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RESEARCH ARTICLE

The Effect of Photoperiod Length on Performance Parameters, Carcass Characteristics and Heterophil/Lymphocyte-Ratio in Broilers

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Abstract

This study was conducted to assess the effects of photoperiod length [Continuous lighting (24L:0D): 24 Lightness:0 Darkness; Constant lighting (16L:8D): 16 Lightness:8 Darkness; Self-photoperiod (SP): 24 Lightness: free choice Darkness] on the performance, carcass characteristics and heterophil/lymphocyte ratio of male broilers grown to 42 d of age. A total of 180 Ross 308 males were exposed to one of the three lighting programmes: 16L:8D; 24L:0D and SP. In the self-photoperiod group, the percentage of animals that preferred to use the dark chamber, progressively increased throughout the trial. Starting from the 2nd week till the end of the trial, the live weights of the animals included in the 24L:0D and self-photoperiod groups were higher than those included in the 16L:8D group ($P<0.01$). The trial groups did not differ from each other for the end-trial feed consumption and feed conversion rates ($P>0.05$). No difference was detected between the groups for mortality rates or carcass percentages ($P>0.05$). The heterophil/lymphocyte ratios (H/L) were similar in the self-photoperiod and 16L:8D groups and were lower than those of the 24L:0D group. In conclusion; when the broilers allowed to regulate their own photoperiod, they had similar body weights but lower stress level than those kept under commercial lighting system.

Keywords: *Broiler, Carcass, Performance, Photoperiod, Stress*

Broilerlerde Fotoperyod Uzunluğunun Performans Parametreleri, Karkas Özellikleri ve Heterofil/Lenfosit Oranı Üzerine Etkisi

Özet

Bu çalışma, farklı fotoperiyotların [Sürekli Aydınlatma (24L:0D): 24 saat aydınlık:0 saat karanlık; Sabit Aydınlatma (16L:8D): 16 saat aydınlık, 8 saat karanlık; Self-fotoperiyot (SP): 24 saat aydınlık: istediği kadar karanlık] 42. güne kadar besi uygulanan etlik piliçlerin performans, karkas özellikleri ve heterofil/lenfosit oranları üzerine etkisini belirlemek için yapılmıştır. Bir günlük yaşta toplam 180 adet Ross 308 erkek civcivlere 24L:0D, 16L:8D ve SP şeklinde aydınlatma programı uygulanmıştır. Self-fotoperiyot grubunda bulunan piliçlerin karanlık bölmelerde zaman geçirenlerin oranı denemenin başından sonuna kadar artış göstermiştir. Denemenin ikinci haftasından deneme sonuna kadar 24L:0D ve self- fotoperiyot gruplarında bulunanların canlı ağırlıkları 16L8D grubunda olanlardan daha yüksek bulunmuştur ($P<0.01$). Deneme sonu yem tüketimleri ve yemden yararlanma oranları bakımından deneme grupları arasında fark bulunmamıştır ($P>0.05$). Ölüm oranları ve karkas parçaları bakımından da farklılık bulunmamıştır ($P>0.05$). Heterofil/Lenfosit (H/L) oranı self-fotoperiyot ve 16L:8D gruplarında benzer ve 24L:0D grubuna oranla daha düşük bulunmuştur. Sonuç olarak, broylerlere, kendi fotoperiyod dönemlerini ayarlama imkanı verildiğinde, ticari ışıklandırma şartlarında yetiştirilenler ile eşit vücut ağırlığına ulaştıkları, ancak daha az stresli oldukları belirlenmiştir.

Anahtar sözcükler: *Broiler, Karkas, Performans, Fotoperiyot, Stres*

INTRODUCTION

With the arrival of spring, migratory birds migrate to temperate regions to nest and lay their eggs in their breeding grounds [1]. It has been ascertained that, very similar to the case in mammals, in domestic poultry, the circadian rhythm is controlled by the visual suprachiasmatic nucleus and the medial suprachiasmatic nucleus [2]. In modern poultry production systems, artificial lighting programmes have found common use in increasing the

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production performance. In contrast to some studies [3,4], which showed no effect of continuous lighting on broiler performance, there are many scientific reports, which declared that the extention of the lighting period stimulated the broilers to increase feed consumption and body weight gain [5-7]. However, it has also been reported that continuous lighting programmes lead to several problems, including locomotory problems, decrease in feed conversion rate and immunosuppression, and thus, have a negative impact on animal welfare, requiring the extension of the dark period the animals are exposed to [8-11]. Besides, consumer demand and industrial operation have increased the importance of factors related to meat quality, such as the colour and pH value of meat and to the best knowledge of the authors, there is a few information in the scientific literature examining the lighting regime and meat quality relations, in the poultry production [12,13].

This study was aimed at determining the effects of three different photoperiods (24L:0D, in which the animals were withheld from the dark; 16L:8D, in which the animals were considered to satisfy their daily requirement of darkness [14], and the self-photoperiod, in which the animals self-determined to use the dark chamber) on broiler performance as well as on slaughter and carcass traits and heterophil/lymphocyte ratios parameters.

MATERIAL and METHODS

Birds and Husbandry

All experimental procedures were performed in accordance with the Turkish National Guidelines for the Care and Use of Animals for Research Purposes (Certificate of Authorisation to Experiment on Living Animals N°2014/52, The Local Ethical Committee of Ataturk University).

The trial was conducted at the Poultry Unit of the Research Farm of Ataturk University, Faculty of Veterinary Medicine. One day-old Ross 308 male broiler chicks obtained from a commercial hatchery were used in the experiment.

Experimental Design

During the first six days, the chicks were maintained in a brooder and kept under continuous lighting (24L:0D). In three different experiment windowless rooms, lighted by fluorescent, from day 7, the chicks were randomly allocated to 1.0 x 1.0 m pens, of which the floor was covered with 10 cm layer of wood shavings. The pens used for housing the broilers of in the self-photoperiod group had 1.4 x 1.0 m floor and the pens had a chamber of 0.4 x 1.0 m in size, which was separated by an opaque, light-proof, air-permeable cloth of 1.2 m height, and into which the animals had the opportunity of passing at any time. Twelve chicks were housed in each pen at a stocking density of 0.083 m^2 per broiler.

The animals included in the trial were fed on broiler chick starter diet between days 1-21 and on broiler chicken growing diet between days 22-42 *(Table 1)*. Throughout the trial period, the animals were provided with *ad libitum* feed, by using hanging tube type feeders, which allowed 9.34 cm space for each bird and water was supplied by nipples.

Treatments

The birds were exposed to one of the three lighting programmes. These were: 16L:8D (22:00-06:00, turn off); 24L:0D and 24L:self-photoperiod.

Total 180 Ross 308 males, twelve birds in each 5 replicates from 3 experiment groups were used in the study.

Light intensity was 20 lux in the open pens and 0 lux in the closed chambers. Light intensity was measured on the head level of the birds, at the center of the pens, by using a light meter (LT Lutron, model LX-105).

Calculation of the Performance Values

Body weight and feed consumption values were measured by weekly weighing (1 g sensitivity). Mortality was recorded on a daily basis. In order to assess uniformity, at the end of day 42, each animal was weighed (10 g sensitivity) individually and their weights were recorded. The proportional body weight gains of the animals, were calculated by proportioning body weight to the value measured a week before.

Rate of Broilers that Preferred the Dark Chamber

In order to determine the number of broiler chickens that preferred to remain in the dark chamber, the animals were observed twice a day (at 10:00 and 22:00) throughout the study period. The number of broilers detected in the

Table 1. *The nutrient composition of the feed used in the study*
Tablo1. *Araştırmada kullanılan yemlerin besin madde kompozisyonları*

Composition	Starter Diet	Growing Diet
Dry matter (g/kg)	880	880
Crude protein (g/kg)	240	200
Crude fiber (g/kg)	60	60
Crude ash (g/kg)	80	80
Acid-insoluble ash (g/kg)	10	10
Calcium (g/kg)	15	15
Phosphorus (g/kg)	7	6.5
Sodium (g/kg)	3	3
NaCl (g/kg)	3.5	3.5
Lysine (g/kg)	12	10
Methionine (g/kg)	5	4
Methionine + Cystine (g/kg)	9	7.5
Metabolic energy (MJ/kg)	12.90	13.40

dark chamber per day was divided by the total number of animals to calculate the percentage of animals that preferred to use the dark chamber.

Sample Collection and Measurements

At the end of the trial, on 42nd day, animals were withheld from feed at 20:00 and after 12 h, they were slaughtered.

A sample of two birds from each subgroup (total=30 birds), with weights between ± 10% of the subgroups mean were chosen. The birds were electrically stunned, bled for 120s, after severing both carotid arteries and at least one *juguler* vein. Broilers were then scalded for 30 s at 54°C, before mechanical plucking. The birds were eviscerated manually, washed, and allowed to drain for 10 min [15]. Eviscerated carcasses were tumble-chilled in ice water for 30 min and were allowed to drain for 5 min.

The carcasses were stored at 3°C for 24 h, and then dissected [16].

The carcass shrink rate was calculated using the formula given below: [17]

Carcass Shrink (%) = [1- (Cold carcass weight/Hot carcass weight)] *100

Analysis for pH

The pH values of the samples were determined using a pH meter (SCHOTT L 6880, Lab Star

The pH value was measured using a direct probe by thrusting the probe into the breast fillets. The pH values measured 24 h after slaughter.

Determination of Colour Values

A Minolta model colorimeter (Model CR-200, Minolta Corp.,) was used for the colour measurements of the breast fillet samples, with a white tile as a reference [CIE L value = lightness, CIE a value = redness, CIE b value = yellowness] [18].

Determination of the Heterophil/Lymphocyte Ratio

Blood samples were collected on day 41, from 2 randomly selected birds from each pen. Two preparations for each bird were made from the blood samples, a drop being smeared on each of 2 glass slides. The smears were stained using the May-Grünwald and Giemsa stains Lucas and Jamroz [19] , approximately 2 to 4 h after methyl alcohol fixation. One hundred leukocytes, including granular (heterophils, eosinophils and basophils) and non-granular (lymphocytes and monocytes) cells, were counted on 1 slide of each bird. For the determination of heterophil and lymphocyte counts and the heterophil/lymphocyte ratio (H/L), the average was taken of the two preparations counted for each bird.

Statistical Analysis

Data were presented as means ± standard error and subjected to one-way ANOVA using the GLM procedure of SAS version 8.02 [20]. Significant differences between the photoperiods applied were distinguished by Fisher's least significant difference (P<0.05) multiple range test.

Wilcoxon signed-rank analysis was conducted on the data from the initial comparison of the percentages of the animals that preferred to use the dark chamber.

Individual body weights were recorded at 42 d of age to assess the final BW uniformity. Pen uniformity was expressed as the CV (variation coefficient) of BW (standard deviation/mean x 100). Due to the variation coefficients calculated having determined not to display a normal distribution pattern; the non-parametric Kruskal-Wallis test was applied. The significance level of the differences observed between the groups was determined using the Mann – Whitney U Test.

RESULTS

Regulation of Photoperiod

The percentages of the animals that preferred to use the dark chamber are given in *Table 2*. Accordingly, the percentage of the animals which preferred to use the dark chamber in the morning was 21.77±1.21%; while the percentage of those, which preferred being in the dark chamber in the evening, was 21.13±1.14% (P>0.05). The number of animals that preferred to spend time in the dark chamber increased with age of the animals (P<0.001).

Performance

The differences observed between the body weights of the animals at the beginning of the trial were statistically

Table 2. *Percentage of broilers that chose the dark chamber, with respect to age (%)*

Tablo 2. *Yaşa göre karanlık bölmede zaman geçirmeyi tercih eden piliçlerin oranı (%)*

Days	RCD (%)
7 - 14	8.33^{c}
15- 21	10.71^{c}
22 - 28	24.05^{b}
29 - 35	32.26^{a}
36- 42	33.61^{a}
Total SEM	21.77 1.33
P	0.000

RCD (%): *Rate of broilers that chose the dark chamber (%);* ***a, b, c:*** *Means within a column with no common superscripts differ significantly (P<0.05);* ***SEM:*** *Standard error of means*

Table 3. *The impact of three different photoperiod treatments on body weight (g) and relative growth rates (wt/wt) between days 7 and 42*
Tablo 3. *Yedinci-42. günler arasında üç farklı muamelenin canlı ağırlık (g) ve relatif büyüme oranları üzerine etkisi (wt/wt)*

Days	Body Weight (g)					Relative Growth Rates *(wt/wt)*				
	SP	24L:0D	16L:8D	SEM	P	SP	24L:0D	16L:8D	SEM	P
7 d	140	141	143.0	1.19	0.081					
14 d	351[a]	350[a]	316.2[b]	5.70	0.001	2.52[a]	2.49[a]	2.19[b]	0.03	0.000
21 d	765[a]	770[a]	697[b]	14.45	0.006	2.18	2.20	2.21	0.04	0.863
28 d	1197[a]	1186[a]	1118[b]	12.13	0.001	1.56	1.54	1.61	0.02	0.085
35 d	1840[a]	1827[a]	1720[b]	22.69	0.005	1.54	1.54	1.54	0.02	0.992
42 d	2499[a]	2530[a]	2395[b]	21.51	0.002	1.36	1.39	1.39	0.02	0.426

SP: *Self-photoperiod;* ***a.b:*** *Means within a row with no common superscripts differ significantly (P<0.05);* ***SEM:*** *Standard error of means*

Table 4. *The impact of three different photoperiod treatments on cumulative feed consumption (g/bird) and feed conversion rate (g/g) between days 7 and 42*
Tablo 4. *Yedinci-42. günler arasında üç farklı muamelenin yem tüketimi (g/piliç) ve yemden yaralanma oranları üzerine etkisi (g/g)*

Days	Daily Feed Consumption During Different Periods (g/bird)					Feed Efficiency (g feed consumption/g gain)				
	SP	24L:0D	16L:8D	SEM	P	SP	24L:0D	16L:8D	SEM	P
7 - 14	257	244	230	12.46	0.338	1.21	1.17	1.35	0.08	0.294
7 - 21	897	951	922	15.49	0.083	1.45[b]	1.52[b]	1.68[a]	0.05	0.019
7 - 28	1594	1675	1657	43.55	0.414	1.52	1.60	1.71	0.05	0.085
7 - 35	2765	2873	2698	47.75	0.067	1.63	1.70	1.72	0.03	0.198
7- 42	4225	4340	4117	63.896	0.086	1.79	1.82	1.83	0.03	0.601

SP: *Self-photoperiod;* ***a.b:*** *Means within a row with no common superscripts differ significantly (P<0.05);* ***SEM:*** *Standard error of means*

Table 5. *The mean and median CV (variation coefficient) values of the birds at 42nd days of the trial*
Tablo 5. *Deneme gruplarına ait CV (varyasyon katsayısı) ortalama ve medyan değerleri*

Treatment	Homogeneity (mean ± SE)	Median
SP	9.24±1.28[ab]	8.09
24L:0D	7.38±0.79[b]	7.02
16L:8D	11.73±1.20[a]	10.61
P	0.038	

SP: *Self-photoperiod;* ***a.b:*** *Means within a row with no common superscripts differ significantly (P<0.05);* ***SE:*** *Standard error*

insignificant (P>0.05). In the following weeks, the effect of photoperiod on daily body weight values was found to be statistically significant (P<0.01). From week 2 until the end of the trial, higher and relatively similar daily body weights were measured for the self-photoperiod and 24 L groups, and the values pertaining to these two groups were lower than those of the 16 L group *(Table 3)*.

Cumulative feed consumptions and Feed conversion rates are shown in *Table 4*. The length of the light period does not affect cumulative feed consumption. Differences between the trial groups for Feed conversation rate were found to be statistically insignificant (P>0.05).

Uniformity was determined to be lowest in the 16L:8D group and highest in the 24L:0D group. The differences between the trial groups were statistically significant (P=0.038) *(Table 5)*.

Carcass Yields

The results of the analysis of variance for slaughter and carcass characteristics are presented in *Table 6*. The influence of the length of the light period on slaughter traits, excluding blood and feathers, was found to be statistically insignificant (P>0.05).

It was determined that the length of the light period had no effect on carcass percentages.

The ultimate pH values measured at 24 h post-mortem are given in *Table 6*.

The color parameters, the L* and a* values, determined for the three trial groups, were observed not to differ statistically, yet the yellowness values of the self-photoperiod and 24 L groups were lower than those of the 16 L group *(Table 6)*.

Carcass shrink percentages in the 16L:8D had the highest (1.14) level, where 24L:0D and self-photoperiod groups were determined as 0.93 and 0.94, respectively (P=0.028). The comparison of the trial groups demonstrated only the 16L:8D group and the self-photoperiod group to statistically differ from each other (P=0.002). The multi-

Table 6. *Slaughter, carcass, pH and colour traits of the broilers included in the three trial groups*
Tablo 6. *Üç farklı deneme grubunda bulunan piliçlere ait kesim, karkas, pH ve renk özellikleri*

Slaughter Characteristic						Carcass Characteristic					
Parameters	**SP**	**24L:0D**	**16L:8D**	**SEM**	**P**	**Parameters**	**SP**	**24L:0D**	**16L:8D**	**SEM**	**P**
BWBS (g)[1]	2544[a]	2407[ab]	2336[b]	48.4	0.017						
HCY (%)[2]	75.1	74.0	74.9	0.43	0.195	Neck (%)	5.61	5.68	5.46	0.19	0.704
Blood (%)	4.01[ab]	4.24[a]	3.54[b]	0.17	0.026	Tail (%)	1.07	1.14	1.18	0.07	0.546
Feather (%)	4.94[ab]	5.43[a]	4.84[b]	0.17	0.049	Wing (%)	11.3	11.2	11.4	0.19	0.724
Head (%)	2.60	2.58	2.73	0.09	0.481	Whole Legs (%)	39.8	39.1	39.5	0.59	0.731
Offals (%)	4.86	4.98	5.16	0.16	0.445	Whole Breast (%)	42.2	42.9	42.5	0.58	0.705
Gizzard (%)	2.11	2.23	2.24	0.12	0.714	pHu[3]	6.12[ab]	6.14[b]	6.07[a]	0.02	0.041
Liver (%)	1.76	1.83	1.96	0.07	0.108	CIE L value[4]	52.6	54.4	52.5	0.64	0.071
Heart (%)	0.59	0.54	0.62	0.03	0.248	CIE a value[5]	5.04	3.17	3.64	1.10	0.456
Feet (%)	4.05	4.16	3.95	0.09	0.262	CIE b value[6]	5.95[a]	6.37[a]	7.76[b]	0.32	0.000

SP: *Self-photoperiod;* ***a.b:*** *Means within a row with no common superscripts differ significantly (P<0.05);* ***SEM:*** *Standard error of means;* [1] *BWBS; g: Body weight before slaughter;* [2] *HCY, %: Hot carcass yield;* [3] *pHu: ultimate pH; the pH at 24 h post-mortem;* [4] *CIE L: lightness;* [5]*: CIE a: redness;* [6] *CIE b: yellowness*

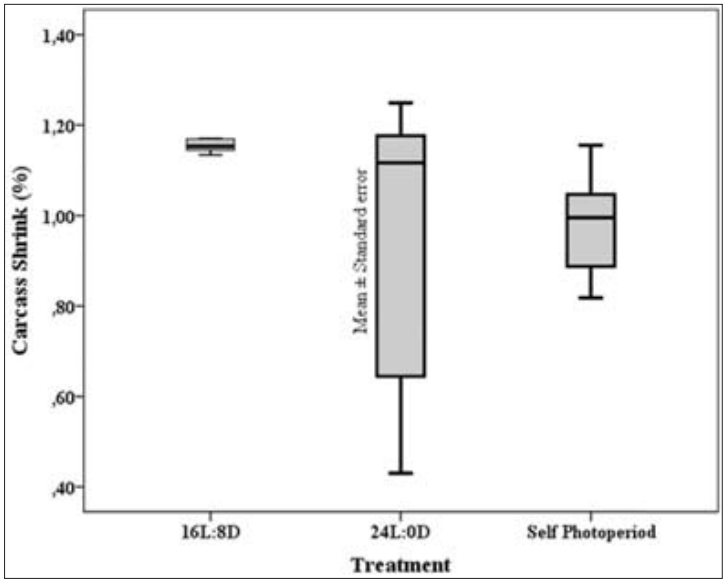

Fig 1. Carcass Shrink (%) values belonging to the groups

Şekil 1. Gruplara ait sıcak/soğuk karkas fire (%) değerleri

Table 7. *The heterophil/lymphocyte ratios and mortality rates of the broiler chickens included in the three trial groups*
Tablo 7. *Üç farklı deneme grubunda bulunan piliçlere ait heterofil/lenfosit ve ölüm oranları*

Treatment	HLR	Mortality %
Self	0.40[b]	0.00
24L:0D	0.94[a]	0.00
16L:8D	0.52[b]	3.30
SEM	0.07	0.013
P	0.000	0.134

SP: *Self-photoperiod;* ***HLR:*** *heterophil/lymphocyte ratios;* ***a,b:*** *Means within a column with no common superscripts differ significantly (P<0.05);* ***SEM:*** *Standard error of means*

faceted comparison of the other groups did not reveal the presence of any statistically significant difference *(Fig 1)*.

Stress and Mortality

The Heterophil/lymphocyte ratio of the self-photoperiod and 16 L groups were found to be similar, whilst the ratio of the 24 L group differed *(Table 7)*.

In the self-photoperiod and 24L:0D groups, the survival rate was 100%, and in the 16L:8D group, this rate was 96.70%. This difference was found to be statistically insignificant.

DISCUSSION

Regulation of Photoperiod

In conventional broiler production systems, for animals that reach a final body weight less than 2.5 kg, it is

suggested that the lighting program be adjusted as 23L:1D between days 0-7, as 20L:4D from day 8 till at least 3 days before slaughter, and as 23L:1D at least three days before slaughter [21]. According to the criteria applied in the European Union, in lighting programmes adjusted to a 24-h cycle, there needs to be 6 h dark period per day, and 4 h of this period should allow for the exposure of animals to continuous darkness [22]. Savory and Duncan [23] reported that broilers preferred to spend approximately 9% of the day in the dark. In the present study, it was observed that the percentage of animals that preferred to use the dark chamber increased from 8.33% during the first 7-14 days post-hatching, to 33.61% at the end of the trial. The percentages of animals preferred to use dark chamber was seemed to increase linearly with the age.

Performance

In the present study, from the second week of the trial, the chickens included in the self-photoperiod group achieved body weights similar to those of the 24L:0D group and higher than those of the 16L:8D group. At the end of the trial, the relative growth rate of the birds were similar in all groups. This result may have arisen from the animals having spent longer periods of time in the dark chamber during the last few days before slaughter. In a study, in which male broilers were exposed to three different lighting schedules, Rozenboim et al.[3] reported that the groups exposed to 23L:1D and 16L:8D did not display any statistically significant difference for the final body weights measured on day 42. Similarly, it has been indicated that lighting schedules of 20L:4D and 16L:8D did not produce any statistically significant difference for broiler body weights [4].

It is suggested that broiler chickens modify their feeding behaviour according to the lighting programme they are exposed to [24,25]. Lewis et al.[25] suggested that, the extension of the photoperiod length during the period up to day 21 increased feed consumption, while between days 22-35, photoperiods longer than 6 hours resulted in similar feed consumption rates.

In another study, the extension of the scotoperiod during days 7-32 reduced feed consumption, increased feed conversation ratio but all groups had consumed equal amounts of feed [26]. Scott [27] reported that the application of a lighting schedule of 23L:1D during the first 10 days post-hatching enabled optimum feed consumption in broilers, thus uniform body weights and intestinal development. Feed restriction in the early growth period has been reported to result in decreased final body weights and daily body weight gain, but has been indicated not to alter feed conversion rates [28]. This result is in contrast wiht the other finding Ayasan et al.[29] which indicate that feed restriction had significant effects on feed intake and feed conversion ratio. Similar to the findings of Lippens et al.[28] during the first week of the present trial, the 16L:8D group was determined to have consumed feed 10.6% less than the self-photoperiod group and 5.9% less than the 24L:0D group. This was considered to have resulted in an effect, similar to the feed restriction in the early growth period.

It should be noted that decline in uniformity in the body weights of broiler chickens results in the decrease of the retail market value of the end product.

In contrast to our findings, Griffin et al.[30] stated that increased photoperiod reduced the uniformity, however Lien et al.[31] declared no effect of photoperiod on uniformity. According to present study, the delayed growth in the 16L:8D group may be attributed to the decrease in uniformity.

Carcass Yields

Hot carcass percentage were not affected by photoperiod length in the present study. This is in line with the findings of Coban et al.[9] in male quails and Downs et al.[32], who was also found no significant differences between carcass yields of broilers housed under different lighting programmes.

In the present study, the internal organ weights of the animals in all groups were similar. In male quails, Coban et al.[9], also reported that internal organ percentages were not affected by photoperiod.

In this study, similar to body weight gain, feather development was also influenced by photoperiod length. The potential muscle development of animals depends on the formation of muscle fibrils in the prenatal period and the hypertrophy of these fibrils in the postnatal period. Berri et al.[33], upon examining the cross-sections of the fibrils of the major pectoral muscle and assessing breast meat quality traits, determined that the correlation coefficient calculated for phenotype was statistically significant and positive while the correlation coefficient calculated for drip loss was statistically significant and negative. In present study, in the 16L: 8D group, the carcass shrink rate (%) was higher and the pH value was lower than other groups. It was considered that the animals in this group had small fibril diameter due to lower body weight gain.

In contrast to present findings, Renden et al.[10], compared the effect of 23L:1D and 16L:8D; and noted that in the 23 h lighting group, breast meat of the carcasses increased; while the animals exposed to short lighting period, the rate of whole legs of the carcasses were higher than the ones, exposed to long photoperiod. Lewis et al.[25] indicated that continuous lighting increased the percentage of breast meat. Similarly, Lien et al.[31] confirmed that the extension of the light period from 16 h to 23 h increased the percentage of the whole

breast. In the present study, in contrast to previous results, whole breast and leg percentages were not affected by photoperiod.

Stress and Mortality

Gross and Siegel [34] suggested that, in birds, the heterophil/lymphocyte should be used for detecting long-term environmental effects. In response to increased environmental stress, the heterophil/lymphocyte ratio increases.

In the present study, the heterophil/lymphocyte ratios of the self-photoperiod and 16L:8D groups were lower than those of the 24L:0D group. Similarly, Coban et al.[9], recorded lower H/L ratio in self photoperiod group than quails exposed to continuous lighting. Campo et al.[8] was in line with our findings and stated that continuous lighting programmes induced the stress in broiler chickens, thereby, resulting in the increase of the heterophil/lymphocyte ratio. However, Lien et al.[31] reported that the heterophil/lymphocyte ratios of the two groups exposed to short and long photoperiod were equal.

It has been noted that rapid growth rates achieved in the early stages of life through the application of long lighting programmes bring about increased mortality [11,26,35,36]. In the present study, mortality rates were similar in all groups, in agreement with the results of Lien et al.[31], indicating no significant effect of lighting on mortality.

According to the present study, it is concluded that; (I) If given an opportunity to prefer to use a dark chamber in the pen, the broiler chickens do choose. (II) When allowed to prefer their dark period by instinct (self photoperiod group), the broiler chickens reached higher final body than 16L:8D hours lighting, as recommended by EU. (III) As indicated by H/L ratio, it seemed that the stress levels were equal in both '16-hours lighting' and 'self photoperiod' groups and H/L ratio was highest in '24 hours' lighted chickens. (IV) Except for feather and blood ratio of the bird, carcass and slaughter parameters were not affected by photoperiod.

According to the present study, 'self photoperiod method' is seemed to have a potential to be a choice/profit for poultry production and may be applied on some other species (e.g. laboratory animals) in the future. Further studies are needed to understand the physiological mechanism and welfare status of the animals, exposed to self photoperiod conditions.

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