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Influence of photostimulation at the end of the egg laying period on layer hen productivity

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Abstract. *An experiment with three groups of 6,000 Bovans Goldline layers in each was carried out to test the effect of photostimulation at the end of the egg laying period. For this purpose, the daylight duration in experimental groups (I and II) at the age of 48 weeks was extended by 2 and 4 hours, to a duration of 16 and 18 hours respectively, whereas in controls (groups III) it remained constant throughout the entire egg laying period. The photostimulation by extending the daylight hours by either 2 or 4 hours at the end of egg laying did not overcome the biological photorefractoriness of layer hens and did not alter the average egg laying rate and eggs per hen housed. The egg mass, the average daily egg mass, feed conversion ratio and the final live body weight of layer hens at the end of the egg laying cycle were not influenced by photostimulation at the end of the egg-laying period, and mortality rate was higher as compared to the group reared under unaltered 16-hour daylight duration. The time of egg laying is shifted insignificantly to later hours of the day, thus evidencing a clear photorefractoriness of layer hens from contemporary strains to photostimulation during the second part of the egg laying cycle.*

Keywords: layer hens, late stimulation, egg performance.

Introduction

The reduction of egg productivity in layer hens reared under stimulated lighting day is attributed not only to their age, but also to the development of the so-called age-related photorefractoriness. This event is important for limitation of the reproductive activity in birds reared in moderate latitudes as it permits the adequate physical and functional development of hatched birds (Lewis et al., 2003). All investigators having attempted to continue the photostimulation of domestic fowl after the initial light stimulation have encountered photorefractoriness (Leighton et al., 1971; Cleaver et al., 1986). The explanations of age-related photorefractoriness are various. The range of photorefractoriness is not clearly specified (Cleaver et al., 1986). Numerous physiologists have investigated the mechanisms of photorefractoriness. It was established that its occurrence is related to hormonal changes in birds and was particularly related to T4, prolactin, and inhibited synthesis of gonadostimulating hormones (Sharp, 1993; Siopes, 2002). In general, most studies focus their attention on juvenile photorefractoriness while it is believed that with regard to adult layers, the age-related photorefractoriness could be overcome by intensive selection for increased egg laying rates.

The layer hen strains used nowadays in poultry husbandry practices are thought to react at a lesser extent to light as compared to older hybrids (Morris, 1978b; Prescott and Wathes, 2002; Lewis and Morris, 2005). Some authors even believe that unlike stock layers, age-related photorefractoriness does not exist in contemporary egg laying hybrids (Lewis and Morris, 2005). The present study aimed to test the effect of photostimulation at the end of the egg laying period on the productive traits of layer hens.

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Material and methods

The experiment was carried out with three groups of 6,000 Bovans layers in each, floor-reared in three premises under identical conditions of housing and feeding. The age of birds at the beginning of the experiment that lasted 52 weeks, was 20 weeks. In groups **I** and **II**, the light part of the day was gradually extended from 8 to 14 hours between the age of 16 to 23 weeks. In group **III** (control), the light hours of the day were extended from 8 to 16 hours in the period from 16 to 24 weeks of age and this duration was preserved until the end of the study. At the age of 52 weeks, the light hours in birds from group **I** were extended once by 2 hours (1 in the morning and 1 in the evening), whereas in group **II** – by 4 hours (2 in the morning and 2 in the evening). The light intensity was 10 lx at bird level.

The following production traits were monitored throughout the study: average egg laying rate, eggs per hen housed, mortality rate, live body weight of layers, egg weight, daily egg mass, feed conversion ratio and distribution of laid eggs during the light part of the day.

Results and discussion

The intensity of egg laying until the age of 52 weeks was almost equal in birds from all three groups, despite the differences in daylight duration – 14 hours in group **I** and **II**, and 16 hours in group **III** (Table 1). Regardless of the considerable changes that were made in the lighting programme at the age of 52 weeks, the laying intensity after the introduction of the extra daylight hours and the average egg laying rate for the entire productive cycle did not differ significantly among the three groups. A similar tendency was observed in the intensity of egg laying per hen housed. The photostimulation during the second half of the egg laying period had no effect on this

parameter. The eggs per hen housed in the three groups did not show significant differences, which were predetermined to a considerable extent by the culling of hens from all groups.

For the entire egg laying period (52 weeks), the mortality in

Table 1. Average laying rate and laying of hen housed, %

Period (weeks)	Average laying rate			Laying of hen housed		
	I group x ± Sx	II group x ±Sx	III group x ±Sx	I group x ± Sx	II group x ±Sx	III group x ±Sx
	Daylight, h			Daylight, h		
	14	14	16	14	14	16
20-23	54.4±3.3	55.36±4.0	55.1±3.3	54.0±2.5	54.9±2.4	54.7±2.5
24-27	85.0±1.3	85.2±1.3	84.3±1.3	83.4±1.3	83.7±1.3	82.9±1.3
28-31	94.2±0.2	94.0±0.2	93 8±0 2	91 6±0 3	91.58±0.3	91.5±0.3
32-35	92.3±0.2	92.4±0.2	92.2±0.2	89.0±0.2	89.3±0.3	89.2±0.3
36-39	92.7±0,2	92.7±0.2	92.8±0.2	88.9±0.3	89.0±0.3	89.2±0.3
40-43	90.9±0.2	90.5±0.2	90.9±0.3	86.5±0.3	86.3±0.3	86.8±0.3
44-47	87.5±0.2	87.2±0.2	87.1±0.2	82.6±0.3	82.1±0.3	82.5±0.3
48-51	82.8±0 3	82.6±0 3	82.9±0 3	77.5±0 3	77.4±0 3	77.9±0.4
	Light stimulation, h					
	14 →16	14 →18	16 →16	14 →16	14 →18	16 →16
52-55	77.9±0.3	78.6±0.2	78.6±0.3	72.2±0.4	72.9±0.4	73.3±0.4
56-59	75.8±0.3	75.7±0.3	75.5±0.3	69.7±0.3	69.6±0.4	69.9±0.3
60-63	72.7±0.3	73.3±0.3	72.6±0.3	66.5±0.3	66.9±0.4	66.8±0.3
64-67	67.0±0.3	67.7±0.2	67.6±0.3	60.7±0.3	61.3±0.3	61.7±0.4
68-71	64.5±0.3	65.2±0.3	64.8±0.3	57.9±0.5	58.4±0.4	58.6±0.3
20-71	**79.8±0.5**	**80.0±0.5**	**80.0±0.5**	**75.4±0.6**	**75.7±0.6**	**75.8±0.6**

Table 2. Mortality, %

Period (weeks)	I group x ±Sx	II group x ±Sx	III group x ±Sx
	Daylight, h		
	14C	14C	16C
20-23	0.86±0.017^{ag}	0.81±0.016^{b}	0.76±0.018^{hc}
24-27	1.08±0.021^{g}	0.93±0.019^{h}	0.89±0.018
28-31	0.88±0.019^{g}	0.79±0.015^{hf}	0.86±0.018^{d}
32-35	0.69±0.018^{h}	0.82±0.018^{g}	0.73±0.017^{h}
36-39	0.57±0.017^{he}	0.67±0.017^{g}	0.64±0.016^{d}
40-43	0.68±0.018^{b}	0.73±0.016^{a}	0.65±0.016^{b}
44-47	0.86±0.019^{dg}	0.78±0.019^{e}	0.73±0.017^{h}
48-51	0.85±0.019^{d}	0.82±0.019	0.78±0.017^{e}
	Light stimulation, h		
	14C →16C	14C →18C	16C →16C
52-55	0.79±0.018^{bd}	0.85±0.018^{ag}	0.71±0.017^{eh}
56-59	0.65±0.017^{h}	0.77±0.017^{g}	0.66±0.016^{h}
60-63	0.74±0.017^{g}	0.76±0.017^{g}	0.63±0.016^{h}
64-67	0.73±0.016^{h}	0.83±0.016^{g}	0.72±0.017^{h}
68-71	0.82±0.018^{h}	0.98±0.019^{g}	0.83±0.018^{h}
20-71	**10.20±0.007^{g}**	**10.54±0.008^{h}**	**9.59±0.007^{i}**

Note: Values within rows with different letters differ significantly: **abc -** p≤0.05; **def -** p≤0.01; **ghi -** p≤0.001.

control hens was 9.59%, whereas in groups **I** and **II** 10.20% and 10.54%, respectively (Table 2). The differences between control and each of the two experimental groups were statistically significant ($p \leq 0.001$) and provided evidence for the negative effect of photostimulation at the end of the egg-laying period upon the survival rate in layer hens.

The tested factor had no statistically significant effect upon feed conversion per one kg egg mass that was similar in all three groups for both the different production periods and the entire egg laying cycle (Table 3). The average egg mass for the entire egg laying cycle was similar in all three groups – 62.2 g for groups **I** and **II** and 62.1 g in the control group **III** (Table 4). The photostimulation of layer hens during the last 20 weeks of the production cycle had no statistically significant effect on egg mass.

The average daily egg mass was also not influenced by photostimulation applied during the second half of the egg laying

Table 3. Feed conversion, kg

Period (weeks)	**I** group x ±Sx	**II** group x ±Sx	**III** group x ±Sx
		Daylight, h	
	14	14	16
20-23	3.896±0.093	3.904±0.092	3.894±0.091
24-27	2.564±0.092	2.576±0.083	2.566±0.083
28-31	2.321±0.098	2.332±0.081	2.324±0.082
32-35	2.332±0.095	2.343±0.084	2.326±0.084
36-39	2.326±0.082	2.333±0.085	2.325±0.085
40-43	2.335±0.096	2.337±0.086	2.334±0.086
44-47	2.378±0.087	2.379±0.083	2.366±0.089
48-51	2.545±0.088	2.553±0.087	2.543±0.087
		Light stimulation, h	
	14 →16	14 →18	16 →16
52-55	2.583±0.084	2.582±0.088	2.578±0.080
56-59	2.596±0.093	2.591±0.019	2.586±0.088
60-63	2.774±0.085	2.674±0.082	2.763±0.081
64-67	2.875±0.092	2.873±0.094	2.862±0.082
68-71	2.985±0.096	2.974±0.083	2.961±0.084
20-71	**2.655±0.023**	**2.650±0.023**	**2.648±0.023**

Table 4. Egg mass, g

Period (weeks)	**I** group x ±Sx	**II** group x ±Sx	**III** group x ±Sx
		Daylight, h	
	14	14	16
20-23	60.4±0.245	60.3±0.323	60.3±0.307
24-27	60.9±0.224	60.9±0.221	60.8±0.213
28-31	60.2±0.233	60.3±0.237	60.1±0.236
32-35	62.1±.0.226	62.1±0.241	62.0±0.222
36-39	61.9±0.232	61.8±0.223	61. 8±0.241
40-43	61.8±0.221	61.7±0.256	61.8±0.264
44-47	62.0±0.224	62.1±0.234	62.1±0.253
48-51	62.8±0.223	62.7±0.249	62.7±0.311
		Light stimulation, h	
	14 →16	14 →18	16 →16
52-55	63.1±0.225	62.9±0.224	62.8±0.225
56-59	62.4±0.223	62.7±0.245	62.5±0.234
60-63	62.4±0.224	62.6±0.238	62.4±0.211
64-67	63.7±0.222	63.5±0.256	63.4±0.233
68-71	64.5±0.226	64.4±0.237	64.4±0.322
20-71	**62.2±0.065**	**62.2±0.064**	**62.1±0.063**

period (Table 5) and the values of this parameter in the three groups were not considerably different.

The photostimulation applied in groups **I** and **II**, in which the daylight hours were increased from 14 to 16 and 14 to 18, respectively, resulted in a slight reduction of the live body weight of birds. By the end of the production cycle, the weight of the birds from groups **I** and **II** was 1965 and 1966 g, respectively, vs 1984 g in the control hens. Therefore, compared to layer hens from group **III**, placed under constant daylight duration, the body weight of hens from groups **I** and **II** was reduced by 0.95% and 0.91% respectively. The differences however were not statistically significant.

Considering the similar values for egg laying rate, the distribution of layings was expected also to be similar in the different groups (Table 6). The main amount of produced eggs in the three groups was laid 4 to 6 hours after turning the light on. After the extension of the daylight hours, an insignificant shift of egg production towards afternoon hours was observed in groups **I** and **II**, whereas in the control group the distribution remained practically unaltered.

Table 5. Egg mass, g/day

Period (weeks)	**I** group x ±Sx	**II** group x ±Sx	**III** group x ±Sx
	Daylight, h		
	14	14	16
20-23	32.9±1.449	33.4±1.461	33.2±1.419
24-27	52.3±1.253	51.9±1.353	51.2±1.328
28-31	56.7±1.334	56.7±1.277	56.4±1.241
32-35	57.3±1.246	57.3±1.243	57.2±1.337
36-39	57.4±1.325	57.3±1.384	57.4±1.262
40-43	56.1±1.267	55.9±1.332	56.2±1.254
44-47	54.2±1.472	54.2±1.291	54.1±1.373
48-51	52.0±1.338	51.8±1.337	52.0±1.385
	Light stimulation, h		
	14C →16C	14C →18C	16C →16C
52-55	49.1±1.324	49.4±1.224	49.4±1.244
56-59	47.3±1.445	47.4±1.453	47.2±1.357
60-63	45.4±1.353	45.9±1.335	45.3±1.238
64-67	42.7±1.426	43.0±1.467	42.9±1.366
68-71	41.6±1.367	42.0±1.370	41.8±1.229
20-71	**49.6±0.381**	**49.7±0.376**	**49.6±0.373**

Table 6. Distribution of layings during the light part of the day, %

Hours from the beginning of the day	**I** group		**II** group		**III** group	
	14C	16C	14C	18C	16C	16C
0 – 2	1.82	1.93	2.28	1.96	1.78	1.73
2 – 4	21.28	22.45	20.79	23.24	23.23	23.47
4 – 6	61.21	57.92	61.06	57.95	57.87	58.03
6 – 8	12.39	13.89	12.40	13.09	12.95	12.85
8 – 10	2.57	2.72	2.68	2.51	3.21	3.02
10 – 12	0.52	0.74	0.57	0.83	0.67	0.64
12 – 14	0.21	0.23	0.22	0.28	0.20	0.18
14 – 16	x	0.12	x	0.11	0.09	0.08
16 – 18	x	x	x	0.03	x	x

Conclusion

The photostimulation of 52-week-old layer hens by extending the daylight hours by either 2 or 4 hours did not overcome the biological photorefractoriness of birds and did not alter the average egg laying rate and eggs per hen housed. The higher number of daylight hours up to 18 hours in group **II**, increased the mortality rate as compared to the same parameter in the groups reared under constant 16-hour daylight duration.

The feed conversion ratio, the egg mass and the average daily egg mass were not influenced by photostimulation at the end of the egg-laying period. The final live body weight of photostimulated 52-week-old layer hens was insignificantly lower and mortality was higher compared to control birds reared under 16-hour daylight conditions. The photostimulation of layer hens by the end of the production cycle resulted in a slight shift of egg laying towards later hours of the day, thus evidencing a clear photorefractoriness of layer hens from contemporary strains.

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