EFFECT OF LIGHT INTENSITY AND COLOR IN SOME PRODUCTIVE AND PHYSIOLOGICAL TRAITS OF JAPANESE QUAIL

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ABSTRACT

This study was conducted to investigate the potential effect of white, red and green color light and two light intensity 5 and 10 lux to each color treatment light on Japanese quail bird's production performance and some physiological traits. One hundred and eighty, one day old Japanese quail birds were randomly assigned into three color light with 5 and 10 lux light intensity per treatment each treatment contain 3 replicate (10 birds /cage). Result showed that the birds reared under the influence of green color were significantly ($p<0.05$) improve body weight, weight gain, feed conversion ratio, relative weight of testes, ovaries, oviduct, male L.H, F.S.H and testosterone hormones also female L.H, F.S.H and estrogen. Sexual maturity for males and females significantly ($p<0.05$) increased by white color treatment.Treatments of birds raised under the influence of 10 lux light intensity significantly ($p<0.05$) increased body weight, weight gain and the average levels of hormones L.H, F.S.H, testosterone for males and L.H, F.S.H, estrogen for females. Green color light with 5 and 10 lux intensity color significantly ($p<0.05$) increased the relative weight of ovary and oviduct.

INTRODUCTION

Light is a type of energy, it is a part of a radial spectrum, which appease at a wavelength between (350-800). Birds sense light through their eyes (retinal photoreceptors) and through photosensitive cells in the brain (extra-retinal photoreceptors) (1).The brightness of light is referred to as light intensity. Brightness is defined as the quantity of luminance falling on a unit area of a surface and is measured in units of lux, equivalent to lumens per square meter (2).

The photosynthetic stimulation through special receptors in the hypothalamus region were sensitive to light directly through the skull, stimulating gonadotropin hormones production.That hormones stimulates the anterior lobe of the pituitary gland to produce F.S.H and L.H (3).

Light is a major environmental factor in poultry production and its important in illustrated by its direct impact on growth and production (4). Alighting programs designed to reach the best productivity standard for poultry (5). The short wavelengths colors had a better effect in obtaining growth rate for quail birds compared with long wavelength colors (6).

The green color stimulated growth in early growth period, while blue color stimulates growth in the late period, and the blue and green colors had a significant increase in body weight and weight gain because the increase in satellite cell in skeletal muscles during the early days of life periods (7,8). Lighting intensity is expressed by the light brightness, which is the amount of light that spread and fill the unit area (9).

The light intensity is an important factor in poultry breeding birds. The intensity illumination (5 or100) lux had no effect on feed consumption and early growth of chickens (10), the birds reared under high light (50, 200) lux intensity can contributed to better health and given a greater opportunities for more normal behavioral rhythmus than 5 lux intensity color (11). Broilers reared under high (180 lux) intensity light were also found to be more active than the broilers reared under low (6 lux) intensity light (12).

Therefore the present study aimed to know the effect of white, red and green color, and lighting color intensity on productive performance and some physiological characteristics of the Japanese Quail.

MATERIALS AND METHODS

The experiment was conducted at quail filed, Agriculture College, Basra university during the period from 15/1/2018 to 26/2/2018. One hundred and eighty, one-day-old quail birds were housed to 42 days of age in battery units. The birds were randomly distributed into three treatments color light (white, red and green), with two color intensities (5 and 10) lux per treatment. Sixty birds per treatment were divided into six cages (10 birds/ cage), three of these cages had 5 lux and the other 10 lux intensity color light. The quail birds were received starter diet from one to 21 days of age and then switched to grower diet from 22-42 days of age. The diet were formulated according to (13) table (1).

Weekly live body weights were individually recorded for each bird and the average live body weights and weekly body weight gains were calculated for each replicate and treatment during the six weeks experimental period. Cumulative feed consumption, feed conversion efficiency were also recorded weekly for each replicate. At the end of six weeks six birds (3 male and 3 female) from each replicate were taken randomly and slaughtered. The weight of right and left testes were taken from the male, and the weight of ovaries and egg oviduct were taken from the females, then the relative weight for testes, ovaries and oviduct were calculated by divided the weight of each tract to body weight of bird.

Blood serum samples were collected from the male and female for measuring the levels of both the FSH, LH and testosterone hormone in the male, FSH, LH and estrogen hormone in the female serum.These hormones were determined using ready kits supplied by German company, and using the Elisa technique type Mindray MR-96A.

Table 1: The proportions of fodder materials included in the composition of the two feeds used in the experiment with the chemical composition calculated for them.

Forage	Starter forage (1-21 day) %	Growth forage (22-42 day) %
Yellow corn	50	53
Wheat bran	8	4
The soybean gain is 44% protein	28	28
Concentrated Protein (1)	10	8
Soy oil	1	3
Vitamin and mineral mixture	0. 5	0.5
Salt	0.5	0.5
limestone	2	3
Computerized chemical composition(2)		
Crude protein (%)	23.02	21.69
Representative energy (kilograms / kg)	21918.5	3095.8
Crude fat (%)	2.06	4
Crude Fiber (%)	2.75	3.24
Lysine (%) (2)	1.42	1.00
Methionine	0.60	0.48
Methionine + cysteine (%)	0.93	0.77
Calcium (%)	0.80	1.05
Phosphorus (%)	0.37	0.52

(1) The Proveime protein concentrated imported from the Jordanian FAPCO company containing 50% crude protein, 2200 kilograms / kg, 3% lysine, 2.5% methionine + cysteine, 8% calcium and 3% phosphorous.

(2) The chemical composition reported according to the analysis of feedstuffs mentioned in (13).

The study data were analyzed using the completely randomized design (CRD), using the ready program (14), and to test the significance differences between the studied averages ales significant difference test (LSD) was used at a significant level ($p<0.0$).

RESULTS AND DISCUSSION

Table 2 shows that the quail birds reared under the influence of green color light had a higher significantly ($p<0.05$) body weight and weight gain (237.50 and 229.26) g respectively at 42 days, while the birds treated with white color light recorded the lowest significantly ($p<0.05$) (209.9 and 201.50) g respectively.

These result were agreed (15,16), who reported that the green color treatments had the highest body weight and weight gain. The overall 10 lux intensity light in all color had a higher significantly ($p<0.05$) body weight and weight gain (226.05 and 217.82) g as compared with 5 lux intensity (220.42 and 212.20) g respectively. there was a linear increased in body weight and weight gain when the intensity color raised from 0.1 to 10 lux(17).

Feed conversion efficiency at green color had improved significantly ($p<0.05$) as compared with white color (2.75 and 3.16) g/g respectively, there was no interference between color light and intensity in body weight, weight gain, feed consumption and feed conversion efficiency,This result was agreed with(18).

Overall mortality percentage result showed there was no significant value between the treatments of color intensity, color light and their interaction. This result was consistent with the findings of (2,18,19) who did not notice any significant differences in the percentage of mortality under the effect of color and light intensity.

Table 2: Effect of color and Lighting intensity on some productive characteristics of Japanese quail at the age of 42 days

Color lighting	Primary Weight (g)	Final weight (g)	Weight gain (g)	Feed intake (g)	Feed conversion efficiency (gm feed/gm increase in weight)	Mortality rate (%)
White	8.200	209.708^{c}	201.508^{c}	636.788	3.160^{c}	8.333
Red	8.240	222.508^{b}	214.268^{b}	614.488	2.870^{b}	5.000
green	8.237	237.502^{a}	229.265^{a}	630.797	2.752a	6.667
SEM	0.058	0.627	0.629	9.016	0.016	3.043
Light intensity (LUX)						
5	8.224	220.429^{b}	212.204^{b}	618.547	2.922	5.556
10	8.227	226.050^{a}	217.823^{a}	636.169	2.932	7.778
SEM	0.047	0.130	0.513	7.361	0.013	2.485
Color lighting × Lighting intensity						
White x 5	8.200	209.500^{b}	201.300^{b}	627.060	3.113^{c}	6.667
White x 10	8.200	209.917^{b}	201.717^{b}	646.517	3.207^{c}	10.000
Red x 5	8.197	216.180^{b}	207.983^{b}	606.390	2.917^{b}	6.667
Red x 10	8.283	228.837^{a}	220.553^{a}	622.587	2.823^{ab}	3.333
Green x 5	8.277	235.607^{a}	227.330^{a}	622.190	2.737^{a}	3.333
Green x 10	8.197	239.397^{a}	231.200^{a}	639.403	2.767^{a}	10.000
SEM	0.082	0.887	0.889	12.750	0.022	4.303
P Value						
Color lighting	0.865	0.000	0.000	0.235	0.000	0.746
Lighting intensity	0.974	0.000	0.000	0.116	0.596	0.539
Color light x Light intensity	0.609	0.000	0.000	0.991	0.000	0.516

Vertically different letters: means that there are significant differences between the averages of the treatments. SEM: standard error of the mean.

Table 3 indicated that green color treatment was significantly ($p<0.05$) increased the relative weight of left and right testes (1.39 and 1.38) % respectively, while the white color light recorded the lowest (1.29 and 1.23) % respectively. The reason for the high testes weights may be attributed in males treated the green color light to the high testosterone levels in the serums blood, which was shown in table 5.

Table 3: Effect of color and intensity of illumination on the relative weights of testes, ovaries and egg ducts of Japanese quail at the age of 45 days

Color Lighting	Left testis relative weight (%)	Right testis relative weight (%)	The relative weight of the ovary (%)	Relative weight oviduct (%)
White	1.297^{c}	1.233^{c}	2.868^{b}	3.547^{b}
Red	1.323^{b}	1.278^{b}	2.907^{b}	3.747^{a}
green	1.395^{a}	^{a}٣٥٧1.	3.255^{a}	3.763^{a}
SEM	0.010	0.007	0.042	0.044
Light intensity (LUX)				
5	1.324^{b}	1.273^{b}	2.976	3.620^{b}
10	1.352^{a}	1.306^{a}	3.044	3.751^{a}
SEM	0.006	0.006	0.034	0.036
Color lighting × Lighting intensity				
White x 5	1.290^{b}	1.233^{b}	2.837	3.530
White x 10	1.303^{b}	1.233^{b}	2.900	3.563
Red x 5	1.290^{b}	1.240^{b}	2.877	3.653
Red x 10	1.357^{a}	1.317^{a}	2.937	3.840
Green x 5	1.393^{a}	1.347^{a}	3.213	3.677
Green x 10	1.397^{a}	1.367^{a}	3.297	3.850
SEM	0.010	0.010	0.060	0.062
P Value				
Color Lighting	0.000	0.000	0.000	0.008
Lighting intensity	0.005	0.002	0.182	0.024
Color light x Light intensity	0.015	0.007	0.978	0.420

Vertically different letters: means that there are significant differences between the averages of the treatments. SEM: standard error of the mean.

There was a positive correlation coefficient between the size of testes to body weight size and testosterone levels. The overall 10 lux intensity color light treatments recorded the highest values of the relative weight to the left and right testes (1.35 and 1.30) % as compared with 5 lux intensity (1.32 and 1.27) % respectively(20). These result were consistent with (21), who explained that the high levels of lighting intensity stimulate the growth of testes in male japonica quail. The Green color light with 5 and 10 lux intensity color were indicated a high significantly affect ($p<0.05$) at ovary and oviduct relative weights (3.25 and 3.76) as compared with white color at 5 and 10 lux intensity (2.86 and 3.54) respectively. These results were agreed with (22).

Table 4: effect of the color and intensity of light in the age and weight of sexual puberty of male and female Japanese quail

Color Lighting	Age of sexual puberty		Weight of sexual puberty	
	M	F	M	F
White	33.27[a]	44.67[a]	139.79	206.84
Red	32.14[b]	43.00[b]	137.89	206.84
green	30.82[c]	41.33[c]	136.56	209.55
SEM	0.338	0.360	4.180	1.958
Light intensity (LUX)				
5	32.66[a]	43.56[a]	138.73	206.07
10	31.49[b]	42.44[b]	137.41	209.53
SEM	0.276	0.208	3.413	1.599
Color lighting × Lighting intensity				
White x 5	33.80	45.33	140.38	203.08
White x 10	32.73	44.00	139.19	210.61
Red x 5	32.87	43.33	138.70	205.41
Red x 10	31.41	42.67	137.08	208.61
Green x 5	31.31	42.00	137.10	209.72
Green x 10	30.33	40.67	135.95	209.38
SEM	0.338	0.360	5.912	1.958
P Value				
Color Lighting	0.000	0.000	0.859	0.335
Lighting intensity	0.001	0.003	0.789	0.051
Color light x Light intensity	0.757	0.579.0	0.805	0.174

Vertically different letters: means that there are significant differences between the averages of the treatments. SEM: standard error of the mean

Table 4 indicated the effect of color light and intensity to the age and body weight of sexual maturity for male and female quail birds. It was recorded that the white light color deleted significantly ($p<0.05$) the sexual age for the males and females (33.27 and 44.67) days respectively, while the puberty at green color light was (30.82 and 41.3) days.

The reason for the early age of sexual puberty for males managed under green color light may be due to the high relative weight of testes of these males, according to the high testosterone levels occurs. (23).

There was appositive correlation factor between the testosterone level and the size of testes and the processes of puberty sexual male quail. The cause of the early sexual maturity for the females reared under green color light may be due to the increase in the ovaries by responsibility to estrogen hormone that works on the positive reverse feedback of the pituitary gland causing increase secretion of hormone L.H which plays an important role in ovulation (24).

High intensity and the interference between light color and the intensity had significantly ($p<0.05$) effect on age and sexual puberty between white and green color.(25) reported the acceleration in the age of sexual puberty when birds reared under the light intensity from 3 to 35 lux.

Table 5: Effect of color and intensity of light in the concentration of hormones (LH, FSH, Testosterone, Estrogen) in the blood serum of male and female Japanese quail.

Color Lighting	Male			Female		
	LH (IU/L)	FSH (IU/L)	Testosterone (ng.ml)	LH (IU/L)	FSH (IU/L)	Estrogen (pg.ml)
White	1.782^{b}	1.667^{b}	2.943^{b}	3.795^{b}	4.913^{c}	158.968^{c}
Red	1.917^{ab}	1.770^{a}	3.130^{a}	4.145^{b}	5.095^{b}	172.655^{b}
green	2.025^{a}	1.780^{a}	3.200^{a}	4.383^{a}	5.245^{a}	179.092^{a}
SEM	0.045	0.029	0.056	0.041	0.048	2.007
Light intensity (LUX)						
5	1.806^{b}	1.673^{b}	2.943^{b}	3.983^{b}	4.893^{b}	166.440^{b}
10	2.010^{a}	1.804^{a}	3.239^{a}	4.232^{a}	5.276^{a}	174.037^{a}
SEM	0.037	0.024	0.046	0.033	0.039	1.639
Color lighting × Light intensity						
White x 5	1.760	1.643	2.880	3.750	4.813	155.653
White x 10	1.803	1.690	3.007	3.840	5.013	162.283
Red x 5	1.800	1.700	2.950	3.967	4.860	168.333
Red x 10	2.033	1.840	3.310	4.323	5.330	176.977
Green x 5	1.857	1.677	3.000	4.233	5.007	175.333
Green x 10	2.193	1.883	3.400	4.533	5.483	182.850
SEM	0.064	0.041	0.079	0.058	0.068	2.839
P Value						
Color Lighting	0.008	0.030	0.019	0.000	0.001	0.000
Lighting intensity	0.002	0.002	0.001	0.000	0.000	0.007
Color light x Light intensity	0.104	0.186	0.218	0.092	0.109	0.939

Vertically different letters: means that there are significant differences between the averages of the treatments. SEM: standard error of the mean

When quail birds treated with green light and light intensity as showed in table (5), a significant ($p<0.05$) increase in the levels of testosterone, estrogen, F.S.H and L.H in males and females of serum blood were recorded. The reason of the high testosterone level in male serum may be attributed to the effect of green light which was stimulated the growth of testicles leading to the high relative weight and size of these birds. There was a positive correlation between the weight of testes and the level of testosterone hormone (26), and also a relationship between gonad size and both of testosterone and L.H formation (27,28).

The reason to the high level of estrogen in blood serum of female under green light treatment may be due to ovarian stimulation (22), which ameliorated the high level of gonadotropins hormones F.S.H and L.H and it was in agreement with the result of current study. It helps to raise the levels of ovarian hormones, especially estrogen and progesterone, which are responsible for the process of growth, development and maintenance of the oviduct to stimulate estrogen hormone in females lead to high level of L.H hormone in blood serum.

This given an assumption of relationship between estrogen and L.H as shown in table (5), while it indicated a significant ($p<0.05$) superiority in the mean level of testosterone, estrogen, F.S.H and L.H in the serum blood of male and female quail birds treated under the influence of 10 lux compared to 5 lux treatments.These results were confirmed by (25) who explained that the L.H increased significantly ($p<0.05$)in the blood serum of Japanese quail females exposed to high levels of light intensity compared to low levels.

تأثير شدة ولون الإضاءة في بعض الصفات الإنتاجية والفسلجية لطائر السمان الياباني

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الخلاصة

أجريت الدراسة الحالية بهدف معرفة تأثير لون وشدة الاضاءة في بعض الصفات الانتاجية والفسلجية لطيور السمان الياباني، أُستخدم ١٨٠ طائر بعمر يوم واحد، وُزعت عشوائياً على ثلاثة معاملات تجريبية وبواقع ٦٠ طائر كل معاملة تمثل لون اضاءة وداخل كل معاملة تربى الطيور بشدتين ضوئية (٥ و١٠) لوكس لكل منها ثلاثة مكررات ولكل مكرر ١٠ طائر، اظهرت نتائج الدراسة تفوقاً معنوياً في معدل وزن الجسم الحي والزيادة الوزنية لمعاملة الطيور التي ربيت تحت تأثير اللون الأخضر فضلاً عن التحسن المعنوي في معامل التحويل الغذائي على باقي معاملات التجربة. وأظهرت النتائج تفوقاً معنوياً في الاوزان النسبية لخصى ومبايض وقناة البيض لمعاملة الطيور التي ربيت تحت تأثير اللون الأخضر مقارنة مع باقي معاملات الدراسة، واشارت النتائج الى ارتفاعاً معنوياً في العمر عند البلوغ الجنسي لذكور واناث معاملة اللون الأبيض على باقي معاملات التجربة. وأظهرت النتائج تفوق معاملة الإضاءة باللون الأخضر في معدل تركيز الهرمونات LH، FSH، Testosterone للذكور وFSH، LH ، Estrogen للإناث على بقية المعاملات وتفوقت معاملة الطيور التي ربيت تحت تأثير شدة الإضاءة ١٠ لوكس في معدل وزن الجسم الحي والزيادة الوزنية بينما سجلت معاملة الطيور التي ربيت تحت تأثير شدة الإضاءة ٥ لوكس تفوقاً معنوياً في العمر عند البلوغ ، واظهرت النتائج تفوق معنوي للطيور المرباة تحت تأثير شدة الإضاءة ١٠ لوكس في معدل تركيز الهرمونات LH،FSH، Testosterone للذكور و LH،FSH، Estrogen للإناث على معاملة ٥لوكس. واظهرت النتائج تفوقا معنوياً في معدل الوزن الحي والزيادة الوزنية والاوزان النسبية لخصى ومبايض وقناة البيض لمجاميع الطيور التي ربيت تحت تأثير الضوء الأخضر وشدة الإضاءة ١٠ لوكس فضلاً عن التحسن المعنوي لطيور هذه المعاملة في معامل التحويل الغذائي، مع انعدام التأثير المعنوي للتداخل بين لون وشدة الإضاءة في ومعدل استهلاك العلف ونسبة الهلاكات الكلية والعمر والوزن عند البلوغ ومعدل تركيز الهرمونات لذكور واناث السمان. يمكن الاستنتاج من خلال الدراسة الحالية تحسن الاداء الانتاجي لطيور السمان الياباني عند تربيتها تحت تأثير الضوء الأخضر وشدة اضاءة ١٠ لوكس فضلاً عن تحسن ادائها الفسلجي.

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