The Effect Of Light On Egg Production And Quality Of Laying Hens

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ABSTRACT

Two experiments were conducted to investigate the effects of different light sources (fluorescent, incandescent, blue and day light) under different intensities (5, 25 & 50 lux) on egg production and quality of laying hens. The first experiment was carried out to study the response of laying hens to different light sources under the same intensity (25 lux). A total of 80 Lohmann brown breed hens at 35-week laying period were kept in deep litter pens and randomly allocated to four experimental groups of 20 hens each. These groups were exposed to four light sources under 25 lux. Egg quality traits of the individual hens were recorded throughout the experimental period. There was a significance effects of light sources on shell thickness, yolk colour and haugh unit, whilst were recorded no effects on other parameters.

In other experiment, the correlative changes in egg quality due to different light sources under two level of light intensities in laying hens were investigated. A total 256 Lohmann brown breed hens were exposed to the same light sources but under 5 and 50 lux throughout. Data were analyzed by two factorial analyses between light sources and its intensities. In this experiment, egg quality parameters were not significantly different among the light treatments, moreover egg production did not affect by different light sources or its intensities.

INTRODUCTION

Poultry production represents a very large and sector. There are many factors that are of potential concern for the welfare of poultry which reflected its production. From these factors lighting programs, which considered as an important tool in the management practices for poultry. It can be manipulated in four areas including source, intensity, wavelength, and photoperiod *(1)*. Typically, incandescent bulbs are common in poultry housing. However, there has recently been a trend towards the use of fluorescent bulbs, day light or high pressure sodium discharge lights because of their longer livability and lower cost.

Reproductive performance was not different among hens exposed to incandescent and blue light when the intensity remained constant *(2)*. Hens stimulated by fluorescent light had reproductive performance similar to that of hens kept under incandescent light *(3)*. Besides, there were no significant differences in fertility, hatchability, egg weight, and egg specific gravity due to light source *(4)*, but egg production of hens maintained under fluorescent light was significantly less than hens under incandescent light. On the other hand, egg production, shell quality and egg weight were unaffected by light sources and its intensities, especially during breeding phase *(5)*. No difference in egg weight and albumen index of hens exposed to light intensity varying from 3 to 25 lux, whilst egg shell thickness was reported to be independent of light intensity *(6)*. In caged turkey hens 22-week of age, egg production was similar in hens exposed to incandescent or fluorescent light *(7)*. Therefore, these experiments were carried out to study the effects of light sources on egg production and quality of laying hens.

MATERIALS AND METHODS

Experiment I

This experiment was conducted at the Research Station (Unterer Lindenhof) of Hohenheim University, Stuttgart, Germany. At the beginning of the experiment, a total of 80 laying hens (Lohmann Classic) at 35 weeks of age were divided into four groups of 20 birds

each. Each group was reared in deep litter pens (2.54 m length x 2.27 m width x 1.6 m height) and 10 cm thickness of wood shaving with floor area of 0.75 m^3 for each bird. The pens were built side by side in stable and windowless, separated by plywood walls allowing auditory but not visual contact. The environment inside the pens was insulated and controlled by ventilators which were regulated with thermostats. The daily temperature was maintained from 21°C to 23 °C. The pen contained the feeder, drinker, nest box (68 cm length x 31 cm width x 76 cm height), elevated perches (70 cm height) and sources of light. The birds were fed and drunk *ad libitum*.

Table 1. Ingredient and chemical Composition of the experimental diet (g /kg).

Ingredient	g /kg	Ingredient	g /kg
Soya bean meal (extra)	232	Sodium bicarbonate	2.5
Ground wheat	390	Sodium chloride	2.5
Ground maize	80	Vitamin premix	2
Ground oats	100	Methionine	1.8
Maize gluten meal	40	Avisant Y 5S	1.6
Soya bean oil	40	Choline chloride	1
Ground lime stone	40	Trace- mineral premix	0.8
Granular lime stone 120	50	Avisant Y 20S	0.6
Monocalcium phosphate	12	Antioxidant	0.15
Luprosil	4	Roxazyme G	0.15
		Sum of ingredient	1001.1

During experimental period, a 14-hour lighting schedule was maintained (3:00 to 17:00) from the different light sources (incandescent light-IL, fluorescent light-FL, day light-DL, and blue light-BL) with the same light intensity (25 lux) and these sources were exchanged every two weeks and at the end of the period egg samples were collected. All eggs were identified by pen number and brought in the same day of collection to the laboratory. The egg samples were stored overnight at 10 to 15°C. The egg quality parameters were determined in the egg quality laboratory of the Institut für Tierhaltung und Tierzuchtung, Universität Hohenheim.

The shell breaking strength was measured by the quasi-static compression test using Istron (Model 4301, Instron Ltd., Coronation Road, High Wycombe, Bucks HP 123 SY, England), where the eggs were compressed at a constant speed of 5.0 mm/min between the poles and the steel surfaces. Shell thickness (including the membranes) was measured on three pieces from the equator of each egg using Ames thickness micrometer gauze. The shell thickness was determined after rinsing shells with distilled water and oven-dried at 100 °C for 4 hours.

The experimental data were analyzed by JMP 5.0.1 program *(8)*. The analysis of variance was performed by the ANOVA (procedure ANOVA analysis) and differences between means by Student's t-test. Egg production was calculated through the following formula:

$$\text{Hen-day egg production (\%)} = \frac{\text{Sum (eggs laid)}}{\text{No. of birds}} \times 100$$

Experiment II

A total of 256 Lohmann Brown Classic hens, 40 weeks of age, were kept in newly constructed floor pens (2.65 m length * 2.58 m width) and were randomly allocated to eight experimental groups of 32 hens each.

Husbandry condition, management and light sources were maintained as in experiment I. In contrast to experiment I, two light intensities were applied – 5 and 50 lux. The same egg parameters were recorded as in experiment I. The experimental data were analyzed as repeated measurements by JMP program. A two-factorial analysis of variance was performed and differences between means were assessed by Student's t-test.The experimental data were analyzed by the same method of experiment I.

RESULTS

Table 2. Mean (±SD) of egg quality its production on laying hens in response to different light sources (IL, FL, DL and BL).

Egg quality	BL	DL	FL	IL	p-value
Egg weight (g)	66.1±5.5	64.5±1.8	65.7±1.0	64.1±3.2	ns
Shell strength (N)	42.4±7.5	46.1±8.5	43.1±6.2	44.6±7.7	ns
Shell thickness (mm)	41.8 ± 1.8^{b}	43.2 ± 2.2^{a}	42.3 ± 2.4^{ab}	41.7 ± 2.2^{b}	0.01
Yolk weight (g)	16.9±1.2	16.8±1.4	16.3±1.6	16.2±3.2	ns
Yolk colour (fan score)	12.3 ± 0.6^{a}	12.0 ± 0.6^{b}	11.9 ± 0.6^{b}	11.9 ± 0.6^{b}	0.02
Shell deformation (*0.01 mm)	0.05±0.01	0.05±0.005	0.04±0.02	0.05±0.01	ns
Huagh unit (HU)	53.6 ± 16.9^{a}	42.6 ± 17.1^{b}	49.8 ± 16.2^{ab}	44.5 ± 16.4^{b}	0.04
% of Egg production	77.1±4.0	77.3±3.3	72.1±5.2	79.9±3.3	ns

*Means for the same parameter within same column with different letters are significantly different (P<0.05).

NB: IL = Incandescent light, FL = Fluorescent light, DL = Day light, BL = Blue light, ns = Non significant, g = Gram, mm = Melli meter, N. = Newton and SD = Stander division.

Table 3. Significance levels in egg quality and its production under different light sources with different intensities (5 & 50 lux).

	Huagh unit	Yolk colour	Yolk weight	Egg thickness	Egg deformation	Egg strength	Egg weight	% Egg production
	P-Value	P-Value	P-Value	P-Value	P-Value	P-Value	P-Value	P-Value
Light source (LS)	ns	ns	ns	ns	ns	ns	ns	ns
Light intensity (LI)	ns	ns	ns	ns	ns	ns	ns	ns
LS*LI	ns	ns	ns	ns	ns	ns	ns	ns

NB: LS = Light source and LI = Light intensity. Ns = Non significant

DISCUSSION

1.The effect of light source on egg production and quality

The effect of light on egg production and quality was represented in Table 2. The egg weight was higher under blue and fluorescent light (66.1±5.5 and 65.7±1, respectively) than incandescent and day light (64.1±3.2 and 64.5±1.8, respectively), but the observed difference do not reach significance. This result agrees with previous studies ***(5, 9, 10 , 11)***, on the other hand, this result disagrees with others recorded ***(12 , 13)***.

Eggshell strength was the highest under day light (46.1±8.5) and the lowest under blue light (42.4±7.5) without significantly difference between light sources. This result may be due to egg weight was the highest under blue light and the lowest under day light. The non significance in eggshell strength was consistent with previous studies ***(5 , 14)*** and disagreed with other recorded ***(13)***.

Eggshell thickness was significantly higher under day light (43.2 ± 2.2^{a}) than fluorescent, incandescent and blue light (42.3 ± 2.4^{ab}, 41.7 ± 2.2^{b} and 41.8 ± 1.8^{b}, respectively). This significance may be due to lower egg weight under day light, hence has reverse effect on shell thickness. Though, this result was disagreed with others recorded studies ***(5 , 14)***.

Although yolk weight was nearly equal in all light sources, but it was little higher under blue light (16.9±1.2), may be due to high weight of eggs. Moreover, light sources had significant effect (p=0.02) on yolk colour, whereas, it was significantly higher under blue light (12.3 ± 0.6^{a}) than incandescent, fluorescent and day light (11.9 ± 0.6^{b}, 11.9 ± 0.6^{b} and 12 ± 0.6^{b}, respectively). No statistical differences were recorded between incandescent and fluorescent light on yolk indexes and yolk colour tone ***(14)***.

No significant difference in shell deformation was found between different light sources. This result may be due to no differences in strength of egg shell between light sources. Haugh unit was higher under blue light (53.6 ± 16.9^{a}) with significantly difference (p=0.04) than fluorescent, incandescent and day light (49.8 ± 16.2^{ab}, 44.5 ± 16.4^{b} and 42.6 ± 17.1^{b}, respectively). This significance may be due to positive correlation between egg weight and its albumen. The albumen height decreases even as the egg weight and total amount of albumen increase and vice versa ***(15,16)***.

Concerning the total percentage of egg production as shown in Table 2, it was the highest under incandescent light (79.9±3.3) and the lowest under fluorescent light than (72.1±5.2), but the observed differences do not reach significance. Higher egg production in incandescent light has negative effects on egg weight. Several investigators reported that warm-white fluorescent light provided less stimulation to egg production in chicken than other light sources ***(1,3,5,10,17)***. Whilst, others reported different effect ***(4, 9 ,18)***.

2. The effect of light source and intensity on production of laying hens.

Results in Table 3 shown that the differences did not reach a significant levels in all parameters under different light sources, intensities and its interaction. No significant difference in egg quality is similar to that reported ***(3 , 19)***. While, it is not in agreement with that recorded previous in other studies ***(20-22)***. Egg production increased linearly as light intensity increased and significant improvement in egg production as light intensity was increased ***(23)***.

From the above mentioned results, the highest value for haugh unit, yellow colour and egg weight were determined under blue light. Light intensities and its interaction with light sources have no effects on egg quality and production.

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الملخص العربي

تأثير الضوء على جودة و أنتاج البيض للدجاج البياض

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تلعب الدواجن دورا هاما بين الصناعات الزراعية في كثير من البلدان. وإضافة إلى ذلك، منتجات الدواجن هي المصدر الرئيسي للبروتين الحيواني بالنسبة لمعظم الناس في جميع أنحاء العالم. وقد وجد في السنوات الأخيرة أن إنتاج الدواجن قد يستند إلى حد كبير على المعتقدات التقليدية،والرأي،وبحكم التجربة،والخبرة، وليس على الحقائق.لذا تم إجراء العديد من التجارب العلمية لتحديد بعض العوامل التي تؤثر على سلوكيات (بخاصة السلوكيات الشاذة مثل الافتراس و نقر الريش) وكفاءة الدجاج البياض. ومن المعروف أن أداء السلوكيات، وبخاصة السلوكيات الشاذة(الافتراس و نقر الريش)يعتبر من المؤشرات الهامة التي تحدد مدى رفاهية الطيور. تمت هذه الدراسة على الدجاج البياض لتحديد مدى تأثير مصادر الضوء المختلفة وشدتها على إنتاج البيض وجودته .ودلت النتائج على الأتي :زيادة سمك القشرة تحت الضوء اليومي زيادة معنوية عن باقي المصادر ,بالإضافة إلى ذلك زيادة الهيوت يونت وشدة اللون الأصفر في صفار البيض تحت الضوء الأزرق .و من ناحية أخرى أوضحت النتائج عن تأثر أنتاج البيض وعلامات الجودة في البيض تحت تأثير شدة الضوء أو تداخل الشدة مع مصادر الضوء المختلفة. .