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INFLUENCE OF TWO DIFFERENT CAGE TECHNOLOGIES ON THE EGGSHELL QUALITY AND THE FEATHER COVER OF LAYING HENS

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Summary
Indexes of the eggshell quality of ISA BROWN hens (weight, compactness, thickness) were investigated monthly in enriched cages (750 cm^2 cage area per hen, perch and nest box) and in conventional cages (550 cm^2 cage area per hen) between 30^{th} and 45^{th} week of a laying period. Index of the feather cover was measured in 41^{st} week. Bigger cage area per hen and the perch presence in enriched cages positively influenced the eggshell quality and feather cover index of laying hens. Statistically significant difference ($P< 0.05$) was found in eggshell compactness (38.36 $N.m^{-2}$ – enriched cages; 36.64 $N.m^{-2}$ – conventional cages) and statistically highly significant difference ($P< 0.01$) in eggshell thickness (0.378 mm – enriched cages; 0.364 mm – conventional cages). Eggshell weight in enriched cages reached 6.59 g and in conventional ones 6.57 g. Index of the body feather cover reached 0.90 in enriched cages (in average 90% of the body area covered with feather) and 0.71 in conventional cages (71%). Better result in the enriched cage technology is consequence of the bigger cage area per bird, which affects the feather cover quality and allows more activities of hens. We suppose that enhanced movement in enriched cages (5.44% comparing to 2.44% in conventional cages) positively influenced utilization of calcium liable for eggshell thickness and compactness increase.
Keywords:
eggshell quality, feather cover, EU Directive 99/74, ethology laying hens

1. INTRODUCTION

The eggshell quality participates in eminent measure of the egg production effectivity because it determines the number of non-standard and useless eggs (Halaj et al., 2003). It is affected by several factors, especially by nourishment, but influence of the housing technology plays also in this question an important role.

Simultaneously in the whole Europe vibrates an issue of the laying hens welfare; adoption of the Directive 1999/74 EC should conduce to improvement of their living conditions according to the increasing production. The directive requires in cage technologies extension of the space per bird and creation of more natural living environment for layers. This is the main reason, why conventional cages will be from the 1^{st} January 2012 banned and substitute for enriched cage technologies. Listed changes will conduce to increasing costs of the table egg production. Van Horne (2003) introduces that costs increase at least about 13 %.

Enriched cages differ from conventional cages by an utility level extension on layer (750 cm^2 vs. 550 cm^2 in conventional cage technologies) as well as by presence of the perch, the nest and the dustbath (Briese et al. 2001; Klecker, 2004).

Suggestions of authors on the eggshell quality in conventional and enriched cages vary. Appleby (2002) affirm that more non-standard eggs (cracked and broken) are in enriched technologies. Quantity of non-standard eggs in enriched technology is in a great extent depending on constructional design of the cage and the nest (Tauson, 2002).

Very substantial for the eggshell quality is its compactness and thickness. These parameters are influenced for the most part by nourishment, but distinctions were discovered in the eggshell quality in different cage technologies with retaining similar nourishment and climatic conditions. Leyendecker et al. (2001) found out by comparison of eggshell values in the cage, the aviary and an intensive free range system, that in the free range system, where layers have more space, is the shell thickness more advanced as in other technologies. It is probable, that different types of cages (different space provision per bird, allowance of equipments which can improve the welfare) may significantly influence parameters of the table eggs shell quality.

A plumage condition is very important for the body and its value may seriously manipulate the economy of rearing. The insufficient feather cover of laying hens body causes gradual decreasing production and hike forage consumption looks like the legitimate reason for thermal regulation balance compensation. Also the plumage condition could be an input level of the laying hens welfare. Abrahamsson et al. (1997) observed that the plumage condition (feather cover) is better on hens housed in enriched cages in comparison with layers from conventional cage technologies. The plumage quality is affected by layers density in the cage and their behaviour. Unsuitable housing conditions conduce to non - aggressive feather pecking between birds, which could have by higher intensity destructive effect on their feather. According to Huber, Eicher et al. (2001) is the feather pecking prevention, which consists assurance of sufficient space for layer, adequate access to the perch and the air cleanness in the housing area. Introduced arrangements result in consequence to plumage condition improvement of layinghens housed in cage technologies.

2. MATERIAL AND METHOD

Trials in laboratory conditions were realised with laying hybrid ISA BROWN between 30th and 45th week of the laying period (from January to April 2004) in conventional and enriched cage technologies which are in accordance with EU - Directive 1999/74.

Indexes of laying period:

- forage consumption per layer and day in g
- eggs cracked and broken (% from all sufferanced eggs during laying period)

Indexes of eggshell quality:

1) shell weight - measured on electric weighing - maschine
2) shell thickness - measured with micrometer on three places
3) shell firmness - measured with method based on statical action of force on the eggshell to the stage of its breakage.

Shell quality of 32 eggs from both technologies were scored with 4 analysis of the quality in monthly intervals during the observed laying period. Results were statistically evaluated with t - test (Program Excel 2000).

Body feather cover index evaluation:

5 body parts were evaluated (8 hens from each technology) - head and neck
- breast,
- abdomen and tail,
- back,
- wings.

Each part was evaluated to the following scale:

Verbal evaluation of the feather cover	% cover of body part	Feather cover index of body part
fully covered	100,0	1,000
majority covered	80,1 - 99,9	0,801 - 0,999
2/3 covered	60,1 - 80,0	0,601 - 0,800
half covered	40,1 - 60,0	0,401 - 0,600
1/3 covered	20,1 - 40,0	0,201 - 0,400
partially covered	0,1 - 20,0	0,001 - 0,200
fully bare	0,0	0,000

Resultant body feather cover index is the average of partial indexes of individual parts of the laying hen body.

Additional behaviour activity - intensity of movement was expressed in % as a share of time, when hens were moving during the full length of the light day (15 hours). This activity was scored in 3 minute intervals.

3. RESULTS AND DISCUSSION

From the 30th to 45th week of the laying period were indexes of the eggshell quality observed. Average results from 4 analysis are recorded in table 1.

Table 1. Analysis of eggshell quality

Observed index	Conventional cages (CC)	Enriched cages (EC)	Difference CC/EC	Significance
Eggshell weight in g	6,57	6,59	+ 0,02	-
Eggshell thickness in mm	0,364	0,378	+ 0,014	**
Eggshell firmness in N	36,64	38,36	+ 1,72	*

Significance: * significant (P< 0.05)
** highly significant (P< 0.01)
*** very highly significant (P< 0.001)

The eggshell quality is in the second half of the laying period affected by the technology. On table eggs from enriched cages were observed significantly higher compactness (P< 0.05) and highly significant thickness of the shell (P< 0.01). No differencies were observed in eggshell weight.

In addition, intensity of movement of laying hens was monitored, because there exists an hypothesis, that this activity could have positive effect on exploitage of calcium in corpus and thereby influences the eggshell quality too. In enriched cages was registrated higher intensity of movement (5,44% vs. 2,39% in conventional technologies). Opinion, that movement really can improve eggshell value, could be on the base of our achieved results real.

Eggshell thickness had throughout the trial (30th – 45th week of the laying period) downwarding trend in both technologies, with much more higher intensity of sinking in conventional technology.

Eggshell compactness had in the conventional technology downwarding trend and in the enriched technology balanced character.

Eggshell weight moved at about equal interval in both technologies.

Enhanced eggshell value had positive effect on occurrence of non-standard eggs. That was lower in enriched cages (1,78% vs. 3,75% in conventional cages).

Body feather cover index is recorded in table 2.

Table 2. Body feather cover

Body part	% cover of body		Index of feather cover	
	Conventional cages	Enriched cages	Conventional cages	Enriched cages
head and neck	85	45	0,85	0,45
breast	75	35	0,75	0,35
abdomen and tail	95	90	0,95	0,90
back	100	100	1,00	1,00
wings	95	85	0,95	0,85
average (general index)	90	71	0,90	0,71

It is evident, that layers from conventional cage technologies often suffer from the lower plumage quality. Strongly were stricken body parts like head and neck as well as breast, when hens during the laying period lost about 60 % of feather, in some cases were stricken body parts completely naked. Reason of such results could be caused by the inadequate cage area per bird. Barnett (1997) by comparising of same cage technologies found out similar results and suggests, that with the presence of the perch in the cage is feather condition better then with its absence. The perch namely reduces housing density on the floor (Cordiner, 2001), which has positive effect on the plumage quantity and quality. General body feather cover index reaches in enriched technologies value 0,90 (in average 90% of the body surface covered with feather) and in conventional technology 0,71 (in average 71% of the body surface covered with feather).

Together with plumage condition was observed forage consumption of laying hens during the day. According to our opinion, higher consumption was registrated by layers from conventional technologies (131,9 g CC vs. 123,0 g in EC) even though layers from enriched technologies were more active (intensity of movement was two-times higher).

Greater consumption could be connected with worse plumage condition. Advanced injury of plumage in conventional cages over all many bare spots on parts of neck and breast, has probably as a consequence enhanced profit energy to ensure thermoregulation balance of the body.

Farmer should evaluate the fact that what he possibly spares on smaller area per bird, he can lose on quantity of consumed forage and on higher occurance of non-standard eggs (cracked and broken), following the lower eggshell quality (low thickness > reduced compactness). Selection of the suitable technology plays with these parameters serious role.

4. CONCLUSION

On the base of comparison of effect conventional and enriched cage technologies by observed indexes we can allege that enriched technologies positively influence the eggshell quality and plumage condition of laying hens. The extended cage area per hen in enriched cage provides them higher possibility to move and supplies lower housing density in the cage. Movement induces better exploitation of calcium in the layers body, the shell of eggs has in consequence higher thickness and compactness, which manifests especially in the second half of the laying period. Smaller housing density also improves plumage condition, decreases the relative non-aggressive feather pecking between layers in the cage. In conventional technologies where is the plumage quality lower, daily forage consumption increases for the reason of lower thermoregulation control, on which feather responsibly participates.

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