



## EFFECT OF MELATONIN ADMINISTRATION WITH DIFFERENT LIGHT COLORS ON FERTILITY TRAITS AND HATCHING OF LOCAL CHICKENS

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### Abstract

This study was conducted at the poultry farm of the Department of Animal Production / College of Agriculture/ University of Baghdad/ Abu Ghraib, on 252 birds (180 females and 72 males). This study aims to observe the effect of melatonin implantation and exposure to different light colors and their interaction on characteristics of fertility and hatching of local Iraqi chickens. The birds were divided into three sections (white, red and green) each section contains two lines, one of which has been planted melatonin under the skin of the neck of birds and the other has not been planted hormones. The results showed that melatonin implantation and exposure to different light colors did not significantly affect the hatching rate of fertilized eggs and embryos mortality rate.

**Keywords :** Melatonin, light colors, hatching, Fertility traits.

### Introduction

The photoperiod not only plays an important role in initiating egg production but is also beneficial in sustaining persistent egg production (Gongruttananun and Guntapa, 2012). Light is one of the main organizing factors of different phylogenetic processes in birds (Olanrewaju *et al.*, 2006), especially reproduction. It is the first regulated light for sexual reproduction and production of male and female reproductive cells (Leska *et al.*, 2012). Light plays a pivotal role in vision, the release of various hormones; it also increases the efficacy of important factors related to the behavior and reproduction of birds (Biyatmoko, 2014). Moreover, it also activates the development of reactive substances, such as enzymes and vitamins in embryos (Er *et al.*, 2007). In recent breeding of domestic birds, including chickens, geese, ducks, and turkeys, and it has been shown that the wavelength and color of light greatly affect the reproductive performance and growth of birds (Hassan *et al.*, 2013). The light color is no less important than the duration of light. The results showed that the wavelength of light 630 nm is within the range of red light and that wavelengths between 600 and 680 and 720 nm improve the production of eggs (Halawani El, 2013). The effect of light is to regulate the concentration of melatonin in the body and regulates its process of production and excretion (Jia *et al.*, 2016). Melatonin plays a vital role in regulating neural processes and endocrine systems in conjunction with daily changes in light (Lazar *et al.*, 2015).

There is no comprehensive study on the effect of light color and melatonin on fertility traits and hatching of local Iraqi chickens. This study aimed to demonstrate the effect of melatonin infertility and hatching, determination of the best photovoltaic color, implantation with and without melatonin, diagnosis of positive and negative changes associated with implantation, the color of light and interaction between them.

### Materials and Methods

Implemented this experiment in the poultry farm of the Department of Animal Production / College of Agriculture/ University of Baghdad/ Abu Ghraib, on 252 birds (180 females and 72 males), Birds were fed balanced diets throughout the experiment (Table 1). Melatonin was planted at the age of 14 weeks by transplantation under the skin of

the neck using the (Ralgro pellet Injector), and melatonin was produced from Productmark USA and Fulfilled by Amazon. The light used was a light-emitting diode (LED) in three colors (white, red and green) with a light intensity of 10 Watt.

**Table 1 :** Percentages of chemical components used in the study and their chemical composition

Ingredient	%
yellow corn	35.8
wheat	32
Soybeans (48% protein)	18.8
Proteins <sup>(1)</sup>	5
Sunflower oil	0.3
Limestone	7.7
Calcium diphosphate DCP	0.5
Food salt	0.2
Vitamins and minerals mixture	0.2
Total	100
	Antitoxin gm 50 +
Calculated Levels <sup>(2)</sup>	
Crude Protein(%)	20
Met. Energy (Kcal/Kg)	3194.92
Lysine(%)	1.1
Methionine(%)	0.46
Cysteine(%)	0.32
Met + Cys(%)	0.78
Calcium(%)	0.75
Available Phosphorus(%)	0.36
P/C%	159.77

<sup>(1)</sup> Proteins Type LAYCON-5 SPECIAL W Chinese Origin

<sup>(2)</sup> According to chemical analysis of NRC (1994)

Followed the way Al-Daraji and. Al-Janabi (2005) in the artificial insemination of females. The fertility rate was calculated according to the formula listed below immediately after hatching, 21 days after incubation of eggs. The number of fertilized and embryos mortality rate and the percentage of hatching of total eggs and of fertilized eggs is calculated as shown in the following equations listed below. The data of this study were analyzed according to Completely Randomized Designs for Factorial Experiments, and the differences between the averages were compared with the

Duncan (1955) multidimensional test. The statistical program SAS (2004) was used in statistical analysis.

Fertilization Rate % = (number of fertilized eggs / Total number of eggs) x 100

Embryos Mortality Rate % = (number of dead embryos) / (fertilized egg number) x 100

Hatchability % = (Number of chicks hatched / Total egg number) x 100

Hatchability of fertilized eggs % = (Number of chicks hatched / The number of fertilized eggs) X100

## Results and Discussion

Table 2 shows no significant differences in the percentage of fertility (%) not affected by the implantation of 10 mg / Kg live weight under the neck skin, during the three periods and the general rate. The Light colors did not affect the same character in the first and second periods and the general rate. With a significant decrease ( $P < 0.02$ ) in the percentage of fertility (%) in the third period when the exposure of local chickens to green light color compared to the color of red and white light. There was also no significant effect of the interaction between melatonin and light colors in the first and second periods. However, the fertility rate decreased significantly ( $P < 0.004$ ) in M0 G compared to the remaining interference in the third period. As for the general rate, the M0 R interaction was found to increase the percentage of fertility (%) significantly ( $P < 0.05$ ) on M0 G, with no significant differences in comparison with other interactions.

The results of Table 3 indicate that melatonin plantation, as well as different Light colors, did not have a significant effect on the percentage of total egg hatch during the first and second periods and the general rate. With a significant increase ( $P < 0.05$ ) in the percentage of a hatch of total eggs (%) during the third period in favor of interaction M0R compared to interference M0G with no significant differences between them.

The results of the statistical analysis shown in Table 4 indicate that the melatonin implantation and exposure to different light colors and their interplay were not significant in the percentage of hatching of fertilized eggs (%), with statistical differences observed during the three durations.

**Table 2 :** Effect of melatonin administration with different light colors on a percentage of fertility (%) for local Iraqi chicken (mean  $\pm$  standard error) in three periods

Factors affecting			percentage of fertility(%)			
			Period 1	Period 2	Period 3	General average
Melatonin	M <sub>0</sub> Without planting		91.67 $\pm$ 2.36	87.78 $\pm$ 3.83	90.56 $\pm$ 3.38	90.00 $\pm$ 1.94
	M <sub>10</sub> Plant 10 mg/kg live wt.		87.22 $\pm$ 3.02	89.44 $\pm$ 1.30	91.67 $\pm$ 1.44	89.44 $\pm$ 1.15
P-value			N.S	N.S	N.S	N.S
Light colors	W White		85.83 $\pm$ 2.01	87.50 $\pm$ 3.82	93.33 $\pm$ 1.67 <sup>A</sup>	88.89 $\pm$ 1.2
	R Red		87.50 $\pm$ 4.23	92.50 $\pm$ 2.14	95.83 $\pm$ 2.39 <sup>A</sup>	91.94 $\pm$ 2.25
	G Green		95.00 $\pm$ 2.58	85.83 $\pm$ 3.96	84.17 $\pm$ 3.00 <sup>B</sup>	88.33 $\pm$ 2.02
P-value			N.S	N.S	0.002	N.S
Melatonin	M <sub>0</sub>	W White	88.33 $\pm$ 3.33	85.00 $\pm$ 7.64	95.00 $\pm$ 2.89 <sup>A</sup>	89.44 $\pm$ 2.22 <sup>AB</sup>
		R Red	91.67 $\pm$ 4.41	95.00 $\pm$ 2.89	98.33 $\pm$ 1.67 <sup>A</sup>	95.00 $\pm$ 2.55 <sup>A</sup>
		G Green	95.00 $\pm$ 5.00	83.33 $\pm$ 8.33	78.33 $\pm$ 3.33 <sup>B</sup>	85.56 $\pm$ 3.38 <sup>B</sup>
	M <sub>10</sub>	W White	83.33 $\pm$ 1.67	90.00 $\pm$ 2.89	91.67 $\pm$ 1.67 <sup>A</sup>	88.33 $\pm$ 1.67 <sup>AB</sup>
		R Red	83.33 $\pm$ 7.26	90.00 $\pm$ 2.89	93.33 $\pm$ 4.41 <sup>A</sup>	88.89 $\pm$ 3.09 <sup>AB</sup>
		G Green	95.00 $\pm$ 2.89	88.33 $\pm$ 1.67	90.00 $\pm$ 0.00 <sup>A</sup>	91.11 $\pm$ 1.11 <sup>AB</sup>
P-value			N.S	N.S	0.004	0.05

interaction between factors M10 G recorded the highest hatching rate of 4% over M0W in the first period. During the second period, the M10G recorded 90.41% versus 79.28% for M10W, while the M10G interaction was 90.74% versus 79.82% for M10 W in the third period, in the general average, the hatching rate of M10G was 88.38% compared to the M10R interference, which recorded a hatching rate (77.07%).

The results of Table 5 showed that 10 mg/kg weight of melatonin under the neck skin of the birds did not significantly affect the percentage of embryos Mortality rate (%) in the three periods and the general mean. The light colors (white, red and green) did not significantly affect the same character and in the same periods and their overall rate. Interference between factors was therefore not recorded in the percentage of embryos mortality rate (%). The researcher Mea mar *et al.* (2016) concluded that sperm storage or freezing of poultry affects negatively the movement of sperm and has a crucial role in reducing fertility. The sperm membrane consists of Phospholipids at baseline and high percentages of polyunsaturated fatty acids that are susceptible to oxidation.

One of the possible ways to improve semen quality is melatonin. The researcher Meamar *et al.* (2016) conducted a study on the effect of 3 mg/Kg of live weight/day to determine its role in some fertility and hatching characteristics when storing semen. It concluded that there was no difference in fertility and hatch characteristics between melatonin treatment and control treatment, but it has significantly improved the quality of sperm and reduced the process of oxidation of fat during the storage of liquid. It also reduced the proportion of polyunsaturated fatty acids in the composition of fat in the sperm membrane but did not affect the proportion of fertility and hatch.

Chang and others (2016) conducted a study on the effect of red and blue light compared with white light in the ratio of fertility and hatch in geese, the researcher found that when the exposure to blue light color has a fertility rate of 62.9%, while the red light color was 74.3% and the white light color was the proportion of fertility is equal to 58.4%. The researcher also noted that the percentage of hatching of total eggs was 52.4% 57.5% and 46.9% when exposed to blue, red and white light, respectively. Hatching rate of fertilized eggs was 80.3%, 78.8%, and 78.7%, respectively.

**Table 3 :** Effect of melatonin administration with different light colors on Hatching percentage of total eggs (%) for local Iraqi chicken (mean ± standard error) in three periods

Factors affecting			Hatching percentage of total eggs (%)				
			Period 1	Period 2	Period 3	General average	
Melatonin	M <sub>0</sub> Without planting		72.22 ± 3.45	73.89 ± 4.31	76.67 ± 4.56	74.26 ± 3.46	
	M <sub>10</sub> Plant 10 mg / kg live weight		70.00 ± 4.33	74.44 ± 3.17	76.67 ± 3.23	73.70 ± 2.42	
P-value			N.S	N.S	N.S	N.S	
Light colors	W White		70.83 ± 4.73	70.00 ± 4.28	75.83 ± 4.36	72.22 ± 3.24	
	R Red		67.50 ± 5.28	77.50 ± 3.82	80.83 ± 5.39	75.28 ± 3.53	
	G Green		75.00 ± 4.28	75.00 ± 5.48	73.33 ± 4.59	74.44 ± 4.34	
P-value			N.S	N.S	N.S	N.S	
Melatonin	M <sub>0</sub>	Light colors	W White	71.67 ± 8.82	68.33 ± 6.01	78.33 ± 7.26 <sup>AB</sup>	72.78 ± 5.88 <sup>A</sup>
			R Red	75.00 ± 5.00	83.33 ± 4.41	86.67 ± 7.26 <sup>A</sup>	81.67 ± 4.19 <sup>A</sup>
			G Green	70.00 ± 5.77	70.00 ± 10.00	65.00 ± 5.00 <sup>B</sup>	68.33 ± 6.74 <sup>A</sup>
	M <sub>10</sub>	Light colors	W White	70.00 ± 5.77	71.67 ± 7.26	73.33 ± 6.01 <sup>AB</sup>	71.67 ± 4.19 <sup>A</sup>
			R Red	60.00 ± 7.64	71.67 ± 4.41	75.00 ± 7.64 <sup>AB</sup>	68.89 ± 2.00 <sup>A</sup>
			G Green	80.00 ± 5.77	80.00 ± 5.00	81.67 ± 3.33 <sup>AB</sup>	80.56 ± 3.38
P-value			N.S	N.S	0.2	N.S	

**Table 4 :** Effect of melatonin administration with different light colors on Hatching percentage of fertilized eggs (%) for local Iraqi chicken (mean ± standard error) in three periods

Factors affecting			Hatching percentage of fertilized eggs (%)				
			Period 1	Period 2	Period 3	General average	
Melatonin	M <sub>0</sub> Without planting		78.86 ± 3.44	84.11 ± 2.93	84.39 ± 2.97	82.45 ± 2.90	
	M <sub>10</sub> Plant 10 mg / kg live weight		79.77 ± 3.01	83.13 ± 3.00	83.54 ± 2.94	82.14 ± 2.15	
P-value			N.S	N.S	N.S	N.S	
Light colors	W White		82.31 ± 4.43	80.14 ± 3.78 <sup>A</sup>	81.13 ± 3.92 <sup>A</sup>	81.20 ± 3.48	
	R Red		76.60 ± 2.97	83.83 ± 3.96 <sup>A</sup>	84.02 ± 4.01 <sup>A</sup>	81.48 ± 2.98	
	G Green		79.04 ± 4.29	86.87 ± 2.82 <sup>A</sup>	86.74 ± 2.73 <sup>A</sup>	84.22 ± 3.01	
P-value			N.S	N.S	N.S	N.S	
Melatonin	M <sub>0</sub>	Light colors	W White	80.80 ± 8.06	81.01 ± 6.36	82.44 ± 7.02	81.42 ± 7.12
			R Red	81.71 ± 2.11	87.98 ± 6.26	87.98 ± 6.26	85.89 ± 4.51
			G Green	74.07 ± 7.41	83.33 ± 3.33	82.75 ± 2.75	80.05 ± 4.50
	M <sub>10</sub>	Light colors	W White	83.82 ± 5.57	79.28 ± 5.50	79.82 ± 5.08	80.98 ± 3.12
			R Red	71.48 ± 3.69	79.68 ± 4.67	80.05 ± 5.04	77.07 ± 2.15
			G Green	84.00 ± 3.53	90.41 ± 4.03	90.74 ± 3.70	88.38 ± 2.80
P-value			N.S	N.S	N.S	N.S	

**Table 5 :** Effect of melatonin administration with different light colors on the Percentage of embryos mortality (%) for local Iraqi chicken (mean ± standard error) in three periods

Factors affecting			Percentage of embryos mortality (%)				
			Period 1	Period 2	Period 3	General average	
Factors affecting	M <sub>0</sub> Without planting		21.14 ± 3.44	15.89 ± 2.93	15.61 ± 2.97	17.55 ± 2.90	
	M <sub>10</sub> Plant 10 mg / kg live weight		20.23 ± 3.01	16.87 ± 3.00	16.46 ± 2.94	17.86 ± 2.15	
P-value			N.S	N.S	N.S	N.S	
Light colors	W White		17.69 ± 4.43	19.86 ± 3.78	18.87 ± 3.92	18.80 ± 3.48	
	R Red		23.40 ± 2.97	16.17 ± 3.96	15.98 ± 4.01	18.52 ± 2.98	
	G Green		20.96 ± 4.29	13.13 ± 2.82	13.26 ± 2.73	15.78 ± 3.01	
P-value			N.S	N.S	N.S	N.S	
Melatonin	M <sub>0</sub>	Light colors	W White	19.20 ± 8.06	18.99 ± 6.36	17.56 ± 7.02	18.58 ± 7.12
			R Red	18.29 ± 2.11	12.02 ± 6.26	12.02 ± 6.26	14.11 ± 4.51
			G Green	25.93 ± 7.41	16.67 ± 3.33	17.25 ± 2.75	19.95 ± 4.50
	M <sub>10</sub>	Light colors	W White	16.18 ± 5.57	20.72 ± 5.50	20.18 ± 5.08	19.02 ± 3.12
			R Red	28.52 ± 3.69	20.32 ± 4.67	19.95 ± 5.04	22.93 ± 2.15
			G Green	16.00 ± 3.53	9.59 ± 4.03	9.26 ± 3.70	11.62 ± 2.80
P-value			N.S	N.S	N.S	N.S	

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