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Hematological indicators of laying hens kept in different housing systems

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Abstract

The aim of the study was to compare selected hematological indicators of laying hens kept in three different housing systems (conventional cage, enriched cage according to Europe Council notice 1999/74/EC, and deep litter). The indicators were observed during laying period and the effect of each technology on internal environment indicators of layers was evaluated too. In the experiment 36 ISA BROWN layers were used and they fed complete feeding mixture *ad libitum*. Blood samples were taken at 22, 28, 35, 41, 47, 52, 58, 66 a 75 weeks of age always between 7.00 and 8.00 AM. The red blood cells count (RBC), hematocrit (Hct), hemoglobin concentration (Hgb) white blood cells-count (WBC) and WBC differential count were determined. The examined values in all groups were in physiological range and non-significant influence of any housing system on the monitored indicators was found.

Key words: internal environment, housing system, laying hens

Introduction

Public concerns about the welfare of laying hens resulted in minimum welfare directives in the European Union, with the ban of conventional cages in 2012 (European Commission, 74/1999). Since then, only enriched cages are allowed with nests, perches, and dust baths, i.e. facilities that improve the behavioral repertoire of the birds (Wall and Tauson 2002). Group size has been shown to have a significant effect on production traits. The general trend in layer strains is higher mortality, more feather and skin damage, and lower egg production as group size increases (Tauson 1998, Bilcik and Keeling 1999). De Boer and Cornelissen (2002) consider the battery cage system, particularly from the perspective of production and several health indicators, to be more beneficial than the aviary systems. Determination of the parameters of internal environment is one of the methods of evaluating the effect of the factors of housing environment on health and production of farm animals. It provides valuable information about relations between the internal environment of the organism, nutrition, age and performance. The objective of this study was to determine and compare hematological indicator caged in different housing system during the laying cycle.

Materials and methods

Animals and breeding conditions

Conventional cage technology - four-tier, total (available) area 550 cm^2/bird (2 birds kept on 1120 cm^2 - 32×35×45cm), 2 nipple drinkers, belt feeder 15 cm/bird, device for claw shortening, *Enriched technology* according to Council Directive 74/99/EC - three-tier, total area 945 cm^2/bird (8 birds kept on an area of 7560 cm^2 - 180×42×45 cm), available area 643 cm^2/bird, 6 nipple drinkers, belt feeder 20 cm/bird, nest (30×35×45 cm), perching area 15 cm/bird, devices for dust bathing and scratching, device for claw shortening, *Deep litter technology* - available area 2000 cm^2/bird (20 birds kept on an area of 40000 cm^2 - 200× 200× 180 cm), tube feeder 5 cm/bird, cylindrical drinker 2cm/bird, wood shavings in depth 10-15 cm. All of the housing technologies were situated in the same building with central system of ventilation and temperature regulation. For each technology, experimental group consisting of 12 birds were established with the mean

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body weight of 1300 ± 50 g. Throughout the study, the hens were fed with balanced diets that contained 875 $g.kg^{-1}$ dry matter, energy content ME_N 11.1 $MJ.kg^{-1}$, content of nitrogen substances 170.7 $g.kg^{-1}$, Ca 35.9 $g.kg^{-1}$ and P 6.3 $g.kg^{-1}$. A constant light-dark (L:D) cycle (15:9, switching on at 4.00 AM, switching off at 19.00 PM) was maintained in all three technologies as recommended in technological instructions for ISA BROWN. The temperature of housing was in the range from 18 to 20 °C; relative humidity of air was ranging from 65 to 70%. No red mite and other parasite or viral infection was presented during experimental period.

Collection of blood samples and analyses

Blood samples (2 ml) of all hens in experimental groups were collected from brachial vein at 15, 22, 28, 35, 41, 47, 52, 58, 66 and 75 weeks of age, always between 7.00 and 8.00 AM. EDTA was used as anticoagulant. The red blood cells count (RBC), hematocrit (Hct), hemoglobin concentration (Hgb) and white blood cells-count (WBC) were determined by automatic analyser Medonic CA 620 (Clinical Diagnostic Solutions, USA). WBC differential count was ascertained from blood smear according to the Pappenheim method.

Statistical analysis

Changes in hematological parameters were analysed by repeated measures ANOVA for factors housing technology as independent variable and age of hens as dependent variable. ANOVA was followed by post-hoc Fischer LSD test for pairwise comparisons, when appropriate. All statistical analyses were performed by Statistica 8.0 statistical software (StatSoft Inc., Tulsa, USA).

Results and discussion

All results are shown in Table 1. The RBC count in all groups during the experimental period ranged among 2.44 and 3.08 $T.l^{-1}$. Lower, but not significant average erythrocytes counts, as compared with other technologies, were established in hens in enriched cages technology. Hemoglobin content increased during the laying cycle in all groups till 58 week of age, subsequently decreased to the end of observation. At 58 and 75 week of age the significant ($P<0.05$) differences between hemoglobin content in hens housed in conventional and deep litter technology were established. Hematocrit increased significantly ($P<0.05$) in conventional and enriched cages in week 58 and in deep litter technology in week 66. Significantly higher ($P<0.01$) was hematocrit in conventional cage compared to deep litter in week 58. There were no significant differences between all of group in WBC count. In week 47 the leukocytes number increased significantly in all monitored groups ($P<0.05$) and subsequently decreased till end of experiment. Sporadically were found significant differences in WBC differential count between the monitored groups during the reproductive cycle, but there was no evident tendency higher or lower leukocytes proportions.

Erythrocyte count found in monitored housing technologies differed slightly and ranged in physiological values according to Freeman and Bell (1983), Jerabek et al. (1993), Tumova et al. (2004). There were some non-significant differences between the groups, which can be due to different egg production in particular technologies as a factor influencing erythropoiesis rate as mentioned Vecerek et al. (2002) and Suchy et al. (2004). Fluctuating tendency of changing average values during laying period recorded also Strakova et al. (2001). Hemoglobin concentration increased at the end of laying cycle in all groups. Suchy et al. (1989) and Strakova et al. (2001) determined similar tendency and they assume association between increased hemoglobin concentration and decreased laying intensity. Average leukocytes counts were in a physiological range in all groups. Although, slightly higher WBC number were found in cage technologies compared to deep litter and this could predicate disturbance of physiological function owing to stressful condition in cage, according to Gross and Siegel (1983). Also Bell et al. (1983) recorded higher WBC count in caged laying hens compared to hens in free range.

Table 1. Hematological indicators in laying hens housed in conventional cage (C), enriched cage (E) and deep litter (DL) during the laying period.

	Housing system	Week of age								
		22	28	35	41	47	52	58	66	75
RBC	C	2.81	2.64	2.79	2.83	2.63	2.56	2.96	3.03	2.99
[T.l^{-1}]	E	2.74	2.44	2.46	2.79	2.61	2.68	2.94	2.93	3.01
	DL	2.66	2.50	2.85	2.60	2.55	2.65	2.86	3.08	2.79
Hgb	C	72.25	76.59	75.67	77.81	73.64	76.42	91.81^{a}	91.37	90.27^{a}
[g.l-1]	E	69.73	67.14	74.36	76.13	74.42	74.19	87.29	82.89	84.22
	DL	68.45	74.79	83.42	79.65	75.36	76.24	80.68^{b}	86.65	77.28^{b}
PCV	C	0.298	0.287	0.286	0.278	0.280	0.270	0.313^{A}	0.311	0.307
[l.l-1]	E	0.284	0.267	0.270	0.278	0.281	0.283	0.304	0.306	0.310
	DL	0.272	0.272	0.295	0.273	0.271	0.284	0.270^{B}	0.310	0.276
WBC	C	20.05	23.42	27.83	26.33	31.50	27.92	22.08	19.17	24.83
[G.l-1]	E	18.68	23.42	24.58	20.91	31.00	29.67	23.67	21.75	28.90
	DL	18.90	22.00	23.33	23.50	29.67	27.25	20.17	22.82	25.75
Lym	C	74.00	77.27	76.08	74.67	70.42	67.33	72.73	75.25	68.92
[%]	E	72.73	75.00	70.50	71.60	71.10	66.73	78.33	73.00	75.33
	DL	75.67	73.21	71.67	71.58	69.42	69.90	72.70	71.64	74.27
Het	C	17.42	15.64	16.00	16.00	19.33	18.83	16.18	17.25	21.58
[%]	E	19.27	16.83	19.75	19.40	18.10	18.64	13.42	18.83	17.58
	DL	16.92	17.67	19.17	18.75	21.00	19.00	19.00	19.55	16.00
Mono	C	5.00	3.36	4.42	5.83	6.67	9.83	6.82	3.50	5.42
[%]	E	4.27	4.25	6.25	5.40	6.40	11.09	4.58	4.17	5.50
	DL	4.08	2.83	5.58	5.83	6.17	7.00	4.11	4.45	4.91
Eo	C	2.27	2.41	1.91	2.13	1.86	2.46	2.63	2.30	2.48
[%]	E	2.60	2.48	2.17	2.50	2.20	1.96	2.30	2.23	2.06
	DL	1.87	2.54	2.14	1.91	2.01	2.12	2.54	2.91	2.46
Ba	C	1.31	1.32	1.59	1.37	1.72	1.55	1.64	1.70	1.60
[%]	E	1.13	1.44	1.33	1.10	2.20	1.63	1.37	1.77	1.53
	DL	1.46	1.29	1.44	1.93	1.40	1.48	1.65	1.85	2.36

a,b .... ($P<0.05$); A, B ..... ($P<0.01$)

Conclusion

On the basis of our results we can conclude, that parameters monitored in all groups were in physiological range and there were not found significant effect of housing technology on hematological indicators.

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