Housing and Illumination of Laying Hens

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ABSTRACT

In the frame of the long time research work the indoors-microclimatic conditions were measured together with the general parameters of egg production (feed consumption and conversion, eggs production and quality, etc.) in experimental building. The main indoors parameters (air temperature and relative humidity, air velocity, carbon dioxide, oxygen and ammonia concentrations, illumination and noise level) were measured during the summer, autumn and winter periods. Attention was paid to the problems of laying nests and illumination in relation to the quantity and quality of egg production. The obtained results from the experiments increased the knowledge about microclimatic conditions in egg production and help us to choose the suitable system for the future farms.

Keywords: Laying hens, microclimate, light, eggs, Czech Republic.

1. INTRODUCTION

Many different housing systems are used worldwide for layers. The most common housing system used on the large commercial farms in Czech Republic is accommodation in the compact battery cages. To meet the rules of the Council Directive 1999/74/EC the standard of these housing systems was changed during the last years and many new technological systems with different equipment have been introduced to keep layers in non-cage systems (Skřivan et al., 2000).

The changes of technology in buildings for laying hens housing are based not only on the enlargement of specific floor area which is increased from 450 cm^2 to 550 cm^2 since year 2003, and to 750 cm^2 since year 2012, but also the special changes of technological equipment for housing of laying hens. Different opinions on the quality of production in cages and alternative housing technologies and different experience from the production are presented in some publications (Ledvinka, et al. 2008, Pokludová, et al. 2003).

The experimental housing of hens on the littered floor was compared with housing system in cages in the frame of research, from which the results are published in this paper. Places preferred by hens for eggs putting were tested in the floor housing depending on quality of the place (nests or floor) and on the light conditions.

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2. MATERIAL AND METHODS

2.1 Experimental Building

In the frame of the long time research work the indoors-microclimatic conditions were measured together with the general parameters of egg production (feed consumption and conversion, eggs production and quality, etc.) in two separated experimental rooms with two different housing systems and technologies. The first room with 72 layers has been equipped by the three tiers battery of cages and the second room with 59 hens and floor housing technology (the cut straw with sawdust was used as a litter on the floor).
Three cross-breeds of laying hens have been in use for the study: Isa Brown, Moravia BSL and Hisex Brown. The readings of continue measurements were taken during the summer, autumn and winter periods. Neither the light intensity nor light regime was regulated during this experiment, only during the winter months (December and January) the illumination was switched on because of working conditions (hens' treatment, feeding, manipulation etc.) at 7 a.m.

2.2 Instruments

The temperatures and humidity of the air were measured with thermocouples and capacitive humidity sensors FH A6x6, carbon dioxide with gas sensor FY A 600 based on infrared optics, oxygen with electrochemical cell sensor FY 9600, ammonia with sensor ZO 9601-FS6V12, illumination with sensor FL A613-VL, and noise with UNITEST 93411 D. The measuring instrument Therm 2590-9 logged all measured parameters.
The temperature and humidity sensors were installed near to the level of the housed hens; there were three sensors in the case of section equipped by the compact battery, one per each floor level; and three sensors in the case of compact battery in section with floor housing technology, one per each part of box (near window, centre and near door). Special attention was paid to the problems of laying nests and illumination in relation to the quantity and quality of egg production. The colour of eggshell was measured in the laboratory with TSS-QRC reflectometric equipment.

3. RESULTS AND DISCUSSION

3.1 Production Results

Complete production results calculated from obtained experiments for all three periods are summarised in the tables 1 to 3. There are presented differences between both sections with different housing systems.
Production results were evaluated in term of intensity of eggs production, feed consumption and hens' losses. The intensity of eggs production was during summer and autumn periods significantly higher in housing in cages, during winter slightly higher in the floor housing, but it was not statistically significant (NS), and it was obviously covered by the significantly higher feed consumption. The feed consumption and hens' losses were significantly lower in the cages

housing during the whole year. The use of room space (biological load of housing area) was markedly higher in the control (cage) housing.

Table 1. Production results in summer experiment

Parameter	Unit	Floor	Cages	Statistical significance
Number of hens	Hens	59	72	---
Number of feeding days	Feeding Day	709	286	---
Intensity of eggs production	%	67,14	74,13	P < 0,01
Feed consumption	g . FD^{-1}	112,68	110,32	P < 0,01
Hens losses	Hens	12	9	---
Hens losses	%	20,3	12,5	---
Colour of eggs shell	%	32,11	34,44	P < 0,01
Biological load of housing area	Hens . m^{-2}	4,552	32,727	---

Table 2. Production results in autumn experiment

Parameter	Unit	Floor	Cages	Statistical significance
Number of hens	Hens	47	63	---
Number of feeding days	Feeding Day	423	567	---
Intensity of eggs production	%	76,8	88,9	P < 0,01
Feed consumption	g . FD^{-1}	129,79	125,58	P < 0,01
Hens losses	Hens	8	2	---
Hens losses	%	17,02	3,17	---
Colour of eggs shell	%	35,6	35,59	NS
Biological load of housing area	Hens . m^{-2}	3,627	28,636	---

Table 3. Production results in winter experiment

Parameter	Unit	Floor	Cages	Statistical significance
Number of hens	Hens	39	61	---
Number of feeding days	Feeding Day	304	305	---
Intensity of eggs production	%	80,84	78,36	NS
Feed consumption	g . FD^{-1}	156,77	120,34	P < 0,01
Hens losses	Hens	-	-	---
Hens losses	%	-	-	---
Colour of eggs shell	%	38,3	39,08	NS
Biological load of housing area	Hens . m^{-2}	3,009	27,727	---

3.2 Microclimatic Conditions

Results of mean microclimatic parameters calculated from data measured in experiments for all three periods are summarised in the tables 4 to 6. There were not big differences in the microclimatic conditions. The small temperature and humidity differences inside the housing sections were due to difference of outside temperature and humidity. The level of CO_2 was lower in the cages during all research periods in despite of bigger number of hens and higher biological load of housing area.

Table 4. Microclimatic conditions in summer experiment

Parameter	Unit	Floor	Cages
Outside temperature	°C	15,05	18,71
Outside relative humidity	%	69,3	66,3
Indoor temperature	°C	20,64	23,33
Indoor relative humidity	%	73,03	62,54
Indoor concentration of CO_2	%	0,16	0,1
Indoor noise level (filter A)	dB	59,23	65,9
Indoor illumination	lx	356,55	146,07

Table 5. Microclimatic conditions in autumn experiment

Parameter	Unit	Floor	Cages
Outside temperature	°C	7,97	11,5
Outside relative humidity	%	83,2	73,8
Indoor temperature	°C	14,98	15,81
Indoor relative humidity	%	86,15	67,72
Indoor concentration of CO_2	%	0,17	0,09
Indoor noise level (filter A)	dB	59,65	64,72
Indoor illumination	lx	86,06	39,29

Table 6. Microclimatic conditions in winter experiment

Parameter	Unit	Floor	Cages
Outside temperature	°C	- 9,36	- 6,2
Outside relative humidity	%	76,5	91,6
Indoor temperature	°C	10,62	10,55
Indoor relative humidity	%	73,84	53,66
Indoor concentration of CO_2	%	0,2	0,11
Indoor noise level (filter A)	dB	46,77	58,21
Indoor illumination	lx	117	59,9

The housing conditions in the floor section were characterised by the distinctively higher illumination during the whole year. The level of noise was lower in the floor housing, which was probably cased mainly as the number of hens was smaller there. There was obvious relation between light level and noise produced by hens. One example of time course of light e (lx) and noise $L_{(A)}$ (dB) during day period in winter is presented in the figure 1.

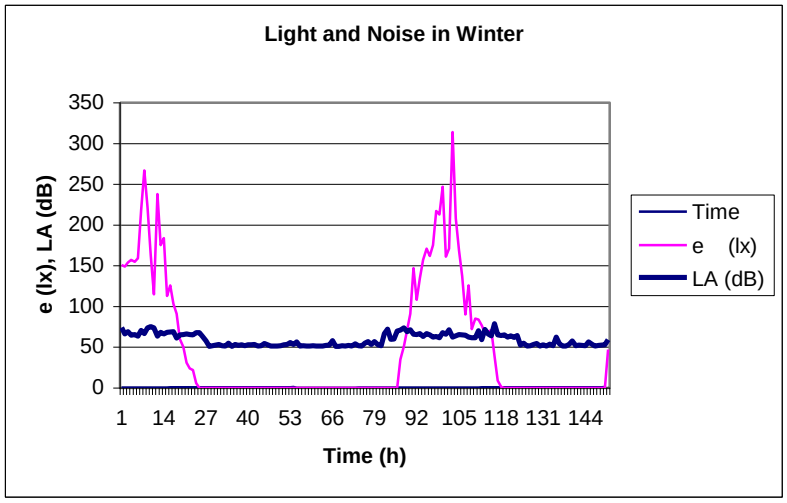

Figure 1. Example of time course of light and noise during day period

Places preferred by hens for eggs putting were tested in the floor housing depending on quality of the place (nests or floor) and on the light conditions. The results of experiment are summarised in the table 7. The majority of eggs (85 %) were put in the special nests, situated in the housing boxes. There were also evaluated preferences of place for putting of eggs, expressed by part of put eggs, depending on the light conditions (figure 2). The light conditions are defined as a relative value, which is local illumination related to the maximum measured value.

Table 7. Results of experiment in preferences for eggs putting

Number of feeding days	Intensity of eggs production	Eggs in nests	Eggs on floor
Feeding Day	%	%	%
259	73,7	85	15

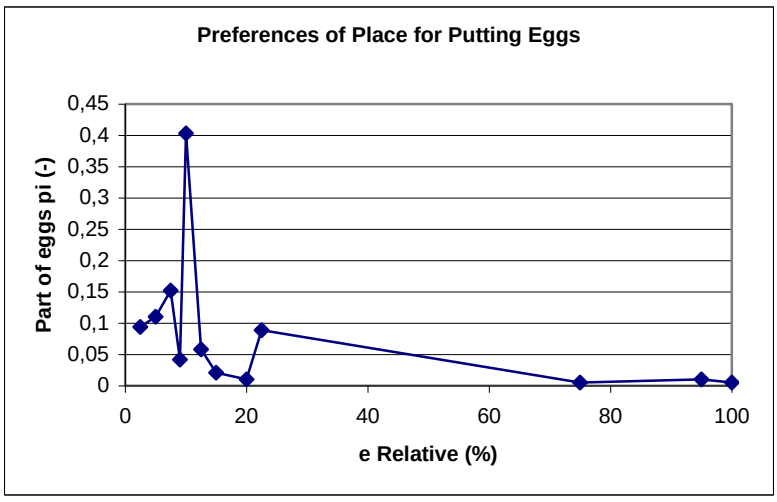

Figure 2. Probability of eggs putting, depending on light conditions

4. CONCLUSIONS

The conclusion based on the described experiments is, that following the implementation of EU Directive 99/74/EC, the system that produces eggs with better results is housing in cages. The importance of the microclimatic control is not only in the comparison of different conditions mutually, but also in the research of the influence of individual components on the results during the year. It is important to continue in the similar research and compare the different housing systems also with the bigger number of hens under the real production conditions in the production farms.

The other production factors should be included, e.g. economic evaluation of production costs, labour quality, veterinary and health aspects etc. Obtained results from the experiments increased the knowledge about microclimatic conditions in egg production and help us to choose the suitable system for the future farms. It should be respected by the designing of new technologies and farms, or in their modernisation.

5. REFERENCES

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