, 2: if bruise likes hazelnut, 3: if bruise likes bean, and 4: there is no bruise on the neck skin). Foot health was determinated by using 1–4 scale (1: if there is abscess and erosive lesions, 2: if there is no inflammation but lots of lesions, 3: if there is no inflammation but one or two superficial lesions, and 4: if there is no inflammation and lesions). Claw length was scored 1 to 4 (1: NL> 40 mm and if claw twisted, 2: NL> 40 mm and if there is no twist, 3: NL> 30 mm, there is no twist, and excessive claw length, 4: NL< 20mm, normal and short claw).

SPSS version 15.0 was used for analysis and a general lineer model (GLM) was designed to reveal the effects of cage position and density on h/l ratio and external appearance characteristics. Data from battery cages having unbroken integrity was used to determine the effect of cage intensity on exterior appearance characteristics. The partial effects of cage position and density for each factor were analysed with least quares means test (Harvey 1987) and multiple comparisons were performed with Duncan test (Duncan 1955). Only cages without density problem were taken to the data basis for analysis of external appearance characteristics and Kruskal-Wallis ANOVA Test was used for this purpose, and multiple comparisons were performed with Mann Whitney U Test (Tekin 2010).

RESULTS AND DISCUSSION

In this study general h/l ratio means, for 3, 4 and 5 hen/cage density groups were found as 0.78, 0.87 and 0.90, respectively, for top, middle and bottom tier level cage position groups were found as 0.94, 0.79 and 0.82 respectively, and there is no statistically significance between cage position and cage density groups. The lowest h/l ratio (0.74) was calculated in the 4 hen/cage density group at 44th week, the highest h/l value (1.01) was determined in the 4 hen/cage density group at 30th week of age. In the study, the statistically nonsignificant interaction was determined between cage position and cage density. External apperance scores of cage density and position groups at 18 weeks of age Denizli chickens are shown in Table 1. The effect of cage density and cage position on general feathering formation, foot health, neck skin trauma and claw length scores at 18 week of age were nonsignificant. The highest general feathering score (16.59) was calculated in the 3 hen/cage density group, the lowest score (8.40) was determined in the 5 hen/cage density group at the 44th week of the study ($P < 0.001$) (Table 2).

Increasing trend in the general mean of h/l ratio related to increasing cage density shows similarities with other studies reporting an increasing h/l trend that carried out on the stressed chickens (Gross and Siegel 1983, Azis 2012). As parallel to this finding, statistically nonsignificant results between cage density groups were consistent with some other studies (Spinu *et al.* 2003, Bishop 2009). However, some studies (Onbasilar 2003, Onbasilar *et al*. 2009) report that cage density has an important effect on h/l ratio have also some similarities with this study stating that h/l was high at increased stress levels. It was thought that there was an increasing trend in stress level related to decreasing floor allowance in Denizli hens as such in usual commercial chicken genotypes used in other studies. There was no statistically significance between cage position groups for

Table 1. External appearance scores of cage density and position groups at 18 weeks of age Denizli chickens

Cage density and position		Feather formation						Foot health	Neck skin trauma	Claw length
		Neck	Breast	Back	Wings	Tail	General			
	n	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Three	63	3.98±0.02	4.00±0.00	3.97±0.02	3.97±0.02	3.97±0.02	19.89±0.05	4.00±0.00	4.00±0.00	4.00±0.00
Four	84	4.00±0.00	4.00±0.00	3.98±0.02	3.99±0.01	3.99±0.01	19.95±0.03	4.00±0.00	4.00±0.00	4.00±0.00
Five	105	3.99±0.01	4.00±0.00	4.00±0.00	3.98±0.01	4.00±0.00	19.97±0.02	4.00±0.00	4.00±0.00	4.00±0.00
P		-1	-	-	-	-	-	-	-	-
Top	84	3.99±0.01	4.00±0.00	3.99±0.01	3.98±0.02	3.99±0.01	19.94±0.03	4.00±0.00	4.00±0.00	4.00±0.00
Middle	84	3.99±0.01	4.00±0.00	3.98±0.02	3.98±0.02	3.99±0.01	19.93±0.03	4.00±0.00	4.00±0.00	4.00±0.00
Bottom	84	4.00±0.00	4.00±0.00	3.99±0.01	3.99±0.01	3.99±0.01	19.96±0.03	4.00±0.00	4.00±0.00	4.00±0.00
P		-	-	-	-	-	-	-	-	-

n - The number of hen at the beginning of the placement to cages (63+84+105=252 hen, 84+84+84=252 hen), 1 nonsignificant.

Table 2. External appearance scores of cage density and position groups at 44 weeks of age Denizli chickens

Cage density and position		Feather formation						Foot health	Neck skin trauma	Claw length
		Neck	Breast	Back	Wings	Tail	General			
	n	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Three	39	3.49±0.10a	3.31±0.12a	3.18±0.14a	3.31±0.11a	3.31±0.10a	16.59±0.42a	4.00±0.00a	4.00±0.00	3.92±0.04a
Four	28	3.25±0.14a	2.75±0.17b	2.96±0.20a	2.82±0.16b	2.75±0.17b	14.54±0.74b	4.00±0.00a	4.00±0.00	3.79±0.08a
Five	30	2.07±0.19b	1.83±0.16c	1.60±0.15b	1.63±0.13c	1.27±0.10c	8.40±0.62c	3.90±0.06b	3.93±0.05	3.30±0.14b
P		***	***	***	***	***	***	*	-1	***
Top	54	3.20±0.11	2.65±0.13	2.65±0.14	2.89±0.11a	2.70±0.14	14.09±0.53	4.00±0.00	3.98±0.02	3.76±0.06
Middle	64	2.97±0.13	2.61±0.12	2.66±0.14	2.48±0.13	2.31±0.13	12.97±0.60	3.97±0.02	3.97±0.02	3.58±0.07
Bottom	56	2.79±0.16	2.64±0.16	2.71±0.16	2.68±0.15	2.41±0.16	13.23±0.74	3.98±0.02	3.98±0.02	3.68±0.08
P		-	-	-	-	-	-	-	-	-

n - number of hen, 1 nonsignificant, 2 data from battery cages having unbroken integrity was used to determine the effect of cage intensity on exterior appearance characteristics, *P < 0.05, ***P < 0.001, a,b,c - means within a column with different superscript are different (P < 0.05).

h/l ratio. Similar results were also reported by Onbasilar (2003) and Onbasilar and Aksoy (2005). According to these results, it can be said that if there is sufficient lighting, ventilation, temperature, and etc. among cage floors; cage position has no significant effects on the stress level in Denizli hens.

General feather formation in Denizli hens was increased related to decreasing cage density and the best feather formation (16.59) was determined in the 3 hen/cage group (P < 0.001). Parallel findings were also reported by Onbasilar (2003), Yener (2004) and Sarica *et al*. (2008). It was thought that decreasing feeder allowance for each bird related to increasing cage density, increasing trend in pecking and feather pecking and stress could have accelerated the loss of feather.

Both foot health and average claw length values were found the lowest in the 5 hen/cage density group. These findings were in consistent with some other studies reporting that decrease in the cage density has positive effects on foot heatlh (Onbasilar 2003, Dozier *et al.* 2006, Onbasilar *et al*. 2008) and claw length (Onbasilar 2003, Lay *et al.* 2011). This positive effect can be attributed to more movement related to more space allowance in the pen and more claw erosion.

Cage position has no important effects on both neck skin bruises and claw length. Yener (2004) reported similar findings on neck skin bruises and claw length related to cage position. It can be said that cage position has no significant effects on claw length and neck skin bruises if there is sufficient animal welfare conditions in the poultry house.

Consequently, it was found that cage density has significant effects on some welfare indicators such as h/l ratio and feather formation in Denizli hens. It can be said that these welfare indicators can be negatively affected by the increasing cage density. And, cage position has no sifnificant effects on h/l ratio and external appearance characteristics. Furthermore, it was thought that because of their fearful nature and nervous behaviours in cage battery systems, Denizli hens should be reared within lower cage densities.

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