EFFECT OF LIGHTING PROGRAM ON DEVELOPMENT OF FOLLICLES DURING SEXUAL MATURATION OF LAYING HENS

Lidija Perić, N. Milošević, Gordana Ušćebić, D. Žikić, A. Božić

Contents: In this work, the influence of intermittent lighting programmes during rearing on development of follicle on ovaries of laying hens has been studied. Hens of control group (A) were reared under standard lighting program (8L:16D) up to 17th week of age. Experimental groups were reared under the following intermittent lighting programmes: Group B - (2L:1D) x 3 + 15D; Group C - (2L:1D) x 4 + 12D; Group D was reared under the same program as Group C until 12th week, and after that it was transferred to standard rearing program (8L:16D). The results have shown the positive effects of intermittent light on the number and development of follicles in the ovary.

Key words: hens, rearing, lighting programmes, follicles, ovary

Introduction and literature review

Choice of lighting programme during rearing and exploitation of hens is very important for success of production since it can influence the beginning of laying, number of eggs and their mass as well as food consumption. Earlier beginning of laying induced by lighting programme leads to laying of more eggs during production cycle but also to lower average egg mass and conversely in case of later beginning of laying (Morris, 1994). Based on previous scientific and practical experiences it is considered that for each 7 days of difference in age of hens at the beginning of laying number of eggs will differ in 5 and egg mass by 1 g (Lewis, 1996). Also body mass of hens is very important in this regard since in early matured animals it is considerably lower (Lewis, 1998; Leeson and Summers, 1987).

Objective of the application of intermittent lighting programme during rearing is to stimulate consumption and improve conversion of food and in this way influence the increase of hens' body mass (Midgley et al., 1988; Morris, 1988). Intermittent lighting programme should be set to avoid disruption of normal stimulative effect of light in sexual maturation of hens and age at the beginning of laying.

Material and methods

Four lighting programmes during rearing have been applied in this investigation – one was standard lighting programme and other three were so called intermittent lighting programmes. Until the second week of age all groups were under same lighting treatment – reduced light from 24 h to 8 h and afterwards the following experimental treatments were used:

Group A – 8h light + 16h dark until 17th week
Group B – (2h light + 1h dark)x3 + 15h dark until 17th week
Group C – (2h light + 1h dark)x4 + 12h dark until 17th week
Group D – (2h light + 1h dark)x4 + 12 h dark until 12th week, followed by 8h light+16 h dark until 17th week.

Intensity of light was the same in all groups and in accordance with technological recommendations for Shaver 579 hybrid used in our investigation. Nutrition, watering, housing density and other technological parameters were equal in all four groups.

Morphological examination of hens’ ovaries was performed in 12th, 15th and 17th week of age. From each group 6 hens from each age group were sacrificed, ovaries and Fallopian tube/oviduct were separated cleaned from surrounding tissue and conserved in 0,1% formalin. Week later, on each ovary number of visible follicles larger than 1 mm was determined and measured in diameter.

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Results and discussion

At the age of 12 weeks number and size of visible follicles per hen was determined. In three experimental groups, in three hens from each group no follicles > 1 mm could be registered and three hens had several visible developed follicles. Hens from group C had the most developed ovaries and in two hens from this group 9 follicles > 1 mm were registered. After their separation from ovaries diameter of follicles was measured and number of follicles of different diameter per group was calculated (table 1).

<table>
<thead>
<tr>
<th>Diameter of follicles, mm</th>
<th>Group A (n=9)</th>
<th>Group B (n=18)</th>
<th>Group C (n=29)</th>
<th>Group D (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>9</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>5</td>
<td>-</td>
<td>4</td>
</tr>
</tbody>
</table>

Results indicate that hens from group C had the most follicles per hen but of small diameter (1 mm), whereas hens from groups B and D had only 3 follicles of 3mm diameter which was the greatest diameter measured at this age.

Distribution of number of follicles of different diameters per groups is presented on graph 1.

![Graph 1. Number of follicles of different diameters (12 weeks)](image)

Also at the age of 15 weeks diameters of all follicles in different groups were measured and distribution of obtained values is presented in table 2.

<table>
<thead>
<tr>
<th>Diameter of follicles, mm</th>
<th>Group A (n=19)</th>
<th>Group B (n=33)</th>
<th>Group C (n=34)</th>
<th>Group D (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>13</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>14</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>4</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>6</td>
<td>-</td>
</tr>
</tbody>
</table>
Hens from group C had the most follicles (34) as well as the highest number of follicles with diameter over 4 mm (6). In hens from group D no follicles over 3 mm were measured and also total number of follicles was the lowest. Obtained values are presented in graph 2. In the 18th week of age hens from group C were clearly distinct from others since they had already started to lay eggs. Of 6 hens sacrificed and sampled 4 hens had already started to lay eggs and their ovaries contained follicles of diameter over 20 mm, and oviduct had already taken on the function of creating the albumen/egg white, membrane and egg shell. In hens from groups A, B and D the development of follicles on ovaries had begun at this age, but none of the hens had started to lay eggs.

Number of follicles of different diameter per hen was determined at this age, however previous classification was not applied so follicles of diameter bellow 1 mm were not registered because there were few and it was not possible to count them precisely. At this age larger follicles are more important and therefore two new categories of follicles over 10 and over 20 mm in diameter were introduced (table 3).

![Graph 2. Number of follicles of different diameters (15th week)](image)

**Table 3. Number of follicles of different diameter at the age of 18 weeks**

<table>
<thead>
<tr>
<th>Diameter of follicles, mm</th>
<th>Group A (n=67)</th>
<th>Group B (n=173)</th>
<th>Group C (n=109)</th>
<th>Group D (n=81)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>37</td>
<td>49</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td>45</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>40</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>5-10</td>
<td>-</td>
<td>39</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>11-20</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>&gt;20</td>
<td>-</td>
<td>-</td>
<td>17</td>
<td>-</td>
</tr>
</tbody>
</table>

Important is also the fact that hens from group C had 4 follicles of over 20 mm in diameter and 2-3 follicles of diameter from 10-20 mm each (graph 3), indicating the hierarchy in forming of egg yolk which enables the continuity in laying of eggs.
Results of morphometric investigation of ovaries and oviducts showed that hens of group C at the age of 12 weeks already have developed ovaries compared to other groups and this trend continues to the end of rearing resulting in the earliest start of laying in hens from this group. In regard to the development of ovaries, hens from group B are right behind group C, whereas the control showed the slowest development of follicles on ovaries observed in the time period from 12th to 18th week of age.

Number of visible follicles on ovaries varies from 1000-3000 and in modern hybrids even more. Follicles of smaller diameter are pale, whereas follicles that already started to grow and develop are yellow (Hocking and McCormak, 1995; Robinson et al., 1996). In results published by Hocking et al. (1987) Leghorn hens at the age when they start to lay eggs (first egg) had in average 6.3 yellow follicles on ovary (span 4-9), which is in accordance with results obtained in this investigation relating to average for 4 hens of group C which started to lay eggs. Other authors state that laying hens in average have 5.2-6.5 large yellow follicles on ovaries (van Middelkoop, 1972; Williams and Sharp, 1978).

Hocking et al. (1987) stated results of trial where on ovaries of hens who started to lay eggs in average 8 follicles of diameter 2-3 mm were found, 5 follicles of diameter 3-5 mm and 2 follicles of diameter 5-8 mm, which is also in accordance with results obtained in this investigation. Gilbert et al. (1983) presumed that there were two mechanisms controlling the size and dynamics of forming of yellow follicles: one controlling the follicle growth and other controlling the atresia. In this way growth of follicles, continuity in laying of eggs and pauses are regulated but also possible end of laying.

Conclusion

It can be concluded that investigation and monitoring of the condition of reproductive organs of hens every three weeks resulted in goof chronological review of changes on ovaries during sexual maturation. Differences between groups in number and size of follicles registered in the 12th week of age remained until 15th and 18th week, therefore it was possible to make early assumption about the effect of applied light regime on sexual maturation of hens in rearing.
UTICAJ SVETLOSNOG PROGRAMA NA RAZVOJ FOLIKULA
U TOKU POLNOG SAZREVANJA KOKOŠI

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Rezime

U ovom radu ispitivan je uticaj primene diskontinuiranih svetlosnih programa u toku odgoja na razvoj folikula na jajnicima. Kokoši kontrolne grupe odgajane su pod standardnim režimom svetla (8 h svetla (S): 16 h mraka (M)) do 17. nedelje starosti. Kod eksperimentalnih grupa primjenjeni su sledeći programi: Grupa B - (2S:1M) x 3 + 15M; Grupa C – (2S:1M) x 4 + 12M; Grupa D je odgajana po istom režimu kao grupa C do 12. nedelje, a zatim je primenjen standardni program (8S:16M). Određivanje broja i veličine folikula izvršeno je u 12, 15. i 18. nedelji starosti kocka Dobijeni rezultati ukazuju na to da su diskontinuirani programi stimulativno delovali na razvoj folikula na jajnicama, a time i na polno sazревanje kokoši.

Ključne reči: kokoši, odgoj, svetlosni program, folikuli, jajnici

Literatura