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EFFECT OF INTERMITTENT LIGHTING ON THE CARCASS CHARACTERISTICS, INTERNAL ORGANS, RELATIVE WEIGHT AND PH VALUE OF THE DIGESTIVE SYSTEM, AND SOME OF THE IMMUNOLOGICAL TRAITS OF BROILER CHICKEN

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ABSTRACT

This study was conducted at the field of poultry farm of the Department of Animal Production / College of Agriculture Engineering Sciences / University of Baghdad / Abu Ghraib during the period from 22/9-10/11/2019 (for a period of 49 days). This study aims to demonstrate the effect of different systems of lighting on production performance, leg abnormalities, total mortality rate and some microbial traits in broiler chickens. 300 unsexed Ross308 chicks were used in the study at one day age with an average initial weight of 37.5 g. They were randomly distributed to five experimental treatments with three replicates for each treatment. Chicks were fed on starter diet for the first three weeks of age, and finisher diets for the fourth, fifth, sixth and seventh weeks of bird age. All birds switched to continuous lighting (24 hours light) during the first week of age. On the eighth day, the experiment was divided into five treatment ,The first program was Tc (control) 24 hours of light, the second T1:18 hours of light: 6 hours of darkness, and the third T2: 19 hours of light: 2 hours of darkness: 1 hour of light: 2 hours of darkness and the fourth T3:17 hours of light: 3 hours of darkness :1 hour of light: 3 hours of darkness, 5 hours of darkness, T4: 15 hours of light: 4 hours of darkness: 1 hour of light: 4 hours of darkness. (Up to the age of 6 weeks) and at the seventh week, all birds were exposed to continuous lighting for 24 hours of light. The results indicated that there were no significant differences in dressing yield with out and with edible organs at 6,7 weeks. While significant differences ($P < 0.05$) were observed in the relative weight of the thighs and wings parts in the treatment T3 compared with the control Tc treatment at the seventh week of age and a high significant superiority ($P < 0.01$) for the treatment T3 in the relative weight of neck cutter for the same age, Whereas, the control Tc treatment was significantly superior ($P < 0.05$) in the relative weight of the liver compared to the T1 treatment at the sixth week of age. Treatment T2 ($P<0.01$ and $P < 0.05$) was significantly compared with all trial treatments in pH value in crop, duodenum and ileum at 7 weeks of age. A significant increase ($P < 0.05$) was observed in the T2 treatment compared to the control treatment in the relative weight of thymus gland at the seventh week of age, and highly significant ($P < 0.01$) in the T3 treatment compared to the control treatment in the antibodies directed against Newcastle disease. Conclusion: It is concluded from this study that intermittent lighting programs Improved immune system function and reinforcement Production of antibodies against Newcastle disease and improved pH value of the digestive system.

Keyword: intermittent light, carcass characteristics, pH value, digestive system, immune system

Introduction

The poultry industry has made improvements in broiler growth efficiency, including genetics, nutrition, and changes in environmental management resulting in more rapid broiler growth. However, to maximize the genetic potential of modern heavy-weight broilers, recommendations for environmental factors (light, air, temperature, humidity) are important to optimize profitability and minimize physiological stress of broilers (Olanrewaju *et al*., 2018).

Light consists of 3 different aspects: intensity, photoperiod (duration), and wavelength (color). Lighting programs can affect many aspects of avian physiology, welfare, behavior, and other factors, including blood chemistry, ocular development, and behavioral rhythms (Olanrewaju *et al*., 2006, 2013; Schwean- Lardner *et al*., 2013). Abreu *et al*. (2011b) reported that carcass and thigh weight were heavier when using the intermittent light program. As well as improving the quality of the carcass (Zdenka *et al*., 2011). Rahimi *et al*. (2005) also confirmed that birds bred using the intermittent lighting program, 1 hour of light: 3 hours of darkness periodically, had a significant effect in reducing the abdominal fat of males and females of broilers at 42 days of age compared to the continuous lighting program of 23 hours of light: 1 hour of darkness. The study of Onbasilar *et al*. (2008) also showed that there were no significant differences in the dressing yield, the relative weights of the main carcass and abdominal fat , and the relative weights of edible giblets among birds exposed to the 24-hour light program and the 16-hour light program: 8 hours of darkness at the age of 42 days. Sirohi *et al*. (2018) indicated that there was a significant superiority in the dressing yield for turkeys when using the intermittent lighting program, 16 hours of light: 3 hours of darkness: 2 hours of light: 3 hours of darkness, and the continuous lighting program of 24 hours of light compared to the

lighting program, 16 hours of light: 8 hours of darkness at the age of 12 weeks, while there were no significant differences with respect to the main carcass and parts, relative weights of the edible giblets between all lighting programs. Further, darkness can induce the secretion of pineal melatonin, which plays an important role in growth performance, immune function, and the reproductive system. Several researchers have focused on the effects of lighting regimens on immune system function, and the results of one investigation indicate that IL improves both cellular and humoral immune responses (Abbas *et al*., 2008, 2013).

The function of immune cells is generally enhanced through exposure to short periods of light and the visible radiation affects the immune system through Certain mechanisms by the skin, the eye and the brain, as specific areas of the brain such as the pituitary gland, hypothalamus and pineal glands receive stimuli for hormone production and may affect immune function (Haldar and Ahmed, 2010). This experiment was conducted to find out the effect of the intermittent lighting on the carcass characteristics, relative weight and pH value of the digestive system members, and some of the immunological traits in broiler chicken.

Materials and Methods

300 broiler chicks at one day old of the Ross308 strain, un-sexed, with an average initial weight of 37.5 g, were prepared from the National Shukr hatchery to produce broiler chicks in the Abo Ghraib district. for the period from 22/9/2019 to 10/11/2019. The chicks were vaccinated against Newcastle and infectious bronchitis diseases with water. They were randomly distributed to five experimental treatments with three replicates for each treatment. Chicks were fed on starter diet (pellet) for the first three weeks of bird age (1-21 days of age, 22.3% P., 3000Kcl E.), and finsher diets for the fourth, fifth, sixth and seventh weeks of bird age (22-49 days of age, 21.4% P., 3100Kcl E.) (Table1). All birds switched to continuous lighting (24 hours light) during the first week of age. On the eighth day, the experiment was divided into five treatment, The first program was Tc (control) 24 hours of light, the second T1: 18 hours of light: 6 hours of darkness, and the third T2: 19 hours of light: 2 hours of darkness: 1 hour of light: 2 hours of darkness and the fourth T3: 17 hours of light: 3 hours of darkness : 1 hour of light: 3 hours of darkness, 5 hours of darkness, T4: 15 hours of light: 4 hours of darkness: 1 hour of light: 4 hours of darkness. (Up to the age of 6 weeks) and at the seventh week, all birds were exposed to continuous lighting for 24 hours of light. In 21,42,49 day the organ relative weight of digestive and immune system, dressing yield without and with the edible internal organs, was calculated. The blood was collected from the alar vein at the age of 42 days, and the blood was placed in tubes that were tilted at an angle of 45 degrees to obtain blood serum, and the samples were placed in a refrigerated box and sent to the group office for veterinary services in Al-Sinak area to perform the antibody test against Newcastle disease using the ELISA test. at 49 day PH was measured using a Romanian-made PH-Meter directly according to the method mentioned in AOAC (1990) after taking 1 gm of the crop, duodenum, jejunum and ileum contents separately and placed in the Cup Tube, then 9 ml of distilled water was added to it and measured after the device was zeroed Using PVR solution (4 and 7).

Table 1 : The chemical composition of the starter and finsher diets

chemical composition *	Startar diets (1-21 days)	Finsher diets (22-35 days)
Crude protein (%)	22.3	21.4
Representative energy (kcl / kg feed)	3000	3100
Crude fiber (%)	2.5	3.3
Fats (%)	3.6	6.3
Ash (%)	5.5	5.0
Phosphorous (%)	0.46	0.69
Sodium (%)	0.20	0.18
Calcium (%)	1.00	0.88
Methionine (%)	0.66	0.50
Lysine (%)	1.35	1.32

Based on the identification tag (lable) attached to the used feed bags

Results

Table 2 shows that there were no significant differences between all the experimental treatments in the dressing yield without and with the edible organs (liver, heart and gizzards) at the age of 6 and 7 weeks, and the table also indicates that there were no differences in the relative weights of carcass parts and abdominal fat at the age of 6 weeks. As for the relative weights of the carcass parts and abdominal fat at the seventh week, the results show that treatment T1 was significantly superior ($P < 0.05$) compared with treatment T3 in the relative weight of the breast, while it did not different significantly with the treatments Tc, T2 and T4, and the treatment of Tc did not different significantly compared with T2, T3 and T4. As for the relative weight of the thighs, the treatment T3 recorded a significant superiority ($P < 0.05$) compared to the treatments Tc, T1 and T4, while it did not different significantly with the treatment T2, and there were no significant differences between the control treatment and between the treatments T1, T2 and T4, and the treatment T3 was significantly superior ($P < 0.05$). Compared with all experimental treatments in the relative weight of the wings, the table shows that there was a high significant ($P < 0.01$) for the treatment T3 compared with the treatments Tc, T1 and T2, while it did not different significantly compared with the treatment T4 in the relative weight of the neck. It is noted from the table that there were no significant differences in the relative weight of the back and the abdominal fat between all the experimental treatments. The results shown in Table 3 indicate the effect of continuous and intermittent lighting on the relative weights of some respiratory and digestive system members at the age of 21 days, as it is noticed that there are no significant differences in the weight of the heart, lungs, gizzard, liver and spleen among all the experimental treatments. However, it was noticed that there was a significant difference ($P < 0.05$) in the relative weights of the glandular stomach and the intestine between the treatments, as the treatments Tc, T1 and T2 significantly differences $p < 0.05$ compared to treatment T4 in the relative weight of the glandular stomach, but these treatments did not different significantly with treatment T3 of the same trait, and with regard to the weight of the intestine The two treatments Tc and T1 were significantly ($P < 0.05$) superior to the two treatmentsT2 and T4, but they did not different significantly with treatment T3. The results of Table 4 indicate that the continuous and intermittent lighting programs did not show a significant effect on the weight of gizzard, heart, glandular

stomach, duodenum, jejunum, and caeca at 6,7 age of weeks, and the relative weight of the pancreas at the age of 6 weeks, and the relative weight of the liver and ileum at the age of 7 weeks. Whereas, the control treatment significantly difference P <0.05 compared with the treatment T1 in the relative weight of the liver and did not different with the treatments T2, T3, and T4, while the treatment T1 did not different significantly with the treatments T2, T3 and T4 in the same traits at the age of 6 weeks, and the control treatment significantly difference P <0.05 compared to with all experimental treatments in the relative weight of the ileum at the sixth week of age.in the seventh week, it is noticed from the same table that treatment T3 was significantly superior to P <0.05 in the relative weight of the pancreas compared with treatment T4 and it did not different significantly with treatments Tc, T1 and T2, and the control treatment did not different with all treatments for the same traits.

Table 2 : The effect of continuous and intermittent lighting on the dressing yield without and with the edible organs and the relative weights (%) of the main and secondary carcass parts and abdominal fat of broilers at 6 and 7 weeks old (mean ± standard error)

Treatment / Traits	age week	Tc(1)	T1	T2	T3	T4	Signifity(3)
Dressing yield with out the edible organs	6	77.280 ±0.994	77.028±0.974	78.998±0.748	78.102±0.419	78.928±0.289	N.S
	7	76.410 ± 0.721	78.003±0.521	76.903±0.219	77.453±0.344	77.563±1.062	N.S
dressing yield with the edible organs	6	81.243±1.030	80.620±1.041	82.578±0.765	81.883±0.449	82.520±0.234	N.S
	7	79.897±0.875	81.653±0.341	80.660±0.012	81.397±0.318	81.583±0.814	N.S
Breast	6	39.322±0.405	38.400±0.670	38.062±0.777	38.480±80.47	39.027±0.624	N.S
	7	41.240 ±60.49^{ab}	43.217±0.688$^{a(2)}$	41.067±0.445	38.973±80.20	40.453±1.69	*
Thighs	6	26.950±0.397	28.072±0.556	27.537±0.574	26.938±0.577	27.357±0.504	N.S
	7	26.440 ±0.344^{b}	26.820±0.528	27.013±0.484	28.667±0.237	26.590±0.837	*
Wings	6	9.490±0.278	10.203±0.214	10.108±0.378	9.707±0.265	10.412±0.484	N.S
	7	9.320±0.02 ^{b}	9.103±0.124	9.327±0.050	10.100±0.058	9.540±0.343	*
Back	6	18.330±0.530	17.257±0.756	18.410± 0.472	18.995±0.569	17.920±0.286	N.S
	7	18.717±0.780	16.717±0.267	17.853±0.593	16.693±0.139	15.090±2.542	N.S
Neck	6	5.778±0.164	5.822±0.228	5.787±0.232	5.745±0.259	5.167±0.260	N.S
	7	4.067±0.397 ^{c}	4.120±0.277^{c}	4.627±0.234^{bc}	0.228±5.550^{a}	5.400±0.046^{ab}	**
Abdominal fat	6	1.165±0.138	1.558± 0.376	1.530±0.066	1.498±0.170	1.700±0.135	N.S
	7	0.068±1.357	1.563±0.268	1.573±0.222	1.813±0.220	1.783±0.043	N.S

(1)Tc:24 hours light, T1:18 hours light: 6 hours darkness,T2:19 hours light:2 hours darkness:1 hour light:2hours darkness, T3:17 hours light: 3 hours darkness:1hour light:3 hours darkness, T4:15hours light: 4 hours darkness:1hour light:4 hours darkness. (2)The different letters within the same row indicate significant differences between the averages.(3)N.S was no significant difference. * There was a significant difference at P <0.05.** There was a significant difference at P <0.01.

Table 3 : The effect of continuous and intermittent lighting on the relative weights (%) of some respiratory and digestive system of broilers at 21 days (mean ± standard error)

Treatment / Traits	Tc(1)	T1	T2	T3	T4	Signifity(3)
Heart	0.543± 0.176	0.503± 0.012	0.530± 0.051	0.577± 0.008	0.553± 0.043	N.S
Lung	0.510 ± 0.050	0.457± 0.033	0.413± 0.028	0.547± 0.064	0.503± 0.043	N.S
Gizzard	2.00± 0.184	2.150± 0.084	1.870± 0.062	1.923± 0.122	1.953± 0.143	N.S
Glandular Stomach	0.543± 0.018^{a}	0.483± 0.029^{a}	0.490± 0.025^{a}	0.447± 0.026^{ab}	0.347± 0.061$^{b(2)}$	*
Intestine	4.180± 0.133^{a}	4.173± 0.144^{a}	3.430± 0.286	3.800± 0.144^{ab}	3.330± 0.185^{b}	*
Liver	2.300± 0.269	2.220± 0.102	2.090± 0.111	0.1322.457±	2.177± 0.057	N.S
spleen	0.057± 0.003	0.053± 0.003	0.063± 0.018	0.077± 0.006	0.077± 0.003	N.S

(1)Tc:24 hours light, T1:18 hours light: 6 hours darkness,T2:19 hours light:2 hours darkness:1 hour light:2hours darkness, T3:17 hours light: 3 hours darkness:1hour light:3 hours darkness, T4:15hours light: 4 hours darkness:1hour light:4 hours darkness. (2)The different letters within the same row indicate significant differences between the averages.(3)N.S was no significant difference. * There was a significant difference at P <0.05.

Table 5 indicates the effect of continuous and intermittent on the pH of the crop, duodenum, jejunum, and ileum, and it is evident that there was a significant decrease in the PH value of treatment T2 in the crop compared with all treatments, and treatment T2 recorded a significant decrease P <0.05 compared with control treatment Tc and did not different Significantly with T1, T3, and T4, there were no significant differences between the control treatment and the

T1, T3, and T4 treatments in the PH value in the duodenum. while there was no significant effect for the different lighting programs on the pH of the jejunum and for all the experimental treatment. High significant decrease p <0.01 in treatment T2 of the pH value in the ileum compared with the all the trial treatments, while there was no significant difference between the control treatment and the treatments T1, T3 and T4.

Table 6 shows the effect of continuous and intermittent lighting in the calculation of antibodies directed against Newcastle disease, as the results show a significant increase in the antibodies directed against Newcastle disease in treatment T3 compared to the control treatment Tc, while there are no significant differences between it (T3) and between the treatments T1. , T2, T4.

Table 4 : The effect of continuous and intermittent lighting on the relative weights of the digestive system organs (%) for broilers 6 and 7 weeks old (mean ± standard error)

Treatment / Traits	age week	Tc[(1)]	T1	T2	T3	T4	Signifity[(3)]
Gizzard	6	1.013±0.066	1.040 ±0.074	0.897±0.104	1.058±0.042	0.985±0.066	N,S
	7	0.876±0.083	0.940 ±0.100	0.846±0.069	0.906±0.083	0.803±0.097	N.S
Heart	6	0.535±0.037	0.528 ±0.013	0.477±0.025	0.512±0.013	0.507 ±0.020	N.S
	7	0.490±0.012	0.483 ±0.043	0.480±0.044	0.470±0.015	0.503±0.034	N.S
Liver	**6**	2.415±0.200[a]	2.012±0.079	2.197 ±0.070	2.202±0.118	2.255±0.071	*
	7	2.110±0.130	2.216 ±0.093	2.420±0.310	2.553±0.231	2.343±0.209	N.S
Glandular stomach	**6**	0.250±0.047	0.315±0.035	0.307±0.009	0.277±0.014	0.323±0.033	N.S
	7	0.236±0.015	0.276 ±0.018	0.250 ±0.006	0.286±0.041	0.263±0.018	N.S
pancreas	**6**	0.205±0.011	0.183 ±0.005	0.203±0.019	0.220±0.012	0.220 ±0.017	N.S
	7	0.176± 0.020[ab]	0.176 ± 0.015[ab]	0.176 ± 0.017[ab]	0.216 ± 0.012[a(2)]	0.163 ± 0.007[b]	*
Duodenum	**6**	0.451±0.033	0.488±0.024	0.560±0.048	0.490±0.023	0.498±0.022	N.S
	7	0.550±0.085	0.446 ±0.003	0.446±0.023	0.576±0.050	0.496±0.033	N.S
Jejunum	**6**	0.943±0.107	0.938 ±0.048	1.00±0.083	0.938±0.057	1.016±0.078	N.S
	7	1.053±1.124	0.880 ±1.012	0.996±0.072	0.873±0.087	0.840±0.070	N.S
Ileum	**6**	0.835±0.073[a]	0.678 ±0.054[b]	0.638 ±0.037[b]	0.648±0.037[b]	0.658±0.040[b]	*
	7	0.723±0.103	0.613 ±0.012	0.673 ±0.052	0.800 ±0.110	0.650±0.038	N.S
caeca	6	0.296±0.021	0.273±0.026	0.253 ±0.030	0.241±0.021	0.271±0.020	N.S
	7	0.346±0.043	0.283 ±0.022	0.243 ±0.019	0.263±0.019	0.243±0.039	N.S

(1)Tc:24 hours light, T1:18 hours light: 6 hours darkness,T2:19 hours light:2 hours darkness:1 hour light:2hours darkness, T3:17 hours light: 3 hours darkness:1hour light:3 hours darkness, T4:15hours light: 4 hours darkness:1hour light:4 hours darkness. (2)The different letters within the same row indicate significant differences between the averages. (3)N.S was no significant difference. * There was a significant difference at P <0.05.

Table 5 : Effect of continuous and intermittent illumination on the pH value of Crop, Duodenum, jejunum and ileum contents of broilers at 7 weeks of age (mean ± standard error)

Traits / Treatment	Crop	Duodenum	Jejunum	Ileum
[(1)]Tc	6.423±0.243[a]	7.143± 0.391	0.14 ±36.656	7.430± 0.208
T1	6.400±0.321[a]	6.933± 0.148[ab]	6.783± 0.052	7.626± 0.090[a]
T2	5.140±0.078[b]	6.133± 0.398[b]	6.570±0.193	6.316± 0.017[b(2)]
T3	6.386±0.261[a]	6.746± 0.023[ab]	6.826± 0.039	7.400± 0.042[a]
T4	6.650±0.100[a]	7.00±0.087[ab]	6.763± 0.019	0.19 ±3[a]7.306
Signifity[(3)]	**	*	N.S	**

(1)Tc:24 hours light, T1:18 hours light: 6 hours darkness,T2:19 hours light:2 hours darkness:1 hour light:2hours darkness, T3:17 hours light: 3 hours darkness:1hour light:3 hours darkness, T4:15hours light: 4 hours darkness:1hour light:4 hours darkness. (2)The different letters within the same row indicate significant differences between the averages.(3)N.S was no significant difference. * There was a significant difference at P <0.05.** There was a significant difference at P <0.01.

Table 6 : The effect of continuous and intermittent lighting in the calculation of antibodies directed against Newcastle disease in broilers at 6 weeks of age (mean ± standard error)

Treatments	Newcastle disease titer
982.3 ±205.78[b]	[(1)]Tc
2495.67±1065.79[ab(2)]	T1
1950.67±448.68[ab]	T2
3357.3 ±816.29[a]	T3
3018.0±590.02[ab]	T4
*	Signifity[(3)]

(1)Tc:24 hours light, T1:18 hours light: 6 hours darkness,T2:19 hours light:2 hours darkness:1 hour light:2hours darkness, T3:17 hours light: 3 hours darkness:1hour light:3 hours darkness, T4:15hours light: 4 hours darkness:1hour light:4 hours darkness. (2)The different letters within the same row indicate significant differences between the averages.(3)N.S was no significant difference. * There was a significant difference at P <0.05

It is evident from Table 7 that there were no significant differences in the relative weights of spleen, fabricius and thymus gland at 6 weeks. At the 7 weeks, treatment T4 recorded a significant increase, P <0.05 in the relative weight of spleen compared with treatment T1 and T3, but it did not different significantly with the treatments Tc and T2. As for the relative weight of fabricius gland, a significant increase was observed with P <0.05 for treatment T1 compared with treatment T2. However, there were no significant differences compared with Tc, T3 and T4. It is noticed from the table that there was a significant increase, P <0.05, in the relative weight of thymus gland in the treatment T2 compared to the control treatment, while it did not different significantly with the treatments T1, T3 and T4.

Table 7 : The effect of continuous and intermittent lighting on the relative weights of some immune organs (%) for broilers at 6 and 7 weeks (mean ± standard error)

Trait	Age week	Treatments					Signify(3)
		(1)Tc	T1	T2	T3	T4	
Spleen	6	0.098±0.009	0.088±0.014	0.103± 007.	0.113± 017.	0.083±0.010	N.S
	7	0.16±0.026^{ab}	0.093±0.007^{b}	0.106±0.003^{ab}	0.086±0.009$^{b(2)}$	0.193±0.059^{a}	*
Fabricius gland	6	0.085±0.018	0.126± 0.026	0.120± 0.023	0.128± 0.017	0.135± 0.018	N.S
	7	0.080±0.029^{ab}	0.03±0^{a}0.140	0.070± 0.006^{b}	0.100± 0.010^{ab}	0.093±0.012^{ab}	*
Thymus gland	6	0.276±0.024	0.02±20.225	0.313± 0.038	0.320± 0.061	0.321± 0.039	N.S
	7	0.236±0.057 ^{b}	0.296±007.^{ab}	0.416± 0.069^{a}	0.320±0.045^{ab}	0.376±0.044^{ab}	*

(1)Tc:24 hours light, T1:18 hours light: 6 hours darkness,T2:19 hours light:2 hours darkness:1 hour light:2hours darkness, T3:17 hours light: 3 hours darkness:1hour light:3 hours darkness, T4:15hours light: 4 hours darkness:1hour light:4 hours darkness. (2)The different letters within the same row indicate significant differences between the averages.(3)N.S was no significant difference. * There was a significant difference at P <0.05.

Discussion

It is noticed from Table 2 that there was no significant effect for all lighting systems in the sixth and seventh weeks of age in the dressing yield without and with edible organs. These results agreed with each of the researchers (Fidan *et al*., 2017a and Olanrewaju *et al*., 2018) who noted no significant differences in the dressing yield when using different lighting systems. The same table also indicates that there were no significant differences in the relative weights of carcass parts at the sixth week of age, and it was in agreement with the results of Adabi *et al.* (2007) and Coban *et al.* (2014). Whereas, significant differences were observed in the relative weights of the thigh, wings, and neck parts in the seventh week, especially for treatment T3 (17 hours of light: 3 hours of darkness: 1 hour of light: 3 hours of darkness) in which the relative weight of these pieces increased compared to the control treatment, and the reason may be due to the significant decrease in relative weight chest part in this treatment and may have had a role in influencing the growth of other parts. These results agreed with Abreu *et al.* (2011b), who indicated that the use of intermittent lighting had a significant effect on the relative weight of the thigh. As for the relative weight of abdominal fat, the same table indicates that there are no significant differences when using different lighting systems, and these results are in agreement with those obtained by Olanrewaju *et al.* (2012-2018).

Table 3 indicates that there was no significant effect of intermittent and continuous lighting systems on the relative weights of some respiratory and digestive system members at 21 days, and these results agreed with each of the researchers (Adabi *et al*., 2007; Onbasilar *et al*., 2007, 2008; El-fiky *et al*., 2008). Table 4 shows that there were no significant differences in most of the relative weights of the digestive system members in the sixth and seventh weeks when using different lighting systems Our results were in agreement with Onbasilar *et al*., 2008 and Coban *et al*., 2014, as they indicated that there were no significant differences in the continuous lighting program compared with the intermittent lighting programs in the relative weights of the heart, liver and gizzard. It is noticed in the same table that there was a significant increase in the relative weight of the ileum in the continuous lighting program compared with the intermittent lighting programs, which were in agreement with the results of Classen Schwean-Lardner and Fancher (an acceptable research for publication), which explained that the intermittent lighting programs increased the size of the crop and reduced the jejunum and ileum weight, which improved feed intake.

Table 5 shows a significant decrease in the pH value of treatment T2 (19 hours of light: 2 hours of darkness: 1 hour of light: 2 hours of darkness) in the follicle, duodenum and ileum compared to the continuous lighting program. The reason for this decrease may be due to the activity of *Lactobacilli* bacteria, which reduced the acidity of the environment in which you live in the crop, which reflected positively on the rest of the digestive system (parts of the small intestine), Cutler *et al*. (2005) showed that exposing turkeys to the 14 hour light:10 hour dark program reduced the pH value of the crop to increase levels of lactic acid and short-chain fatty acids. This study was in agreement with the results of Dalal (2016), which indicated that the pH value of crop in exposed broilers decreased to 13 hours of light: 11 hours of darkness. The reason for a significant superiority in antibodies directed against Newcastle disease in the T3 treatment compared with the continuous light treatment, which is consistent with the interpretation of Onbasilar *et al*. (2007), may be attributed to the fact that the intermittent lighting programs positively affected the immune response to Newcastle disease, and our results agreed with Abbas *et al.* results (2008-2013) who indicated that the intermittent lighting improved the functions of the immune system, as it indirectly affected through the effect of the hormone melatonin on inhibiting kinase proteins, stimulating peripheral lymphocyte proliferation, increasing the number

of antibodies, and enhancing the production of glycoproteins in the spleen (splenocyte interleukin-2) produced by white blood cells. to regulate the immune response in male broilers(Table6).

It is evident from Table 7 that there were no significant differences in the relative weights of spleen, fabricius and thymus gland in the sixth week between the continuous lighting treatment and the intermittent lighting treatments, as there were no significant differences in the relative weights of spleen and fabricius gland in the seventh week between all intermittent lighting treatments and the control treatment. These results are in agreement with the results of Onbasilar *et al.* (2007, 2008) and Yang *et al*. (2015) who indicated that there was no significant effect of the intermittent lighting programs compared with the continuous lighting program in the relative weights of spleen and fabricius gland. As for the relative weight of the thymus gland, treatment T2 (19 hours of light: 2 hours of darkness: 1 hour of light: 2 hours of darkness) recorded a significant increase compared with the treatment of continuous lighting in the seventh week of age, which may be attributed according to the interpretation of Zheng *et al.* (2013) who indicated an increase The relative weight of thymus gland indicates an enhanced immune function and the ability to infection resistance, disease and stress. Fox and Grasman (1999) also found that the numbers of lymphocytes in the fabricius and thymus gland are related to the weight of the organ.

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