Effect of photo stimulation of broiler hatching eggs during the hatching period on the productive performance

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Abstract:

The experiment aimed to study the effect of photo stimulation of broiler (ROSS 308) eggs during the hatching period on the productive performance of hatched chicks during the rearing phase. The eggs were incubated from April 20, 2024, to May 10, 2024, at the Al-Anwar Poultry Company hatchery in Babil Governorate. 900 eggs were laid and divided into three treatments, each containing 300 eggs divided in four replicates. Each replicate contained 75 eggs . The treatments were as follows: Treatment 1: The control treatment was a continuous dark lighting system. Treatment 2: The lighting system was 12 hours of light to 12 hours of darkness. Treatment 3: The lighting system was 18 hours of light to 6 hours of darkness.. The photo stimulation process continued until hatching was complete. The chicks were then transferred to the experimental field of the Al-Anwar Company in Babil Governorate for a rearing experiment. 240 one-day-old chicks were tested from May 11, 2024, to June 15, 2024, with 80 chicks per treatment randomly distributed into four replicates (pens). The results showed no significant differences ($P \leq 0.05$) in body weight, weight gain, feed consumption, and feed conversion ratio of broiler chickens across the three treatments.

Key wards: photo stimulation , hatching, broiler

Introduction

The incubation stage is one of the most important stages in a chick's life, as the environment to which the embryo is exposed during embryonic development has long-term effects on its future growth and overall well-being (1). Therefore, the incubation and rearing periods have gained increasing importance in recent years, as these two stages represent half of the entire production cycle. Furthermore, artificial incubators have played a key role in the development of the commercial poultry industry by contributing to the production of large numbers of newly hatched chicks (DOCs.(

Compared to natural hatching, artificial incubation allows for uniform production with an increased hatchability rate (2). Scientists are seeking to introduce interventions in incubation conditions to improve hatchability, embryonic growth, and the overall response of chicks to the new environment. This is achieved through epigenetic modifications induced by the introduction of specific stimuli during the embryonic development stage (3). Some epigenetic changes during the embryonic stage have contributed to the production of more efficient birds, adapted to environmental temperatures (4.(

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Environmental changes significantly affect the production and welfare of poultry (5, 6), and light stimulation during the incubation period is a recent research trend in poultry science. Numerous studies (7, 8, 9) have shown that light stimulation can affect the hatching window, hatchability, hatchability of fertile eggs, chick quality, post-hatching performance, and the bird's response to stress.

We know that light plays a critical role in embryonic development. (10) indicated that providing light during the incubation period can help birds adapt to the environment after hatching (11), as the embryo begins to respond to light from the second day of incubation (12). (7) demonstrated that lighting eggs during incubation improves aspects of the bird's animal welfare (1) and enhances overall economic aspects. It has been observed that the use of LED lighting during incubation reduces stress levels in chicks (7) and helps newly hatched chicks start life with less fear (13). This improved response to stress is attributed to changes in hormone levels and the consistency of circadian rhythms (8). Permanent darkness or the absence of light during artificial incubation appears to act as a stress factor on developing embryos, hindering the hatching process and negatively impacting post-hatch performance. Although there is extensive data on the effect of complete light or complete darkness during incubation on hatching outcomes, the effect of light stimulation during different time periods on hatching outcomes and post-hatch performance remains unclear and warrants further research. The aim of the current study was to evaluate the effect of different time periods of light stimulation (0 hours, 12 hours, and 18 hours per day) during hatching on the productive performance of chicks hatched from eggs incubated under these light periods.

Materials and Methods

This experiment began on April 20, 2024, and May 10, 2024, when 900 eggs were introduced into the hatchery of Al-Anwar Poultry Company in Babil Governorate, Iraq. They were distributed into three treatments, each containing 300 eggs, distributed into four replicates (75 eggs per replicate). The eggs used in the experiment were of the Dutch Rose 308 strain. The treatments were as follows: Treatment 1: Control treatment. Lighting system: continuous darkness.

Treatment 2: Lighting system: 12 hours of light and 12 hours of darkness.

Treatment 3: Lighting system: 18 hours of light and 6 hours of darkness.

The lighting equipment used for photosynthesis was LED candles from Next Light, a Chinese brand, with a power of 60 watts and a light intensity ranging from 360-400 lux. Light intensity was measured using a German Amprobe LM-120 light meter. Production. Candles were placed inside the hatching machines and the lighting was directed vertically on the eggs for the photo stimulation treatments. To ensure continuous electricity supply, a continuous power supply (UPS) was equipped, produced by Farber, a Chinese brand, with a capacity of 360 watts. A flash timer was also connected between the power source and the photo stimulation system from Chant, a Chinese brand, to regulate the lighting hours for the second and third treatments. The photo stimulation process continued until the hatching process was completed. After that, the hatched chicks of three treatments were weighed and their safety and activity inside the hatchery were ensured before being transferred to the farm for research experiments of Al-Anwar Company in Babil Governorate to start the breeding experiment on 5/11/2024 and ended on 6/15/2024. 240 day-old chicks were used and randomly distributed into three treatments, with 80 chicks per treatment, which included four replicates (Pens) of 20 chicks per replicate in the form of iron cages measuring 1 m wide and 1.5 m long. The lighting system in the field was continuous for 24 hours per day, while maintaining ideal rearing conditions,

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including providing suitable environmental conditions (temperature, humidity, ventilation), as well as providing feed and clean, contaminated drinking water. All chicks were freely fed on a starter diet for 10-1 days of age, a grower diet for 11-24 days, and a finisher diet for 25-35 days, as shown in Table (1). Feed values were calculated according to NRC (1994). (14) The Statistical Analysis System -SAS (2018) (15) statistical program was used to analyze the data to study the effect of various factors on the traits studied in the two experiments, according to a completely randomized design (CRD). Significant differences between means were compared using a multiple-nomial test (16.(

Table (1) Components of broiler feed with calculated chemical composition

Feed components	Diets		
	Starter (1-10) days	Growth (11-21) days	Finsher (22-35) days
Yellow Corn	52.8	58.65	62.4
Wheat	10	10	10
Soybean Meal (48% Protein)	29.8	24	20.5
Protein Concentrate*	5	5	5
Sunflower Oil	0.3	0.3	0.3
Limestone	1.14	1.21	1.22
Dicalcium Phosphate (DCP)	0.5	0.35	0.2
Methionine	0.17	0.17	0.13
Lysine	0.19	0.22	0.15
Salt	0.1	0.1	0.1
Total	100	100	100
Computed chemical analysis			
Crude Protein(%)	21.94	19.66	18.29
M E (kcal/kg Feed)	2940	2995	3035
Lysine(%)	1.39	1.26	1.11
Crude Fiber(%)	2..73	2.64	2.58
Calcium(%)	0.9	0.88	0.83
Methionine + Cysteine(%)	1.03	0.97	0.9
Available Phosphorus(%)	0.44	0.41	0.38

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Protein concentrate: The Dutch-made Brocon brand used. Each kg contains: 40% crude protein, 5% fat, 2.20% fiber, 5% calcium, 4.68% available phosphorus, 3.85% lysine, 4.12% methionine + cysteine, 0.42% tryptophan, 2017 kcal/kg metabolizable energy, 1.70% threonine, and contains a mixture of vitamins and trace minerals that meet the bird's need for these elements. ** Based on the chemical analysis of the feed according to the NRC (1994(

Results and Dissection

Table (2) shows the effect of photo stimulation treatments on broiler ROSS 308 hatching eggs during the hatching period on live body weight. The table shows no significant difference in the initial weight of hatched chicks from the three photo stimulation treatments (T1, T2, and T3). As for the body weight of the chicks in the first week of life, the table shows a significant superiority (P≤0.05) for T2 compared to the control treatment T1. There is no significant difference between treatments T2 and T1, and T3 for rearing. It is noted that there is no significant difference in the average body weight between (T1, T2, and T3) in the second, third, fourth, and fifth weeks .

Table 2: Effect of photostimulation of broiler hatching eggs during the hatching period on the average live body weight of hatched chicks.

Treatments	Age					
	WK1	WK2	WK3	WK4	WK5	Total
T1	0.93 ±0.02b	1.12 ±0.04	1.886 ±0.06	2.56 ±0.12	2.91 ±0.19	1.32 ±0.03
T2	0.96 0.00 ±a	1.17 ±0.02	1.895 ±0.05	2.53 ±0.06	2.91 ±0.15	1.34 ±0.02
T3	0.96 ±0.02 ab	1.16 ±0.06	1.97 ±0.07	2.50 ±0.14	2.86 ±0.19	1.33 ±0.02

T1 (Control): Continuous darkness T2: 12 hours of light and 12 hours of darkness T3: 18 hours of light and 6 hours of darkness. Different letters within each column mean a significant difference (p≤0.05

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Table (3) shows the effect of photo stimulation of ROSS 308 broiler hatching eggs during the hatching period on the weekly weight gain rate. We note a significant difference (P≤0.05) in the body weight gain rate of T2 broiler chickens in the first week compared to T1, the control treatment. Treatments T1 and T2 did not differ significantly from those of T3. The table also shows no significant difference in the weight gain rate for the second, third, fourth, and fifth weeks, in addition to the total weight gain between the three treatments (T1, T2, and T3). The results of our current study are similar to those of (7, 17, 18, 19), who indicated that light stimulation during incubation had no significant effect on average live body weight and weekly weight gain. The results of our current study differ from those of (20, 22, 23), who indicated that light

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stimulation during incubation had a significant effect on average body weight and weight gain

Table 3: Effect of photostimulation of broiler hatching eggs during the hatching period on the weekly weight gain rate of hatched chicks.

Treatments	Age					
	WK1	**WK2**	**WK3**	**WK4**	**WK5**	**Total**
T1	148.46 ±4.52b	324.45 ±3.65	493.92 ±13.44	571.10 ±17.81	652.26 ±58.28	2190.20 ±75.68
T2	162.48 ± 2.30a	328.07 ±3.71	498.77 ±2.40	576.96 ±22.13	622.10 ±38.81	2188.40 ±13.65
T3	156.11 ±3.62ab	324.02 ±10.34	492.01 ±11.84	564.58 ±19.43	641.97 ±31.50	2178.69 ±43.99

T1 (Control): Continuous darkness T2: 12 hours of light and 12 hours of darkness T3: 18 hours of light and 6 hours of darkness. Different letters within each column mean a significant difference (p≤0.05.(

Table (4) indicates the effect of photo stimulation treatments on ROSS 308 broiler hatching eggs during the hatching period on weekly feed consumption rates. There was no significant difference in the feed consumption rate of broiler chickens under the three treatments (T1, T2, and T3) during the first, second, third, and fourth weeks, as well as in total feed consumption. The results of our current study agree with those of (22; 17; 18; 19), who reported that photo stimulation during incubation had no significant effect on feed consumption rates during rearing. Our results differed from those of (23), who demonstrated a significant effect of photo stimulation during incubation on feed consumption rates during rearing.

Table (5) shows the effect of photo stimulation treatments on the feed conversion ratio (FCR) of ROSS 308 broiler chickens during the three weeks of rearing (T1, T2, and T3). From the table, we observe no significant difference in the feed conversion ratio (FCR) of broiler chickens under the three treatments (T1, T2, and T3) during the first, second , third, fourth, and fifth weeks of rearing, nor in the overall feed conversion ratio (FCR). The results of our current study are consistent with those of studies conducted by (7; 18). Our results differ from those of studies conducted by (22; 23), which found that photo stimulation during incubation had a significant effect on the FCR during rearing.

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Table 4: Effect of photo stimulation of broiler hatching eggs during the hatching period on the feed consumption rate of hatched chicks.

Treatments	Age					
	WK1	WK2	WK3	WK4	WK5	Total
T1	139.08 ±6.93	365.67 ±13.70	611.67 ±15.53	831.41 ±32.14	943.58 ±52.08	2891.42 ±102.34
T2	157.25 ±2.25	386.67 ±2.08	621.50 ±9.04	832.75 ±11.75	954.25 ±41.40	2952.42 ±56.89
T3	150.50 ±6.65	376.58 ±8.31	639.17 ±2.02	809.91 ±27.64	926.17 ±45.33	2902.33 ±85.10

T1 (Control): Continuous darkness T2: 12 hours of light and 12 hours of darkness T3: 18 hours of light and 6 hours of darkness. The absence of letters within each column means no significant difference (p≤0.05.(

Table 5: Effect of photostimulation of broiler eggs during the hatching period on the feed conversion ratio (FCR) of hatched chicks.

Treatments	Age					
	WK1	WK2	WK3	WK4	WK5	Total
T1	0.93 ±0.02	1.12 ±0.04	1.886 ±0.06	2.56 ±0.12	2.91 ±0.19	1.32 ±0.03
T2	0.96 0.00 ±	1.17 ±0.02	1.895 ±0.05	2.53 ±0.06	2.91 ±0.15	1.34 ±0.02
T3	0.96 ±0.02	1.16 ±0.06	1.97 ±0.07	2.50 ±0.14	2.86 ±0.19	1.33 ±0.02

T1 (Control): Continuous darkness T2: 12 hours of light and 12 hours of darkness T3: 18 hours of light and 6 hours of darkness. The absence of letters within each column means no significant difference (p≤0.05 .(

Conclusions:

Photo stimulation had no significant effect on live body weight, weekly weight gain, feed consumption, or feed conversion ratio during the three weeks of rearing.

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