The Effect of White and Monochromatic Lights on Chicken Hatching

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Abstract
The study considers the effect of white and monochromatic light on the hatching of the hybrid ROSS 208 chickens. The chicken embryos were most sensitive to white light, reaching the hatching time of 499.80±2.65 hours, the hatchability of 95.08±2.43 %, and an average weight of the hatched chickens 47.17±3.08 g. Of the monochromatic lights, the chicken embryos were most sensitive to yellow light with the hatching time of 501.16±1.84 hours, the hatchability of 94.97±1.92% and average weight of hatched chicken 45.88±2.32g. The least reaction of chicken was observed with blue light, with the hatching time of 506.74±1.57 hours, hatchability 92.11±2.18 % and average weight of hatched chicken 42.13±2.07 g. The influence of blue light brings the same effects as we observed in the case of hatching in darkness when the hatching time reached 505.76 ± 2.15 hours, hatchability 91.62±1.62 % and an average weight of hatched chicken 41.73±1.95 g.

Keywords: chicken hatching, white and monochromatic lights

1. Introduction

The visible light belongs to the biologically most important kinds of non-ionising radiation and it is important for many living functions of plants and animals [1]. Experiments of numerous authors showed that the influence of light on embryonic and post embryonic development of birds increases the activation of some active substances [2]. Light has a regulative effect on the vegetative nervous system; it enhances the ability of regeneration [3]. According to Johnston & Rogers [4], light can activate the development of active substances (enzymes, fermets, and vitamins) in chicken embryos. The exposure to light during incubation can shorten the embryonic development of chickens [5], or to increase hatchability [6].
In our study we observed the influence of light radiation during incubation on the hatching of ROSS 208 hybrid chickens.

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2. Materials and methods

In this experiment, 540 eggs of meat hybrid ROSS 208 set with average weight of 60±0.5 g, from parental brood aged 45-48 weeks, were studied. The egg set was incubated in the BIOS MONO 06 hatcheries, with temperature of 37.5–38.2ºC and humidity of air 55-65% (first 18 days of incubation) and 65-90% (the last 3 days). The control group egg embryos were not stimulated by light. The experimental groups were exposed to light for 24 hours a day between 14th and 21st day of incubation. The chicken embryos were exposed to white and monochromatic (blue, green, yellow and red) lights. As the source of light were used bulbs (5 W) - type Biolux, made by the Osram company.
Following factors were observed: beginning of beakclapping**,** total beakclapping time, total hatching time, hatchability and average weight of hatched chicks. Summary of results introduced in the table were obtained during the three consecutive measurements. The acquired results

served for the calculation of the elementary vario - statistical indicators.

3. Results and discussion

The development of chicken embryos was speeded up when exposed to light during the hatching [7]. The chicken embryos were more sensitive to white light than the monochromatic one [8].

When white light was used for the stimulation, the beakclapping of chicks started after 489.68±1.52 hours of incubation and the duration of the hatching process was 499.80±2.65 hours. In the control group (an incubation without illumination), the beakclapping of chicks started after 493.12±0.96 hours of incubation and the hatching process lasted 505.76±2.15 hours (Table 1). The results correspond with the findings of Bohren & Siegel [5].

Of the monochromatic lights used during hatching, chicken embryos were most sensitive to yellow light (hatching for 501.16±1.84 hours), then to a green (502.88±3.02 hours), and, finally, to a red one (503.77±2.41 hours). These results correspond with the ones achieved by Prescott & Wathes [9]. The chicken embryos were least sensitive to blue light, the hatching process in this group lasted for 506.74±1.57 hours. Similar results were arrived at and proved also by Johnston et. al. [10].

Light stimulation during the last week of incubation also increased the hatchability of chicken embryos. The highest hatchability rate was observed with white light stimulation (95.08±2.43%), then yellow (94.97±1.92%), green (94.13±2.37%), and, finally, red one (92.79±1.87%). The lowest hatchability was achieved during the stimulation of chicken embryos with blue light (92.11±2.18%), as well as in the control group without illumination (91.62±1.62 %).

The 3-4 % increase of hatchability of embryos exposed to light, in comparison with the control group non-exposed to light, was also observed by Cooper [6]. An average weight of hatched chicks, exposed to illumination during the incubation, was higher in comparison to the weight of chicks in the control group that was non-exposed to any kind of illumination.

In the final stage of incubation, embryos in eggs are oriented in such way that the left eye is covered and only the right eye is stimulated by light [11].

Epiphysis is a light-sensitive organ innervated by synaptic nervous system that mediates a transfer of light stimulus from retina. Epiphysis controls a level of melatonin and serotonin [12]. We can observe a high level of serotonin and low level of melatonin during the exposition to illumination influence [8].

Serotonin is highly effective physiological matter [13]. According to Wenke et. al. [15], serotonin can accelerate metabolism. The results of experiments carried out by Digney [16] point to the fact that serotonin can increase an utilization of nutriment from the yellow bag and the white of chicken embryos.

We suppose that the accelerated metabolism shortened the development of chicken embryos in our experiment, which was reflected in shorter time needed for the hatching process. Better conversion of nutriment from the yellow bag and white of chicken embryos probably influenced higher level of the average weight of hatched chicks. We observed that the highest average weight of hatched chicks was in the first experimental group where the chicken embryos were stimulated by white light (47.17±3.08 g). On the contrary, the lowest levels of weight were observed in the third experimental group (42.13±2.07 g) where the chicken embryos were stimulated by blue light, and in the control group (41.73±1.95 g) where the chicken embryos were hatched in the dark.

The results of experiments indicate that chicken embryo perceptiveness of light depends on its wavelength. Rogers et. al. [17] suggest that the chicken embryos are most sensitive to the light with average wave length about 550 - 560 nm.

4. Conclusions

Presented average wavelength corresponds to white light in our experiment. In this we achieved the highest hatchability, the highest average weight of hatched chicks and the shortest hatching time. The lower wavelength of stimulating light (blue light, 450-460 nm), the lesser embryo sensibility to this light

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