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Influence of Darkness Program on Performance Characteristics and Some Physiological Parameters of Ross 308 Boiler Chicks

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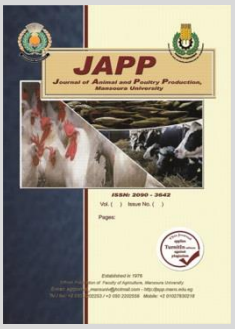

ABSTRACT

The experimental designed to measure the effect of darkening programs on growth rates and some blood parameters in broiler chicks. Six hundred Ross308 chicks Wing-banded at 1-day old were divided into four trail groups, each with 3 replications. The chicks were raised on ground litter containing sawdust. Chick's were subjected to four darkness program: Treatment 1, serviced as a control (24 light + zero dark), Treatment 2 (18 L + 6 D continues when chicks arrived 150 g), Treatment 3 (1 hour of darkness at 2nd day, 2 hours of darkness at the start of the 2nd week, 3 hours of darkness at the start of the 3th week, 4 hours of darkness at the start of the 4th week and 5 hours of darkness at the start of the 5th week) and Treatment 4 (1 hour of darkness from the 4th day until the 7th day, 4 hours of darkness from the 8th day until the 14th day, and 6 hours of darkness from the 15th day until the 30th day). The results indicated that, the positive effect of the darkness schedule program which used in the experimental trail is treatment four.

Keywords: Darkness, Schedule, Growth, Physiological parameter

INTRODUCTION

Darkness program is one of the most important factors for improving physiological processes and improving poultry performance and behavior. Several investigations have recently been undertaken to determine the optimal darkness systems to be employed in contemporary breeding. Since producers place a high value on production characteristics, displaying positive effects on these variables might be useful in persuading them to make management changes in their farms (Shynkaruk *et al*. 2019). Because broiler chicks are less active at night, current research has concentrated on limiting light schedules to increase performance and productivity (Rahimi *et al*. 2005).

Accordingly, there is a shortening of the length of the photoperiod with the light and dark periods that can be applied continuously or discontinuously. Exposure to light and dark plays a significant role in the production and well-being of commercial meat broilers, as an appropriate day-night cycle regulates physiological rhythms including that of melatonin production (Schwean-Lardner *et al*., 2014). Continuous lighting programs for long periods of time have been used in raising broiler chickens in order to increase the rate of feed consumption and increase the growth rate. However, it was found that continuous lighting programs have harmful effects, including syndrome death and not taking rest periods. Accordingly, the use of intermittent programs was reached as one of the modern systems in raising broiler chickens Campo and Davila (2002).

Darkness can exposure has many similar benefits regardless of the delivery method; the majority of research studied has tended to focus on intermittent programs or increasing/decreasing programs when compared to constant or near-constant light. Long dark periods prevent regular access to food, as a consequence, consumption is reduced and the growth of chicken is limited (Classen *et al*. 2004). A possible compromise solution is the introduction of intermittent lighting (Ingram and Hatten, 2000) that does not extend the duration of the photo period and a allows frequent access to food. Continuous (23L:1D) photo periods to enhance feed intake and growth rate. However, multiple research demonstrated that employing continuous light programming generates sleep deprivation and causes' vere physiological stress responses (Campo and Davila, 2002; Kliger *et al*. 2000).

This experiment was designed to study the effect of the number of hours of darkness in intermittent and continuous lighting programs on performance characteristics and some physiological measures.

MATERIALS AND METHODS

According to Darkness, program, six hundred (600) unsexed Ross308 chicks Wing-banded at 1-day old were divided into four treatments. Treatment 1 serviced as a control (24 light + zero dark), Treatment 2 (18L + 6D continuous) when chicks arrived 150 g. Treatment 3 (1 hour of darkness at 2nd day, 2 hours of darkness at the start of the 2nd week, 3 hours of darkness at the start of the 3rd week, 4 hours of darkness at the start of the 4th week and 5 hours of darkness at the start of the 5th week of age), Treatment 4 (1 hour of darkness from the 4th day until the 7th day, 4 hours of darkness from the 8th day until the 14th day, and 6 hours of darkness from the 15th day until the 30th day of age, after that, a continuous 24 hour lighting program is opened until the sale age 35 days old).

Darkness program for all treatment groups was carried out at one point (from 6:00 pm). The chicks were brooded at a temperature of 34 degrees Celsius, then the temperature continued to drop daily at a rate of half a degree according to the breeding catalogue, Diet and water *ad libtium*. However, the amount of diet consumption thorough out all experimental period

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was limited to 3kg diet per/bide. Diet was distributed as follows: 800 grams of starter diet (23.1% curd protein and ME3000 kcal/kg diet), the experimental birds were fed on them until the 18th day of age; 1200 grams of the grower diet (21.17%curd protein and ME 3015kcal/kg diet), the experimental birds were fed on them until the 28th day of age.1000 grams of finisher (19.24% curd protein and ME 3128.31kal/kg diet), experimental birds were fed on them until the 35th day of age, Table 1. The chicks were raised under uniform environmental conditions and the same bio security systems.

Chicken's live body weight (L.B.W) and feed intake (F.I) were weekly recorded at treatment basis for chicks housed. Body weight gain (B.W.G) and feed conversion ratio (F.C.R) were calculated. The cumulative means of LBW, FI, BWG, and FCR were calculated for the whole experimental period (0-35 days of age). Mortality rate of chicks was also monitored throughout the experimental period. Growth rate percentage by all chicks was weekly for each treatment. Body weight gain was calculated according to the following formula rate of growth.

$$\text{Rate of growth (\%)} = \frac{W2 - W1}{(W2 + W1)/2} \times 100$$

Feed conversion ratio (FCR) was calculated according to the following formula:

$$\text{FRC} = \frac{\text{Feed intake (g)}}{\text{Weight gain}}$$

Nine chicks were choice randomly from each group to take the plasma sample, (the blood sample was collected from the broiler by slaughtering with a surgical scalpel, cutting the jugular vein, and then filtering the blood with a tube containing 0.1 ml heparin), and the sample was centrifuged at 3000 rpm per minute for 15 minutes to separate the plasma which gets heparinzed tube by centrifuge the whole blood sample.

Plasma concentrations of glucose (Glu), cholesterol (Cho), triglyceride (Tri), low-density lipoprotein (LDL), high-density lipoprotein (HDL), total protein (TP), albumin and globulin were determined. As well as the activity of plasma aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured as indicator to kidney function. All parameters were measured by commercial kits (commercial kits: Spectrum Diagnostic kits, 2022).

Total concentration of plasma T3 and T4 was determined using comer. kits of a diagnostic examin. (Equipar, Italy) according to the methods described by Sterling, (1975) and liewendahi (1990), respect. Plasma corticosterone level was also determined use comer. kits of diagnostic examine. [Diagnostic Product Corporation Los Angeles ,U.S.A] According to the method explain (Sianio *et al*. 1988). The T3/T4 R. was calculated as a pointer of the bioconversion rate of T4 to T3.

Statistical analysis

Our data were subjected to statistical analysis by SAS (2004) computer program use the GLM. When the *F*-statistic was sign. ($p<0.05$), a mean separation was performed use the least sign. difference by Tukey test.

RESULTS AND DISCUSSION

Data in table (2) and figure (1) summarized the heavier body weight for birds in experimental treatment (4) which have a darkness program (1 hour of darkness from the 4th day until the 7th day, 4 hours of darkness from the 8thday until the 14thday, and 6 hours of darkness from the 15thday until the 30thday of age) and there were sign. differences ($p\leq0.05$) between other groups. Whereas the heavier body weight gain either achieved for birds in treatment (4). The feed conversion ratio also significantly different among the experimental treatments. Treatment (4) had the lower value of feed conversion (1.17) when providing a fixed amount of diet (3 kilograms) for all treatments (table 1 and figure 2).

Table 1. Chemical and calculated analysis of the diet which used in the experimental treatments

Ingredients %	Starter	Grower	Finisher
Yellow corn	55.40	59.27	63.65
Soybean meal (46 % CP)	33.23	30.90	25.90
Corn gluten (60 % CP)	5.18	3.20	3.20
Soybean oil	1.75	2.30	3.10
Dical-phos.	1.90	1.80	1.70
Ground limestone	1.30	1.40	1.30
Salt	0.40	0.40	0.40
Min.-Vit. Premix*	0.30	0.30	0.30
DL-meth.	0.25	0.23	0.24
L-lys.-HCl	0.29	0.20	0.21
Total	100	100	100
Calcu. Analy.**			
Crude protein, %	23.1%	21.17%	19.24%
Metaboliz. energy (Kcal/kg)	3000	3015	3128
Calcium (Ca), %	1.01	1.02	0.92
Av.ph, %	0.46	0.43	0.41
Lys., %	1.38	1.21	1.1
Methionine, %	0.63	0.57	0.56
Meth. + Cys., %	1.08	0.92	0.88

Premix composition:-

***: Vit E 10 mg, Vit .A 1000 I.U., Vit B1 5mg,Vit D3 2000 I.U., Vit K 1 mg, VitB2 5mg, vit B6 1.5 mg, Vit B12 0.01 mg,Biotin 0.05mg, folic acid 0.35 mg, Pantothenic acid 10 mg, Choline 250 mg, Fe 30 mg,Niacin 30 mg, Zn 50 mg, Cu 4 mg and Se 0.1 mg.**

****: according to N.R.C. 1994**

Table 2. Effect of darkness program on performance characteristics of Ross308 broiler chick

Treatments	Final body weight, g	Total body weight gain, g	Feed conversion ratio
T1	2034^{d}	1989^{d}	1.54^{a}
T2	2349^{c}	2305^{c}	1.34^{b}
T3	2447^{b}	2402^{b}	1.27^{c}
T4	2600^{a}	2555^{a}	1.17^{d}
SEM	5.7	5.7	0.0025
Sig.	**	**	**

$^{a-d}$: Means in the same column having different superscripts are significantly different at($P\leq0.05$).

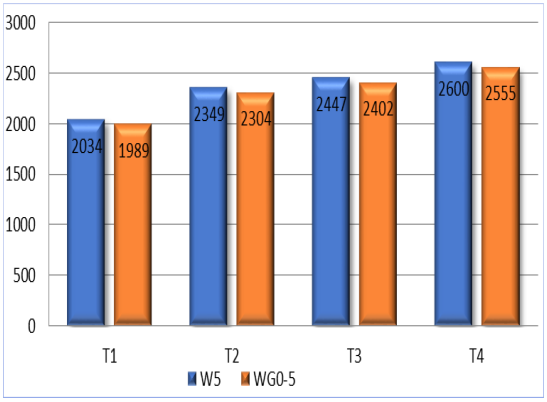

Fig. 1. Effect of darkness Schedule on body weight and weight gain of Ross 308 broiler chick's

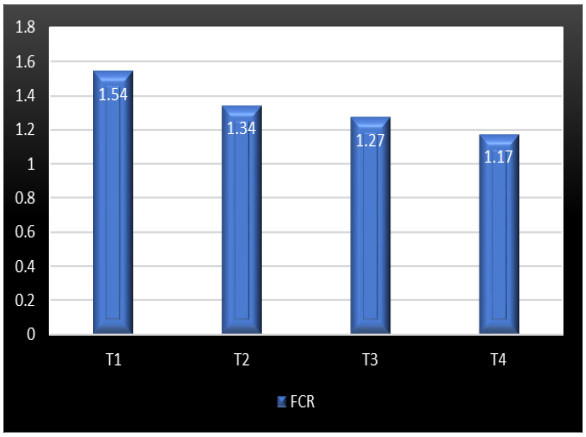

Fig. 2. Effect of darkness Schedule on feed conversion of Ross 308 broiler chick's

The obtained results agree with those reported by Abdulaziz *et al.* (2022), who found that birds received an intermittent lighting program (1L:3D 6 times per day; I.L. groups), under heat-stress conditions. Also, the birds had better ($p< 0.05$) performance in the final body weight by 13% and in the body weight gain by 20%, with a considerable improve in feed conversion ratio compared with birds that received a continuous lighting program (23L:1D a day; C.L. groups) in the heat-stressed group.

In common birds are very responsive to light. Light allows the birds to found rhythm city and synchronize many essential functions, including body temperature and various metabolic steps that facilitate feeding and digestion. Lower increasing feed intake and significantly improved feed conversion werepractical in chicken under an intermittent program (1h light:3h dark from 8 to 49 days) compare with those under a continual lighting schedule (23 h light: 1 h dark) (Sahraei, 2012**)**. In addition, it was concluded that split darkness (14 L: 4 D: 2 L: 4 D) lighting regimen might be used for broiler chickens from young breeders to get better live body weight without affecting feed conversion ratio Sabry *et al*. (2015). On the other hand, no experiments have been conducted on continuous or semi-continuous light EL-Sagheer *et al*. (2004), found that flocks of broiler chicks in which continuous lighting programs were compared with intermittent lighting programs had a greater effect on daily weight gain than flocks that were raised under the influence of irregular intermittent lighting programs. In a study conducted by Hassanzadeh *et al*. (2005) on the effect of continuous lighting programs and intermittent lighting programs on the final body weight, it gave significant differences, but it was noted that the increase in the final body weight in broiler chickens that were raised under the influence of continuous lighting programs was higher than in the flocks that were raised under the influence of intermittent lighting programs. According to Charles *et al*. (1992), birds treated with rising illumination programs compared to birds under constant photoperiods may have faster growth rates due to higher plasma concentrations of testosterone. Additionally, Buyse *et al*. (1996) contended that the observed increase in nitrogen retention of male broilers raised under intermittent lighting as compared to those raised under continuous lighting is caused by high plasma levels of growth hormone and insulin-like growth factor-I.

Fast growth rates and good feed conversion are required for successful broiler production. To the fulfillers, diets should be supplied *ad libitum* and stock should be kept under constant or virtually continuous lighting. A continuous illumination on the other hand, a continuous illumination program locomotors activity, may consume additional energy and hence reduce feed conversion efficiency (Perry, 1981). Yousaf *et al*. (2021), it was found that the chick that was hatched in single stage hatching machines does not consume more than 3 kg of feed during the rearing period of 35 days.

Skoglund *et al.* (1966) There was a noticeable difference in the amount of feed consumed between the groups that were raised under the intermittent lighting program system 2, 3, and 12, with no significant difference between the group of 12 and the group raised under the continuous lighting system. Darkening programs are designed to regulate and limit feeding periods (Ballard and Biellier, 1975). Cave *et al.* (1985), it was noted that larger amounts of feed were consumed in the birds raised under the continuous lighting program than in the birds raised under the intermittent lighting program, but this affected the conversion rate, so it was better in the second group than in the first at 48 day of age. In study (Ohtani and Tanaka, 1998) observed that IL broiler rushed to the feeder and vigorously ate at one time quickly after the onset of the lighting period, but CL chickens exhibited less interest at eating. They also concluded that, in IL chickens, the upper digestive system could have remained empty during the time of darkness, and the birds were instantly again ready to feed when the light came on.

Blood parameters:

According to the results shown in Table (3) lipid profile measurements were considerably impacted by treatments in this study. Whereas the treatment 4 (1 hour of darkness from the 4th day until the 7th day, 4 hours of darkness from the 8th day until the 14th day, and 6 hours of darkness from the 15th day until the 30th day) increased total lipid, triglyceride, cholesterol, high density lipoprotein (HDL) and low density lipoprotein (LDL) levels compared to other treatments. Whereas the treatmentT2 had given a highest of total protein, albumin and globulin compared to other treatments, this is the protein profile results showed in Table 4. As well as in Table (5) treatment 3 (1 hour of darkness at second day, 2 hours of darkness at the start of the 2nd week, 3 hours of darkness at the start of the 3rd week, 4 hours of darkness at the start of the 4th week and 5 hours of darkness at the start of the 5th week), had a highly concentration kidney function because they achieved a lower concentration of creatinine (0.307 mg/dl) and had a highly liver function (21 U/l, AST) but treatment 4 had a highly concentration ALT, (37.78 U/l), these values show the liver function of the birds that were treated with the darkening programs in this study. Albumin is one of several proteins made in the liver. body needs these proteins to fight infections and to perform other functions. Lower than usual levels of albumin (3.5 to 5.0 g/dL) and total protein (6.3 to 7.9 g/dL) may mean liver damage or disease. These low levels also can be seen in other gastrointestinal and kidney-related conditions), AST, Aspartate transaminase, AST is an enzyme that helps the body break down amino acids. Like ALT, AST is usually present in blood at low levels.

An increase in AST levels may mean liver damage, liver disease or muscle damage. This test is sometimes referred to as SGOT.), ALT Alanine transaminase, ALT is an enzyme found in the liver that helps convert proteins into energy for the liver cells. When the liver is damaged, ALT is released into the bloodstream and levels increase. This test is sometimes referred to as SGPT, Gastroenterology and GI Surgery hospital, (2023). In addition to the results presented in Table (6) which shows the impact of treatments on thyroid function had given a highest of Triiodothyroninein treatment T2 (18L+6D) while Thyroxin was increased in the control treatment.

The present results agree with those found by Gharib *et al*. (2008) noted that broiler chicks that were raised under an intermittent lighting program had a higher concentration of the hormone triiodothyronine in their blood than in the blood of chicks that were raised under a continuous lighting program. In contrast, Abdulaziz *et al*. (2022) showed that the birds which received the intermittent light program expressed a lower level of TP and a higher level of Triiodothyronine compared to those levels in the birds which received the continuous light program. Previous studies with Scott, (2002) reported that increase glucose concentration in the blood of chicks that were raised under a continuous lighting program for sixteen hours than in the blood of birds that were raised under a continuous 23-hour lighting program. Furthermore, Kühn *et al*. (1996) demonstrated that male broiler chickens raised under near continuous lighting (23L: 1D) and irregular lighting (1L: 3D) had higher growth rates, plasma growth hormone levels, and testosterone concentrations than birds raised under continuous lighting (24L:0D). In addition, Olanrewaju *et al.* (2013) which indicated that higher T3 level associates with increased protein deposition. The high level of T3 hormone and T.P in both long continuous and regular/intermittent photoperiod groups probably relates to feed intake during the light period. It has been documented that hormone T3 is the main thyroid hormone regulating oxygen consumption (ROC), particularly in young chickens and metabolically more active substance than T4 hormone.

Table 3. Effect of darkness program on lipid profile of Ross308 broiler chick.

Treatments	Glucose mg/dl	Total Lipid mg/dl	Triglyceride mg/dl	Cholesterol mg/dl	HDL mg/dl	LDL mg/dl
T1	234.00^{b}	229.32^{b}	67.333^{b}	110.78^{b}	24.778^{b}	72.533^{ab}
T2	277.89^{ab}	355.87^{a}	78.333^{b}	122.00^{b}	35.889^{a}	70.444^{ab}
T3	282.22^{a}	255.67^{b}	74.333^{b}	86.33^{b}	34.889^{a}	36.578^{b}
T4	236.44^{b}	385.07^{a}	140.333^{a}	173.89^{a}	37.111^{a}	108.711^{a}
SEM	11.483	21.151	9.773	12.062	2.009	10.62
Sig.	**	**	**	**	**	**

$^{a-b}$: Means in the same column having different superscripts are significantly different at (P≤0.05).

Table 4. Effect of darkness program on protein profile of Ross308 broiler chick.

Treatments	Total protein g/dl	Albumen g/dl	Globulin g/dl	A/G ratio
T1	3.089^{b}	1.156^{ab}	1.933^{b}	0.611^{ab}
T2	3.711^{a}	1.200^{a}	2.511^{a}	0.489^{bc}
T3	3.400^{ab}	0.967^{b}	2.433^{a}	0.411^{c}
T4	3.156^{b}	1.222^{a}	1.933^{b}	0.667^{a}
SEM	0.125	0.051	0.095	0.033
Sig.	**	**	**	**

$^{a-c}$: Means in the same column having different superscripts are significantly different at (P≤0.05).

Table 5. Effect of darkness program on kidney and liver function of Ross308 broiler chick

Treatments	Creatinine mg/dl	AST U/l	ALT U/l
T1	0.556^{ab}	12.56^{b}	12.778^{b}
T2	0.756^{a}	24.67^{a}	15.889^{b}
T3	0.307^{c}	21.00^{a}	12.167^{b}
T4	0.433^{bc}	12.22^{b}	37.778^{a}
SEM	0.063	1.358	1.634
Sig.	**	**	**

$^{a-c}$: Means in the same column having different superscripts are significantly different at (P≤0.05).

Table 6. Effect of darkness program on thyroid function of Ross308 broiler chick.

Treatments	Triiodothyronine (T3) nmol/l	Thyroxin (T4)nmol/l	(T3)/(T4) ratio
T1	0.3595^{bc}	15.4083^{a}	0.0232^{d}
T2	0.4740^{a}	12.9000^{b}	0.0367^{b}
T3	0.3184^{c}	10.6927^{c}	0.0302^{c}
T4	0.4115^{b}	9.7467^{c}	0.0433^{a}
SEM	0.0139	0.4093	0.0016
Sig.	**	**	**

$^{a-d}$: Means in the same column having different superscripts are significantly different at (P≤0.05).

Free T3 and T4 are crucial anabolic hormones because they are essential for the metabolism of proteins, carbon dioxide, and lipids. According to Abbas *et al*. (2008), compared to non-intermittent lighting programs, both intermittent and non-intermittent lighting programs significantly raised the serum T3 level. Additionally, when the dark time lasted longer, serum melatonin levels rose. As a result, the leptin level rose, which in turn raised the T4 levels (Charles *et al*., 1992; Legradi *et al*., 1997). Contrarily, Hassanzadeh *et al.* (2012) found that broilers participating in a non-intermittent illumination regimen had considerably higher blood T3 and T4 levels than those during the darkness phase. These hormone levels dropped, which in turn decreased the body's need for oxygen and its associated metabolic workload. As a result, they are more resistant to ascites and other cardio-vascular illnesses. In a different study, Hassanzadeh *et al.* (2005) found that intermittent lighting programs reduced plasma T3 levels in young broiler chicks in particular. Their T4 levels were also raised, which reduced the metabolic stress.

mortality and viability

Data on the effects of the darkness program on the mortality and viability rate of the present study are summarized in Table 7. The results of treatment 4 showed that no mortality recorded when the birds subjected to the light program in treatment 4. However, mortality rate recorded 8% in treatment 2, 6.67% in treatment 1 and 3.33% in treatment 3, respectively. This reflects the positive effect of the darkening program which used in the experimental treatment four. Our results are in line with those of Kieu, (1999) who discovered that continuous lighting 24 hours a day caused homeostasis, as indicated by an increase in the percent of heterophils and a decrease in the percent of

lymphocytes. Early feed and light restriction reduced the occurrence of leg abnormalities and mortality in birds slightly. Shah and Petersen (2001) discovered significantly lower mortality in broiler chicks reared under increasing daylight (2.8%), decreasing daylight (5.0%), and broiler chicks reared under 23 L: 1 D (7.8%) throughout the experimental period.

Table 7. Effect of darkness program on mortality and viability rate of Ross308 broiler chick.

Treatments	Mortality	Viability
T1	6.67^{a}	93.33^{b}
T2	8.00^{a}	92.00^{b}
T3	3.33^{ab}	96.67^{ab}
T4	0.00^{b}	100.00^{a}
SEM	0.016	0.016
Sig.	**	**

a-b: Means in the same column having different superscripts are significantly different at (P≤0.05).

CONCLUSION

The results of this study indicated that, there was positive effects of the darkness schedule program which used in the experimental treatment four (1 hour of darkness from the 4thday until the 7thday, 4 hours of darkness from the 8thday until the 14thday, and 6 hours of darkness from the 15thday until the 30thday), on broiler performance and secretion of T3, T3/T4 ratio; liver and kidney function.

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تأثير برامج الإظلام علي المظاهر الإنتاجية وبعض المقاييس الفسيولوجية لكتاكيت التسمين روص ٣٠٨

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الملخص

أجريت هذه الدراسة لقياس تأثير برامج الإظلام على معدلات النمو وبعض مقاييس الدم في كتاكيت التسمين. تم استخدام ٦٠٠ كتكوت في هذه الدراسة من سلاله الروص ٣٠٨ وتم ترقيم الجناح في اليوم الأول من العمر ثم تم تقسيم الكتاكيت إلي أربعه مجاميع تجريبية وكل مجموعه قسمت إلي ٣ مكررات وتم إسكان الطيور ارضيا ثم تم تطبيق أربعه برامج إظلام علي الطيور التجريبية. المعاملة الأولي اعتبرت كمجموعه ضابطه (كنترول) (٢٤ ساعة إضاءة + صفر إظلام)المعاملة الثانية (١٨ ساعة إضاءة + ٦ ساعة إظلام متواصل عند وصول الكتاكيت إلي متوسط وزن ١٥٠ جم) المعاملة الثالثة (ساعة إظلام عند اليوم الثاني و حتي نهاية الأسبوع الأول وساعتين إظلام في الأسبوع الثاني ٣ ساعات في الأسبوع الثالث و ٤ ساعات إظلام في الأسبوع الرابع و٥ساعات إظلام في الأسبوع الخامس) والمعاملة الرابعة (ساعة إظلام من اليوم الرابع وحتي اليوم السابع و ٤ ساعات من اليوم الثامن وحتي اليوم الرابع عشر و٦ ساعات إظلام من اليوم الخامس عشر حتي اليوم الثلاثين. أظهرت النتائج إن المعاملة الرابعة لها نتائج ايجابيه علي معدلات الأداء الإنتاجي وكذلك بعض مقاييس الدم.