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# FIRST STUDY OF THE EFFECT OF THE USING OF THE LEDS MIX BLUE WITH GREEN COLORS AND INTENSITY ON EMBRYONIC DEVELOPMENT DURING INCUBATION OF THE SYRIAN LOCAL HENS

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**AUTHORS' CONTRIBUTIONS**

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The main aim of this study was to investigate the effect of exposing fertile eggs of the Syrian local hens during the incubation period to three different light colors, T1 dark (control), T2 blue, T3 green and T4 mix blue with green, with intensity 35 lux. This study was conducted in Syria during the period of 2022 (from 25 June to 22 July). In the experiment, A total of 360 eggs were assigned to four groups, each group 90 eggs has three replicates, using complete randomized design. The results showed that the averages the percentages of the early, late and total embryonic mortality in the four treatments were as follows: T2 (1.11, 2.32, 6.79)%, T3 (0, 3.37, 4.48)%, T4 (0, 2.24, 3.35)% and T1 (2.22, 8.53, 17.54)%. For the embryos weight the values were T2 (1.08, 6.17, 29.67)g, T3 (1.34, 7.45, 30.04)g, T4 (1.52, 7.32, 30.17)g and T1 (1.03, 5.40, 27.79)g. The hatching time at treatment T4 took less hatching time (481.6), compared to the treatment T1 (490.8) hours, and for the hatchability, the hatching rate and the fertility T4 (88.90, 78.65, 75.40)%, T3 (87.11, 76.85, 74.61)%, T2 (85.43, 76.50, 75.04)% and T1 (80.22, 71.42, 69.75)%. And for the weights of the newly hatched chicks and at the age of the first week were T2 (33.38, 115.5)g, T3 (38.56, 108.7)g and T4 (39.11, 119.1)g and T1 (37.35, 100.2)g. The results concluded, the differences statistically significant ($p<0.05$) were observed among the averages of the three treatments, compared to the control, as a result of using different light colors during the incubation period. Thus, treatment T4 outperformed the rest of the other treatments. These results showed the importance of applying the lighting mix blue with green (Light 12: Dark 12) system and its role in improving the hatching process and the quality of the hatched chicks.

**Keywords:** LED lights; embryonic; artificial incubation; Syrian local hens.

## 1. INTRODUCTION

The artificial incubation considered the most essential and important period in the life cycle of the broiler in the intensive industry, and incubation environment conditions (temperature, humidity, ventilation and egg turning) has a lasting effect on the health, production, behavior and welfare of birds throughout their lives

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[1,2]. In addition, the high fertility of eggs and the maintenance of a suitable environment during this period have a major role in embryonic development [3,4]. In nature, chicken embryos receive some light during incubation, whereas in industrial hatcheries, eggs were incubated in the dark for 21 days. Several studies demonstrated that exposing fertile eggs to light could increase the growth of the embryo and decrease the incubation period [5-7]. However, the incubation of fertile eggs is still completely dark in current commercial hatcheries [8]. With the development of the technology implementation and application of modern light-emitting diode (LEDs) strips technology in the incubations, this required more studies on the effects of different light regimes. Such as different light source, color, intensity, length of light, spectra, the hours of illumination and the timing of exposure to light, these are very important factors for the success of this application to determine the suitable light programs during incubation period [9-13].

Recent studies have shown that the light stimulation during incubation have significant effects on embryo growth and development, physiological characteristics functions and increase overall hatchability, hatching conditions, shorten hatching time, increase in embryo weight, chick quality and performance after hatching and increasing broiler production efficiency [6,14-17]. It has also observed that had positively affected on post-hatch promotion of skeletal muscle growth and bone development [18,19]. In addition, shows circadian rhythms in living organisms. Which leads to reducing fear response and stress of chicks after hatching [20-25], and helpful for chicks to adapt to the new environment after hatching [12]. As broiler embryos have photosensitive pineal glands and are significantly affected by light [26,27]. Therefore, the circadian biological rhythms associated with the hormone melatonin, which was secreted from pineal, can be developed by photoperiodic lighting schedules during the embryonic period. The hypothalamic pacemaker and pineal gland are the main parts of the circadian avian system and embryonic cell proliferation increases with high intensity [28,29]. Due to the light considered as one of the most important external environmental factors in broiler management [30,31]. Recently there are many options for using lighting systems including fluorescent light and LED light. The use of LED lights has increased due to it has some characteristics such as the durability, color accuracy, high electrical energy efficiency, easy installation, environmentally friendly, economical cheap and low cost and closer to the effects of daylight [32-34]. Moreover, the pigment of the eggshell affects the wavelengths of light that cross the shell and reach in to the embryo and contributed to the differences in hatching time, when using different types of fluorescent lamps, which is attributed to the preventing of the eggshell some spectra of light from passing through. Many previous studies have shown differences in post-hatching growth as a result of hatching in the presence of light, contrasted with other studies that reported differences in growth and weight [1,35]. While others showed absence of the changes in performance and production [32]. Other studies indicated the effect of the lighting during incubation and rearing period were conducted with different LED colors (blue, green, red, yellow and mix blue with green) on growing broilers and layers. While there was relatively fewer studies on the local hens on the period of rearing [6,14-24].

## 2. THE IMPORTANCE AND AIMS OF RESEARCH

The main aim of this study was to evaluate the effect of exposing fertile eggs of the Syrian local hens to different light colors, (blue, green and mix of blue with green). With intensity 35 lux with photoperiod program (light 12: dark 12) during the incubation period on the percentage of the embryonic mortality, weight of the embryos, hatching time, percentage of the hatchability, hatching rate, fertility and the body weight of the hatched chicks for 21 days. By application of modern light LEDs technology as an additional environmental factor in incubations, environmentally safe. In view of absence studies concerned with the effect of the modern light LEDs technology systems (mix blue with green- intensity 35 on the development of the local hens embryos during the artificial incubation and post- hatched period in the Syrian Arab Republic, locally, regionally and globally. The use of modern light LEDs technology in the artificial incubation was conducted for the first time in this study. Hence, the objective here was to address the latter question by assessing the effect of the light systems mix blue with green with intensity 35 lux on embryonic development, and the vitality of hatching chicks and show the quantitative and qualitative characteristics of the these Syrian local chicks.

## 3. MATERIALS AND METHODS

### 3.1 The Experiment Site and Period

This study was conducted in the incubator of the broiler laboratory in the Department of Animal Production, Faculty of Agricultural Engineering, Tishreen University, Lattakia Governorate, Syria. During the period of 2022 (from 25 June to 22 July).

### 3.2 Experimental Design and Fertile Eggs

In this experiment, a total of 360 fertile eggs from the Syrian local hens 45 wk –old, were collected in the same farm and were laid on the same day. The eggs weighed individually by a digital scale, and numbered upon incubation 12 random eggs, then selected to measure the egg quality traits for each treatment. Then classified into three different weight categories, the weight of the eggs ranged between (49-53)g, and the eggs were distributed equally in the incubation trays after disinfection procedures, with an average weight to four different groups (treatments), each group 90 eggs has three replicates with 30 eggs in each replicates.

## 3.3 Incubation Environment and Programme of Lighting Factor

Automatic incubator made in Lattakia, Syria with a capacity of 1000 eggs was calibrated using a digital standard thermometer and hygrometer before incubation. The temperature and relative humidity of incubation was maintained from the period 1 to 6 day 38°C and the (RH) 60%. Then adjusted to 37.8°C and 55% from 7 to 12 day, 37.6°C and 60% from 13 to 18 day, 37.2°C and 70% from 19 to 21 day. For the eggs turning, from the day 1 to 19 turned once every two hours, then stooped turning from day 19 to 21. The incubator was separated by a divider constructed made of PVC black plastic material, then equipped with LEDs strips (Samsung 2835, Korea), with average light intensity 35 lux, measured and adjusted by digital lux-meter device (LM-8000, Taiwan). The photoperiod program (light 12: dark 12) was provided using three different light colors, T1 dark without light (D) (control) ($0L_{\text{Without light 35 lux}}$ : $24D_{\text{Dark}}$), T2 blue light (BL) ($12L_{\text{Blue 35 lux}}$:$12D_{\text{Dark}}$), T3 green light (GL) ($12L_{\text{Green 35 lux}}$:$12D_{\text{Dark}}$) and T4 mix blue with green ($12L_{\text{Mix Blue+Green 35 lux}}$ :$12D_{\text{Dark}}$).

## 3.4 Measurements and Studied Traits

### 3.4.1 Candling incubated eggs and percentage of the embryonic mortality

Incubated eggs were candled at different stages of the embryonic development during the incubation period on the days 7, 11 and 19, with 6 eggs for each treatment. In addition, the eggs were opened in the three stages from the incubation period after removing the embryonic membranes. At the first light candle checking on the 7th day, was conducted to determine whether they are fertile or non- fertile to check the growth and development of the live embryos and weight them, and to detect the early embryonic death. While the second light examination was conducted on the 11th day of embryonic development, to evaluate the dead embryos, the degree of development and growth of live embryos, and the third examination was made on the 19th day, the dead embryos were excluded, and evaluated the condition of live embryos was. After the hatching was completed all unhatched eggs were broken on the day 21 to determine the stage of mortality: which is classified according to Cobb – Vantress [36] to determine the early (EEM)% (0-7 days), intermediate (IEM)% (8-14 days), late (LEM)% (15-21 days) mortality. The mortality rate for each stage was calculated according to the following formula [37-39]:

$$(\text{EEM})\% = \frac{\text{Early embryo mortality number}}{\text{Total fertile eggs number}} \times 100$$

$$(\text{IEM})\% = \frac{\text{Intermediate embryo mortality number}}{\text{Total fertile eggs number}} \times 100$$

$$(\text{LEM})\% = \frac{\text{Late embryo mortality number}}{\text{Total fertile eggs number}} \times 100$$

### 3.4.2 Weight of the embryos

Non-hatched eggs were broken with 18 eggs for each treatment at different stages of the embryonic development during the incubation period on the days 7, 11 and 19 to evaluate the weight of the embryos.

### 3.4.3 Hatching time and the percentage of hatchability, hatching rate and fertility

After the complete end of incubation, the hatching rate time (hours) was calculated when (50%) of the chicks hatched. The hatchability% was determined as the number of chicks hatched divided by the number of fertile eggs; and the hatching rate% is the ratio of hatching chicks to total fertile eggs (the percentage of chicks leaving the eggs) and the fertility% is the ratio of fertile eggs to total incubated eggs. All of these parameters were calculated in each group using of the following formula below [37-39]:

$$\text{Hatchability}\% = \frac{\text{Hatched chicks number}}{\text{Total fertile eggs number}} \times 100$$

$$\text{Hatching Rate}\% = \frac{\text{Hatched Chicks Number}}{\text{Incubated eggs number}} \times 100$$

$$\text{Fertility}\% = \frac{\text{Fertile eggs number}}{\text{Total incubated eggs number}} \times 100$$

### 3.4.4 Body weight of the hatched chicks

After hatching was completed all chicks were removed from the incubator at the end of the

experiment and were collected, then weighed individually at the 1-day-old and the 7th day.

### 3.5 Statistical Analysis

The data of the experiment was designed using complete randomized (CRD), with two factors, and then subjected to analysis of variance (ANOVA), using the GenStat (v.12) program. Using Duncan's test to show the significant differences between the averages of the three treatments, compared to the control treatment during the incubation period at a significant level of 5% ($P \leq 0.05$).

## 4. RESULTS AND DISCUSSION

### 4.1 Candling Incubated Eggs and Percentage of the Embryonic Mortality

Table 1 shows results of the candling incubated eggs at different stages on the days 7, 11 and 19 on the non-fertile eggs, early, intermediate and late embryo mortality and normal embryonic development in each treatment that exposed to different light colors during the incubation period for 21 days. The results on the seventh day of incubation showed that the blood vessels were completely free from the non-fertilized eggs Fig. 1(a), on the other hand, early mortality fetuses showed with very few blood vessels that do not correspond to the age of the fetus of 7 days Fig. 1(b). For the intermediate embryos mortality, (during the optical examination at the age of 11 days), they appeared in a dim color and a small in size that did not match the embryonic age of 11 days Fig. 1(c). As for late mortality, it was clearly confirmed at the end of the experiment when the non-hatched eggs were broken the embryos appeared in a very dark color and in a small size that was not commensurate with the age of my embryo at the age of 21 days Fig. 1(d). While the normal embryos, they showed a clear and well developed blood vessels at the age of 7 days, with an increase in the clarity and regularity of this vessels at the age of 11 days, then the embryos occupied the entire cavity of the eggs at the age of 19 days Fig. 1(e, f, g).

For the results of the number and the percentage% of the embryonic mortality at the early, intermediate, late and total in the all treatments that exposed to the different lighting regimes shows in Table 2. The results shows that there were significant ($p<0.05$) differences in the percentage and stages of embryonic mortality in all experimental treatments. The lowest rates of the early, late and total embryonic mortality in the treatments were as follows: T2 (1.11, 2.32, 6.79)%, T3 (0, 3.37, 4.48)% and T4 (0, 2.24, 3.35)% compared to the treatment T1 (2.22, 8.53, 17.54)%.

**Table 1. Candling the incubated eggs at the three phases 7, 11 and 19 days of the embryonic development during the incubation period**

| Embryonic development | Eggs candling three stages /day | | |
|---|---|---|---|
| | **First 7th d** | **Second 11th d** | **Third 19th d** |
| Non-fertile eggs | The egg looked light of color and without any blood vessels | Exclude | - |
| Early embryo mortality | Fewer blood vessels compared to the age | Dark threads | Exclude |
| Intermediate embryo mortality | Visible blood vessels less developed than others | Fetus dim color and small in size | Non excluded to confirm the fetus condition after breakage the egg at the end of the incubation period |
| Late embryo mortality | Clear blood vessels | Developed the blood vessels and the embryo dim and small in size | The fetus was dim, less in size and the blood vessels were less regular and non excluded to confirm the fetus condition after breakage the egg at the end of the incubation period |
| Normal embryo | Clear blood vessels and well developed | Increased clarity of blood vessels and the embryo | The embryo occupied the entire cavity of the egg and was appears dark |


**Fig. 1. (a, b, c, d, e, f, g) the candling eggs at different stages on the days 7, 11 and 19 on the non-fertile eggs, early, intermediate and late embryo mortality and normal embryonic development during the incubation period**

**Table 2. The effect of exposure to different light colors on embryo mortality of the early, intermediate, late and total during the incubation period**

| Embryo mortality number and Percentage (%) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatments** | **Early** | | **Intermediate** | | **Late** | | **Total mortality** |
| | **n** | **%** | **n** | **%** | **N** | **%** | |
| T1 (0L $_{\text{Without light 35 lux}}$ : 24D $_{\text{Dark}}$) | 2b | 2.22$^{b}$ | 6a | 6.81$^{a}$ | 7b | 8.53$^{b}$ | 17.54$^{b}$ |
| T2 (12L$_{\text{Blue 35 lux}}$:12D $_{\text{Dark}}$) | 1a | 1.11$^{a}$ | 3a | 3.37$^{a}$ | 2a | 2.32$^{a}$ | 6.79$^{a}$ |
| T3 (12L$_{\text{Green 35 lux}}$:12D $_{\text{Dark}}$) | 0a | 0a | 1a | 1.11$^{a}$ | 3b | 3.37$^{b}$ | 4.48$^{b}$ |
| T4 (12L$_{\text{Mix Blue+Green 35 lux}}$ :12D $_{\text{Dark}}$) | 0a | 0a | 1a | 1.11$^{b}$ | 2a | 2.24$^{b}$ | 3.35 $^{a}$ |
| LSD 5% | 1.01 | 5.45 | 0.66 | 4.06 | 0.79 | 5.45 | 9.28 |

*Treatment groups: The photoperiod (light 12: dark 12), intensity 35 lux. T1 dark Control (D), T2 blue light (BL), T3 green light (GL) and T4 Mix blue with green (12LMix Blue+Green 35 lux :12D Dark), n = Number of the embryo mortality, (%) = The percentage of embryo mortality. $^{a,b,c}$ Means in the same column with significant differences among averages (p<0.05)*

That is, there was a positive role for the application of a color light system (12L: 12D) in reducing embryonic mortality in these two stages. This is due to the improvement of embryonic development because of the introduction of light compared to hatching in complete darkness, and the reduction of stress resulting from continuous exposure to light during hatching and exposing eggs to a light system significantly reduced the rate of early and late embryonic mortality [40]. The results of this study consistent with the previous results of [41] the total mortality ratio in the treatment exposed to colored light was the lowest, which means that successed of the 12L:12D colored light system in reducing the total mortality ratio. This may be because light accelerates the growth process during the early stage of the egg incubation period, so it reduces the mortality rate during the critical hours of embryos growth [15].

## 4.2 Weight of the Embryos

Table 3 shows results of the effect of using three different light colors on weight of the embryos during the incubation three phases of the embryonic development 7, 11 and 19, with opening 18 eggs from each treatment. A significant increasing (p<0.05) were observed among the averages of the embryos weight in the three treatments, compared to the control as the following: T2 (1.08, 6.17, 29.67)g, T3 (1.34, 7.45, 30.04)g, T4 (1.52, 7.32, 30.17)g, in the control treatment the values were T1 (1.03, 5.40, 27.79)g respectively.

**Table 3. The effect of exposure to different light colors on the embryos weight (g) during the incubation three phases**

| **Treatments** | **Embryos weight g/day** | | |
|---|---|---|---|
| | **7** | **11** | **19** |
| T1 (0L $_{\text{Without light 35 lux}}$ : 24D $_{\text{Dark}}$) | 1.03$^{c}$ | 5.40$^{c}$ | 27.79$^{c}$ |
| T2 (12L$_{\text{Blue 35 lux}}$:12D $_{\text{Dark}}$) | 1.08$^{c}$ | 6.17$^{b}$ | 29.67$^{b}$ |
| T3 (12L$_{\text{Green 35 lux}}$:12D $_{\text{Dark}}$) | 1.34$^{b}$ | 7.45$^{a}$ | 30.04$^{a}$ |
| T4 (12L$_{\text{Mix Blue+Green 35 lux}}$ :12D $_{\text{Dark}}$) | 1.52$^{a}$ | 7.32$^{a}$ | 30.17$^{a}$ |
| LSD 5% | 0.061 | 0.092 | 0.611 |

*Treatment groups: The photoperiod (light 12: dark 12), intensity 35 lux. T1 dark Control (D), T2 blue light (BL), T3 green light (GL) and T4 Mix blue with green (12L$_{\text{Mix Blue+Green 35 lux}}$ :12D $_{\text{Dark}}$), (7, 11 and 19) = Incubation three phases. $^{a,b,c}$ Means in the same column with significant differences among averages (p<0.05)*

The results of this study are consistent with [42] that applied lighting regime from 8 to 16 hours during the incubation period on the day 11 and 19 gives heavier weight embryos. The light-induced stimulation of

development may be related to an increase in embryo metabolism during hatching photo phase, compared to the darkness [29]. Light contributes to the acceleration and stimulation of embryonic growth [43], this stimulation depends on the amount of the light that can reach to the fetus [44]. Bird embryos float above the yolk and located under the eggshell, which stimulates the embryos to consume more calcium from the eggshell [45]. Thus, it enhances metabolic activity [46] light can also stimulate mitosis of the neural crest cells, which leads to stimulation of mesoderm cell proliferation, and this leads to an acceleration in the growth of the embryonic body [47].

### 4.3 Hatching Time and the Percentage of Hatchability, Hatching Rate and Fertility

Figs. 2, 3, 4, 5 shows results of the effect of using three different light colors on hatching time and the percentage of the hatchability%, the hatching rate% and the fertility% in each treatment during the incubation period. A significant increasing ($p<0.05$) were observed among the averages of the three treatments, compared to the control. The results shows that the averages of the hatching time at treatment T4 took less hatching time (481.6) hours, followed by the treatment T3 (482.3) h then the treatment T2 (484.1) h compared to the treatment T1 (490.8) h as showed in (Fig. 2). And the averages of values for the hatchability % was showed in the (Fig. 3) as the following: T4 (88.90)%, T3 (87.11)%, T2 (8543.)% and T1 (22.80)%, while the averages of the values of the hatching rate % were as showed in (Fig. 4) T4 (78.65)%, T3 (76.85)%, T2 (76.50)% and T1 (71.42)%, and the averages of values for the fertility % were as the following T4 (75.40)%, T3 (74.61)%, T2 (75.04)% and T1 (69.75)% showed in the (Fig. 5).

In agreement with the results [48,49] there were observed decrease of the hatching time duration of the eggs, when lighting was introduced into the hatching process. Which improves the productivity of this process, as many researchers have proven using different colors lighting programs with a continuous or daily lighting cycle, led to an acceleration of the growth of the chicken embryos and occurrence of early hatching before the normal date, due to the increase longer exposure to light during the incubation period [15-27]. In addition, this increase in the hatching rate is not only statistically significant, but also financially significant for broiler breeders. Even increasing the hatching rate by less than 1% can contribute to a significant increase in revenue [15]. And the results vary depending on several factors such as the type of the light used or the breed of the birds, where the length of the hatching period and the hatching time are controlled by environmental, physiological, and behavioral mechanisms, which confirms the role of the photosystem in accelerating access to the hatching stage [50]. Exposure of eggs to light during hatching also affects the duration and pattern of hatching, as the green light decreases the duration of hatching for broiler eggs when exposed to the continuous light stimulation during the last week of hatching, comparison to exposing the fertilized eggs to darkness during the hatching [34]. This increase in the hatching rate of the colored light treatments can be attributed to the fact that incubating the eggs under the influence of colored light can lead to an increase in the biochemical components in the blood plasma of the developing embryos, and thus an increase in metabolic activity due to hyperactivity of the thyroid gland [44]. The increase in the metabolism process is associated with an increase in the secretion of the thyroid hormones thyroxine (T4) and Triiodothyronine (T3), which leads to stimulation of a set of developmental and metabolic processes necessary for the success of the hatching process. Including an increase in the ability of the embryo to convert to pulmonary respiration in the late embryonic stage, and this leads to speed the hatching process [51]. These results were consistent with some previous studies, which showed that there was an increase in the hatching rate when the light factor was added to the hatching system. The use of LED light in the first 18 days of hatching according to the (12L:12D) system resulted in an increase in the percentage of egg hatching for both laying hens and broilers, in addition to local hens, compared to eggs that incubated in the dark [45,52]. And introduction of a colored light system during hatching may contribute to giving fully developed embryos capable of completing the hatching process, and this indicates a significant increase in the hatching rate in the treatment T4 (78.65)% compared to T1 (71.42)% [22].

### 4.4 Body weight of the Hatched Chicks

Fig. 6 shows the results of the body weight of the hatched chicks at the hatching day (g/d) in the studied treatments as the following: T2 (38.33)g, T3 (38.56)g and T4 (39.11)g compared to the treatment T1 (37.35)g. For the body weight of the hatched chicks at the age of one week (g/w) Fig. 7 shows the results as the following: T2 (115.5)g, T3 (108.7)g and T4 (119.1)g compared to the treatment T1 (100.2)g.

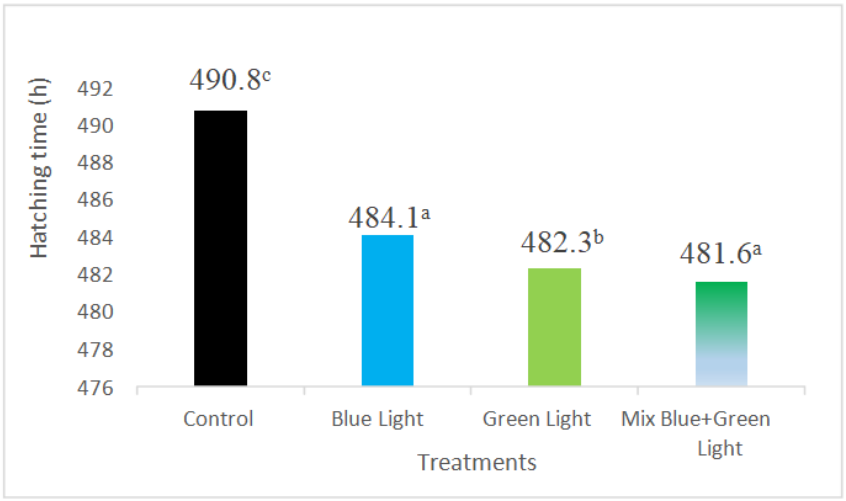


**Fig. 2. The effect of exposure to different light colors on hatching time (hour), [a,b,c] Means the significant differences among the averages (p<0.05)**

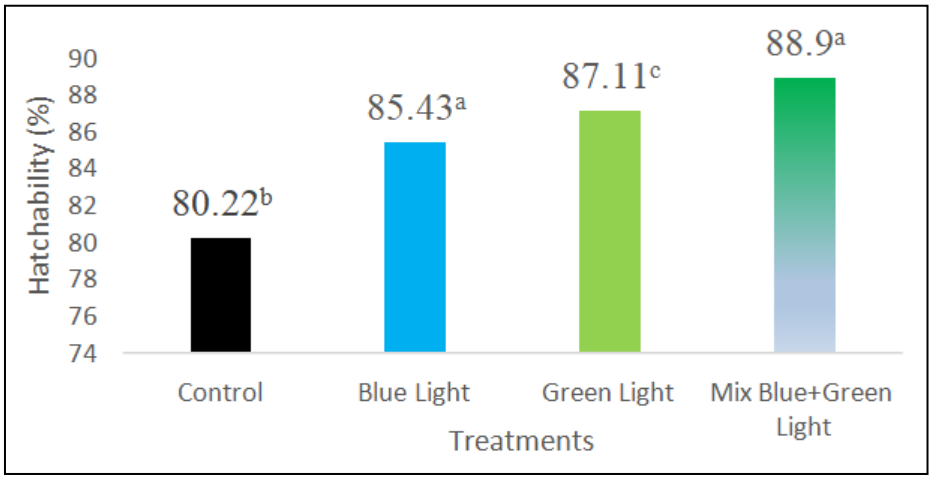


**Fig. 3. The effect of exposure to different light colors on the hatchability (%), [a,b,c] Means the significant differences among the averages (p<0.05)**

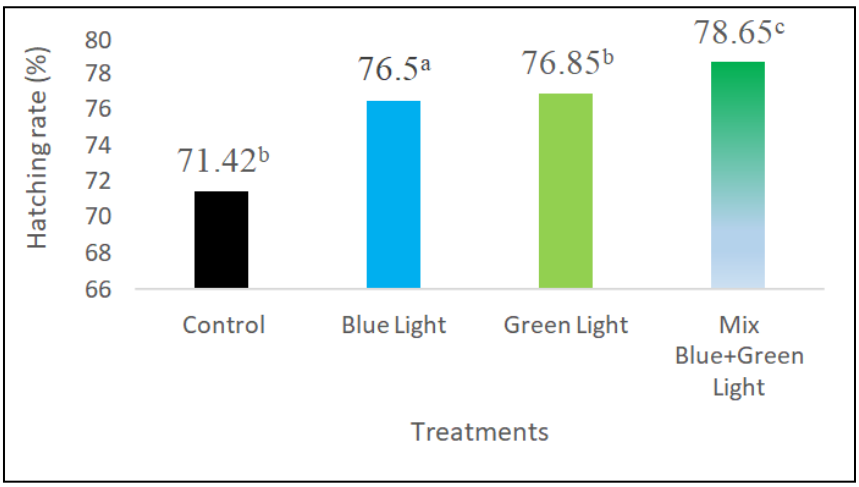


**Fig. 4. The effect of exposure to different light colors on the hatching rate (%), [a,b,c] Means the significant differences among the averages (p<0.05)**

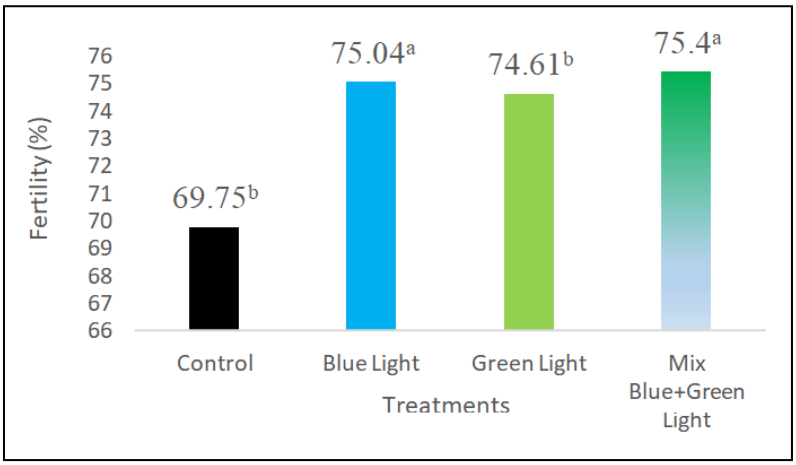


**Fig. 5. The effect of exposure to different light colors on the fertility (%)[a,b,c] Means the significant differences among the averages (p<0.05)**

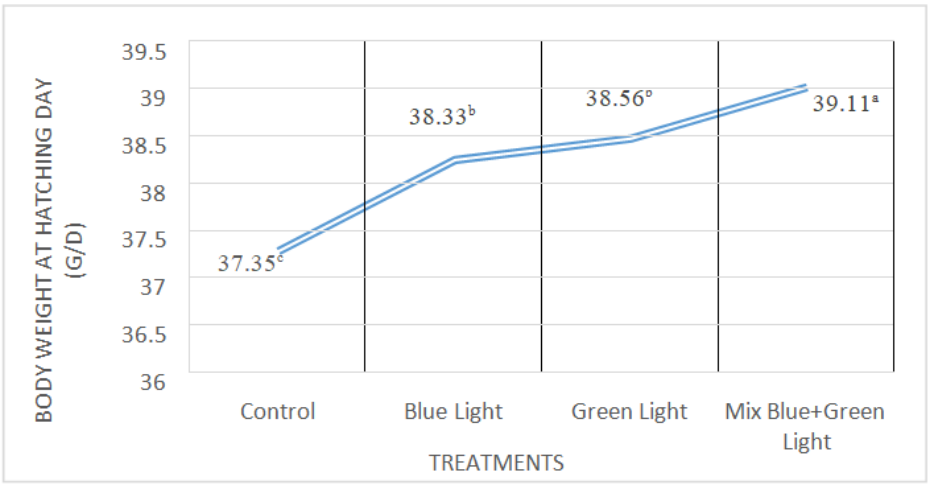


**Fig. 6. The effect of exposure to different light colors on the body weight of the hatched chicks at hatching day (g/d), [a,b,c] Means the significant differences among the averages (p<0.05)**

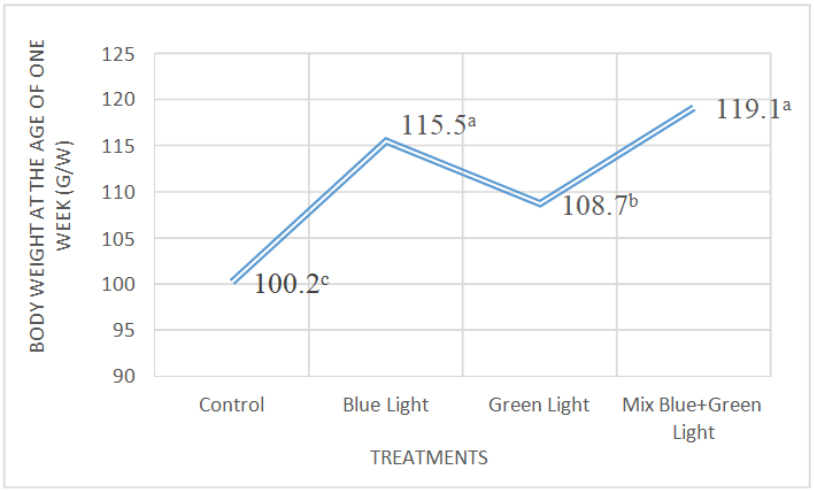


**Fig. 7. The effect of exposure to different light colors on the body weight of the hatched chicks at the age of one week (g/w), [a,b,c] Means the significant differences among the averages (p<0.05**

Live body weight was considered one of the most important criteria for the productive performance of broiler, so determining the effect of lighting systems on the body weight takes an exceptional dimension, research results have differed in the effect of light on the weight of hatched chicks. The use of light during the incubation of eggs led to an increase in the weights of the chicks. And the highest weights were at hatching day and at the age of one week for the chicks in the treatment T4 (39.11, 119.1)g. Providing LED lighting in specific colors such as green during incubation period could improve the vitality and weight of the newly hatched chicks. Which has reflected in them weights during the breeding period and gives higher weights at the age of one week [17]. The increase in body weight may result from the increase in the multiplication and growth of myoblasts and myofibers due to light stimulation [53]. The reason for the higher weight at the hatching day and at first one week of the chicks age in the colored light treatments, comparison to the dark control treatment, may be attributed to the high percentage of total protein in the eggs exposed to light during the embryonic stage [44,45,54]. As there is a positive correlation coefficient between the live weight and total serum protein [55]. In addition, protein synthesis in embryos increased when exposed to light because of photostimulation of all cellular components and increased metabolic processes [56]. Exposing the eggs to alternating lighting also led to an increase in the melatonin hormone in the chicks, whose secretion is related to the darkness period [19]. Melatonin hormone stimulates the hypothalamus to secrete growth hormone-releasing hormone GNRH, which stimulates the pituitary gland to secrete growth hormone. Which, in turn, stimulates muscle growth, growth and development of bones, and regulates and accumulates the fats [51], in addition to regulating food metabolism [57]. Also the melatonin hormone levels of broiler chicks incubated under green light of the 12L:12D colored light system were higher compared to chicks incubated in darkness [58].

## 5. CONCLUSIONS

In general, using colored LED light during the period of the hatching eggs of the Syrian local hens, led to a significant increasing at the three treatment groups (T2, T3 and T4), compared to the control group (T1). Especially in the treatment T4 (12LMix B + G35lux: 12D) contributed to an increase in the Hatchability%. Thus, treatment (T4) outperformed the rest of the other treatments. In addition, colored lighting has shortened the incubation period and contributed to an increase in the weights of the hatched chicks and the growth of them after hatching. This provides and achieves great an economical importance and to a significant increase in revenues in the hatcheries and for broiler breeders, and guide to the optimal use of the different colored lighting systems. Therefore, for these reasons, we suggest conducting more studies to clarify these results regarding to the lighting conditions in terms of the intensity or the duration during the incubation period. Moreover, this study have further benefits an effective management practice, ensuring healthy, productivity conditions, and welfare of the birds after hatching.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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