Effect of housing condition on the welfare traits of laying he

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Abstract

Effects of housing conditions on some welfare traits were investigated i laying hens. From week 18 after hatching, three groups of 50 hen (brown Lohmann Traditional) were kept in pens with winter garden (WG in one group and with WG and range (open area with one tree) in th other two groups. Position of the range in relation to WG was differe from group to another. The range located in front of WG (D-range) c side of WG (S-range). At 44 weeks of age, TI reactions of 20 hens fror each group were measured and blood smears from 10 hens from eac group were analysed for differential leukocyte counts. Feather scorin was carried out at 6 ages from 25 to 48 weeks. The availability of loos feathers on the floor of each pen and WG as well as faecal dropping was collected at 52, 54, 56 and 58 weeks of age. All birds ha transponders to record the movements of each hen between inside an outside areas and the time spent in each area during 24 h. Hens tha were reared in house with S-range had higher level of fearful than thos reared in house with D-range or without range (P=0.0021). Hens tha were access to range (either S- or D-range) had lower H/L ratios tha hens that were access only to winter garden (P=0.0011). Hens kept wit winter garden only had more feather damage than groups have side c direct range (P=0.0041). The availability of loose feathers on pen floc and number of faecal feather material were more in WG group than othe groups with range (P=0.0001, P=0.0093, respectively). Hens in D-rang group moved more frequently to the outside areas and spent less time i range than hens in S-range group (P=0.0001). Floor eggs were more i groups with range than in group without range (P=0.0369). It i concluded that the welfare of the laying hens is superior when they wer housed with outside range and the position of range in relation to hous should be considered. Delay opening of pop holes was recommended.

Key words: Housing condition – welfare – fearfulness – stress – laying hens

Introduction

Improvement of farm animals' welfare is a major goal of husbandry mar strategies. One approach to reach this goal is to reduce fearfulness, st increase adequate adaptation to stressors in live stock, including laying hens houses for laying hens vary substantially according to the kind of bird and the of rearing. The alternative systems for egg production have arisen becaus harmful effect of cages on poultry welfare (Broom, 2001). The base of housi hens in alternative systems is to provide them with increased freedom of m

the ability to express a wide range of behaviour patterns, a more appropri nest site and access to substrate for ground scratching and dustbathing (A Hughes, 1991).

Free range is one of several alternative systems which consist of a h range. The birds have continuous daytime access to open-air runs, which covered with vegetation. In the outside run, birds are under a natural e where they are exposed to a variety of climatic conditions, unfamiliar predators. Free range systems potentially provide a major advantage welfare. However, in practice, there are problems such as dirty and displ parasites, interference by predators, uneven distribution of birds, preferer area close to the house, grassland damage, feather pecking and cannibalis et al. 1992; Bubier and Bradshaw 1998).

If the outdoor areas are attractive and safe for birds to stay and pe behaviours this will not only lead to a lower density in the house (Nicol et al. also increase the frequency of movements to the outside and the proport spent in open areas (Mahboub et al., 2004). Increased environmental co outdoor enclosures has been investigated as a means to achieve practical resolve welfare problems, such as decreasing fear responses (Jones and W 1992). Fearfulness was assessed by recording the birds' tonic immobility manual restraint. The duration of tonic immobility is positively related to fearfulness (Boissy, 1995; Jones, 1996). Stress in chickens suppresses activity, cell-mediated immunity and antibody synthesis (Freeman, 1987 birds show an increase in basophils and heterophils and a decrease in l and, as a result, an increase in the heterophil:lymphocyte (H:L) ratio that co as an indicator of stress (Gross and Sigel, 1983). With time, the H:L ratio o to normal (Katanbaf et al., 1988), but basophils remain elevated and thu used to assess prolonged stress (Maxwell et al., 1990).

Feather eating has been observed in a few species of birds includ strains of domestic fowl (Savory and Mann, 1997). The function of feath domestic fowl is unclear, because fowl does not possess the ability to keratin in the digestive tract and feathers cannot have any nutritive value feather eating in the domestic fowl is a form of pica (consumption of material with no apparent function) (Mckeegan and Savory, 1999). Rec reported that eating feathers increase the speed of feed passage and s effects to insoluble fiber (Harlander-Matauschek et al., 2006). When hen conspecifics, they may misperceive feathers as a foraging material (Riber peck at, pluck and eat the feathers. Harlander-Matauschek et al. (2008) fo motivation to eat feathers was an important incentive to peck at and plu from other birds. Therefore, birds that showed high rate of feather peckin more freely available feathers than birds exhibited low feather apec (Harlander-Matauschek and Häusler, 2009).

Floor eggs, those laid outside the nests, can be a problem in lo systems. A high frequency of floor eggs results in increasing labour re impaired egg quality and fewer saleable eggs (Appleby, 1984). The aim was to investigate the effect of housing condition on tonic immobility, feath feather eating and floor eggs in laying hens as well as heterophil/lymphocyt

Materials and Methods

This study was performed in the Research Centre for Animal Scienc Natural Sciences Faculty III, Martin-Luther University Halle-Wittenberg, Germa

Birds and housing conditions

This experiment included 150 brown Lohmann Traditional birds. T provided by Lohmann Tierzucht GmbH, Cuxhaven, Germany. The chicks we on deep litter and were not beak-trimmed. At 18 weeks of age, the bi transferred to the experimental building, where they were randomly distribute pens at stocking rate of 6 hens/m^2 (50 hens of each). Each pen was conne open winter garden (roofed scratching room, WG) in one group and with range (open area with one tree) in the other two groups. Position of the relation to WG was differed from group to another. The range located in fro (D-range) or side of WG (S-range), see Figure 1. The distance between pop the fence was 20 m in D-range group and 5 m in S-range group. Each bird ha to 10 m^2 of grassland that was fenced by 180 cm height wire fence. The pe the pen was straw-bedded, while the WG was littered with shredded tree bark could freely pass between housing areas via passages (0.65m long x 0.18 0.24m high) identified by antennas to enable individual recordings.

All other housing characteristics, such as space at feeder, number drinkers, number of nests or the perch space per bird, were the same for ea Food and water were provided *ad libitum*. The light regimen in the house light: 10 h dark with a light intensity of 5 lux (on average) and temperature were kept between 18 and 28°C.

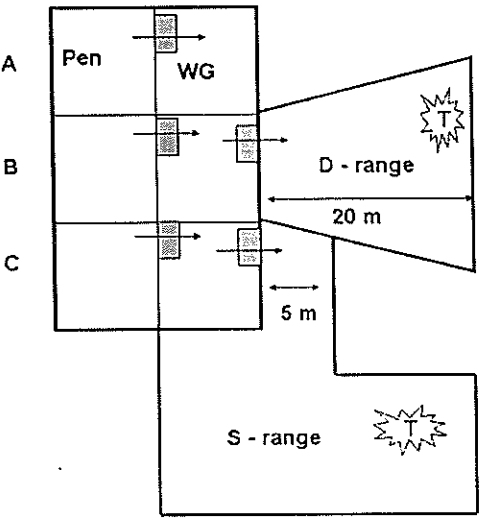

Fig. 1. Housing design: A) winter garden group, B) D-range group, C group. Each range has tree (T). The passages between different areas by arrows

Measurements and statistical analysis of data

Tonic immobility test

Tonic immobility (TI) reactions were measured at 44 weeks of age *et al.*, 2004). Testing was took place between 08:00 to 14:00 h before hens l to the outside area. In separate room adjacent to the rearing pens (n auditory contact), 20 hens from each group were tested individually as soo caught, by placing the hen on its back with the head hanging in a U-shap cradle covered with several layers of clothing (Jones and Faure 1980 restrained for 10 second (s). Then the observer sat in a full view of the birc meters away and fixed his eyes on the bird. If the bird remained immobile fc the experimenter removed his hands, a stopwatch was started to record lat the bird right itself. If the bird righted itself in less than 10 s., it was cons tonic immobility had not been induced, and the procedure was repeated. If induced after three attempts the duration of TI was considered 0 s. (ZUL 2000). The minimum and maximum score for the acceptable duration of T 10 and 1200 s, respectively.

Heterophil/lymphocyte (H/L) ratios

To obtain the heterophil to lymphocyte ratio, 44-week-old hens (1(each group) were carried to a separate room, and collection of blood immediately. Two drops of blood were taken from a small puncture of a wi drop being smeared on each of two glass slides. After fixation of the methyl alcohol, they were stained using Wright's stain (Shen and Patte One hundred leukocytes, including granular (heterophils, eosinophils, ba non-granular (lymphocytes, monocytes) cells, were counted at x1000 (o lens), and the heterophil to lymphocyte ratio was calculated.

Feather condition

All birds in the three groups were individually inspected for dama and missing feathers and bald patches at 25, 30, 35, 40 and 48 weeks of scoring method modified from previous methods (Bilcik and Keeling 1999) Table 1. The body was divided into 4 parts and each part included 2 following: cranial part (head and upper neck), dorsal part (back and rump) (tail and belly), and lateral part (wing-primaries, wing-coverts and leg). F of feather condition, all hens were collected in the pen, between 07:00 and then each hen taken out of the group. Each body area was given a (no damage) to 6 (completely denuded area for body feather or almos missing for flight feather). All values of areas were summed to give eac The minimum and maximum score for each part was 0 and 12, respectiv values were summed to give a total body score for each bird. Additiona inflammation (redness, oedema) was scored.

Feather availability and faecal feather material

Feather eating is examined here in the context of its relationship condition. The level of feather eating is estimated by measuring floor feath and examining faecal droppings for evidence of feather material.

The availability of loose feathers on the floor of each pen and WG as droppings was collected at 52, 54, 56 and 58 weeks of age. The faecal

approximately equal size were collected (many of these has been trodden flattened, and may have been incomplete), broken and examined for evi feather material (which is not digested and can be clearly seen within dr (McKeegan and Savory, 1999).

Visits to winter garden and range measured by transponder technique

The transponder system has been described by Mahboub (2004). were individually equipped with transponders (Diehl ident [Daisy], Roeth Germany) attached to the wing, for recording the frequency of changes betwe (PH) and outside (WG, GL) areas and the time hens spent in each area o Data of outdoor visits were represented by 78 days between 24 and 55 weeks

Feed intake and floor egg

Weekly Feed consumption was recorded for each group from 22 to 2 of age then feed intake per hen was calculated. Number of floor eggs, cracked eggs was recorded for each group daily.

Statistical analysis

Statistical analyses were performed using the statistical system SA Institute Inc., 1999-2001, SAS System for Windows, V8, Cary, NC, US proportion of time spent in winter garden (DWG 24%) and range per day (D was calculated. Tonic immobility, leukocyte numbers, H/L ratios, feather score availability, faecal feather material, movement of hens and duration of time each outdoor area were analysed with ANOVA using PROC GLM. Pearson co coefficients were analysed among the availability of loose feathers in pen ar garden and feather material in droppings.

Results

Duration of tonic immobility and heterophil to lymphocyte ratio were sig affected by housing condition as shown in Table 2. Hens that were reared with S-range had higher level of fearful than those reared in house with D- without range (P=0.0021). On contrary, hens that were access to range (either range) had lower H/L ratios than hens that were access only to winter (P=0.0011). But number of basophils was significantly low in D-range gro compared to S-range and WG groups (P=0.0066).

Hens kept with winter garden only had more feather damage than grou side or direct range (P=0.0041, Table 3). Hens in group without range had areas (score ≥ 6) in dorsal, caudal and lateral body parts. Also, hens in D-ran showed severe feather damage in their caudal parts than hens in S-rang (P=0.0347). On the other hand, footpad inflammation was more in D-rang (P=0.0188) than S-range and WG groups (Table 3).

Table (4) shows the effect of housing condition on number of floor feat feather material in droppings. The availability of loose feathers on pen f number of faecal feather material were more in WG group than other gro range (P=0.0001, P=0.0093, respectively). But the number of feather on the WG was less in group with D-range than other groups (P=0.0029). Numbers feathers on the pen floor were correlated positively with numbers of feather m

dropping (r=0.73, P=0.0019). In the same time, floor feather counts in winter were not correlated significantly with feather material in droppings (r=0.27, P=0.

The results of movement of hens to the outside areas and duration of ti spent per day in winter garden and range were summarized in Table 5. He range group moved more frequently to the outside areas and spent less time than hens in S-range group (P=0.0001). Hens housed with WG only spent mor the winter garden than other group with range (P=0.0036). Also, hens that ha to S-range spent less time in winter garden than those had access to D-range.

Floor eggs were more in groups with range than in group without r shown in Table 6) (P=0.0369). On the other hand, number of dirty eggs was groups with S-range than other groups (P=0.0048). Number of cracked e similar in all groups (P=0.1891). Feed intake per hen per day was increase group than groups with range.

Discussion

In the present study, several variables were significantly affected by conditions. Hens with access to S-range showed prolonged TI duration and ratios when compared to hens kept without range and hens with access to The current results are in contrast with Jones et al. (1988) who reported t characterised by high H/L ratios also showed longer duration of TI. In their s ratios were elevated in adult White Leghorn layers after corticosterone However, these results are in accordance with Campo and Redondo (199 who reported negative relationships between H/L ratios and TI. Moreover, numbers were higher in S-range and WG groups than in D-range group, in prolonged stress on the birds (Maxwell et al., 1990). Therefore, position of r an increasing effect on fearfulness and was associated with chronic str possible explanation of these results could be that birds in S-range lost the dir contact with the pop holes thus they were foraged in small area close to the escape easily and quickly to inside if they were frightened. Also the pos exposure to or seeing of novel objects was more obvious in the large range in the small one (JONES 1996), consequently hens in D-range group spent le outside range. This may be attributed to the dimension of D-range that was r broad in front of pop holes in compared to outside range in S-range group. the roofed winter garden offered more protection for D-range group that sp time in it (Mahboub 2004).

The hens kept under restricted housing conditions (WG group) h feathers than the other groups with ranges. Also, body parts of the hens k group showed many denuded areas this means high percent of feather loss. Keeling (1999) suggested that feather scoring is considered a reliable meth assessment of feather pecking activity in the flock. Consequently, bad condition may be attributed to increased feather pecking activity among without range (Huber-Eicher and Sebö 2001). Position of the range had no feather condition, although, hens kept with access to D-range had mo inflammation than those kept in S-range group. This may be attribute frequency of movement to outside areas that showed by D-range group.

accordance with Mahboub et al., (2004) who reported obvious positive cor between the frequency of movements and footpad inflammation.

Group with winter garden only had more floor feather counts and faecal materials than other groups with access to range. The positive correlation b number of floor feathers and faecal feather materials did confirm the incre feather eating in group with winter garden. This may be attributed to the pecking that is associated with stress (El-Lethey et al., 2000). Therefore, conditions that promote high rate feather pecking may lead to feather dama feather loss thus feather eating (Bilcik and Keeling, 1999; McKeegan and 1999; Harlander-Matauschek and Häusler, 2009).

Free access to range increased the prevalence of floor eggs which led number of dirty eggs (Appleby et al., 1992). This may be attributed to the condition as the grassland is attractive to the birds and may encourage them tc and spend more time outside the pen to forage. However, the exposure of the mucous membranes immediately after the actual expulsion of an egg may attra hens which start vent pecking (Savory, 1995) particularly when the hens ha areas in their caudal parts and laid in winter garden or range where the light inte higher than in pen. Hens laying their eggs outside the nests would therefore p have a higher risk of being cannibalised. Consequently, to reduce the incid outside floor eggs, keep the hens inside the pen until 09.00 h. On range, her obtaining a significant amount of their diet from the pasture (Appleby et al., 199 may explain why hens kept with range were consumed less food than hens group.

Conclusion

In conclusion, the results of this study show that position of outside run in of house has significant effects on indicator of fearfulness, body condition, mo of bird to open-air area and time spent outside the house. Therefore, the welfar laying hens is superior when they were housed with outside range and the po range in relation to house should be considered. Delay opening of pop hol recommended to reduce outside floor eggs.

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Table 1. Description of scoring method used to evaluate the feather cond and footpad inflammation:

Scores	Body feather	Flight feather	Footpa inflammat
0	Intact feathers.	Intact feathers.	No inflammatic
1	Some feathers scruffy and/or up to 5 damaged feathers.	Few separated feathers up to 5, but none damaged, broken or missing.	Inflammation c footpad
2	> 5 damaged feathers and/or up to 5 broken feathers.	> 5 feathers separated and/or up to 5 damaged feathers.	Inflammation c footpad
3	> 5 broken feathers and/or up to 5 missing feathers.	All feathers separated, or > 5 feathers damaged or up to 3 broken.	--
4	Bald patch < 5 cm or < 50 % of area.	All feathers damaged and/or > 3 feathers broken or up to 3 feathers missing.	--
5	Bald patch > 5 cm or > 50 % of area.	All feathers broken or > 3 feathers missing.	---
6	Completely denuded area.	Almost all feathers missing.	---

Table 2. Effect of housing condition on duration of tonic immobili leukocyte counts and H/L ratio in LT laying hens (Means ± standard e value):

Variable	Housing condition			*P*-va
	WG[1]	S – range[2]	D – range[3]	
TI (s)	492.20 ± 84.36[b]	784.92 ± 73.30[a]	352.92 ± 69.53[b]	0.0
Lymphocytes	53.90 ± 1.63[b]	59.60 ± 1.15[a]	56.65 ± 0.95[ab]	0.0
Monocytes	6.80 ± 0.46[b]	7.30 ± 0.56[ab]	8.85 ± 0.61[a]	0.0
Basophils	3.15 ± 0.06[a]	3.85 ± 0.39[a]	2.00 ± 0.26[b]	0.0
Esinophils	3.35 ± 0.40	2.85 ± 0.34	2.45 ± 0.37	0.2
Heterophils	32.80 ± 1.61[a]	26.30 ± 1.01[b]	30.05 ± 0.71[a]	0.0
H:L ratio	0.63 ± 0.05[a]	0.45 ± 0.02[b]	0.54 ± 0.02[b]	0.0

[1]WG: winter garden
[2]S-range: range was located to the side of the winter garden.
[3]D-range: range was in front of the winter garden.

Table 3. Effect of housing condition on feather condition and footpad inflammation in LT laying hens (Means ± standard error, *P*-value):

Variable	Housing condition			*P*-v
	WG	S – range	D – range	
Body parts:				
Cranial	4.60 ± 0.21[a]	4.23 ± 0.18[ab]	3.82 ± 0.18[b]	0.
Dorsal	6.58 ± 0.14[a]	6.12 ± 0.14[b]	5.72 ± 0.16[b]	0.
Caudal	6.29 ± 0.21[a]	5.13 ± 0.15[c]	5.67 ± 0.19[b]	0.
Lateral	7.51 ± 0.21[a]	6.92 ± 0.16[b]	6.98 ± 0.18[b]	0.
Total body parts	24.98 ± 0.72[a]	22.39 ± 0.57[b]	22.19 ± 0.65[b]	0.
Footpad inflammation	0.14 ± 0.07[b]	0.10 ± 0.05[b]	0.40 ± 0.12[a]	0.

Table 4. Effect of housing condition on number of floor feathers and faec feather material (Means ± standard error, *P*-value):

Variable	Housing condition			*P*
	WG	S – range	D – range	
Available feathers on:				
Pen floor	83.60 ± 13.14[a]	21.80 ± 5.42[b]	9.00 ± 1.79[b]	
Winter garden floor	64.60 ± 8.02[a]	43.40 ± 8.84[a]	20.00 ± 2.92[b]	
Faecal feather material	11.20 ± 1.74[a]	4.60 ± 1.03[b]	5.60 ± 1.13[b]	

Table 5. Effect of housing condition on the frequency of movements to the outside areas/d, duration of time hens spent/d (%) in winter garden (DWG) and range (DR 24%) in LT laying hens (Means ± standard error, *P*-value):

Variable	Housing condition			*P*-va
	WG	S – range	D – range	
Movement (n)	26.43 ± 0.51^{c}	33.78 ± 0.42^{b}	40.43 ± 0.58^{a}	0.0
DWG/24 h (%)	18.10 ± 0.32^{a}	9.49 ± 0.19^{c}	10.85 ± 0.26^{b}	0.0
DR/24 h (%)	--	25.41 ± 0.94^{a}	23.20 ± 0.37^{b}	0.0

Table 6. Effect of housing condition on floor, dirty and cracked eggs (Mean standard error, P-value) and feed intake per hen per day:

Variable	Housing condition			*P*-va
	WG	S – range	D – range	
Floor eggs (n)	1.00 ± 0.15^{b}	1.73 ± 0.14^{a}	1.66 ± 0.14^{a}	0.0
Dirty eggs (n)	1.22 ± 0.13^{b}	2.33 ± 0.25^{a}	1.48 ± 0.16^{b}	0.0
Cracked eggs (n)	1.30 ± 0.10	1.46 ± 0.11	1.61 ± 0.13	0.1
Feed intake (g)	112.97	106.57	106.49	

ن العربى

ة المسكن على خصائص الرفاهية في الدجاج البياض

ي حسين محبوب . فون بورل*

ة وتنميه الثروة الحيوانية - كليه الطب البيطري فرع السادات – جامعه المنوفية - مصر. *كلية الزراعة و جامعة مارتن لوثر- المانيا

استهدف هذه البحث دراسة تأثير حالة المسكن على مستوى الخوف وحالة الريش و أكل نسبة البيض خارج الاعشاش و كذلك مستوى الاجهاد في سلالة اللهمن البني البياض. عند اسبوع قسمت الطيور الى ٣ مجموعات (٥٠ دجاجة في كل مجموعة) تبعا لحالة المسكن. WG : وهي عبار عن مسكن متصل بحديقة مقفلة بسلك. مجموعة D-range : عبارة عن حديقة و ملعب خارجي متصل مباشرة و على نفس مستوى الحديقة. مجموعة S-range : ن مسكن و حديقة و ملعب خارجي يختلف في وضعه عن مجموعة D-range بحيث يكون ليس أمام الحديقة.

تائج كالتالي: مجموعة S-range اظهرت مستوى عالي من الخوف بالمقارنة بالمجموعات كما كانت اقل اجهادا بالمقارنة بمجموعة D-range .حالة الريش كانت الاسوء بين الدجاج ون ملعب خارجي. أما عدد الريش على الارضية و بقايا الريش الموجودة في الزرق كانت عنبر الدجاج المربى بدون ملعب و هذا دليل على ارتفاع نسبة اكل الريش. مجموعة D- كانت اكثر حركة بين الخارج و الداخل و قضت اقل وقت على الملعب الخارجي بالمقارنة S-range . كانت اعلى نسبة بيض خارج الاعشاش في المجموعات التي لها ملعب.

النتائج يتضح أن وضع الملعب الخارجي بالنسبة للمسكن له تأثير معنوي على مستوى الخوف جسم و حركة الدجاج و الوقت التي تقضيه في الخارج. كما أن افضل رفاهية كانت للدجاج ي مسكن له ملعب خارجي. ولتقليل نسبة وضع البيض خارج الاعشاش يوصى بتأخير فتح الملعب.