



EFFECT OF LIGHT COLOR INTERMITTENT AND CONTINUOUS LIGHTING ON PRODUCTIVE PERFORMANCE DURING GROWTH PERIOD OF LOCAL IRAQI LAYER HENS.

Saja T. Othman¹*, Basil M. Ibrahim², Yusuf Mohammed Attia Maaeni³

¹Department of Animal Production, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq., saja.t@coagri.uobaghdad.edu.iq

²Department of Animal Production, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq, Basil.m@coagri.uobaghdad.edu.iq

³Department of poultry Research, Office of Agriculture Researcher, Ministry of Agriculture, Baghdad, Iraq. yusufkm780@gmail.com

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ABSTRACT

This study was conducted to determine effect of light colors intermittent and continuous lighting on productive performance for local Iraqi layer hens during growth period (12-16) weeks at Poultry Research Station / Agricultural Research Department of Ministry of Agriculture - Abu Ghraib during period from 21/06/2022 to 27/02/2023. The experimental treatments were divided into 5 treatments according to lighting system followed as follows: T1: C-control solar lighting with Continuous lighting treatment lighting system at Poultry Research Station (10 light: 14 darkness), T2: C+: solar lighting with intermittent lighting system for experiment 6 solar light: 7 darkness: 4 solar light: 7 darkness, T3: WL: white lighting with intermittent lighting system for experiment 6 white light: 7 darkness: 4 solar light: 7 darkness, T4: RL: red lighting with intermittent lighting system for experiment 6 red light: 7 darkness: 4 solar light: 7 Darkness, T5: UVR: UV lighting with intermittent lighting system for experiment 6 UV rays: 7 Darkness: 4 Solar light: 7 Darkness. Results showed a significant increase in amount of feed consumed for continuous lighting treatment, a significant increase ($p \leq 0.05$) for WL treatment at first egg weight and for UVR treatment at body weight at first egg, and a significant decrease for C- treatment at age at first egg. There were no significant differences in body weight during growth period, egg weight, and age at 50% production.

Keywords: body weight, egg weight, solar light, intermittent lighting, light colors

تأثير لون الضوء والاضاءة المتقطعة والمستمرة في الاداء الانتاجي في فترة النمو للدجاج البياض العراقي المحلي

سجى طريف عثمان¹، باسل محمد ابراهيم²، يوسف محمد عطيه³

¹باحث، قسم الانتاج الحيواني، كلية علوم الهندسة الزراعية، جامعة بغداد، بغداد، العراق، saja.t@coagri.uobaghdad.edu.iq

²استاذ، قسم الانتاج الحيواني، كلية علوم الهندسة الزراعية، جامعة بغداد، بغداد، العراق، Basil.m@coagri.uobaghdad.edu.iq

³باحث، قسم بحوث الدواجن، دائرة البحوث الزراعية، وزارة الزراعة، بغداد، العراق، yusufkm780@gmail.com

الخلاصة

أجريت هذه الدراسة لمعرفة تأثير الالوان الضوئية والاضاءة المتقطعة في الاداء الانتاجي للدجاج العراقي المحلي خلال فترة النمو (12-16) اسبوع في محطة ابحاث الدواجن / دائرة البحوث الزراعية التابعة لوزارة الزراعة - ابو غريب للمدة من 2022/06/21 الى 2023/02/27، قسمت معاملات التجربة الى 5 معاملات تجريبية حسب نظام

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الإضاءة المتبع كالتالي : T1 : C- : السيطرة (الإضاءة الشمسية) بنظام الإضاءة في محطة إبحاث الدواجن (10 إضاءة : 14 ظلام), T2 : C+: الإضاءة الشمسية بنظام الإضاءة المتقطعة للتجربة (6 ضوء شمسي:7 ظلام:4 ضوء شمسي:7 ظلام), T3 : WL : الإضاءة باللون الأبيض بنظام الإضاءة المتقطعة للتجربة (6 ضوء أبيض:7 ظلام:4 ضوء شمسي:7 ظلام), T4 : RL : الإضاءة باللون الأحمر بنظام الإضاءة المتقطعة للتجربة (6 ضوء أحمر:7 ظلام:4 ضوء شمسي:7 ظلام), T5 : UVR : الإضاءة بأشعة UV بنظام الإضاءة المتقطعة للتجربة (6 أشعة UV:7 ظلام:4 ضوء شمسي:7 ظلام), أظهرت النتائج ارتفاع معنوي في كمية العلف المستهلك لصالح معاملة الإضاءة المستمرة وارتفاع معنوي ($p \leq 0.05$) لمعاملة WL في وزن أول بيضة ولمعاملة (T4) UVR عند وزن الجسم عند أول بيضة وانخفاضاً معنوياً لمعاملة (T1) C- في العمر عند أول بيضة ولم تظهر فروق معنوية في وزن الجسم خلال مرحلة النمو ووزن البيضة والعمر عند 50% إنتاج.

الكلمات المفتاحية : وزن الجسم ، وزن البيض ، ضوء الشمس ، الأضاءة المتقطعة ، لون الضوء .

INTRODUCTION

In Asian countries, including Iraq, local layer hens are considered a valuable economic resource (Kaur *et al.*, 2024). Therefore, many recent studies have been conducted to increase this economic resource, including studies related to nutritional aspect that would improve physiological characteristics of poultry, as in study conducted by (Shanin and Hassanein, 2022). As well as studies conducted to improve presence of hatching eggs (Al-Hatheel and Ibrahim, 2022). Many studies have been conducted on environmental adaptation and ability to withstand harsh weather and climate fluctuations in region, which will affect the quantity and quality of production (Al-Ali *et al.*, 2022), which limits the feasibility of its economic investments and requires environmental or administrative solutions because production is directly affected by genetic and environmental factors (Razouqi *et al.*, 2022; Al-Hasani *et al.*, 2023). Light and its components are considered to be among the most important environmental factors affecting growth and production processes (Cassone and Kumar, 2022). This is because exposure to light signals stimulates the hypothalamic-thyroid-gonadal axis (Johnson, 2015), which is only activated by stimulating the conversion of T3 to T4. This in turn regulates the body's absorption of nutrients, initiates metabolic pathways, and produces energy (Mengesha *et al.*, 2022), so light plays a fundamental role among other environmental factors (Raabe *et al.*, 2024). In addition to improving the welfare of birds and reducing the effects of stressful situations, light and its components also integrate with immune system processes and behavioral changes (McPhee *et al.*, 2024). It has been shown that specific light wavelengths or colors can effectively control immune responses, growth, production, and behavioral expression (Sampaio *et al.*, 2024). According to Karal *et al.* (2024), despite all of the above, there are no known specific lighting systems or programs that meet the lighting needs of local chickens, leading to the best performance and production. Instead, commercial breed programs are the only ones that meet the lighting needs of local chickens in Iraq, and understanding these programs and systems will require specialized studies. Therefore, aim of this research is to investigate effects of light colors and intermittent lighting programs on local Iraqi layer hens growth and sexual maturity, Reproductive efficiency and productivity.



MATERIALS AND METHODS

This study was conducted at Poultry Research Station - Agricultural Research Department belongs to Ministry of Agriculture - Abu Ghraib for period from 21/06/2022 to 27/02/2023. The aim of this study is to demonstrate effect of light colors intermittent and continuous lighting during growth period in local Iraqi layer hens. The experiment involved 270 local brown chickens (225 hens and 45 roosters) that were purchased at 12 weeks of age from the Poultry Research Station. Prior to usage, the veterinary health department at the station performed the required examinations and immunizations on the animals. After sexing birds at six weeks of age, 15 females and 3 males were divided among the pins. Every pin in hall measured 180 by 260 centimeters. We used an automatic hanging circular watering can and a 10 kg/pin feeder. For each treatment, a different light color was used: solar, white, red, and ultraviolet UVR (with intermittent lighting system) and solar (with station's lighting system/continuous lighting system). Males were separated from females within same treatment during growth period. Birds were weighed individually at week 12 to show degrees of homogeneity among flock members. Treatments were divided into:

1. T1; C-: solar light (10 light: 14 dark)
2. T2; C+: 6 solar light - 7 darkness - 4 solar light: 7 darkness
3. T3; WL: 6 white light - 7 darkness - 4 solar light - 7 darkness
4. T4; RL: 6 red light - 7 darkness - 4 solar light - 7 darkness
5. T5; UVR: 6 ultraviolet - 7 darkness - 4 solar light - 7 darkness

Lighting Programs

Several colored LED lights were employed; wavelengths of various colors are as follows: sunlight and white light have a wavelength of 390-700 nm, red light has a wavelength of 635-700 nm, and ultraviolet light has a wavelength of 368 nm. Fly traps were employed in large enough quantities to produce rays of this kind with a light intensity comparable to the other parameters. The Lux Meter instrument measured it.

Table (1): Light-colored, intermittent and continuous lighting was used during experiment.

Age/weeks	Light and Darkness/Day	Total Hours/Day	lighting (Lux)
16-12	6 Color Light: 7 Darkness: 4 Light: 7 Darkness	10 light: 14 dark	
17	6.5 Color Light: 7 Darkness: 4 Light: 6.5 Darkness	10.5 light: 13.5 dark	10
17.5	7Color Light: 7 Darkness: 4 Light: 6 Darkness	11 light: 13 dark	10
18	7.5 Color Light: 7 Darkness: 4 Light: 5.5 Darkness	11.5 light: 12.5 dark	10
18.5	8 Color Light: 7 Darkness: 4 Light: 5 Darkness	12 light: 12 dark	10
19	8.5 Color Light: 7 Darkness: 4 Light: 4.5 Darkness	12.5 light: 11.5 dark	10
19.5	9 Color Light: 7 Darkness: 4 Light: 4 Darkness	13 light: 11 dark	10
20	9.5 Color Light: 6.5 Darkness: 4 Light: 4 Darkness	13.5 light: 10.5 dark	10
20.5	10 Color Light: 6 Darkness: 4 Light: 4 Darkness	14 light: 10 dark	10
21	10.5 Color Light: 5.5 Darkness: 4 Light: 4Darkness	14.5 light: 9.5 dark	10
21.5	11 Color Light: 5 Darkness: 4 Light: 4 Darkness	15 light: 9 dark	10



22	11.5 Color Light: 4.5 Darkness: 4 Light: 4 Darkness	15.5 light: 8.5 dark	10
22.5	12 Color Light: 4 Darkness: 4 Light: 4 Darkness	16 light: 8 dark	10
36-23	12 Color Light: 4 Darkness: 4 Light: 4 Darkness	16 light: 8 dark	10

Studied characteristics:

Productive performance at Growth phase

1. **Body Weight:** Birds were weighed individually at the age of 12 weeks (initial weight) for males and females to select uniformity birds by weight and weighing was done every two weeks using an electronic scale (**Al-Fayyad et al., 2011**)
2. **Feed intake:** amount of feed consumed by birds in each replicate was calculated weekly according to following equation:

Feed consumed (g) = feed provided during week – feed remaining at end of period (Naji and Ahmed 1985).

3. **Sexual maturity (Body weight, age, and egg weight when producing first egg):** Recording age when first egg was laid which is age of sexual maturity, measuring its weight with a sensitive scale, and measuring average body weight of each replicate at first egg.
4. **Age at 50% egg production and weight of first egg:** When production rate in replicate reached 50%, record age of sexual maturity in days for this replicate.

Statistical analysis of data was conducted using statistical analysis system (**SAS, 2002**) program to study influence of treatment on different characterization and according to significant comparative between means in **Duncan (1955)**.

RESULTS AND DISCUSSIONS

Body weight

Since there were no changes in average body weight during all age groups across five experimental treatments, Table (2) shows impact of light-coloured, intermittent and continuous lighting program on average body weight during growth phase. This suggests that growth performance was not adversely affected by light colors or intermittent lighting and that effect's neutrality might have resulted from modest growth pace. Either way, these out comes resemble those of **House et al. (2020)** shows that when broilers were exposed to LED-UV lights as contrary to white LED lamps, no appreciable changes in productivity metrics were seen. According to **Magee et al. (2022)**, broilers did not exhibit any reaction when lighting hours were reduced from 23 to 20 hours. Programs such as 24-hour light, 6-dark: 18-light, 16-dark: 8-light and 2-light: 4-dark did not have an impact on body performance (**Kim et al., 2022**). While intermittent systems outperformed continuous systems in terms of body weight rates, **Olanrewaju et al. (2019)** observed higher body weight rates under PS-LED compared to ICD. But according to **Ghanima et al. (2021)**, body performance was improved by continuous lighting for 22 hours as compared to intermittent lighting.

Table 2. Effect of light color intermittent and continuous lighting program on average body weight during growth phase (g/bird) (mean $\pm$ standard error).



Treatment	Age (week)			
	12	14	16	17
C-	788.90± 64.12	1055.69± 72.27	1200.69± 74.45	1249.81± 70.90
C+	830.33± 78.22	1040.03± 80.82	1232.53± 110.58	1286.55± 102.97
WL	818.21± 74.34	1024.91± 79.06	1172.82± 103.79	1222.64± 98.72
RL	843.26± 80.02	1040.56± 77.03	1206.89± 85.04	1261.30± 74.50
UVR	829.03± 47.92	1027.79± 49.60	1208.20± 85.49	1255.80± 73.31
Significance	N.S.	N.S.	N.S.	N.S.

C-: Solar light (10 light: 14 dark) C+: 6 solar light - 7 darkness - 4 solar light: 7 darkness WL: 6 white light - 7 darkness - 4 solar light - 7 darkness RL: 6 red light - 7 darkness - 4 solar light - 7 darkness UVR: 6 ultraviolet - 7 darkness - 4 solar light - 7 darkness. N.S.: No significant differences.

Feed intake

Table (3) shows results of effect of intermittent lighting with light color on feed intake in growth phase, C+, WL and RL treatments recorded a significant decrease when compared with the C- treatment at age of 12- 14 weeks, and UVR treatment did not differ at same age from rest of treatments, and WL, RL and UVR at age of 14-16 weeks recorded a significant decrease when compared with C- treatment, and C+ treatment differed from rest of treatments. At age of 16-17 weeks, WL and RL treatments recorded a significant decrease when compared to C- treatment, C+ and UVR treatments did not differ from rest of treatments. Regarding total duration, a highly significant decrease ($p \leq 0.01$) was observed for intermittent lighting treatments compared to continuous lighting treatment, although there was no significant difference in body weight between intermittent and continuous lighting treatments (Table 2). **Ghanima et al. (2021)** indicated that intermittent lighting program increases food intake rates and then metabolic levels, as intermittent lighting enhances productivity of thigh and drumstick (**Abreu et al., 2011**). **Zamanizad et al. (2019)** noted that colors white, blue and green did not affect food intake during growth stage. This was supported by **Sun et al. (2023)**, who indicated that light colors did not affect food intake rates for a period of 17 weeks. **Al-Zubaidi and Ibrahim (2021)** did not observe significant differences in food intake rates between continuous and intermittent lighting treatments.

**Table (3):** Effect of light color intermittent and continuous lighting program on feed intake during growth phase (g/bird) (mean $\pm$ standard error).

Treatment	Age (week)			
	14	16	17	Total
C-	754.22 $\pm$ 15.27a	827.89 $\pm$ 47.07a	476.04 $\pm$ 36.41a	2058.15 $\pm$ 122.05a
C+	695.78 $\pm$ 8.00b	723.75 $\pm$ 40.76 ab	382.13 $\pm$ 7.75abc	1801.66 $\pm$ 20.73b
WL	632.55 $\pm$ 8.00b	710.61 $\pm$ 21.98 b	321.16 $\pm$ 19.07c	1664.32 $\pm$ 103.61b
RL	678.09 $\pm$ 25.76bc	714.91 $\pm$ 9.53b	352.67 $\pm$ 8.40bc	1745.67 $\pm$ 72.83b
UVR	655.23 $\pm$ 46.62ab	669.44 $\pm$ 37.23 b	441.36 $\pm$ 51.43ab	1766.03 $\pm$ 7.26 b
Significance	*	*	*	**

C-: Solar light (10 light: 14 dark) C+: 6 solar light - 7 darkness - 4 solar light: 7 darkness WL: 6 white light - 7 darkness - 4 solar light - 7 darkness RL: 6 red light - 7 darkness - 4 solar light - 7 darkness UVR: 6 ultraviolet - 7 darkness - 4 solar light - 7 darkness. **: ($p \leq 0.01$)

Egg weight, body weight, and age of bird at sexual maturity

Results of effects of light color intermittent and continuous lighting program on weight of first egg, body weight at first egg and hen age at first egg shown in Table (4). A significant increase ($P < 0.05$) was found for WL treatment when compared with C- treatment in average weight of first egg, and no significant differences appeared with rest of treatments for same trait and a significant increase ($P < 0.05$) was observed for UVR treatment when compared with C-, C+, and WL treatments, and RL treatment did not differ from the aforementioned treatments. Regarding age of production of first egg (sexual maturity), a significant increase ($P < 0.05$) was observed for WL, RL, and UVR treatments when compared with the C-treatment, and C+ treatment did not show significant differences compared to all experimental treatments.

Table (4): Effect of light color intermittent and continuous lighting program on egg weight (g), body weight (g) and hen age at first egg (day) (mean $\pm$ standard error).

Treatment	Age (week)		
	first egg weight (g)	Body weight at first egg (g)	Age at first egg (day)
C-	28.16 $\pm$ 0.44b	1099.33 $\pm$ 21.45 b	126 $\pm$ 3.1 b
C+	31.00 $\pm$ 2.51ab	1087.33 $\pm$ 30.11 b	132.33 $\pm$ 2.72 ab
WL	36.00 $\pm$ 1.15a	1102.67 $\pm$ 29.98 b	139.33 $\pm$ 2.18 a
RL	29.33 $\pm$ 3.33ab	1160.33 $\pm$ 43.41 ab	137 $\pm$ 4.50 a
UVR	34.00 $\pm$ 1.15ab	1201.00 $\pm$ 3.78 a	142.33 $\pm$ 0.66 a
Significance	*	*	*

C-: Solar light (16 light: 8 dark) C+: 12 solar light - 4 darkness - 4 solar light: 4 darkness WL: 12 white light - 4 darkness - 4 solar light - 4 darkness RL: 12 red light - 4 darkness - 4 solar light - 4 darkness UVR: 12 ultraviolet - 4 darkness - 4 solar light - 4 darkness. * ($p \leq 0.05$)



Ekinci et al. (2023) indicated a positive significant correlation between body weight and weight of eggs produced, this was proved by **Yenilmez and Atay (2023)** when they indicated that body weight at sexual maturity can affect productive performance of laying hens. **Biyatmoko (2014)** explained that relationship between the light colors yellow, red, blue, and green and intensity of light on sexual maturity in Alabio ducks showed a significant effect on the early laying of first egg, and that blue color accelerated sexual maturity compared to other three colors green, red and yellow.

Egg weight and age at 50% of egg production

From Table (5), we can see there are no significant differences between all treatments in characteristics of egg weight and age at 50% of egg production these results are consistent with **Sun et al. (2023)**, who demonstrated that light colors had no effect on age at 50% egg production in Beijing-You chickens. While **Farghly (2023)** indicated that lighting program had no effect on age at 50% egg production. It did not differ from what was stated by **Watanabe et al. (2024)**, as it showed that there were no significant differences in age at 50% egg production under influence of continuous and intermittent lighting programs. The results of this study were in agreement with **Liu et al. (2018)**, who showed that parameters of his light experiment, which were dim red PS-LED (poultry-specific LED) 49% red light and white fluorescent light 19% FL red light did not give any difference in age at sexual maturity. The results of this study did not agree with the results of the study conducted by **Zhang et al. (2009)**, who observed significant differences in average egg weight at 50% production for Beijing-You chickens and Lhomann chickens under effect of continuous and intermittent lighting, which proved that lighting system and strain have an effect on egg quality.

Table (5): Effect of light color and intermittent and continuous lighting program on egg weight (g) and hen age at 50% of egg production (day) (mean $\pm$ standard error).

Treatment	Age (week)	
	Egg weight (g) at 50% production	Age (days) at 50% production
C-	33.77 $\pm$ 1.75	152.66 $\pm$ 2.02
C+	36.52 $\pm$ 3.12	155.33 $\pm$ 2.96
WL	34.41 $\pm$ 0.91	156 $\pm$ 0.57
RL	35.59 $\pm$ 1.45	155 $\pm$ 2.64
UVR	34.75 $\pm$ 2.75	158 $\pm$ 1.00
Significance	N S	N S

C-: Solar light (16 light: 8 dark) C+: 12 solar light - 4 darkness - 4 solar light: 4 darkness WL: 12 white light - 4 darkness - 4 solar light - 4 darkness RL: 12 red light - 4 darkness - 4 solar light - 4 darkness UVR: 12 ultraviolet - 4 darkness - 4 solar light - 4 darkness. N.S.: No significant differences.

CONCLUSION

The use of intermittent lighting system and different lighting colors on poultry farm during growth period led to a significant increase in feed consumption, Body weight at first egg (g) and age at first egg (day) and thus contributed to improving productive performance of local Iraqi layer hens.



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