THE EFFECT OF USING ULTRAVIOLET RAYS WITHIN THE LIGHTING SYSTEM ON PRODUCTIVE PERFORMANCE OF BROILER

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Abstract

The current study was conducted from December 20, 2021 to January 23, 2022 in Poultry houses of the Department of Animal Production at the Faculty of Agriculture, University of Basra. To study the effect of ultraviolet radiation on the productive performance of broilers. The study was divided into 35-day field experiment. In this study, 180 non-naturalized chicks and one-day-old ROSS 308 were used. Chickens are randomly assigned to five experiments, three replicates for each treatment (12 chicks per replicate). Treatment is as follows UVB lamps and wavelengths (280-320) nm were used. The birds were reared in separate sections, where each section is assigned for one treatment. The Experience is as follows; The control treatment is regular light (LED) without using UV radiation, while the T1, T2, T3 and T4 treatments use UV lamps for different periods of time (30, 60, 90 and 120 minutes/day) respectively during the 35-day trial period. The birds were fed two available diets, the first containing 23.33% crude protein and 2990 kcal/kg metabolic energy. The second diet contained growth containing 20.24% crude protein and 3119 kcal/kg metabolic energy. The results of this study showed a significant increase ($P \leq 0.05$) in body weight in birds with T2, T3 and T4 treatments at week 5, in addition to weight gain at week 4 and the cumulative T3 and T4 treatments increased significantly ($P \leq 0.05$). It also showed no significant influence of UV use on the amount of weekly and cumulative feed intake, feed conversion ratio, total mortality and production index. There is no significant effect of the use of UV radiation on carcass characteristics (cultivation percentage, relative weight of breast, thighs, back, wings and neck) and relative weight of internal organs (heart, liver, gizzard, spleen and bursa and the Fabricius gland).

Keywords: Ultraviolet, Productive Performance, Broiler

Introduction

The poultry industry is an important source of animal protein that contributes to nutrition to cope with the rapid growth of the world population (1). Air speed, radiation, and appropriate lighting system are another environmental factor that are essential for the growth of meat chicks on farms (2). Light is an important part of the poultry house system and lighting programs are important techniques for influencing productive, physical, immunological, reproductive and welfare performance, including many aspects of menstruation and photosynthesis, as well as qualitative aspects of them (3). Solar radiation is part of the electromagnetic field and a prerequisite for the continued existence of life on the earth's surface, including the electromagnetic field. Part of its waves are visible (380-780) nm, while others are invisible such as UV radiation (100-380) nm (4). Ultraviolet light consists of shorter wavelengths (100-400) nm from the electromagnetic

radiation spectrum, and are divided into three distinct parts UVA nm (315-400), UVB (315-280) (and UVC nm (280-100) (5).

The implementation of providing UV lamps in poultry houses is still being evaluated and will improve poultry welfare until further research is completed. However, research shows that UVB supplementation can improve growth and yield in poultry increase (6). There is growing interest in UV applications in the poultry industry and studies have shown that UV radiation stimulates growth through an increase in muscle weight in birds exposed to UV radiation. This increase may be the result of an increase in Satellite cells in skeletal muscles, particularly in the early days of the bird's life (7). Due to the variety of lighting programs that can be followed in the breeding programs of meat chicks, the current study aims to find out the influence of UV radiation within the lighting system on the production performance of meat chicks.

Materials and Methods

Animal and Animal Husbandry

A total of 180 one-day-old Ross 308 chicks were used in this study. In the poultry house of the Department of Animal Production, Faculty of Agriculture, Basra University, the chicks were reared separate sections that prevented the transmission of ultraviolet radiation from one section to another, where each section was allocated for one treatment under controlled conditions from 1 day to 35 days. The chicks were housed in five light groups in individual rooms of 3 x 1 x 1 m (length× width× height (, with an average of 36 chicks per room. The treatment is as follows: it applied using UVB lamps and wavelengths (280) nm and intensities of 6 watts were used. The birds were reared in separate periods, where each period is assigned a treatment. The Experience included a control treatment where there is regular light (LED) without using UV radiation, while the T1, T2, T3 and T4 treatments use UV lamps for different periods of time (30, 60, 90 and 120 minutes/day) respectively during the trial period. The birds are supplied with 24 hours of continuous light every day, provided with an initial temperature of 33°C and was then reduced by 2°C/week to 25°C after 35 days. The birds were fed two available diets, the first containing a crude protein of 23.33% and a metabolic energy of 2990 kcal/kg and the second diet containing growth containing 20.24% crude protein and a metabolic energy of 3119 kcal /kg contained. The diet was formulated according to (8) table (1). Cylindrical plastic feeders were placed in each pen. Food and water were provided ad libitum to these birds.

Measurement of Productive Performance

Body weight, weight gain, feed intake, feed conversion ratio was calculated according to (9). Mortality and production index wear recorded at the end of the study. At the end of the study period on the 35th day, two birds of similar body weight from each treatment were used to study carcass characteristics. The weight of the carcass pieces (breast, back, thighs, wings and neck) was calculated according (10). The relative weights of the organs were collected, expressed as a percentage of the live body weight.

Table (1): Composition and nutritional content of experimental diets.

Forage	Starter (1-21 day) %	Growth (22-35 day) %
Wheat bran	16	20
Yellow corn	44.2	48.7
Concentrated Protein (1)	4	1
The soybean gain is 44% protein	32	22
Soy oil	0.5	2.5
Vitamin and mineral mixture	1	1
Salt	0.3	0.3
limestone	2	1.5
Computerized chemical composition (2)		
Crude protein (%)	23.04	19.14
Representative energy (kilograms / kg)	2945	3170

(1) The concentrated protein imported from Jordan Company of FAPCO contains 2200 kcal/kg, 50% crude protein, 2.5% methionine + cysteine, 3% lysine, 3% phosphorus and 8% calcium.

(2) The chemical composition is based on the NRC (1994) analysis of the feed stuffs mentione

Statistical Analysis

Study data were analyzed using a completed randomized design (CRD) analysis of variance to analyze the results using the completed SPSS program (11). The Dancan's test (12) was applied to separate means at a significant level ($P \leq 0.05$).

RESULTS AND DISCUSSION

Body weight and weight gain:

Table (2) refers to the effect of UV radiation on the live weight of broilers, a significant effect of UV-B used under normal lighting (LED) on the live weight of birds is found in different transactions during the 1st, 2nd, 3rd and 4th weeks. While the results indicated significant differences ($P\leq 0.05$) in living body weight between the study treatments in the 5th week, since the T4 treatment had showed the highest living body weight of 1891.93 g/bird that did not differ significantly in the T2 and T4 transactions, and those are averaged 1874.30 and 1886.00 g/ bird, respectively. Whereas the control treatment with normal lighting LED showed the lowest rates of 1855, 00 g/ bird, that did not differ significantly from the T1 treatment, which was recorded at 1858.33 g/bird.

The results from Table (3) showed that there was no significant difference at 1st, 2nd, 3rd and 4th weeks in weekly weight gain (g) for all experimental treatments. The results showed that there was a significant difference ($P\leq 0.05$) at week 4, with the peak T4 rate being 562.33 g/bird, which was not significantly different from the T2 and T4 treatments with 548, 00, 550.00 g/bird. On the other hand, the control treatment had the lowest rates of 542.00 g/bird, which was not significantly different from the T1 treatment of 545.0 g/bird and the T2 and T3 treatments. The results show that there is a significant difference ($P\leq 0.05$) between different experimental transactions in

cumulative weight gain, with T4 having the highest cumulative weight gain of 1849.93 g/bird, and this did not differ significantly from T1, T2 and T3 treatment, with the rates being 1816.33, 1832.30 and 1844.00 g/bird, respectively. The control treatment had the lowest rates at 1813.00 g/bird, which was not significantly different from the T1 and T2 treatments.

The fact that UV radiation factors gradually outperform by means of increasing duration of exposure in live weight and weekly and cumulative weight gain, may be due to the potential effect of short wavelengths to stimulate growth by stimulating the body to produce vitamin D which may promote the growth and effectiveness of structural muscle satellite cells (7). The high levels of vitamin D in UV radiation treatments may have an effect on increasing the process of muscle protein synthesis (13). In addition, vitamin D acts directly at the muscle cell level and its deficiency is associated with muscle weakness and atrophy. Several studies have shown that vitamin D stimulates muscle growth through protein synthesis by activating vitamin D receptors, as well as an increase in muscle mass. Increased Vitamin levels cause increased and rapid integration of amino acids into muscle proteins needed to increase protein synthesis in musculoskeletal fibers (7) and (14).

Short wavelengths can stimulate increased plasma androgen levels. Androgens promote protein synthesis and reduce protein breakdown, as a result androgens causes increased muscle growth and participate in the normal maintenance of muscle tissue (15). (16) found that short wavelengths can stimulate body growth by affecting the hypothalamus gland, which stimulates the gonads to produce their growth-stimulating hormones and bird activity. The results of this study coincided with those of (17), (18) and (19) who reported that UV exposure generally increases body growth. The results of their studies have shown that UV reared broilers tend to show higher growth than birds reared under normal lighting.

Table (2) The effect of using UV radiation within the lighting system in the weight of the living body (g) of the broiler (average ± SE.).

Treatments	Initial live weight	Week 1	Week 2	Week 3	Week 4	Week 5
Control	42	160.03 ± 1.50	447.56± 4.21	837.33± 5.24	1379.33± 10.33	±1855.00^{c} 3.46
T1	42	160.67± 2.67	449.97± 4.28	840.00± 5.77	1385.00± 8.39	±1858.33^{bc} 3.38
T2	42	162.83± 2.48	451.63± 7.11	842.67± 5.78	1390.66± 9.24	±1874.30^{from} 7.66
T3	42	164.07± 1.84	453.26± 3.43	852.33± 3.53	1402.33± 4.63	±1886.00^{a} 3.79
T4	42	164.57± 1.99	456.97± 5.76	845.60± 5.21	1407.93± 8.49	±1891.93^{a} 8.17
Sig. level	N. S	N. S	N. S	N. S	N. S	*

***a,b,c Means of different superscripted vertical lines are significantly different (p<0.05).**

***N.S. not important. SE: standard error.**

Table (3) The effect of the use of UV radiation within the lighting system in weight gain (g) of broiler (average ± SE.)

Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	Cumulative weight gain
Control	118.03± 1. 50	287.53± 2.76	389.76± 4.26	±542.00^{b} 7.21	475.67± 8.41	±1813.00^{b} 3.46
T1	118.66± 2.68	289.30± 1.89	390.03± 2.08	±545.00^{b} 2.64	473.33± 6.36	±1816.33^{ab} 3.38
T2	120.83± 2.48	288.80± 4.98	391.03± 4.82	±548.00^{ab} 4.04	483.63± 2.19	±1832.30^{ab} 7.66
T3	122.07± 1.84	289.20± 2.74	399.06± 4.92	±550.00^{ab} 3.78	483.66± 1.20	±1844.00^{a} 3.78
T4	122.57± 1.99	288.70± 1.96	392.33± 3.18	±562.33^{a} 3.66	484.00± 1.15	±1849.93^{a} 8.16
Sig. level	N. S	N. S	N. S	*	N. S	*

*a,b,c Means of different superscripted vertical lines are significantly different ($p<0.05$).

*N.S. Not Important. SE: Standard error.

feed intake and feed conversion ratio

Tables (4) and (5) show the effect of UV use within the lighting system on the amount of weekly and cumulative feed intake (g) and weekly and cumulative feed conversion ratio (g feed/g weight gain) of broilers. Table 4 shows that the differences between the different experimental treatments were not statistically significant in the amount of feed eaten weekly and cumulatively, although there were differences between them, but they were considerable. Birds treated control while the lowest rate was 2871.47 g/bird for the T4 treatment birds.

. Table (5) shows that despite the improvement in cumulative nutrition, there are no significant differences in the ratio of

weekly and cumulative feed conversion between different experimental transactions in the conversion ratio of UV treatments compared to the control, but there were differences in the calculation. The T4 treatment recorded the lowest cumulative feed ratio rate of 1.55 g feed/g weight gain, while the peak rate of 1.61 g feed/g weight gain recorded weight gain in the control treatment. These results were consistent with those of the researchers (20), (21) and (19) who indicated that the use of UV radiation as a supplement to the normal lighting system has no significant effect on the rate of feed ingestion and the feed conversion ratio.

Table (4) The effect of UV use within the lighting system on the weekly and Cumulative feed intake (g/bird/weekly) of broiler (average ± SE.).

Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	Cumulative feed
Control	139.66± 3.76	±384.76 5.31	578.72± 6.013	888.84± 10.38	924.16± 14.55	2916.15± 20.59
T1	140.00± 2.31	387.73± 6.99	576.16± 5.94	887.16± 9.25	914.70± 19.44	2905.76± 10.38
T2	±141.00 3.21	391.03± 5.79	581.47± 5.85	883.81± 9.27	908.68± 10.73	2906.00± 7.37
T3	140.33± 2.19	391.00± 5.03	575.38± 7.81	881.63± 7.19	900.13± 8.93	2888.48± 13.57
T4	139.00± 3.46	381.63± 8.55	574.37± 5.19	880.31± 14.39	896.15± 11.68	2871.47± 21.67
Sig. level	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

* N.S. not significant. SE: standard error

Table (5) The effect of UV use within the lighting system on weekly and Cumulative feed conversion ratio (g feed/g weight gain) of broiler (average ± SE.)

Treatments	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Cumulative feed conversion ratio**
Control	1.18± 0.017	1.33± 0.031	1.48± 0.020	1.64± 0.038	1.94± 0.056	1.61± 0.014
T1	1.18± 0.039	1.34± 0.017	1.47± 0.018	1.63± 0.012	1.93± 0.032	1.60± 0.009
T2	1.16± 0.028	1.36± 0.040	1.49± 0.006	1.61± 0.026	1.88± 0.030	1.59± 0.007
T3	1.15± 0.003	1.35± 0.008	1.44± 0.033	1.60± 0.017	1.86± 0.023	1.57± 0.006
T4	1.13± 0.028	1.32± 0.022	1.46± 0.013	1.56± 0.024	1.85± 0.020	1.55± 0.012
Sig. level	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

* N.S. not significant. SE: standard error

Table 6 shows the effect of UV use on total mortality and production index of broilers, and it is clear that there is no significant effect of UV use on total mortality rate in different transactions during the period (1-35) days. This finding is consistent with his findings (20) and (22), whose study results indicated that there was no significant effect of UV use on the total mortality rate of broilers. The results of the table also showed no significant differences in the production index between the different experimental treatment, although the improvement in the value of this measure for the T1, T2, T3 and T4 UV treatments, was 313.61, 318.64, 334.46 recorded and 338.72 thus when compared to control at 310.90, respectively, did not rise to the level of significance.

Table (6) The effect of the use of ultraviolet radiation within the lighting system on the percentage of total mortality and the productive index of broilers (average ± SE.).

Treatments	mortality (%)	Production index
Control	5.56± 5.56	310.90± 15.68
T1	5.56± 2.77	313.61± 11.55
T2	5.56±5.56	318.64± 16.74
T3	2.77± 2.77	334.46± 9.62
T4	2.77± 2.77	338.72± 11.80
Sig. level	**N. S**	**N. S**

* N.S. not significant. SE: standard error

The characteristics of sacrifices (the ratio of Carcass yield and the relative weights of the carcass pieces)

From Table 7 which gives the effect of the use of ultraviolet radiation within the lighting system on the properties of carcasses at the age of 5 weeks, it is clear that there are no statistically significant differences in carcass yield rates despite the difference in the differences of the existing experimental treatments where the values of the treatments T1, T2, T3 and T4 reached 72.53, 72.85, 72.53 and 72.95 respectively. The yield of the carcass was higher than the values of the control coefficient where it was 72.50, and corresponds to the results of the current study with the results of (18) who found in their study that there are no significant differences in carcass yield between the total number of broilers bred under the influence of ultraviolet radiation and normal light.

Table 7 shows that there are no significant differences between the relative weights of the carcass characteristic measurements (breast, thighs, back, wings and neck) between the different treatments, although the UV treatments outperformed the control treatment in terms of the relative weights of the main carcasses (breast and thighs), but they did not reach the level of significance as the relative weights of the breast were 34.70, 35.17, 34.88, 35.10 and 34.67 for UV treatments and control, respectively. The relative weights of the thigh were 27.85, 27.98, 27.97, 28.23 and 27.83, respectively. This result agreed with that of (23) study that had no significant effect on carcass

cutting using UV radiation. We conclude from the current results that the use of UV radiation within the lighting system had no negative or significant impact on carcass properties.

Table (7) Effect of the use of ultraviolet radiation within the lighting system on Carcass Characteristics at the end of the fifth week of life of broilers (average ± SE.).

Treatments	Carcass yield (%)	Breast yield (%)	Thigh yield (%)	Back yield (%)	Wing yield (%)	Neck yield (%)
Control	72.50± 0.23	34.67± 0.28	27.83± 0.24	22.15± 0.45	±9.90 0.14	5.44± 0.05
T1	72.53± 0.16	34.70± 0.23	27.85± 0.14	22.36± 0.16	±9.62 0.40	5.47± 0.04
T2	72.85± 0.03	35.17± 0.23	27.98± 0.39	21.80± 0.42	±9.69 0.30	5.35± 0.05
T3	72.53± 0.19	34.88± 0.22	27.97± 0.25	21.82± 0.12	±9.91 0.03	5.42± 0.06
T4	72.95± 0.18	35.10± 0.29	28.23± 0.24	21.55± 0.25	±9.72 0.18	5.40± 0.01
Sig. level	N. S	N. S	N. S	N. S	N. S	N. S

* N.S. not significant. SE: standard error

Relative organs weights

Table (8) refers to the effect of UV use within the lighting system on the relative weights of internal organs (heart, liver, gizzard, spleen and bursa of Fabricius gland) in various experimental treatments at 35 days of age. The table shows that there are no significant differences in the use of UV radiation in the relative weight of the heart in different treatments. The highest relative weight of the heart of 0.59% was observed in the T2 and T4 treatments and a relative weight of 0.57 % recorded in the control. Table 8 shows no significant effect of UV application on relative liver weight and recorded the highest relative liver weight of 2.60% in T4 treatment sacrifices, while the lowest relative liver weight was recorded at 2.43% in the birds treated with the control. The results of this study comply with (24) who suggested that there was no significant effect of UV exposure on the relative weights of the heart and liver. For the effect of UV radiation on relative gizzard weight, (Table 8) results showed no significant effect of UV radiation on this property and recorded the highest relative gizzard weights of 1.66 and 1.65% at T2 and T4 treatments, while the relatively lowest weight gizzard was 1.53% of control birds.

Table 8 shows that there is no significant effect of UV radiation on the relative weights of the spleen and Fabricius gland bursa in broiler carcasses at different transactions at 35 days of age. The highest relative weight of the spleen was measured at T4 with 0.133%, while the lowest was at T1 with 0.120%. With regard to the relative weight of the Bursa Fabricius gland, the results of the study were consistent with what (24) who found that the relative weight of the spleen was not affected when using the UV-B lighting system compared to the normal LED lighting system.

(8) The effect of UV use within the lighting system in the relative weight of the internal organs at the end of the fifth week of the life of the broiler (average ± SE.).

Treatments	Heart (%)	Liver (%)	gizzard (%)	Spleen (%)	Bursa of Fabricius gland (%)
Control	0.57± 0.032	2.43± 0.103	1.53± 0.06	0.123± 0.009	0.003 ±.0049
T1	0.58± 0.014	2.45± 080.	1.54± 0.05	0.120± 0.017	0.002 ±0.044
T2	0.59± 0.020	2.53± 110.	1.66± 0.01	0.132± 0.009	0.003 ±0.042
T3	0.58± 0.017	2.51± 08. 0	1.55± 0.02	0.130± 0.011	0.002 ±0.041
T4	0.59± 0.030	2.60± 070.	1.65± 0.01	0.133± 0.009	0.003 ±0.040
Sig. level	N. S	N. S	N. S	N. S	N. S

* N.S. not significant. SE: standard error

Conclusion

It could be concluded that broilers reared under the influence of UV light showed improvement in growth performance (body weight, weight gain) and had no significant impact on feed intake, feed conversion ratio, mortality, production index, carcass characteristics and relative organ weights.

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