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المجلة العراقية لبحوث السوق
وحماية المستهلك

THE EFFECT OF LONG AND SHORT LIGHTING SYSTEMS AND THE WAVELENGTH OF LIGHT COLORS ON THE CARCASS CHARACTERISTICS OF MALES BROILERS AND THE RELATIVE WEIGHTS OF SOME ORGANS OF THE DIGESTIVE AND IMMUNE SYSTEMS

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ABSTRACT

The aim of this study was to evaluate the effects of wavelength of light and duration of illumination on the growth characteristics of broiler chickens of the Ross 308 line. at the Ministry of Agriculture - Department of Agricultural Research - Livestock Research Division - Poultry Research Station. three hundred one day of age male broiler chicks were used, divided randomly into 5 groups with replicates (20 birds per replicate). Treatments consisted in a: negative control treatment (C-); Long illumination, 23 hours of light (white): 1 hour of dark; Positive control treatment (C+);short illumination, 20 hours of light (white) with 4 hours of darkness; other treatments GL, RL, and BL, 20 hours of light with 4 hours of darkness (green, red, and blue, respectively). body weight, carcass weight, percentage of dressing (with and without internal organs), relative weights of primary and secondary carcass parts, abdominal fat and relative weights of certain organs of the digestive and immune systems were not found to differ significantly between treatments.

Keywords: broilers Ross 308, light color, dressing percentage, carcass cuts.

[*] **This article is taken from the first researcher's master's thesis.**

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تأثير انظمة الاضاءة الطويلة والقصيرة والطول الموجي لألوان الضوء في صفات الذبيحة لذكور لفروج اللحم والاوزان النسبية لبعض اعضاء الجهاز الهضمي والمناعي

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الخلاصة

اجريت هذه الدراسة لتقييم تأثير مدة الاضاءة والطول الموجي للضوء في خصائص النمو لفروج اللحم سلالة روز 308 في وزارة الزراعة - دائرة البحوث الزراعية - قسم ابحاث الثروة الحيوانية - محطة ابحاث الدواجن، استخدم 300 فرخ ذكر من فروج اللحم بعمر يوم واحد ، وزعت عشوائياً على خمسة معاملات بواقع ثلاث مكررات/ معاملة (20 طيراً لكل مكرر)، وكانت المعاملات كالاتي:- معاملة السيطرة السالبة C^-: الاضاءة الطويلة (23 ساعة ضوء (لون الضوء أبيض): 1ساعة ظلام) ومعاملة السيطرة الموجبة C^+: الاضاءة القصيرة(20 ساعة ضوء (لون الضوء أبيض):4 ساعة ظلام) و المعاملات الاخرى GL وRL وBL (20 ساعة ضوء :4 ساعة ظلام (لون الضوء أخضر و أحمر و أزرق) على التوالي.اشارت النتائج الى عدم وجود فروق معنوية في وزن الجسم الحي وكذلك في وزن الذبيحة ونسبة التصافي مع الاحشاء القابلة للأكل وبدونها وفي الاوزان النسبية لقطعيات الذبيحة الرئيسية والثانوية ودهن البطن وكذلك عدم وجود فروق معنوية في الاوزان النسبية لبعض اعضاء الجهاز الهضمي والمناعي بين جميع المعاملات.

الكلمات المفتاحية : فروج اللحم روز308 ، لون الضوء ، نسبة التصافي، قطعيات الذبيحة.

INTRODUCTION

Lighting is one of several environmental elements that influence the rearing of broiler chickens. Poultry production is highly dependent on light, and different lighting schedules have the potential to affect productivity, health and behavior. Photoperiods (the length and distribution of light in a 24-hour period), intensity, and wavelength (the color of light) are the three basic components of lighting systems; these components can affect different areas of broiler production **(Akyüz & Onbaşilar, 2018)**. Important processes such as energy conservation, tissue development and repair, and behavioral and neurological functions are controlled by light **(Forslind *et al.*, 2021)**.

In modern chicken breeding, artificial lighting is used to increase performance in the late phase of production. The development and production of broiler chickens can be improved and the growth of muscle fibers can be effectively stimulated by light-emitting diode (LED) lighting, which is an approximation of daylight **(Cao *et al.*, 2008; Mohamed *et al.*, 2014)**. The number of dark hours is determined by the photoperiod, while the length of the light period is determined by the photoperiod. The productivity of broiler chicks is strongly influenced by the lighting systems used in poultry production, regardless of whether these are continuous or intermittent. Their feed intake is strongly influenced by the darkness they experience during rearing, causing them to lose weight. As **Blokhuis (1984), Campo & Davila. (2002) ; Fidan *et al.* (2017)** found, birds' stress levels and general health can be improved if they are given sufficient rest periods.

Research has shown that broiler chickens need at least four hours of sleep per day. Stress levels could increase due to reduced feed intake as a result of prolonged darkness during the day **(Pandey, 2019)**. From incubation to hatching, light is an essential part of a chick's life cycle. According to **Yang *et al.* (2016) ; Soliman & El-Sabrout (2020)**, the health, behavior, feed intake, production (body weight) and overall well-being of birds are improved by implementing the following light program, resulting in a more profitable economic return.

Green light has a wavelength of 545-575 nm, blue and violet light has a wavelength of 400-480 nm and orange and red light has a wavelength of 580-700 nm. The light visible to birds has a wavelength between 380 and 740 nanometers, which is in the middle of the invisible infrared and ultraviolet spectrum **(Parvin *et al.*, 2014)**. Studies by **Rosenboim *et al.* (2004) ; Mohamed *et al.* (2017)** showed that broiler chickens exposed to short-wavelength light, particularly green (560 nm) and blue (460 nm), significantly increased their body weight. When birds are exposed to light, it releases hormones necessary for their growth, maturation and reproduction. According to studies by **Deep *et al.* (2012); Yang *et al.* (2016); Olanrewaju *et al.* (2016)**, the production of melatonin and the circadian clocks of birds mediate this control. According to many studies **(Parvin *et al.*, 2014; Elkomy *et al.*, 2019; Soliman & El-Sabrout, 2020)**, the wavelength and intensity of light are two influential parameters that strongly affect poultry behavior and performance.

In studies by **Mohamed *et al.* (2017); Rozenboim *et al.* (2004)**, it was shown that broilers exposed to short wavelengths of light such as green (560 nm) and blue (460 nm) showed a significant increase in body weight. According to many studies **(Parvin *et al.*, 2014; Elkomy *et al.*, 2019; Soliman & El-Sabrout, 2020)**, the two most important elements that influence poultry behavior and production are the wavelength and intensity of light.

According to a study by **Urmila *et al.* (2022)**, different light colours affect different aspects of the carcasses of broilers. Here we see that green light at 565 nm had the highest percentage of body weight and gutted carcass weight, while white light at 650 nm had the lowest percentage of carcass weight. In broilers kept under different light conditions (red, green, blue and white), the main components, carcass weight and percentage of belly fat did not change significantly, according to the study by (**Leigh *et al.* ,2017)**.

The mortality rate does not change until five weeks of age, and several studies have proven that wavelength has no effect on this **(Rogers *et al.*, 2015)**. because the mortality rate is higher when broilers are raised with white diseases compared to blue colours **(Franco *et al.*, 2022)**. The aim of this study is therefore to investigate the effects of lighting duration and wavelength on mortality rates, carcass characteristics and the relative masses of different digestive and immune system organs.

MATERIALS AND METHODS

Experimental design:

This study was conducted at the Poultry Research Station of the Ministry of Agriculture, which is part of the Department of Livestock/Agricultural Research. Within a hall of 36 x 10 x 2.5 meters, there were five different sections. Each section measured 7 x 10 x 2.5 meters. The different areas were separated by a thick, black, opaque tarpaulin, which was double-layered to ensure that each area was completely dark and did not let any light in.

To determine the effects of long and short lighting programs with different wavelengths, three hundred one-day-old male broiler chicks of the Ross 308 breed with an average weight of 39.5 grams were used in this study. The chicks came from Al-Amiri hatchery in the Taji area near Baghdad and were reared on the floor in sawdust. The chicks were divided among the five treatments: twenty chicks per replicate, with three replicates per treatment: the first group, designated C-, was treated with white light for 23 hours and darkness for 1 hour. The second group, labeled C+, was exposed to 20 hours of white light and 4 hours of darkness. The third, fourth and fifth treatments, labeled GL, RL and BL, were also performed. Green, red and blue light are the three primary colors of light.

Luminaires from Maha (AL-MAHA) were used for the study. Each luminaire has a 9-watt bulb. In the first week, all experimental treatments were illuminated with 30–40 lux light. Thereafter, the lighting intensity was reduced to twenty lux for the last two weeks. The Ross 308 breeding guide recommends a light intensity of 5-10 lux for the experiment. This light intensity was measured with a digital luxmeter from DrMeter (LX1010B).

NUTRITIONAL DIETS

The birds were fed ad libitum, using pellet feed. The birds were offered three different types of food depending on their age: Starter, Grower and Finisher. These feeds were to contain 3000, 3100 or 3200 kilocalories of energy per kg of feed. The crude protein content should be 22.5%, 21% and 19% for the starter. Different diameters depending on the quality of the above-mentioned relations, grower and finisher feeds respectively (Table 1).

Table (1): Chemical composition of the diets used during the study.

Energy represented (kcal/kg feed)	**Starter (1-11 days)**	**Grower (12-25 days)**	**finisher (26 - 35 days)**
	3000	3100	3200
Crude protein (%)	22.5	21	19
Calcium	0.95	0.87	0.8
Phosphorus	0.48	0.43	0.4
Lysine	1.28	1.15	1.03
Methionine-Cysteine	0.95	0.87	0.8
Threonine	0.86	0.77	0.69
Valine	0.96	0.87	0.78
Sodium	0.16	0.16	0.16
Chlorine	0.21	0.21	0.21

INDICATORS

1) Mortality rate:

The formula presented by **Al-Zubaidi (1986)** was used to calculate the mortality rate.

$$\text{Mortality \%} = \frac{\text{Deaths}}{\text{Number of birds}} \times 100$$

2) characteristics of the carcass:

According to the following equations referred to by **Al-Fayad & Naji (1989)**

- Purity ratio = carcass weight / live weight * 100.
- Percentage of purification within internal organs = carcass weight + internal organs (including heart, liver, and gizzard) / live weight* 100.
- Relative weights of carcass pieces (thigh, leg, chest, back, neck, wing) = weight of pieces / on carcass weight * 100.

3) Fat percentage = fat weight / live weight * 100.

4) The relative weight of some organs of the digestive and immune system (spleen, ventricle, small intestine, fibrous gland):-

-Organ ratio = organ weight / carcass weight * 100.

STATISTICAL ANALYSIS

The data used in this study were analyzed using **SAS (2012)** statistical software and **Duncan's (1955)** multinomial test was used to compare means for significant differences.

RESULTS

Mortality rate:

The use of a long or short lighting system or different wavelengths of light colors had no significant effect on the mortality rate for 35 days, as shown in Table 2.

Table (2): Effect of long and short lighting systems and the wavelengths of colored light on the rate (%) of 35-day-old broilers (mean ± standard error)

Treatments	Mortality (%)					
	1 – 7 days	8 – 14 days	15 – 21 days	22 – 28 days	29 – 35 days	1 – 35 days
C-	0.00±0.00	0.00±0.00	0.00±0.00	3.33±1.67	3.33±1.67	6.67±3.33
C+	0.00±0.00	0.00±0.00	0.00±0.00	5.00±2.89	5.00±2.89	10.00±5.00
GL	0.00±0.00	0.00±0.00	0.00±0.00	1.67±1.67	3.33±1.67	5.00±2.89
RL	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	3.33±1.67	3.33±1.67
BL	0.00±0.00	0.00±0.00	0.00±0.00	1.67±1.67	3.33±1.67	5.00±2.89
Sig.	N.S	N.S	N.S	N.S	N.S	N.S

The negative controls (C-) were as follows: long light: 23 hours of light (white): 1 hour of darkness; the C+ positive control: short light: 20 hours of light (white): 4 hours of darkness; and the GL, RL, and BL: 20 hours of light:4 hours of dark (green, red, and blue, respectively NS: No significant differences.

CARCASS CHARACTERISTICS

Dressing percentage

There were no significant differences in average live body weight and average carcass weight between the five treatments, as shown in Table 3. The percentage of dressing with and without internal organs is the same for all treatment combinations.

Table (3): Effect of long and short lighting systems and the wavelengths of colored light on the live body weight, carcass weight and Dressing percentage (%) of 35-day-old broilers (mean ± standard error).

Treatments	Live body weight	Carcass weight	Dressing percentage without internal organs	Dressing percentage with internal organs
C-	2403.21 ± 84.21	1815.40 ± 63.62	75.54 ± 0.00	79.24 ± 0.12
C+	2527.67 ± 79.83	1900.95 ± 71.26	75.15 ± 0.79	78.52 ± 0.78
GL	2621.22 ± 48.68	1983.74 ± 36.84	75.68 ± 0.00	79.25 ± 0.08
RL	2424.45 ± 89.86	1786.34 ± 66.21	73.68 ± 0.00	77.11 ± 0.14
BL	2479.40 ± 77.35	1871.45 ± 58.38	75.48 ± 0.00	79.39 ± 0.12
Sig.	NS	NS	NS	NS

The negative controls (C-) were as follows: long light: 23 hours of light (white): 1 hour of darkness; the C+ positive control: short light: 20 hours of light (white): 4 hours of darkness; and the GL, RL, and BL: 20 hours of light:4 hours of dark (green, red, and blue, respectively NS: No significant differences.

Relative weights of main and secondary carcass cuts:

Table 4.5 shows the results of statistical analysis of the relative weights of the cleaned main and secondary carcass parts. No significant differences appeared between the experimental treatments in the relative weights of the parts of the cleaner, thigh, chest, neck, wings, and back.

Table (4). Effect of long and short lighting systems and the wavelengths of colored light on Relative weights of main carcass cuts (%) of 35-day-old broilers (mean ± standard error).

Treatments	Breast (%)	Thigh (%)	drummer's stick (%)
C-	38.75 ± 0.97	15.68 ± 0.44	13.06 ± 0.27
C+	39.65 ± 0.42	14.70 ± 0.46	13.03 ± 0.22
GL	39.42 ± 0.86	15.06 ± 0.26	13.19 ± 0.29
RL	39.22 ± 0.65	15.82 ± 0.55	13.16 ± 0.44
BL	38.39 ±1.00	14.73 ±0.35	13.69 ±0.44
Sig.	**NS**	**NS**	**NS**

The negative controls (C-) were as follows: long light: 23 hours of light (white): 1 hour of darkness; the C+ positive control: short light: 20 hours of light (white): 4 hours of darkness; and the GL, RL, and BL: 20 hours of light:4 hours of dark (green, red, and blue, respectively NS: No significant differences.

Table (5): Effect of long and short lighting systems and the wavelengths of colored light on Relative weights of secondary carcass cuts (%) of 35-day-old broilers (mean ± standard error).

Treatments	Back (%)	Wings (%)	Neck (%)
C-	16.69±0.37	9.25±0.28	5.89±0.40
C+	16.50±0.38	9.24±0.16	6.36±0.41
GL	16.62±0.41	8.99±0.24	6.18±0.48
RL	15.84±0.63	9.59±0.19	5.97±0.29
BL	17.27±0.82	9.05±0.21	6.30±0.23
Sig.	**NS**	**NS**	**NS**

The negative controls (C-) were as follows: long light: 23 hours of light (white): 1 hour of darkness; the C+ positive control: short light: 20 hours of light (white): 4 hours of darkness; and the GL, RL, and BL: 20 hours of light:4 hours of dark (green, red, and blue, respectively NS: No significant differences.

Relative weights of internal organs:

Tables 6 and 7 show that the relative weights of the edible internal organs (heart, liver and gizzard), spleen, small intestine, proventriculus, Fabricius gland and percentage of abdominal fat were not significantly affected by lighting systems and light colors.

Table (6): Effect of long and short lighting systems and the wavelengths of colored light on Relative weights of internal organs (heart, liver, and gizzard; %) of 35-day-old broilers (mean ± standard error).

Treatments	heart	liver	gizzard
C-	0.52 ±0.03	2.22 ±0.06	0.96 ±0.06
C+	0.49 ±0.01	2.10 ±0.10	0.77 ±0.04
GL	0.49 ±0.03	2.20 ±0.08	0.88 ±0.05
RL	0.48 ±0.02	2.17 ±0.13	0.77 ±0.04
BL	0.52 ±0.02	2.45 ±0.14	0.94 ±0.05
Sig.	**NS**	**NS**	**NS**

The negative controls (C-) were as follows: long light: 23 hours of light (white): 1 hour of darkness; the C+ positive control: short light: 20 hours of light (white): 4 hours of darkness; and the GL, RL, and BL: 20 hours of light:4 hours of dark (green, red, and blue, respectively NS: No significant differences.

Table (7): Effect of long and short lighting systems and the wavelengths of colored light on Relative weights of some digestive system organs, some immune organs, and abdominal fat (%) of 35-day-old broilers (mean ± standard error).

Treatments	Spleen (%)	Small intestine (%)	Fabricius gland (%)	Proventriculus (%)	abdominal fat (%)
C-	0.12 ± 0.02	4.51 ± 0.22	0.12 ± 0.01	0.32±0.04	1.19 ± 0.20
C+	0.10 ± 0.01	3.83 ± 0.21	0.14 ± 0.02	0.39±0.04	0.86 ± 0.10
GL	0.09 ± 0.01	4.07 ± 0.23	0.13 ± 0.01	0.37±0.03	0.86 ± 0.13
RL	0.09 ± 0.01	4.01 ± 0.25	0.15 ± 0.02	0.41±0.03	1.04 ± 0.08
BL	0.11 ± 0.01	3.94 ± 0.09	0.15 ± 0.01	0.45±0.06	1.17 ± 0.13
Sig.	**NS**	**NS**	**NS**	**NS**	**NS**

The negative controls (C-) were as follows: long light: 23 hours of light (white): 1 hour of darkness; the C+ positive control: short light: 20 hours of light (white): 4 hours of darkness; and the GL, RL, and BL: 20 hours of light:4 hours of dark (green, red, and blue, respectively NS: No significant differences.

DISCUSSION

The results demonstrated that there were no statistically significant differences in the use of long and short lighting systems and the wavelength of light colors. This is consistent with studies that found no statistically significant differences in wavelength using lighting intensity and degree of light (wavelengths of light). As mentioned by **Franco *et al.* (2022); Deep *et al.* (2010)**. The results of this experiment confirmed the results of **Cao *et al.* (2012); Kumar *et al.* (2017); Urmila *et al.* (2022)**, who did not find significant differences in live weight, carcass weight, and draining percentage when using colored lighting. The average live body weight, carcass weight, and dressing percentage are all related to each other, as **Al-Fayad & Naji (1989)** pointed out. The average relative weights of the main and secondary carcass parts of 35-day-old broilers were not affected by lighting systems or different wavelengths of light. Green, red, and blue light did not significantly affect broiler carcass production; This result is consistent with other research that found no effect of photoperiod on primary or secondary cuts or carcass weight **(Fidan *et al.*, 2017; Kim *et al.*, 2022)**. The results of this study on the average relative weights of edible internal organs (heart, liver, and gizzard) and digestive organs (glandular stomach and small intestine) are consistent with the results of previous studies **(Mosa *et al.*, 2015; Urmila *et al.*, 2022; Reyad *et al.*, 2023)**. Specifically, there were no significant differences in these characteristics when broilers were raised under different colored lighting (red, green, and blue combined).

CONCLUSIONS

We conclude from the experiment that different wavelengths of light (color of light) and long and short lighting systems do not have a negative effect on the characteristics of the carcass.

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