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Effect Of Photoperiod On The Performance Of Two Broiler Genotypes (Fast And Slow Growth) In Relation To Some Immune Organs.

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Abstract:
The objective of the present study was to investigate the effect of two lightning programs on the productive performance of both broiler genotypes (fast and slow growth) chicks. A total of 417 un-sexed broiler chicks of two different commercial strains (163 Cobb as a type of fast-growth broiler and 254 Sasso as a type of slow-growth broiler) were reared in two different continues photoperiods regimens (24 h. of light:0h of dark. and 20h of light: 4h. of dark) from 1 to 35days of age.
The most important results were:
1- There were highly significant differences (P≤0.01) between boiler genotypes in live body weight at different ages.
2- Sasso (as the low growth genotype) in the second photoperiod (20h.) was heavier than in the first photoperiod (24h.) from the first day to 19 d of age, after that the opposite occurred. So, the best photoperiod for the low-growth type broiler was 20h of light at the first three weeks of age, followed by 24h/d afterward. At the first week of age, a 20 h/d photoperiod is enough for the fast growth type broilers, 20 h/d photoperiods, followed by 24 h/d afterward for obtaining heavier final body weight.
3 - Differences between two genotypes of broiler in liver weight were highly significant (P≤0.01).
4- There were no significant differences between the two genotypes of the broiler and between two photoperiods in GPT, GOT, Ca, and Mg in blood samples collected at 21d of age.
So, it may be concluded that fast and slow-growth broilers needed a number of darkness hours at the first period of age to reach the heaviest final weight.
Keywords: *photoperiod, broiler chicks, fast growth, slow growth.*

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I. INTRODUCTION

Maximizing the genetic potentiality of broiler chickens requires more attention to environmental factors (i.e. temperature, humidity, air, and light) to obtain optimal production by minimizing physiological stress on broiler birds (Olanrewaju et. al., 2018). One of the important microclimate factors that affect broiler performance is light (Yang et. al., 2016; Olanrewaju et. al., 2018). The pineal gland, a photosensitive region between the cerebral hemisphere and cerebellum, can receive light signals and have a promotive effect on the secretion of serotonin and melatonin hormones, therefore, playing significant roles in circadian rhythm and various endocrinology functions (Csernus et al., 2007). The hypothalamus located in the pre-optic section of the forebrain can directly modulate the secretion of gonadotropin-releasing hormone (GnRH), thereby regulating the pituitary and downstream gonad to secrete endocrine hormones and then participating in the circadian rhythms, physiological activities, and growth performance of broilers (Baxter et al., 2014).

Photoperiod affects multiple aspects of poultry production including physiology, blood chemistry, and growth performance (Olanrewaju et. al., 2018). It has been reported that using continuous lighting programs increases feed intake and body weight gain (Lewis et. al., 2006). Birds subjected to long continuous photoperiods have access to feed for long periods, as a result, these birds reach high body weight compared with that subject to shorter photoperiods (Olanrewaju et. al., 2018). They reported that birds subjected to shorter/non-intermittent photoperiods showed decreased feed consumption, growth rates, and carcass yields (Olanrewaju et. al., 2018).

Classen and Riddell (1989) suggested that any potential health benefit associated with increasing photoperiod may result from reduced early growth rate, increased activity, increased androgen hormone production, changes in metabolism, or combinations of these. Classen and Riddell (1990), concluded that improved bird health under increasing photoperiod was due primarily to reduced early growth and to a lesser extent to the lighting program itself.

Most environmental factors like light, temperature, and ventilation are known to affect broiler performance (Attia et al., 2011 Bovera et al., 2013). Lighting regimens including length, intensity, and type of light have been reported to affect the growth performance of broiler chickens. Earlier studies revealed that continuous lighting leads to significantly higher body weight and livability (Beane et al., 1962 and Freeman et. al., 1981). During the broiler production period, it is predicted that broiler chicks are exposed to the daily dark period of at least four hours (Olanrewaju et. al., 2006). Several researchers have focused on the effects of lighting systems and regimens on broiler performance including growth, some blood biochemical parameters, behavior, carcass traits, and its quality and immune system function and its organs such as the bursa of Fabricius and thymus gland (Pelek et. al., 2005, Abbas et. al., 2008 and Yang et. al., 2015).

In addition; liver enzymes (GPT and GOT) are produced mainly in the liver. GOT is found in several tissue muscles, the brain, kidneys, and lungs, Its concentration in the blood is related to the extent of tissue damage. GPT is produced in small amounts in the heart, muscles, and kidneys. Increasing one or both of them occur in situations of liver diseases (Johnston, 1999 and Rochling, 2001). Also, chickens with high immune responses had heavier lymphoid organs than chickens with low immune responses (Gebriel et. al., 2013).

Regarding that, the preset experiment aimed to study the effect of photoperiod on the performance of two genotypes of broiler chickens (fast and slow growth).

II. MATERIALS AND METHODS

Genotypes of broiler chicks:

The present experiment was carried out at a commercial farm in Elbihera governorate from July to august (2015). A total of 417 non-sexed broiler chicks of two different genotypes of commercial strains (163 Cobb500 as a type of fast-growth broiler and 254 Sasso as a type of slow-growth broiler) were used in the present study. At one day old, chicks of both genotypes have been divided into two groups. The first group was exposed to 24h of continuous lighting regimen without darkness), while the second group was exposed to 20 h of lighting and 4h of darkness daily. The type of light used was fluorescent at the same intensity. All chicks were reared at the same time under the same environmental conditions. Both of the two genotype groups had *ad libitum* access to feed during the study period. A commercial starter diet containing 22-23 % crude protein was used from 1 d. to 7d. of age. Remaining period birds have been fed a commercial growing diet containing 20% crude protein. All procedures and handling of birds were conducted in compliance with the guidelines of the Institutional Laboratory Animal Care and Use Committee, Menoufia University, Egypt.

Studied traits:

Body weights: Individual body weight was recorded for both groups at 7,14,19, 28 and 35 d of age (g).

Carcass weight at 35 d. of age: Twenty-one birds were slaughtered at 35d of age 11 from the first group (5 Cobb + 6 Sasso) and the other 10 were slaughtered from the second group (5 Cobb +5 Sasso) to measure the carcass quality traits.

Immune organs weight:

Some Immune organ's weight (Bursa and spleen) in addition to the liver were recorded at slaughtering time (35 days of age).

Blood biochemical parameters:

Blood samples were taken individually (at 21d.of age) from wing veins in sterile tubes and serum was separated and stored at -20°C until the measurement of blood biochemical parameters contained total Ca according to the method of Gindler and King (1972). Mg according to Mann and Yoe's method (Mann and Yoe, 1957), and Thomas (1998). GPT and GOT in blood samples were measured according to the method of Reitman and Frankel (1957).

III. Statistical analysis:

Collected data were subjected to statistical analysis using IBM SPSS (2012) program for windows (v. 21.0) under the following two way analysis of variance (ANOVA) model:

$Yijk = \mu + S_i + L_j + SL_{ij} + E_{ijk}$

where:

Y_{ijk} = value of kth observation.

μ= overall mean common to all observations.

S_i= effect of i^{th} genotypes.

L_j= effect of j^{th} photoperiod regimen.

SL_{ij}= effect of interaction between i^{th} strain and j^{th} photoperiod regimen.

E_{ijk}= the random error assumed to be normally distributed with zero mean and variance σ_e^2

IV. RESULTS AND DISCUSSION

Most researchers have compared different genotypes of boiler chickens only between fast-growth strains (Cobb, Ross, Hubbard, Anak Titan, Arbor Acer, …….). But, comparison between fast-growth and low-growth broilers is rarely done, for example, **Emara (2020)** compared four fast-growth strains (Hubbard, Cobb, IR and Ross.), **Singh et al., (2019),** studied two different fast-growth strains (Vencobb-400 and Hubbard strains)

Means of body weight of different genotypes:

The effect of photoperiod treatments within each genotype of broiler (fast and slow growth) on body weight at different ages (7, 14, 19, 28, and 35 d.) of age are presented in Table (1). These results pointed out that Cobb (as a fast type) had heavier body weight than Sasso (as a slow type) overall different ages. Body weight means of Sasso were 101.29, 234.15, 385.2, 809.14, and 1027.18 g. at 7, 14, 19, 28, and 35 d. of age, respectively. Where, Body weight means of Cobb were 183.58, 422.1, 673.52, 1349.05, and 1857.42 g. at 7, 14, 19, 28, and 35 d. of age, respectively. Results in Table (1) assured the previous point and it showed that there were highly significant differences between strains ($P \leq 0.01$) in all weights at different ages. The differences between the two types could be correlated to the genetic structure of the two types.

Effect of photoperiod regimens on body weight:

Data in Table (1) showed the effect of two different photoperiod regimens on Sasso type. The results pointed to the first photoperiod (24h.) being greater than the second photoperiod (20h.) at the final body weights (at 28 d. and 35 d. The mean body weights at the first photoperiod in Sasso were 901 and 1034.6 g. at 28 and 35 d. of age respectively. Where the second photoperiod (20h.) body weight means in Sasso type were 763.21 and 1021 g. at 28 and 35d. of age. The opposite occurred at early ages of growth, the second photoperiod (20h.) had greater body weights than the first photoperiod (24h.) in Sasso type at early periods of growth (7, 14, and 19 d.) of age. The means of body weights of Sasso at early periods of growth at the first photoperiod (24h.) were 97.27, 228.68, and 382.43gm. at (7, 14, and 19 d.) of age respectively. Where the second photoperiod means in Sasso were 104.9, 239.14, and 378.91 gm. at (7, 14, and 19 d.) of age respectively.

Table (1) showed the means of body weight of two photoperiods in Cobb chicks. The effect of the first photoperiod (24h.) on Cobb, body weights was greater than the second photoperiod (20h.) at 14, 19,28, and 35 of age. Means of body weights of the first photoperiod (24h.) in Cobb were 423.8, 672.88, 1393.57, and 1889.37at 14,19,28 and 35 d. of age. respectively. Where, the means of body weights of the second photoperiod (20h.) in Cobb were 419, 67.98, 1318.03, and 1812.2 at 14, 19, 28, and 35 d. of age. respectively. But the second photoperiod (20h.) was greater than the first photoperiod (24h.) at earlier growth in Cobb. The first photoperiod body weight means in Cobb was 178.3g. at 7d. of age. Where the second photoperiod body weight means was 191.75g. at 7d. of age. (Table 1) show that there were high significances between different photo periods ($P \leq 0.01$) in body weights at 7 and 28 d. of age. but there was no significant between photoperiods in body weights at 14, 19 and 35 d. of age. Also, there was no significant interaction between strains (broiler types) and photoperiods regimens (24h. and 20h.) in body weights at different ages (7,14, 19,28, and 35 d.).

From the previous results, it could be concluded that the slow-growth broiler type in second photoperiod (20h.) was heavier than in the first photoperiod (24h.) from the first day to 19 d. of age, after that the opposite occurred. So, it should be for the best photoperiod to the slow growth type of broiler (20h. of light) at the first three weeks of age, after that it can be used the full daylight (24h.) to reach the best final body weight. Where in the fast growth type, using photoperiod (20h.)/d. at the first week of age is enough, then followed by (24h.)/d. for obtaining the heaviest final weight. These results disagreed with the results which obtained by (Schwean-Lardner et. al., 2013). They reported that darkness increasing the reduces early growth rate, and this is thought to reduce the growth –associated diseases Most of the studies on photoperiods on broiler start photoperiod regimens after 2 to 7 d. of age like (Ingram and Hatten, 2000; Yang et.al., 2015).

The interaction effects of genotypes and photoperiod regimens on carcass weight and weight of some internal organs:

The effect of different two photoperiod regimens on carcass weight and weight of some internal organs (liver, spleen, and bursa) in Sasso and Cobb was presented in Table (2). Results showed that, in the two genotypes of broilers (slow and fast growth), carcass weight in the first photoperiod (24h.) was heavier than carcass weight in the second photoperiod (20h.). Means of carcass weight in Sasso were 725.6 and 704 g. in the first and second photoperiods, respectively. Where, the means of carcass weight in Cobb were 1392.2 and 1093.6 g. in the first and second photoperiods, respectively. Generally, the carcass weight in the cobb was heavier than the Sasso carcass weight. Differences between the two types of broiler in carcass weight were highly significant ($P \leq 0.01$) as presented in Table (2)

In addition, results in Table (2) showed that, in Sasso, liver weight in the first photoperiod (24h.) was lighter than liver weight in the second photoperiod (20h.), but in Cobb, the opposite was taken place; liver weight

in the first photoperiod (24h.) was heavier than liver weight in the second photoperiod (20h.). The means of liver weight in Sasso were 28 and 28.83 g. in the first and second photoperiods, respectively. Where, the means of liver weight in cobb were 49.2 and 48 g. in the first and second photoperiods, respectively. Generally, liver weight in cobb was heavier than Sasso. Differences between the two types of broilers in liver weight were highly significant ($P \leq 0.01$) as shown in Table (2).

Also, results in Table (2) explained that spleen weight in Sasso in the first photoperiod (24h.) was heavier than spleen weight in the second photoperiod (20h.). but not the same in Cobb, the opposite was taken place. Spleen weight in the first photoperiod (24h.) was lighter than spleen weight in the second photoperiod (20h.). The means of spleen weight in Sasso were 0.002 and 0.0018g. in the first and second photoperiods, respectively. Where, the means of spleen weight in Cobb were 0.002 and 0.0088 g. in the first and second photoperiods, respectively. Table (2) showed that there were no significant differences between the two types of broilers and two different photoperiods and interaction between strains and photoperiods in spleen weight. These results agreed with (Yang et. al., 2015).

Moreover, Results in Table (2) showed that the bursa weight in Sasso in the first photoperiod (24h.) was heavier than the bursa weight in the second photoperiod (20h.). but in Cobb bursa weight in the first photoperiod (24h.) was equal to the bursa weight in the second photoperiod (20h.). The means of bursa weight in Sasso were 0.0026 and 0.0018g. in the first and second photoperiods, respectively. Where, the means of spleen weight in Cobb were 0.0024 and 0.0024 g. in the first and second photoperiods, respectively. there were no significant differences between the two types of broilers and two different photoperiods and interaction between strains and photoperiods in bursa weight (Table 2). Results in Table (2) agreed with the results reported by El Sabry et. al. (2015). They reported that there was no effect of photoperiod regimens on the weight of the liver and bursa of Fabricius. The previous results disagreed with the result of Zheng et. al. (2013). They reported that darkness has a positive effect on the bursa.

The Interaction between genotypes and photoperiod regimens on liver enzymes and some minerals:

The effects of photoperiod regimens on liver enzymes (GOT and GPT) and Ca, and Mg in blood collected at 21d. of age in both broiler genotypes (Sasso and Cobb) were presented in Table (3). Liver enzymes were affected by photoperiods in the same way in the two genotypes (Sasso and Cobb)., liver enzymes in the first photoperiod (24h.) were lower than in the second photoperiod (20h.), but in the normal range. Means of GOT in Sasso were 98.56 and 101.06 mg/dl in the first photoperiod (24h.) and second photoperiod (20h.), respectively. Where, the means of GOT in Cobb were 87.23 and 106.25 mg/dl in the first photoperiod (24h.) and second photoperiod (20h.), respectively. The means of GPT in Sasso were 36.31 and 47.486 mg/dl in the first photoperiod (24h.) and second photoperiod (20h.), respectively. Where means of GPT in Cobb were 27.46 and 48.13 mg/dl. in the first photoperiod (24h.) and second photoperiod (20h.), respectively. These results differed from the results of Silva et.al. (2007). These results pointed to the mean of total Ca in blood being 8.85 mg/dl and Mg being 2.47mg/dl. Where GOT mean was 228.95 u/ml. at the same age in a recent study. These differences may be related to different broiler genotypes used in the recent study and the strains used by Silva et. al. (2007).

The means of Ca in Sasso were 7.35 and 7.31 mg/dl in the first photoperiod (24h.) and second photoperiod (20h.), respectively. Where, the means of Ca in Cobb were 7.84 and 7.89 in the first photoperiod (24h.) and second photoperiod (20h.), respectively. Previous results were located in Table (3). The means of Mg in Sasso were 4.9 and 5.27mg/dl in the first photoperiod (24h.) and second photoperiod (20h.), respectively. Where, the means of Mg in Cobb were 5.43 and 5.85 mg./dl in the first photoperiod (24h.) and second photoperiod (20h.), respectively. There were no significant differences between the two genotypes of broiler and between two photoperiods in GPT, GOT, Ca, and Mg in blood samples collected at 21d of age (Table 3).

Table (1): Body weight (B.W) in g. at different ages as affected by broiler genotypes and light regimens.

Broiler genotypes	**NO. light hours**	**Body weight (g) at different ages**									
		B.W7*		**B.W14**		**B.W19**		**B.W28**		**B.W35**	
Sasso		No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E
	24h.	120	97.27 ±1.67	120	228.68 ±4.10	119	382.43 ±10.9	26	901 ±21.69	5	1034.6 ±64.84
	20h.	134	104.9 ±1.6	132	239.14 ±3.245	127	387.91 ±6.41	52	763.21 ±18.69	6	1021 ±36.91
	Total	254	101.29±1.81	252	234.15±2.6	246	385.2±6.2	78	809.14±16.12	11	1027.18±33.7
Cobb	**24h.**	99	178.3±1.74	99	423.8±3.82	97	673.88±4.72	23	1393.57±66.49	7	1889.7±65.47

	20h.	64	191.75±3.77	64	419.47±4.97	64	672.98±6.98	33	1318.03±22.39	5	1812.2±85.83
	Total	163	183.58±1.88	163	422.1±3.03	161	67352±3.96	56	1349.05±30.387	12	1857.42±51.11

B.W*: body weight at 7,14,19,28, and 35 d. of age.

Table (2): Carcass and some organs weight as affected by broiler genotypes and light regimens.

Broiler genotypes	**NO. light hours**	**Traits**							
		carcass W*(g).		liver W.(g)		spleen W.(g)		bursa W.(g)	
Sasso		No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E
	24	5	725.6 ±52.69	5	28 ±1.76	5	0.002 ±0.0003	5	0.0026 ±0.0004
	20	6	704 ±26.5	6	28.83±1.4	6	0.0018 ±0.00016	6	0.0018 ±0.0003
	Total	11	713.8±26.61	11	28.45±1.09	11	0.0019±0.00016	11	0.002±0.0002
Cobb	24	5	1392.2±42.96	5	49.2±3.7	5	0.002±0.0003	5	0.0024±0.0002
	20	5	1093.6±248.18	5	48±2.19	5	0.0088±0.0055	5	0.0024±0.00024
	Total	10	1242.9±128.7	10	48.6±2.06	10	0.005±0.002	10	0.0024±0.00016

W*weight in grams.

Table (3): GPT, GOT, Ca and Mg in blood samples collected at 21d. of age as affected by broiler strain and light regimens.

Broiler genotypes	**NO. light hours**	**Traits**							
		GOT.*(U/ml)		GPT*(U/ml)		Ca**(mg/dl)		Mg**(mg/dl)	
Sasso		No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E	No.	$\underline{x}$ ± S.E
	24	16	98.56 ±9.95	16	36.31±8.57	16	7.35±0.95	16	4.9±0.57
	20	33	101.06±6.4	33	47.486±6.92	33	7.31 ±0.58	33	5.27 ±0.32
	Total	49	100.24±5.38	49	43.84±5.44	49	7.33± 0.49	49	5.15±0.287
Cobb	24	13	87.23±11.55	13	27.46±8.69	13	7.84±1.08	13	5.43±0.51
	20	24	106.25±7.49	24	48.13± 9.23	24	7.89± 0.72	24	5.85±0.42
	Total	37	99.57±6.47	37	40.86±6.84	37	7.87±0.59	37	5.71±0.32

GPT*,GOT*: liver enzymes.Ca, Mg**:blood calcium and magnesium.

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الملخص العربي

تأثير طول الفترة الضوئية علي الأداء الانتاجي لدجاج التسمين المختلف في التراكيب الوراثية (السريع والبطيء النمو) وعلاقتها ببعض الأعضاء المناعية

تم رعاية عدد 417 كتكوت تسمين غير مجنس من سلالتين تجاريتين مختلفين في التراكيب الوراثية (163 من سلالة Cobb ممثلة لدجاج التسمين سريع النمو و254 من سلالة الساسو ممثلة لدجاج التسمين بطئ النمو) تحت نظامين مختلفين للإضاءة (24 ساعة اضاءة : 0 إظلام و20 ساعة اضاءة : 4 ساعة اظلام) من عمر يوم وحتي عمر 35 يوم . هدفت الدراسة إلي مقارنة برامج الإضاءة المختلفة وتأثيرها علي أداء كل من دجاج التسمين السريع والبطيء النمو.

وكانت أكثر النتائج أهمية كما يلي:

هناك اختلافات معنوية جدا ($P \leq 0.01$) بين السلالتين المختلفين في التراكيب الوراثية في جميع أوزان الجسم عند الأعمار المختلفة.

دجاج الساسو ممثلا للتركيب الوراثي البطيء النمو كان أثقل في المجموعة الثانية (20 ساعة ضوء) عن المجموعة الأولي من الأسبوع الأول وحتي 19 يوم ثم بعد ذلك حدث العكس ، لذلك (20 ساعة ضوء) تكون أفضل فترة اضاءة في الثلاث أسابيع الأولي لدجاج لساسو . بعد ذلك العمر يمكن استخدام الاضاءة الكاملة علي مدار اليوم (24 ساعة) للوصول للوزن النهائي الأفضل . في حين أنه عند رعاية دجاج التسمين السريع النمو فيكفي استخدام فترة الإضاءة (20ساعة إضاءة / اليوم) بالأسبوع الأول من العمر للحصول علي أوزان نهائية أثقل.

وجدت اختلافات عالية المعنوية ($P \leq 0.01$) بين السلالتين المختلفين في التركيب الوراثي في وزن الكبد.

لا يوجد اختلافات معنوية بين السلالتين المختلفين وراثيا ولا بين فترتي الإضاءة في إنزيمات الكبد (GPT, GOT) ومستويات الكالسيوم والمغنسيوم بالدم بالعينات المجمعة عند 21 يوم من العمر.