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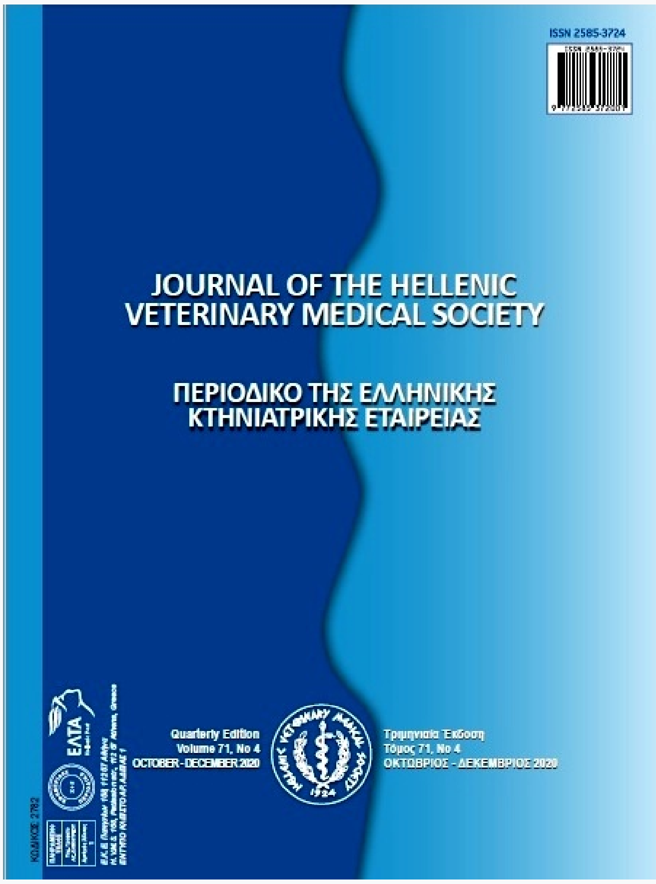

Effects of Housing Locations on Feather Damages of Laying Hens in a Free-Range Housing System

METIN PETEK

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Effects of Housing Locations on Feather Damages of Laying Hens in a Free-Range Housing System

Metin Petek

Bursa Uludag University, Faculty of Veterinary Medicine, Department of Animal Science Bursa Turkey

ABSTRACT: This study was made to evaluate the effects of different locations of a free range housing system on feather damages of laying hens. The experimental house consisted of three different locations as closed indoor plastic slats, closed indoor litter and outdoor range area. The birds were able to move freely between the locations of the experimental house and they had continuous access to outdoor range during the day. The feather damages of the birds was evaluated with a distance scoring system at 64 weeks of age. Five area in each location of the experimental house were determined at first and then feather damages of five body parts of ten birds in each location were scored to measure plumage quality. Total feather score was defined as the sum of the scores of five body parts of the birds. Best plumage quality was measured in neck in all housing locations (*P<0.01, P<0.05 and P<0.01*) and total feather score of the birds was significantly greatest (worst) in slats (*P<0.05*).

***Keywords*:** Free range, housing location, plumage quality

Corresponding Author:
Metin Petek, Bursa Uludag University, Faculty of Veterinary Medicine, Department of Animal Science Bursa Turkey
E-mail address: petek@uludag.edu.tr

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INTRODUCTION

Feather pecking can represent an important welfare problem in all housing systems in commercial egg production, probably may be resulting in canibalism and mortality as well as production loss for the damaged birds (Petek and Mckinstry, 2010; Scherwin *et al*., 2010; 2013). Any outbreaks of feather pecking or injurious pecking is currently impossible to control, despite a number of proposed interventions (Lambton *et al.*, 2015). The causes of feather pecking and canibalism are very complicated and multi-factorial including drinker, genotype, insufficient or improperly placed feeder or drinking space, farm location, lighting program, housing system, lenght and type of perches (Lambton *et al*., 2010; Sherwin *et al*., 2010; Coton *et al*, 2019; Ellen *et al*.,2019; Kaukonen and Valros 2019). Therefore, any approach to prevent or reduce prevaleness of feather pecking in commercial flocks should use a multifactorial approach to reduce this problem (Bestman and Wagenaar, 2003; Petek *et al*., 2015; Petterson *et al*., 2017).

Currently, there has been increasing focus on understanding the risk factors and alternative methods to reduce feather pecking in laying hens (Ellen *et al*., 2019). The ability to predict feather damage and canibalism in advance would be a valuable research tool for identifying which management or environmental factors could be the most effective interventions in egg production. Some scientific findings suggests that feather pecking and canibalism could be largely prevented by the use of appropriate husbandry techniques without the use of beak trimming (Weeks *et al*., 2011; Lambton *et al*., 2013). Good housing design and layout of equipment are very important to reduce deletorius effects of injurious pecking in laying hens (Featherwell Booklet, 2013; Liebers *et al*., 2019). Pecking activity of a layers can be different in different location of a house depending on the condition as light intensity, feeding time, presence of something remarkable or competition (Petek *et al*. 2015; Temple *et al*. 2017) and this can be important to understand and solve the feather pecking problem of free range laying hens. Blokhuis and Arkes (1984) showed that birds housed on slatted floors showed more feather pecking and less ground pecking than birds housed on litter. When birds housed on litter were transferred to slatted floors, feather pecking increased in these birds (Lambton *et* al., 2010). Dust bathing and litter scratching in litter and range area are the key factors that decrease the risk of injurious pecking (Defra Booklet, 2005) Feather pecking is very rarely seen out on the outdoor grazing area (Ellen *et al.,* 2019) and it is clear that the risk of feather pecking in free-range layer chickens might be lower when an outdoor grazing area is provided as early as possible (Shimmura *et al*. 2008; Petek *et al.* 2015). Lambton *et al*.(2010) showed that risk of vent pecking may be reduced by delaying the onset of lay and subsequently encouraging range use. Whereas, it was reported earlier that there were no significant relationships between feather condition and use of outside run (Leenstra *et al*., 2012). Mahboup *et al*.(2004) reported that the percentage of time spent on grassland and feather damage were inversely correlated. The aim of this study was to determine the level of feather damage of layer chickens observed in different locations of a free range house such as slats, litter and range area.

MATERIALS AND METHODS

This study was carried out at Research and Experimental Farm of Bursa Uludag University, in Turkey. The experimental procedures employed in this study were in accordance with the principles and guidelines set out by the Committee of Bursa Uludag University on animal care. Data collected from a Lohman Brown layer hens housed in an experimental free-range house.

Management

The experimental house was consistent of three locations as indoor raised plastic slats, indoor ground litter (one third of total indoor floor space) and outdoor range area to the birds. White plastic slats (100x60 cm) and rice hull (about 10 cm deep) were used as a slatt and litter material. In this study, automatic nest boxes (1 m^2 of nest space in a group nest for every 100 hens), hanging feeders (30 cm in diameter with 10-15 kg capacity, each) and bell drinkers were provided for the birds in the experimental house. The birds were beak trimmed by hot blade method at first week of age and mean stocking density within the groups was 5 birds per 1 m^2 indoor and 4 birds per 10 m^2 outdoors. The standard layer diet was supplied (2700 kcal kg-1 metabolizable energy and 18 % crude protein) as ad libitum throughout the experiment (NRC, 1994). The birds were able to move freely between the indoor and foraging area of the experimental house and they had continuous access to outdoor range during the day. The daily photoperiod consisted of 16 h of light and 8 h of darkness and the lighting intensity was arranged as 3.0 lx m^2.

Data

In this study, a distance scoring system was used to assess feather damage in hens at 64 weeks of age (Bright *et a*l., 2006; Lambton *et al*., 2013). The birds' body divided into three regions and all of the body regions were scored for plumage damage using five point scale. Neck, back and rump regions of the birds' bodies were scored from 0 (no or very little feather damage) to 4 (severe damage to feathers or large naked areas on the body). Wing and tail of the birds were also scored from 0 (intac feathers) to 4 (all feathers missing or broken). At first, five area in each location (for the slat, litter and range area) of the experimental house were determined and then the feather cover of five different body regions of ten birds in each part in each location were scored to measure plumage quality (50 birds for slat, 50 birds for litter and 50 birds for range). Because it is considered that a sample of 50 hens will provide a good indication of the state of a flock about their plumage quality (Temple et al., 2017; Decina et al., 2019). Ensure that the hens are selected at random within the sampling point, every second bird sampled to avoid drawn towards specific birds with bad or good feather cover. Flock prevalence of feather pecking in all area was calculated as a percentage of birds with damaged feathers from the total birds scored. Total feather score was defined as the sum of the scores of five body parts in a part of experimental house or as average of the scores of three location of the experimental house for a body region.

During data collection, indoor temperature, relative humidity and ammonia concentrations, and outdoor temperature and relative humidity were continuously monitored at 10-minute intervals with a weather monitor (Kestrel Handhend Weather Monitor 3500) and an ammonia meter (GasBadge Pro: Single Gas Detector:Ammonia) and was recorded.

Statistical Analysis

ANOVA test procedure was used to analyze all the data investigated in SPSS version 13.00 (Spss, 2004). Duncan test was using for mean seperation (Snedecor and Cochran, 1989).

RESULTS

The average scores of plumage observed in different body region of the hens in relation to different location of the experimantal house were presented in table 1. There were a significant differences for plumage score/feather damage of different body region of the birds in every location of the experimental house including slats, litter and range area, respectively (*P<0.001, P<0.05 and P<0.001*). Best plumage quality in all housing location was measured in neck and it was significantly greatest in range area. Differences for the average feather scores of rump, tail and wing of the layers in slats, litter and range location were found to be significantly important in this study, respectively (*P<0.05, P<0.01 and P<0.01*).

Table 1. Observed plumage score in different body region of the birds in different house locations (Mean ± SEM)

House location/	Body Region					
	Neck	Back	Rump	Tail	Wing	***P***
Slatt	$0.188{\pm}0.23^{Bd}$	$0.531{\pm}0.23^{Ac}$	$1.250{\pm}0.22^{Ab}$	$1.742{\pm}0.24^{Aa}$	$1.000{\pm}0.22^{Ab}$	*0.001*
Litter	$0.182{\pm}0.22^{Bc}$	$0.500{\pm}0.23^{Ab}$	$0.875{\pm}0.23^{Bb}$	$1.281{\pm}0.23^{Ba}$	$0.818{\pm}0.21^{Ab}$	0.050
Range	$0.265{\pm}0.20^{Ab}$	$0.441{\pm}0.21^{Ab}$	$0.500{\pm}0.20^{Cb}$	$1.206{\pm}0.23^{Ba}$	$0.529{\pm}0.22^{Bb}$	*0.001*
P	0.05	n.s	0.05	0.01	0.01	

a-d : within rows, values with different superscript letters differ significantly (P<0.05, P<0.001), n.s.;no significant.
A-B: within columns, values with different superscript letters differ significantly (P<0.05, P<0.01).
SEM; Standard error of means

Flock prevalence of feather damage, average and total feather scores of birds in different house locations and different body region were showed in table 2. Based on the study, plumage quality was the worst in birds in slatt location of the experimental house compare to the other two house locations. The mean proportion of birds affected by any feather damage in slatt, litter and range locations of the house were calculated as 60.00, 47.50 and 41.88, respectively. There were significant differences for total feather score between all body region (P<0.001). The flock prevaleness of feather damage was found to be significantly greatest in tail and 90.62% of the birds has a varied tail damages. The final total feather score in neck, back, rump, tail and wing of the birds were 0.211, 0.491, 0.875, 1.419 and 0.783, respectively and significantly important. The effects of house location and body region on average feather score were found to be significantly important, respectively (P<0.01, P<0.001).

Table 2: Flock prevalence of feather damage, average and total feather scores in different house location and body region of the birds (Mean ± SEM)

Factors	Flock Prevalance (%)	AFS[1]	TFS[2]
Housing location			
Slatt	60.00	0.942±0.067[a]	4.711±0.121[a]
Litter	47.50	0.731±0.066[b]	3.656±0.112[b]
Range	41.88	0.588±0.064[b]	2.941±0.098[b]
P		0.01	0.01
Body Region			
Neck	13.54	0.211±0.084[c]	0.635±0.080[c]
Back	34.37	0.491±0.085[c]	1.472±0.081[c]
Rump	59.37	0.875±0.083[b]	2.625±0.095[b]
Tail	90.62	1.410±0.086[a]	4.229±0.162[a]
Wing	51.04	0.783±0.085[b]	2.347±0.091[b]
P		0.001	0.001

a-c: within columns, values with different superscript letters differ significantly (P<0.01, P<0.001) , SEM; Standard error of means
[1]; AFS: Average feather score was defined as average of the scores of each body parts in total of the experimental house and of the scores of each three locations of the experimental house.
[2]; TFS; Total feather score was defined as the sum of the scores of each five body parts in total of the experimental house and of the scores of each three locations of the experimental house.

The humidity level in slat, litter and range locations were found to be 60.63, 53.80 and 34.35%, respectively. Inside slat and litter locations temperature and outside temperature on range area at bird level were measured as 28.13, 28.03 and 30.50 *C*°, respectively. Inside ammonia level on slat and litter location were 0.016 and 0.006 *p.p.m* during the data collection (table 3).

Table 3: Environmental measurements at hen head height in different house location

Location	Humidity (%)	Temperature (C°)	Ammonia (p.p.m)
Slat	60.63	28.13	0.016
Litter	53.8	28.03	0.006
Range	34.35	30.50	*Not measured*

DISCUSSION

Free-range housing systems provide outdoor access for layers and they have a choice between indoor and outdoor areas. The behavioral demands of a free range bird may be higher than those experienced within enclosed indoor systems due to the large areas to navigate and variable environmental conditions (Campbell *et al*., 2018). In reality, birds may only use certain areas of the house throughout the flock cycle (Petterson *et al*., 2017), and fearful birds may be hesitant to go to outside (Campbell *et al*., 2016, Hartcher *et al*., 2016) in a free range housing. In most flocks, many birds appear reluctant to leave the poultry house and only small proportions of the flocks are reported to be observed outside (Grigor, 2013). However, daily access to range and a greater proportion of range using during the laying period reduces the occurrence of feather pecking on a flock level (Bestman and Wagenaar, 2003; Jung and Knierim, 2018).

According to the results and in agreement with previous finding (Giesberg *et al.,* 2017), the best plumage quality within the all body region was measured in neck. Although, vent pecking is most prevalent in hens housed in a free range housing system (Sherwin *et al.,* 2010), we found that the tail was the most severely affected body part in all location of the experimental house. The second most commonly affected body region of the birds was rump in slats and litter locations, whereas it was wings in range location. Feather pecking is not uniformly directed to the whole body and the tail, back and rump receive most pecks (Gunnarson *et al*., 1995). Feather pecking is usually accepted the cause of plumage damage to the tail and rump (Petek and Mckinstry, 2010). Ramadan and Von Borel (2008) reported that wings, rump, tail and back were the main targets for feather pecking in laying hens and feather damage for these body region were found to be greater in slats in our study. While feather damage in back and rump is generally associated with injurious pecking, feather damage in the head and neck can be indicate aggression or equipment damage than to feather pecking behavior. Similar with findings of Ramadan and Von Borel (2008) feather damage in rump and tail were found to be significantly greater in slats compare to litter and range location of the experimental house. In a study, Pickova *et al.(*2017) reported that the proportion of featherless areas in the rump region differed significantly between the housings from week 8 of the experiment and on the back and rump region from week 12.

In this study, the prevalence of feather damage were 60.00, 47.50 and 41.88% in slats, litter and range location of the experimental house, respectively. This means the birds located in slats had more feather damage or birds located in all area had more or less feather damage. Ramadan and Von Borel (2008) reported that the feather pecking occurred mainly on the floor (66%) and followed by feeding area (26%), perches (4%) and slats (4%). In this study, plumage quality as average and total feather score were found to be worst in slats probably due to feeder and drinker lines which is affecting bird distribution and pecking behaviour around. The result of this study clearly showed that litter or especially range using is very important to reduce pecking damage because less feather damage were observed in range or litter compared to slats. There is evidence flocks with many birds outside using all areas of the range have better feather cover (Chielo *et al*., 2016) and it would be beneficial to attract layers to litter or foraging area to reduce pecking behaviour. As reported previously, greatest range use can be achieved by letting the hens use the range as early as possible (Petek *et al*., 2015). Maintaining litter quality in litter area is the single most important enrichment you can provide to reduce the risk of feather pecking (Temple *et al*., 2017) and pecking stones or alfaalfa bales can be useful for attracting birds to the litter (Schreiter *et al*., 2019). Rearing environment can also play an important role in the later development of pecking problems (Janczak and Riber 2015).

In this study, the location of the hens (slats, litter or range area) did not affect air temperature or relative humidity. The ammonia concentration was 0.016 and 0.006 *ppm* in slat and litter area and no measurement outside range area. No significant differences for the relative humidity and ammonia levels were found between slat and litter location due to probably proper ventilation rate and optimum poultry stocking density with proper amount and type of litter. Because ammonia concentration and relative humidity are mainly affected by manure accumulation under the slats and higher moisture content of the litter (Oliveira et al., 2019). Moreover, free range access to fresh air helped to reduce the inside ammonia level.

When searching for an on-farm solution to reduce feather pecking behaviour, it is importance to identify the potential risk factors involved in the development of feather pecking activity on every flock. Free range housing systems should be designed so that birds can easily move throughout the house including slats, perches, feeder and drinker lines. This gives them ease of access to all facilities thus reducing the risk of feather pecking and it will make it easier for them to escape any pecking attempts. Slatted floors, some ramps and stairs may be used to facilitate an easy access to and movement through the system.

CONCLUSION

The study underlines the importance of housing locations, especially indoor housing design, in preventing pecking problems and indicates that increasing use of range area and spending less time on the slats location in a free range house would be very beneficial to reduce feather pecking of layer chickens. Further research covering a large number of flocks should be also very usefull to see the clear effects of house locations on pecking behavior and plumage quality in free range flocks.

CONFLICT OF INTEREST

None declared.

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