

## The effect of housing system on egg quality of Lohmann white and Czech hen

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The effect of housing systems (conventional cages and litter) and genotype (Czech hen and Lohmann) on egg quality was investigated. The experiment with 132 laying hens from the 20 to 60 weeks of age was carried out. The totals of 1500 eggs were analysed. A significant interaction between housing system and genotype was found in shape index ( $P \leq 0.001$ ) and eggshell weight ( $P \leq 0.027$ ). The housing system significantly ( $P < 0.001$ ) affected egg weight. Higher values in Czech hen were detected in litter on other hand in Lohmann were found in cage. Higher egg weight (61.18 g vs. 49.19g) and eggshell weight (6.02 g vs. 4.79 g) was found in Lohmann compared to Czech hen. Shape index (76.46 g vs. 75.15g) and deformation (0.31 N vs. 0.29 N) was higher in eggs from Czech hen compared to Lohmann. Significant interaction between housing system and genotype in albumen weight ( $P \leq 0.023$ ), albumen share ( $P \leq 0.018$ ), albumen index ( $P \leq 0.042$ ) and yolk share ( $P \leq 0.034$ ) were detected. Yolk share, yolk index and yolk colour were higher in eggs from Czech hen compared to yolk weight.

**Keywords:** hens, genotype, housing system, egg quality

### 1. Introduction

The monitoring of egg quality characteristics is important mainly in terms of production economy. The attention is devoted especially to eggshell quality, because cracked eggshell presents higher losses for market-egg producers. Therefore, it is very important to evaluate the egg quality characteristics and factors affecting them (Zita et al., 2009). Egg quality is influenced by many internal and external factors, of which genotype and housing system are major importance (Tůmová et al., 2009). The genotype plays an important role not only egg weight but also other egg characteristics (Heil and Hartmann, 1997; Ledvinka et al., 2000; Leyendecker et al., 2001; Vits et al., 2005). Egg weight is one of the most important characteristics because each of the egg component depends on egg weight (Hartmann et al., 2000). Numerous studies indicate that housing system has considerable effect on egg quality. Egg quality characteristics are better in eggs produced in cages compared to alternative housing systems (Moorthy et al., 2000; Tůmová a Ebeid, 2003; Ledvinka et al., 2004).

The aim of study was to evaluate the effect of housing system on egg quality in contrast genotypes.

### 2. Material and methods

The experiment with 132 laying hens from the 20 to 60 weeks of age was carried out. The effect of housing

system and genotype was observed in eggs from Czech hen and Lohmann white. The laying hens were housed in conventional cages (550 cm<sup>2</sup>) and on litter (9 birds per m<sup>2</sup>). Laying hens in both housing systems were fed identical commercial feed mixtures, N1 from 20 to 40 weeks and N2 from 41 to 60 weeks of age. The feed and water were supplied *ad libitum*. The daily photoperiod consisted of 15 h light. Microclimate conditions corresponded to standard conditions for laying hens. The analyses were performed every 28 days. A total of 1500 eggs were analysed. Individual eggs were weighed on laboratory scale. Shape index was calculated: (maximum width/maximum length) × 100 (Anderson, 2004). From eggshell quality characteristics there were evaluated eggshell weight and deformation of eggshell was evaluated by Instron model 3342 (Instron – USA). Albumen quality was expressed through the use of albumen weight, albumen share, albumen index (albumen height (mm) / [albumen length (mm) + albumen width (mm)] × 100 and Haugh unit ( $100 \times \log(\text{Albumen height} + 7.57 - 1.7 \times \text{egg weight}^{0.37})$ ) (Nesheim et al., 1979). Yolk was evaluated on the basis yolk weight, yolk share, yolk index (yolk height/yolk width × 100) and yolk colour by the colorimetric method and QCC device (TSS, York, UK).

Resultant values were statistically analysed by SAS (SAS Institute INC., 2003) program and an analysis of variance (ANOVA) was used for resultant values

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evaluation. There was studying the interaction of housing system and genotype.

### 3. Results and discussion

Table 1 shows the results of basic technological characteristics of egg and eggshell. The housing system significantly ( $P < 0.001$ ) affected only egg weight. Higher values in Czech hen were detected in litter on other hand in Lohmann white were found in cage. This is in the accordance with the results of Hidalgo et al. (2008) however Ledvinka et al. (2012) did not confirm higher

egg weight in litter. The significant ( $P \leq 0.001$ ) effect of genotype was detected in egg weight. This parameter was higher in Lohmann white. A significant interaction between housing system and genotype was found in shape index ( $P \leq 0.001$ ) and eggshell weight ( $P \leq 0.027$ ). The highest shape index was detected in cage from Czech hen (76.46 %). Eggs from cages laid by Czech hen were significantly rounder compared to eggs from Lohmann white. No significant differences between genotype were observed in eggs from litter. The highest value of eggshell weight was measured in litter from

**Table 1** The effect of housing system and genotype on egg weight, shape and some characteristics of eggshell quality

Housing system	Genotype	Egg weight in g	Shape index in %	Eggshell weight in g	Deformation in mm
Cage	Czech hen	49.04	76.46 <sup>a</sup>	4.59 <sup>c</sup>	0.31
	Lohmann	61.18	74.91 <sup>b</sup>	6.01 <sup>a</sup>	0.29
Litter	Czech hen	49.19	75.22 <sup>b</sup>	4.79 <sup>b</sup>	0.31
	Lohmann	60.05	75.15 <sup>b</sup>	6.02 <sup>a</sup>	0.29
<b>Significance</b>					
<b>Housing system</b>		<0.001	0.787	0.609	0.110
<b>Genotype</b>		<0.001	<0.001	<0.001	$\leq 0.001$
<b>Housing system × Genotype</b>		0.143	$\leq 0.001$	0.027	0.748

a, b, c  $P \leq 0.050$

**Table 2** The effect of housing system and genotype on albumen quality

Housing system	Genotype	Albumen weight in g	Albumen share in %	Albumen index in %	Haugh unit
Cage	Czech hen	28.13 <sup>c</sup>	57.44 <sup>c</sup>	7.96 <sup>c</sup>	78.81
	Lohmann	37.54 <sup>a</sup>	61.40 <sup>a</sup>	10.73 <sup>a</sup>	88.88
Litter	Czech hen	28.43 <sup>c</sup>	57.94 <sup>c</sup>	7.38 <sup>d</sup>	76.01
	Lohmann	36.60 <sup>b</sup>	61.02 <sup>b</sup>	9.51 <sup>b</sup>	84.80
<b>Significance</b>					
<b>Housing system</b>		<0.001	0.006	<0.001	<0.001
<b>Genotype</b>		<0.001	<0.001	<0.001	<0.001
<b>Housing system × Genotype</b>		0.023	0.018	0.042	0.250

a, b, c, d  $P \leq 0.050$

**Table 3** The effect of housing system and genotype on yolk quality

Housing system	Genotype	Yolk weight in g	Yolk share in %	Yolk index in %	Yolk colour
Cage	Czech hen	15.37	27.71 <sup>a</sup>	44.95	6.04
	Lohmann	16.14	22.84 <sup>c</sup>	44.31	4.83
Litter	Czech hen	15.09	25.40 <sup>b</sup>	44.97	6.27
	Lohmann	16.14	22.57 <sup>c</sup>	43.43	5.11
<b>Significance</b>					
<b>Housing system</b>		0.573	0.201	$\leq 0.001$	<0.001
<b>Genotype</b>		<0.001	<0.001	$\leq 0.001$	<0.001
<b>Housing system × Genotype</b>		0.451	0.034	0.136	0.633

a, b, c  $P \leq 0.050$

Lohmann (6.02 g). Significantly higher shape index and deformation were determined in Czech hen compared to eggshell weight where higher values were found in Lohmann white. Similar results were confirmed also by Tůmová et al. (2011). Main deviations in egg composition, egg weight and eggshell quality are between brown and white hybrids (Singh et al., 2009).

Significant interaction between housing system and genotype in albumen weight ( $P \leq 0.023$ ), albumen share ( $P \leq 0.018$ ) and albumen index ( $P \leq 0.042$ ) were observed (Table 2). The heaviest albumens (37.54 g) were measured in eggs from cage by Lohmann as well as in albumen share (10.73 %) and albumen index (10.73 %). The significant effect of housing system and genotype was discovered in all of the albumen quality characteristics. Considerably higher values of albumen index and Haugh unit were in cages compared to litter. Ledvinka et al. (2012) also found the effect of housing system on albumen index and Haugh units. In terms of housing system, Lohmann showed a higher quality of albumen in cages. Czech hen had lower albumen quality indicator of albumen compared to Lohmann.

Significant interaction in yolk quality measurements only in yolk share was detected ( $P \leq 0.034$ ) (Table 3). The highest values were measured in eggs from Czech hens in cages (27.71 %). The significant differences ( $P < 0.001$ ) in the yolk index and yolk colour were found between cage system and litter system. Higher values of yolk share (25.40 %), yolk index (44.97 %) and yolk colour (6.27) were evident in eggs of Czech hen compared to Lohmann. However yolk weight was higher in Lohmann (16.14 g). These results are in agreement with Ledvinka et al. (2012) who also detected effect of genotype on yolk quality.

#### 4. Conclusions

In our study the significant interactions between housing system and genotype in egg weight, albumen weight, albumen share, albumen index and yolk share were found. The housing system significantly affected the most parameters of egg quality especially egg weight and albumen. All monitored parameters were influenced by genotype. Higher egg weight, eggshell weight and all albumen characteristics were detected in Lohmann.

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