EFFECT OF ACCESS TO DUSTING SUBSTRATE ON BEHAVIOUR IN LAYERS FROM DIFFERENT TYPES OF CAGES

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Summary. The objective of this work was to study effect of access restriction to dusting substrate on behaviour in laying hens when they were reared and housed for a long time under conditions close to commercial conditions. Twenty laying hens of ISABROWN hybrid at the age of 28 weeks were used in the experiment involving two types of technologies (A group from furnished cages, B group from nonfurnished cages). Means for egg production were 89.7 and 92.20 % at the ages of 28 and 29 weeks. Dustbathing was recorded in two locations of the aviary: in the housing area and in the dustbath place (DBP). The water ford obstructed the access to DBP. A DBP was made available with alternating levels of difficulty. The first level of difficulty was a lack of water ford; the others included water. Day 1 – difficulty level 1. Day 2 – difficulty level 2, access to DBP through a water (20 mm). Day 3 – difficulty level 3, access to DBP through a water (70 mm). Day 4 – difficulty level 4, access to DBP through a water (150 mm). Day 5 – difficulty level 5, access to DBP through a water (180 mm). The observations were performed during 12 hours during five consecutive days. Experiment had two repetitions. We tested the hypothesis whether limitation of access to dustbathing substrate influences behaviour of hens. Highly significant differences were found among technologies, levels of difficulty and hours. Lower average times of dustbathing in the housing area and slightly higher average times of dustbathing in the DBP were recorded in group from furnished cages. Statistical differences were calculated between groups with difficulties 1, 2 and 3. The most performed activities with each difficulty were feeding, standing, and perching. The greatest differences between groups were in the 3rd difficulty. Hens of A group received feed longer time (312 min versus 204 min; $P<0.001$) and stood shorter time (36 min versus 96 min; $P<0.01$) than hens from B group. Results suggested that dustbathing is under the control of external factors, especially of former housing.
Keywords: layers, behaviour, dustbathing, restriction.

DULKIŲ VONIŲ ĮTAKA VIŠTŲ, LAIKOMŲ SKIRTINGO TIPO NARVELIUOSE, ELGSENAI

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Santrauka. Tyrimo tikslas buvo nustatyti dulkių vonių įtaką vištų elgsenai, kai priėjimas prie teritorijos yra apsunkintas. Tyrimui naudota dvidešimt 28 savaičių ISABROWN hibridizuotos veislės dedeklių vištų, laikytų dviem būdais (A grupė – uždaruose narveliuose, B grupė – atviruose narveliuose). Kiaušinių dėjimo intensyvumas 28 ir 29 savaičių vištų buvo atitinkamai 89,7 proc. ir 92,20 proc. Vištų elgsena buvo fiksuojama dviejose paukštidės vietose – pačioje paukštidėje ir teritorijoje, kur dažniausiai vištos imdavo dulkių vonias (DBP). Norint apsunkinti priėjimą prie DBP, teritorija buvo atskirta vandeniu. Vandens lygis kas penkias dienas buvo keliamas nuo 0 mm iki 180 mm. Stebėjimai buvo atliekami kiekvieną dieną po 12 val. visas penkias dienas. Bandymas kartotas du kartus. Buvo tikrinama hipotezė, ar dulkių vonių nebuvimas ženkliai veikia vištų elgseną. Nustatyta, kad vištos, laikytos skirtingo tipo narveliuose, elgėsi skirtingai. Vištos, laikytos uždaro tipo narveliuose, daug daugiau laiko praleido DBP nei paukštyno teritorijoje. Aukštėjant vandens užtvaros lygiui, statistiškai ženkliai mažiau laiko vištos praleido DBP. A grupės vištos lesė 312 min., o B grupės − 204 min. ($p<0,001$). Ištirta, kad A grupės vištos stovėjo trumpiau 36 min., o B grupės – 96 min. ($p<0,01$). Mūsų tyrimų rezultatai parodė, kad vištų laikymo būdas ir galimybė iminėti dulkių vonias ženkliai pakeičia jų elgseną, kuri gali turėti įtakos ir produktyvumui.
Raktažodžiai: elgsena, dulkių vonios, apribojimai, vištos dedeklės.

Introduction. Establishment of animal welfare is conditioned by the knowledge of their behavioural needs, priorities and preferences (Curtis, 1987; Petek et al., 2010). Each behavioural manifestation of an animal has, however, a natural variability, which is influenced by many factors – both environmental and individual, neurophysiologic and constitutional properties of the animal, which lead to a variety of conclusions sometimes contradictory, found in a lot of research.

Dustbathing is a maintenance behaviour consisting of several behavioural elements that lead to dust collecting between the feathers (Liere van, 1992). Because this behaviour involves rotational and pushing motions of the legs, it could be a form of exercise that improves the leg condition. Possible causes of this manifestation are removal of superfluous fat from feathers (Liere van et al., 1991); improvement of structure and arrangement of feathers (Liere van et al., 1987); or removal of ectoparasites (Duncan et al., 1998). Poultry hatches with a predisposition on dustbathing, which enables it to distinguish substrate suitable for dustbathing (Petherick, 1989).

Dustbathing shows a clear diurnal rhythm. Under unrestricted conditions, hens dustbathe about every 2 days. Birds deprived of litter show a rebound in dustbathing behaviour when litter is again made available (Olsson and Keeling, 2005). Laying hens have preferences for dustbathing substrates (Petherick et al., 1995). However, the purpose and regulation mechanism of dustbathing are still not understood.

Dustbathing should focus more on the welfare of hens that are kept without litter (nonfurnished cages) or with limited access to litter (furnished cages) and perform sham dustbathing (Olsson and Keeling, 2005; Wichman and Keeling, 2008). Modern cages include dust baths (furnished cages) to provide birds with the opportunity to perform dustbathing (Colson et al., 2007; Barnett et al., 2009).

Materials and Methods. Twenty laying hens of ISABROWN hybrid were used in the experiment involving two types of technologies. Ten layers were reared and housed in furnished cages (group A) and the other ten were reared and housed in nonfurnished cages (group B) before experiment. The experiment started when the birds were 28 weeks of age. Means for egg production were 89.7 and 92.20 % at the ages of 28 and 29 weeks. Observations were conducted in two aviaries (for group A and B) placed in a single room. Dustbathing was recorded in two locations of the aviary: in the housing area (sham dustbathing) and in the dustbath place with the ash (DBP) (complete dustbathing).

The water ford obstructed the access to DBP and it helped to examine the will of layers to cross it and dustbath. The observations were performed during 12 hours of light-day (from 7 am to 7 pm) during five consecutive days. The birds were given 3 days to habituate to the testing environment before the trial. The same schedule was used in the second trial of the experiment (repetition). There was a weeklong break between the consecutive trials. The hens were marked with colored, numbered identification tags. The video-recorded behaviour was analyzed using continuous behaviour and focal animal sampling at 60-second intervals.

An obstruction method was used to measure motivation. This involves placing an obstacle between the animal and the place, where this animal can perform some of its positive behaviours. A dustbathing place with the ash (DBP) was made available with alternating levels of difficulty. The first level of difficulty was a lack of water ford; the others included water.

Day 1 – difficulty level 1, free access to DBP through a ford without water. Day 2 – difficulty level 2, access to DBP through a ford with water. The water level (20 mm) exceeded the first finger of layers. Day 3 – difficulty level 3, access to DBP through a ford with water. Water level (70 mm) to the middle of carpometacarpus. Day 4 – difficulty level 4, access to DBP through a ford with water. Water level (150 mm) to shank bone (ossa antebrachii). Day 5 – difficulty level 5, access to DBP through a ford with water. Water level (180 mm) to the middle of shank bone (ossa antebrachii).

Maintenance activities (feeding, drinking, walking, standing, staying, perching, eggs collating, shame dustbathing) were recorded in the housing area. Dustbathing was also recorded in DBP.

The experiment was evaluated by means of a 4-way variance analysis. Individual combinations of trials and technologies (groups) were calculated by means of 2-way variance analyses in cases where we expected differences between trials or technologies, as well as significant interactions that could significantly impact how these effects are being understood.

The data were analyzed using a statistical package STATISTIX, Version 9.0 (Anonymous 2008). The normal distribution of data was evaluated via Wilk-Shapiro/Rankin Plot procedure. We used 4 ANOVA factors with fixed effects.

Results.

Dustbathing in housing area

We found lower average times of dustbathing in the A group (Figure 1). No layer performed the dustbathing with difficulty 5 in A group. During hour 8 am to 10 am and 3 pm to 7 pm of the observation, no layer performed dustbathing. During the first Trial, we did not notice dustbathing in group B at difficulty levels 4 and 5. At the difficulty level 1 in this group, dustbathing lasted 8 minutes. During hour 8 am, 4 and 7 pm of observation, no layers performed dustbathing. Statistical differences were calculated between groups with difficulty levels 1 and 3 only (Table 1).

Dustbathing in DBP

The A group showed slightly higher average times of dustbathing (Figure 2). During the first Trial, the shortest time of dustbathing was 1 min with difficulty level 4, and the longest time was 22 min with difficulty level 1 in group A. The shortest dustbahing time was in 8 am, and the longest in 10 am. In Trial 2 of the observation, the time of dustbathing varied from 1 minute at difficulty level 4 to 14 minutes at difficulty level 1.

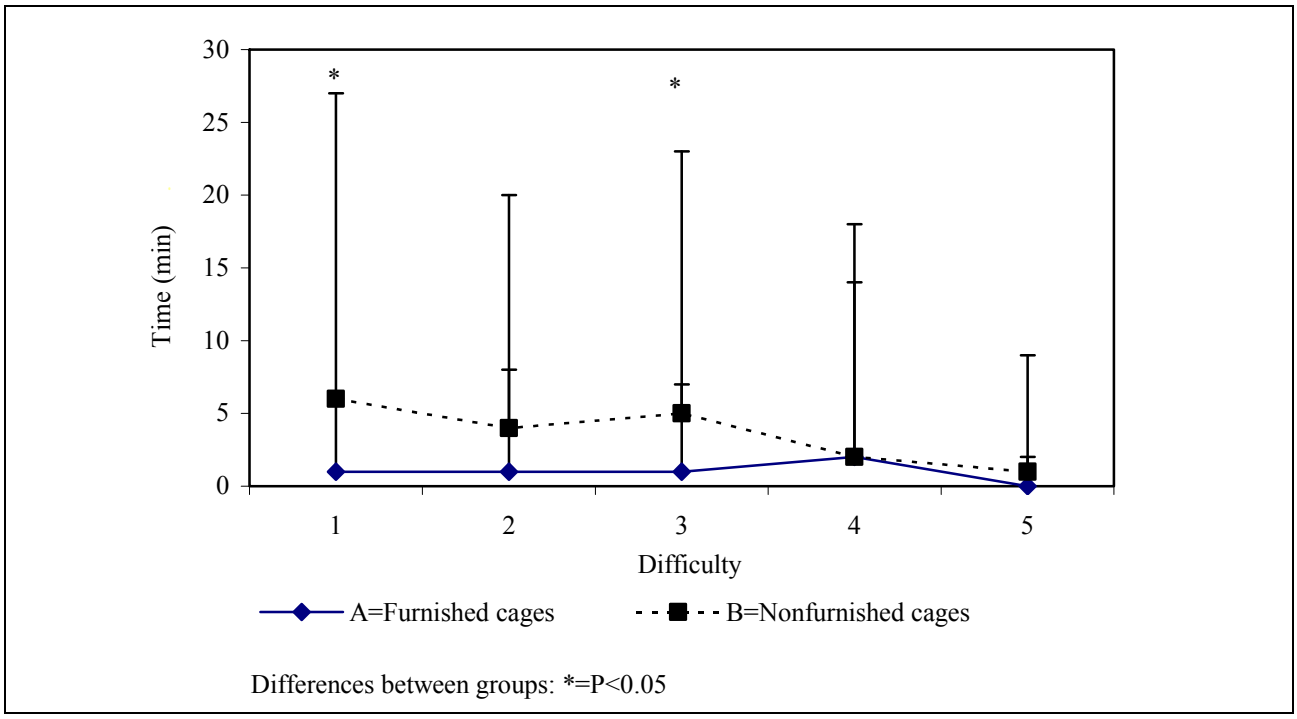

Figure 1. **Times of dustbathing in housing area**

Table 1. **Average times of behaviours in both trials**

Activity	Group	Difficulty										Significance between groups in difficulties
		1		2		3		4		5		
		mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	
Feeding	A	246	110	294	103	312	102	270	107	258	95	1,5*; 2,4**; 3***
	B	222	100	216	119	204	110	180	115	198	120	
Drinking	A	30	43	18	34	18	39	24	38	24	40	NS
	B	18	30	18	31	24	32	12	29	12	28	
Walking	A	48	56	66	61	36	56	24	39	36	48	3,4,5*
	B	60	65	78	73	72	64	66	60	68	65	
Standing	A	54	59	42	55	36	53	42	55	66	64	2*; 1,3**
	B	102	83	78	79	96	80	60	62	70	85	
Sitting	A	12	28	12	28	12	28	6	28	18	28	NS
	B	12	27	6	28	6	15	12	27	30	44	
Perching	A	48	54	66	67	84	66	138	269	102	80	2,5*
	B	72	74	102	92	114	95	144	107	154	105	
DB in HA	A	1	5	1	7	1	6	2	16	0	2	1,3*
	B	6	21	4	16	5	18	2	12	1	8	
DB in DBP	A	18	35	4	15	3	13	1	9	5	17	1,2,5*
	B	5	22	2	10	2	14	4	16	2	16	

* P<0.05, ** P<0.01, *** P<0.001
A = furnished cages; B = nonfurnished cages; HA = housing area; DBP = dustbathing place

In group B we found the shortest duration of dustbathing being 1 minute at difficulty level 5, with the highest value being 5 minutes at difficulty level 4 in Trial 1. During the eighth hour, no layers were dustbathing. In Trial 2 the time of dustbathing varied from 2 min at difficulty level 2 to 6 min at difficulty level 1. Statistical differences were calculated between groups with difficulty levels 1, 2 and 3 (Table 1). In general, dustbathing reached the maximum value between 10 am and 2 pm continuing until 4 pm.

The 4 factor variance analysis showed that there are statistically highly significant differences among technologies, levels of difficulty, and hours. The interactions between difficulty and hours were always statistically highly significant.

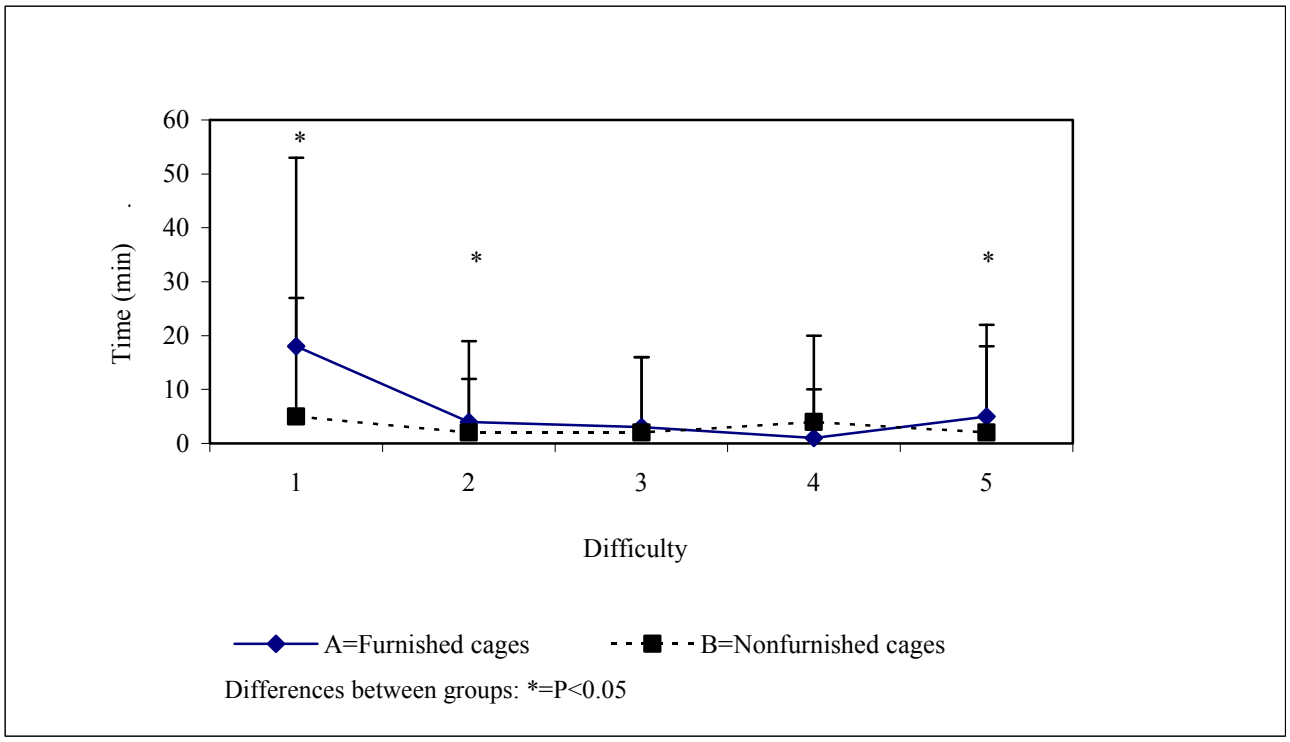

Figure 2. **Times of dustbathing in ash**

Table 2. **Differences among difficulties 1 to 5 in individual behaviours**

Activity	Group	Significance
Feeding	A	1:2,3,4**; 2:4,5**; 3:4,5**
	B	1:3*; 1:4,5**; 2:4**; 2:5*; 3:4**; 4:5*
Drinking	A	1:2,3**; 1:4*; 2:4,5**; 3:4,5**
	B	1:3**; 2:3**; 3:4,5**
Walking	A	1:2,4,5**; 1:3*; 2:3,4,5**; 3:4**; 4:5**
	B	1:2,5**; 2:3,4**; 4:5*
Standing	A	1:2*; 1:3,4,5**; 2:5**; 3:5**; 4:5**
	B	1:2,4**; 2:3,4,5**; 3:4**; 4:5**
Sitting	A	1:4*; 2:5**; 4:5**
	B	1:3,5**; 2:3,4,5**; 3:4,5**; 4:5**
Perching	A	1:2,3,4,5**; 2:3,4,5**; 3:4,5**; 4:5**
	B	1:2,3,4,5**; 2:4*; 2:5**; 3:4,5**; 4:5**
Dustbathing in HA	A	1:4**; 2:4**; 3:4**; 4:5**
	B	1:2,3,4,5**
Dustbathing in DBP	A	1:2,3,4,5**; 2:4*; 4:5**
	B	1:3,4,5**; 2:3,5**; 3:4,5**; 4:5**

* P<0.05, ** P<0.01, *** P<0.001
A = furnished cages; B = nonfurnished cages; HA = housing area; DBP = dustbathing place

Maintenance activities

The most performed activity at each difficulty level was feeding. The second most frequent activity was perching (Table 1). Standing was an activity with a similar course. Differences among difficulties were significant in all behaviours (Table 2). The greatest differences between groups were in the 3rd difficulty level (Table 1). Hens of group A were receiving feed for a longer period of time (312 ± 102 min versus 204 ± 110 min; P<0.001) and stood for a shorter period time (36 ± 53 min versus 96 ± 80 min; P<0.01) than hens from group B.

Discussion. At the present study a lower times of dustbathing in the housing area and higher times of dustbathing in the DBP were recorded in hens from furnished cages. This could be caused by the earlier experience of these hens having opportunities to dustbathe during the rearing and production phases.

Significant differences were found among groups, lev-

els of difficulty and hours. However, two-, three- and four-factor interactions were also statistically highly significant, with the exception of a two-factor interaction between trial and groups, which was not statistically significant. In such case, it is difficult to ascertain the influence of key factors.

The two-factor variance analysis with dustbathing in DBP indicates, however, that interaction difficulty and hours were statistically highly significant in both trials. A set of mutually operating internal, peripheral and external factors controls dustbathing. It is a fact that the tendency to dustbathing varies according to the part of day as far as internal factors are concerned. It occurs more often in the middle of day, which indicates an internal everyday biorhythm of motivation (Vestergaard, 1982). These findings were confirmed also in our experiment. At the present work, dustbathing reached the maximum value from 10 am to 2 pm continuing until 4 pm.

Poultry motivation to dustbathe can be influenced by different factors such as internal behavioural needs (Hogan and Boxel, 1993), external factors such as the manner of rearing, substrate sight and quality, light or noise in barn (Petherick et al., 1995; Duncan et al., 1998). Some authors also showed that if poultry have access to litter during longer time can change their preference and use different dustbath materials (Wichman and Keeling, 2008).

If the animals are deprived of the opportunities to dustbathe, the tendency to dustbathing increases with the time of deprivation, which suggests Lorenzian's model of motivation (Vestergaard, 1980). In our experiment, the number of passing the ford decreased with an increasing difficulty; however, the length of dustbathing in a comfortable ash place was not the shortest. The above-mentioned motivation model was not confirmed. Layers that passed the obstacle dustbathed longer.

Conclusion. Based on the above results, we surmise that dustbathing is more impacted by external factors than internal effects. The housing manner before moving of hens to experimental aviary had impact on their behaviour. Dustbathing is a behaviour that is incorporated also in the absence of dustbathing opportunities. However, deprivation of the opportunities to dustbathe per se is not a sufficient cause for suffering in layers.

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