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INFLUENCE OF PHOTOPERIOD AND CRUDE PROTEIN LEVELS ON PRODUCTIVE TRAITS AND ECONOMIC EFFICIENCY OF MUSCOVY DUCKLING MALES DURING SUMMER SEASON

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ABSTRACT:

The present study was conducted to estimate the effect of lighting program and protein level in the diet and their interaction on productive performance, carcass characteristics, blood parameters and economical efficiency at the summer season. A total of 180 Muscovy ducklings ,one day old, was individually weighed and randomly distributed equally into two groups (90 birds, each) according to lighting programs, L_1 (natural day light as complement the natural lighting to 22-hour using artificial light) and L_2 (22 hours / day using artificial light). Ducklings in each light program were divided into three groups (30 birds in each) with three replicates (10 birds, each) according to levels of crude protein in the diet: Low protein level (P1) (21, 17 and 16%) medium protein level (P_2) (22, 18 and 17%) and high protein level(P_3) (23, 19 and 18%) for starter, grower and finisher periods, respectively, during experimental period from one–day to 12 weeks of age.

The obtained results showed that *Muscovy duckling males exposed to (L_2) program had significantly ($P \leq 0.01$) higher LBW at 8 weeks of age and BWG, during period 4-8 wks of age as compared to that exposed to (L_1) program. The L2 birds consumed significantly ($P \leq 0.05$ or $P \leq 0.01$) higher amounts of feed than that L_1 birds during all periods studied, except during period 4-8 wks of age. Birds reared under L_1 system had the significantly ($P \leq 0.05$) best feed conversion ratio for cumulative feed conversion ratio (0-12 wks), as compared with that reared under L_1 system.*

Significant effects of CP levels or natural day light on protein intake, protein utilization and performance index at the end of the experimental period. Also, there were significant differences between CP levels with lighting programs of protein intake and performance index at the end of the experiment while, protein utilization was not *significant. The duckling males reared under L2 system gave significantly ($P \leq 0.05$) higher percentage of thighs than that reared under L1 system.*

Duckling males received (P_3) diet recorded significantly ($P \leq 0.01$) higher LBW at 4, 8 and 12 wks of age and BWG during periods 0-4 and 4-8 wks of age and during whole period (0-12 wks of age) followed by birds received (P_2) and (P_1) diets, respectively. The birds of P_3 diet consumed significantly ($P \leq 0.05$ or $P \leq 0.01$) lower amounts of feed than those birds of P_2 or P_1 diet, respectively. Birds fed P_3 diet had the significantly ($P \leq 0.01$) best feed conversion ratio for cumulative feed conversion ratio (0-12 wks) followed by P_2 and P_1 diet, respectively. The birds fed on P_2 diet recorded the highest values of percentage of breast and tend, while, the highest values of abdominal fat were recorded by birds fed on P_3 diet. Birds fed P3 diet had significantly ($P \leq 0.05$) higher serum creatine concentration compared to birds fed P_1 diet.

The interaction between lighting program and protein levels showed that duckling males received (P_3) diet and exposed to (L_1) program group recorded the highest values of both LBW and BWG when compared to other groups. Birds fed on P_3 diet and exposed to either L_1 or L_2 program consumed significantly ($P \leq 0.01$) lower amounts of feed, and had the significantly ($P \leq 0.01$) best feed conversion ratio than other groups during whole experimental period (0-12 wks). Using high protein level (P_3) in the diets of ducks with natural day light (L1) improved economic efficiency and relative economic efficiency of ducks compared with other groups. Birds reared under L_2 system and fed P_1 diet recorded significantly ($P \leq 0.01$) best abdominal fat compared to other groups. All studied serum proteins and serum lipids were not significantly affected due to both lighting system and crud protein level effect and their interaction.

***Conclusively,** it could be concluded that dietary high CP (%) with natural day light might have positive effects on growth performance traits and economic efficiency (%) of growing Muscovy duckling males, during summer season.*

Key words: Photoperiod, Crude Protein Levels, Productive Traits, Economic Efficiency, Muscovy Ducks, Summer Season

INTRODUCTION

Light allows the bird to establish rhytlimicity and synchronize many essential functions, including body temperature and various metabolic steps that facilitate feeding and digestion. Also, light stimulates secretory patterns of several hormones that control, in large part, growth, maturation, and reproduction (Olanrewaju *et al.,* 2006).

Many avian species are photoperiodic, regulatory mechanisms responsible for adjusting their physiology and behavior to annual changes in day length. It has been observed that continuous light is accompanied by an increased incidence of leg problems, metabolic and circulatory diseases, such as sudden death syndrome, asides and poor feed efficiency. Recent studies failed to find a consistent depression in live weight when birds were grown on shorter photoperiods. There are many potential welfare benefits associated with short photoperiods. These benefits include: increased sleep, low physiological stress, improved immune or responsiveness, improvements in bone metabolism and leg strength, reduction in mortality and improvement in feed conversion. Furthermore, using short photoperiods results in lower production costs (Gordon, 1994).

In poultry diets, protein is important nutrients representing majority of total cost of the diets. Protein is the key component of cell, playing an important role in the process of life (Wang and Lin, 2002 and Kamran *et al*., 2004). At present, many studies were conducted to examine the effects of the dietary protein level on the growth of broiler chickens (Dozier et al., 2006, 2007 and Ghaffari *et al.,* 2007).Therefore, reducing dietary crude protein without deleterious effects on broiler performance is a great challenge for broiler nutritionist. Not only reduced protein regimes diets in poultry nutrition are considered an alternative application to reduce feeding costs, but also to reduce the environmental pollution .

Therefore, the aim of the present study is estimate of lighting program and protein levels and their interactions on productive performance, carcass characteristics, blood parameters and economic efficiency of Muscovy ducklings during summer season.

MATERIALS AND METHODS

This study was performed in El-Serw Waterfowls Research Station, Dumyat, Animal Production Research Institute (APRI), Agricultural Research Center (ARC), Ministry of Agriculture, Egypt, from June to October 2013**.**

Experimental birds and management:

A total number of one hundred and eighty unsexed Muscovy duckling from one–day to 12 weeks of age were used in this experiment . Birds were housed in well ventilated brooding pens (3.4 x 8.6 m) from one-day up to 3 weeks of age. Ducks were reared from June to October 2013 while the temperature was recorded ranged from 36°C Max. to 19°C Min.

At the end of brooding period ducklings were permitted to go to out yards. Ducklings were fed starter diets up to the end of 4^{th} week, grower diets from 4 to the end of 8^{th} week and finisher diets from 9 to end of the 12^{th} weeks of age. Fresh water and mash feed were provided *ad-labium*. Birds were housed in naturally ventilated houses. Wheat straw was used as a litter throughout the experimental period. Ducklings were reared under similar hygienic and managerial conditions.

Experimental design and procedures:

A total of 180 Muscovy ducklings, one day old, was individually weighed and randomly distributed equally into two groups (90 birds, each) according to lighting programs, L_1 (natural day light as complement the natural lighting to 22-hour using artificial light) and L_2 (22 hours / day using artificial light). Ducklings in each light program group were divided into three groups (30 birds, each) with three replicates (10 birds, each) according to levels of crude protein in the diet: Low protein level (P_1) (21, 17 and 16%), medium protein level (P_2) (22, 18 and 17%) as recommended to (NRC, 1994**)** and high protein level (P_3) (23,19 and 18%) for starter, grower and finisher periods, respectively. The formulation and calculated analysis of the experimental diets were according to (NRC, 1994) are presented in Table 1. The starter, grower and finisher diets were formulated from plant origin.

Lighting programs:

Two lighting system were used in this study as following**:**

Table 1: Composition and calculated analysis of the experimental diets, during summer season

Ingredients %	Starter (0- 4wk)			Grower (4- 8wk)			Finisher (8- 12wk)		
	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3
Yellow corn	64.20	62.00	59.85	72.80	70.65	68.50	74.95	72.80	70.65
Soybean meal (44%)	22.90	23.70	24.40	20.20	20.90	21.55	19.55	20.20	20.90
Gluten meal (60%)	8.85	10.25	11.70	2.95	4.40	5.90	1.45	2.95	4.40
Di-calcium phosphor.	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Limestone	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Vit. & Min. Premix[1]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Salt (Na Cl)	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Dlmethione(97%)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
L- lysine HCL	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Calculated analysis[2]									
CP %	21.00	22.00	23.00	17.00	18.00	19.00	16.00	17.00	18.00
ME (kcal/ kg)	3002	3000	3000	3003	3002	3002	3002	3003	3002
Calcium (%)	1.05	1.05	1.06	1.04	1.04	1.05	1.04	1.04	1.04
Av. Phosphorus(%)	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.44	0.44
Methionine (%)	0.52	0.55	0.57	0.42	0.45	0.47	0.40	0.42	0.45
Lysine (%)	0.98	1.01	1.04	0.86	0.89	0.92	0.83	0.86	0.89

Each 3 kg of the Vit. and Min. premix contains: Vitamin A 10000000 IU, Vit. D 2000000 IU, Vit. E 10g, Vit. K2 g, Thiamin 1g, Riboflavin 5g, Pyridoxine 1.5g, Niacin 30g, Vit. BI2 10mg, Pantothenic acid 10g, Folic acid 1.5g, Biotin 50mg, Choline chloride 250g, Manganese 60g, Zinc 50g, Iron 30g, Copper 10g, Iodine 1g, Selenium 0.10g, Cobalt 0.10g. and carrier $CaCO_3$ to 3000g. 2- According to NRC (1994).

1- Natural day light during the summer months according to CLAC 2013 as shown in Table 1 and complemented the natural lighting to 22-hour using artificial light.
2- Artificial light start after two hours from the sun down (two hours darkness), while, artificial light was provided by a sixty-watt incandescent bulb located at the center of each pen and lasted until natural day light start then bulb done. The averages of natural light (hrs), were recorded in indoor farm during experimental period as the following Table 2.

Measurements:

Individual body weight of ducklings in grams was recorded weekly from hatching up to 12 weeks of age. Feed consumption in grams was recorded

Table 2 : Day length in Dumyat Governorate during the summer season.

Weeks	June		July		August	
	hrs	Min.	hrs	Min.	hrs	Min.
1	14	03	14	02	13	37
2	14	06	13	58	13	23
3	14	07	13	51	13	16
4	14	06	13	46	12	51
Mean ± SE	14.55±0.088		13.69±0.173		13.07±0.223	

Central Laboratory For Agricultural Climate (CLAC 2013) .

weekly for each replicate and treatment and calculated cumulatively for the three periods of growth (0 – 4 weeks, 5 - 8 weeks and 9 – 12 weeks of age). Mortality for all treatments was daily recorded and Mortality rate was calculated. Live body weight, weight gain, feed consumption and feed conversion ratio (FCR) (g feed/g gain), performance index (Live body weight (Kg) / FCR * 100)) were calculated according to North (1994), during the same periods. The daily intake of protein was calculated by multiplying the amount in the feed by feed consumption. Also, the protein utilization efficiency (PUE) (g body weight gain /g protein consumed) was calculated during the same periods.

Slaughter traits and samples collection:

At the end of experiment (12 weeks of age), a total number of 36 ducks from both sexes (3 males and 3 females in each treatment) were taken randomly and deprived of feed for 16 hr in order to study the carcass characteristics and blood profile . Birds were weighed just before slaughter, as well as, after bleeding. After complete bleeding and remove feathers by hand, carcasses were manually eviscerated to determine some carcass traits, carcass partitioning as following parts were taken and weighed thighs, breast, giblets (liver, heart, gizzard), edible weight, dressing percentage. Weight of abdominal fat were recorded and expressed as relative weight (mg/100 g of live body weight).

Blood samples:

At marketing age, blood sample from each duckling was collected without anticoagulant and kept at room temperature for one hour to clot. Tubes were centrifuged at 3000 rpm for 15 minutes to separate clean serum that used for determination of serum total protein (Gornal *et al.*, 1949), albumin

(Doumas *et al.,* 1971), creatinine (Schirmeister, 1964), total cholesterol (Richmond *et al.*, 1973), HDL cholesterol (Lopez – Virella *et al.*, 1977), and triglycerides (Fassati and Prencipe 1982). These biochemical measurements were performed calorimetrically by using commercial kits.

Economical efficiency

At last, economical efficiency was calculated as Net return / Total cost.

Statistical analysis:

Data were analyzed by the least squares means analysis of variance using the General Linear Models procedure of the statistical analysis model (SAS, 2001). The statistical model was used for the growth performance traits as follows:

$$Yijk = \mu + Li + Pj + (LP)\ ij + eijk$$

Where Yijk= Observation measured; Li = Lighting system effect (i=1,2) , Pj = Crude protein level effect (j= 1,2 and 3), LPij = Interactions between them (ij= 1,2….and 6), and eijk = Random error component assumed to be normally distributed.

Significant differences among treatment means were determined using Duncan's Multiple Range- Test (Duncan, 1955).

RESULTS AND DISCUSSION

Live body weight (LBW) and weight gain (BWG):

Data presented in Table 3 show means of LBW and BWG from hatch up to 12 weeks of age of Muscovy ducklings as affected by both main effects. Birds exposed to L_2 program had significantly ($P \leq 0.01$) high LBW at 8 weeks of age and BWG during period 5-8 wks of age compared to that exposed to L_1 program. Ducklings received P_3 diet recorded significantly ($P \leq 0.01$) high LBW at 4, 8 and 12 wks of age and BWG, during periods 0-4 and 4-8 wks of age and during whole period (0-12 wks of age) followed by birds received P_2 and P_1 diets, respectively. There were significantly ($P \leq 0.01$) differences due to interaction effect between lighting system and crud protein level on LBW at 4, 8 and 12 wks of age and BWG during all studied periods. Generally, the birds received P3 diet and exposed to L_1

Table 3: Means and standard errors of live body weight (g) and body weight gain (g/bird/) of Muscovy ducklings at various periods in the summer season as affected by lighting system, crude protein level and their interactions.

Item		Live body weight (g.)				Body weight gain (g./bird/)			
		At hatch	At 4-wks	At 8-wks	At 12-wks	0-4 wks	4-8 wks	8-12 wks	0-12 wks
Effect of lighting system (L):									
L1		60.11	1258.89	2716.00 [b]	3800.00	1198.78	1457.11 [b]	1084.00	3739.89
L2		60.00	1256.67	2792.22 [a]	3828.11	1196.67	1535.56 [a]	1035.89	3768.11
SEM		**±0.82**	**±7.41**	**±6.36**	**±17.40**	**±7.48**	**±8.82**	**±17.19**	**±17.34**
Sig.		**NS**	**NS**	**	**NS**	**NS**	**	**NS**	**NS**
Effect of crud protein level (P):									
	P1	60.17	1233.33[b]	2696.67[c]	3734.50[c]	1173.17[b]	1463.33[b]	1037.83	3674.33[c]
	P2	60.17	1244.17[b]	2762.83[b]	3819.17[b]	1184.00[b]	1518.67[a]	1056.33	3759.00[b]
	P3	59.83	1295.83[a]	2802.83[a]	3888.50[a]	1236.00[a]	1507.00[a]	1085.67	3828.67[a]
SEM		**±1.00**	**±9.08**	**±7.80**	**±21.30**	**±9.16**	**±10.80**	**±21.05**	**±21.23**
Sig.		**NS**	**	**	**	**	**	**NS**	**
Effect of interaction (L x P):									
L1	**P1**	60.67	1241.67[b]	2693.67 [d]	3720.33 [d]	1181.00[b]	1452.00[b]	1026.67[ab]	3659.67[d]
	P2	60.00	1236.67[b]	2717.33 [cd]	3825.00[bc]	1176.67[b]	1480.67[b]	1107.67 [a]	3765.00[bc]
	P3	59.67	1298.33[a]	2737.00[c]	3854.67[ab]	1238.67[a]	1438.67[b]	1117.67 [a]	3795.00[ab]
L2	**P1**	59.67	1225.00[b]	2699.67 [d]	3748.67 [cd]	1165.33[b]	1474.67[b]	1049.00[ab]	3689.00 [cd]
	P2	60.33	1251.67[b]	2808.33[b]	3813.33[bcd]	1191.33[b]	1556.67 [a]	1005.00[b]	3753.00 [bcd]
	P3	60.00	1293.33[a]	2868.67[a]	3922.33[a]	1233.33[a]	1575.33 [a]	1053.67[ab]	3862.33 [a]
SEM		**±1.42**	**±12.84**	**±11.02**	**±30.13**	**±12.95**	**±15.28**	**±29.77**	**±30.03**
Sig.		**NS**	*	**	**	*	**	*	**

[a,b,c,d] Means in the same column followed by different letters are significantly different (P ≤0.05)
NS : Not significant * Significant (P ≤0.05) ** Significant (P≤0.01)

program group recorded the highest values of both LBW and BWG compared to other groups. These results are in agreements with Smith and Pesti (1998) and Temim *et al.* (2000) who reported that increased dietary protein content in the broiler diet results in improve LBW and BWG, However, Zhaye *et al.*, (2009) showed no significant effect of varying CP level in broiler diets on LBW and BWG during starter phase.

Azazi *et al.* (2015) mentioned that growth of the chicks can be influenced by lights, and added that increasing lights may have aided early growth in this experiment by providing the chicks more opportunity to feed. Hanaa Khalil *et al.* (2007) indicated that low difference between the lengths of light hours (2-4 hours) has low impact on body weight and body weight gain. On the other hand, Schwean-Lardner *et al.* (2013) reported that broiler health improved with decreasing day length. These observations may be due to increasing sleep, low physiological stress, improved immune or responsiveness, improvements in bone metabolism and leg strength, reduction in mortality and improvement in feed conversion.

Feed intake (FI) and feed conversion ratio (FCR):-

Data presented in Table 4 showed that there were highly significantly ($P\leq0.01$) differences in the amounts of feed consumed due to lighting program effect of Muscovy duckling during all periods studied except during period 4-8 wks of age. However, the L_2 birds consumed highly significantly ($P\leq0.01$) higher amounts of feed than L_1 birds during the previous periods. In this respect, the birds of P_3 diet consumed significantly ($P\leq0.01$) lower amounts of feed than those of P_2 or P_1 diet, respectively. These results are in agreement with Mohanty *et al*., (2016) who reported a significantly higher feed consumption for experimental ducks fed 14% dietary protein as compared with that fed 16 or 18 % dietary protein.

The data of FCR were presented in Table 4. It was observed that there were highly significant ($P\leq0.01$) differences in FCR values due to lighting system during periods 4-8, 8-12 and 0-12 wks of age. Birds reared under L_1 system had the significantly ($P\leq0.05$) best FCR during 0-12 wks, as compared with L2 system. There were highly significant ($P\leq0.01$) differences in FCR values due to crud protein level during all periods studied. However, birds fed P3 diet had the highly significant ($P\leq0.01$) best FCR during 0-12 wks followed by P_2 and P_1 diet, respectively. The interaction effect between lighting system and crud protein level was highly

Table 4 : Means and standard errors of feed intake (g. feed/bird/period) and feed conversion (g feed/g body gain/bird/period) of Muscovy ducklings at various periods in the summer season as affected by lighting system, crude protein level and their interactions

Items		**Feed intake (g feed/bird/period)**				**Feed conversion (g feed/g body gain/bird/period)**			
		0-4 wks	**4-8 wks**	**8-12 wks**	**0-12 wks**	**0-4 wks**	**4-8 wks**	**8-12 wks**	**0-12 wks**
Effect of lighting system (L):									
L1		1645.89 ^{b}	4370.89	5555.44 ^{b}	11572.22 ^{b}	1.37	3.00 ^{a}	5.14b	3.10 ^{b}
L2		1690.89 ^{a}	4369.33	6231.67 ^{a}	12291.89 ^{a}	1.40	2.85 ^{b}	6.03 ^{a}	3.26 ^{a}
SEM		**±2.93**	**±13.15**	**±12.59**	**±19.31**	**±0.01**	**±0.02**	**± 0.10**	**±0.02**
Sig.		*	**NS**	**	**	**NS**	*	**	*
Effect of crud protein level (P):									
	P1	1670.50 ^{a}	4496.83 ^{a}	6125.00 ^{a}	12292.33 ^{a}	1.43 ^{a}	3.07 ^{a}	5.90 ^{a}	3.34 ^{a}
	P2	1672.83 ^{a}	4424.00 ^{b}	5998.00 ^{b}	12094.83 ^{b}	1.41 ^{a}	2.92 ^{b}	5.72 ^{a}	3.22 ^{b}
	P3	1631.83 ^{b}	4189.50 ^{c}	5557.67 ^{c}	11379.00 ^{c}	1.32 ^{b}	2.79 ^{c}	5.14b	2.97 ^{c}
SEM		**±3.59**	**±16.11**	**±15.42**	**±23.65**	**±0.01**	**±0.03**	**±0.12**	**±0.02**
Sig.		*	**	**	**	*	**	*	**
Effect of interaction (LxP):									
L 1	**P1**	1670.00 ^{a}	4367.00 ^{c}	5654.33 ^{dc}	11691.3 ^{d}	1.41 ^{a}	3.01 ^{b}	5.51 ^{b}	3.19 ^{c}
	P2	1666.33 ^{a}	4525.00 ^{b}	5610.67 ^{d}	11802.00 ^{c}	1.42 ^{a}	3.06 ^{ab}	5.08 ^{bc}	3.14 ^{c}
	P3	1601.33 ^{b}	4220.67 ^{d}	5401.33 ^{e}	11223.33 ^{f}	1.29 ^{c}	2.93 ^{b}	4.84 ^{c}	2.96 ^{d}
L 2	**P1**	1671.00 ^{a}	4626.67 ^{a}	6595.67 ^{a}	12893.33 ^{a}	1.44 ^{a}	3.14 ^{a}	6.29 ^{a}	3.49 ^{a}
	P2	1679.33 ^{a}	4323.00 ^{c}	6385.33 ^{b}	12387.67 ^{b}	1.41 ^{a}	2.78 ^{c}	6.36 ^{a}	3.30 ^{b}
	P3	1662.33 ^{a}	4158.33 ^{d}	5714.00 ^{c}	11534.67 ^{e}	1.35 ^{b}	2.64 ^{d}	5.45 ^{b}	2.99 ^{d}
SEM		**±5.07**	**±22.78**	**±21.81**	**±33.45**	**±0.02**	**±0.04**	**±0.17**	**±0.03**
Sig.		**	**	**	**	*	**	**	**

^{a,b,c,d} Means in the same column followed by different letters are significantly different (P ≤0.05)
NS : Not significant * Significant (P ≤0.05) ** Significant (P≤0.01).

significant ($P \leq 0.01$) on the FI, and the FCR during all periods and during whole experimental period. However, birds fed on P3 diet and exposed to either L_1 or L_2 program consumed highly significant ($P \leq 0.01$) lower amounts of feed, and had highly significant ($P \leq 0.01$) best FCR than other groups, during whole experimental period (0-12 wks).

Ducks exposed to long photoperiod consumed significantly ($P \leq 0.05$) more feed than those exposed to short photoperiod (Rahimi *et al.,* 2005). These results are in agreement with those obtained by Nawar and Bahie EI-Deen (2000), Hanaa Khalil *et al*. (2007) and Kout Elkloub *et al.* (2012) who reported that chicks reared under natural light consumed significantly ($P< 0.05$) less feed than that reared under artificial light. Classen *et al.* (2004) showed that long periods of darkness prevent regular access to feed and consequently reduce feed intake. Photoperiods less than 18 h have been observed to decrease feed consumption (Schwean – Lardner *et al*., 2006). Azazi *et al.* (2015) remark that ducks fed high protein diets had low feed intake than those fed low dietary protein level, the same author, reported that high protein level with natural day light gave the best FCR.

Performance index (PI):

The effects of lighting programs or dietary crude protein levels and their interaction on performance index (PI %) are presented in Table 5. Performance index values were significantly ($P \leq 0.05$) increased by natural light, except during period (4-8 wks), L_2 was more effective. The best performance index during the all experimental period was significantly achieved by high protein level P3%. These results are inagreement with that reported by Azazi *et al.* (2015) who remark that best value of PI (%) when experimental diets contained high protein level. However, there is significant ($P \leq 0.05$) interaction effect among lighting program and CP levels on PI during all experimental period was observed when ducks exposed for high light program L2 and fed high protein diet P3 as shown in Table 5.

Protein utilization efficiency (PUE):

Results of Table 5 shows the effect of different lighting programs or CP levels on Muscovy duckling's protein utilization efficiency (PUE) during different periods of age. The best values of PUE were observed during interval 8-12 wks and 0 – 12 wks, when ducks treated with L_1 lighting program, PUE value significantly ($P \leq 0.05$) was decreased.

Table 5: Means and standard errors of performance index and protein utilization efficiency of Muscovy ducklings at various periods in the summer season as affected by lighting system, crude protein level and their interactions

Items		Performance index (%)				Protein utilization Efficiency (PUE)			
		0-4 wks	**4-8 wks**	**8-12 wks**	**0-12 wks**	**0-4 wks**	**4-8 wks**	**8-12 wks**	**0-12 wks**
Effect of lighting system (L):									
L1		91.89	90.61^{b}	74.31^{a}	122.97^{a}	3.31	1.86^{b}	1.15^{a}	1.79^{a}
L2		90.06	98.63^{a}	64.03^{b}	118.06^{b}	3.26	1.96^{a}	0.98^{b}	1.71^{b}
SEM		**±1.08**	**±0.87**	**±1.52**	**±1.25**	**±0.02**	**±0.01**	**±0.02**	**±0.01**
Sig.		**NS**	**	**	*	**NS**	**	**	**
***Effect of crud protein level (*P):**									
	P1	86.65^{b}	87.81^{c}	63.62^{b}	111.88^{c}	3.34^{a}	1.91	1.06	1.76
	P2	88.09^{b}	95.04^{b}	67.80^{b}	118.80^{b}	3.22^{b}	1.91	1.05	1.72
	P3	98.20^{a}	101.01^{a}	76.10^{a}	130.87^{a}	3.29^{ab}	1.90	1.09	1.76
SEM		**±1.32**	**±1.07**	**±1.86**	**±1.53**	**±0.03**	**±0.02**	**±0.02**	**±0.01**
Sig.		**	**	**	**	*	**NS**	**NS**	**NS**
Effect of interaction (LxP):									
L1	P1	87.86^{b}	89.56^{cd}	67.59^{bc}	116.49^{b}	3.37	1.95^{a}	1.13	1.13^{a}
	P2	87.39^{b}	88.94^{cd}	75.57^{ab}	122.07^{b}	3.21	1.82^{b}	1.16	1.16^{a}
	P3	100.43^{a}	93.31^{c}	79.78^{a}	130.35^{a}	3.36	1.80^{b}	1.15	1.15^{a}
L2	P1	85.43^{b}	86.05^{d}	59.64^{c}	107.27^{c}	3.32	1.87^{ab}	0.99	0.99^{b}
	P2	88.80^{b}	101.13^{b}	60.03^{c}	115.53^{b}	3.22	2.00^{a}	0.93	0.93^{b}
	P3	95.96^{a}	108.71^{a}	72.43^{ab}	131.38^{a}	3.22	1.99^{a}	1.03	1.03^{ab}
SEM		**±1.86**	**±1.51**	**±2.62**	**±2.62**	**±0.04**	**±0.03**	**±0.03**	**±0.03**
Sig.		**	**	**	**	**NS**	*	**NS**	*

[a,b,c,d] Means in the same column followed by different letters are significantly different ($P \leq 0.05$)

NS : Not significant * Significant ($P \leq 0.05$) ** Significant ($P \leq 0.01$).

Results indicated that PUE values were increased for the groups treated by L_1 with P_1, L_1 with P_2, L_2 with P_2 and L_2 P_3. This result agree with Nguyen and Bunchasak (2005) who reported that the chicks fed low protein diet converted protein to body weight gain more efficiently than those fed high protein diets.

***Carcass traits*:**

Data listed in Table 6 illustrated that the duckling reared under L2 system gave significantly ($P \leq 0.05$) higher percentage of thighs than that reared under L1 system. While, spleen and abdominal fat was insignificantly ($P \leq 0.05$) higher for L2 system than that L1 system. There were highly significant ($P \leq 0.01$) differences due to crud protein level on percentage of breast, tend and abdominal fat. However, the birds fed on P_2 diet recorded the highest values of percentage of breast and tend, while, the highest values of abdominal fat were recorded by birds fed on P3 diet. The interaction effect between lighting system and crud protein level in the diet on all carcass traits, except abdominal fat. However, birds reared under L_2 system and fed P_1 diet recorded highly significantly ($P \leq 0.01$) abdominal fat compared to other groups.

These results are inagreement with Azazi *et al.* (2015) who reported that interaction between CP levels and lighting programs did not effect in all these parameters except, abdominal fat which was significantly increased by natural day light. Also, Malone *et al.* (1980); Cave (1981) reported a reduction in abdominal fat content at slaughter of broiler chickens reared under intermittent light.

Biochemical characteristics:

Data of serum proteins (serum total protein, albumin (A), globulin (G) and A/G ratio), creatinine and serum lipids (serum total cholesterol, high density lipoproteins (HDL) and triglyceride) concentration of Muscovy duckling at 12 wks of age as affected by lighting system and crud protein level in the diet and their interaction are presented in Table 7. Serum proteins and serum lipids were not significantly affected due to both lighting system and crud protein level effect and their interaction. Also, serum creatinine concentration was not significantly affected by lighting system and the interaction between lighting system and crud protein level. While, there was

Table 6 : Means and standard errors of carcass traits of Muscovy ducklings in the summer season as affected by lighting system, crude protein level, and their interactions

Items		% of LBW					mg/100g.bwt
		T. edbl.	**Evs. carcass**	**T. giblets**	**Thighs**	**Breast**	**Abdominal fat**
Effect of lighting system (L):							
L1		72.70	67.24	5.46	22.81 [b]	22.91	1448.87
L2		72.77	67.35	5.42	23.36 [a]	22.54	1615.69
SEM		**±0.28**	**±0.25**	**±0.10**	**±0.15**	**±0.18**	**±117.38**
Sig.		**NS**	**NS**	**NS**	*****	**NS**	**NS**
Effect of crud protein level (P):							
	P1	72.69	67.11	5.58	23.07	22.54 [ab]	1149.23 [b]
	P2	72.60	67.20	5.39	22.95	23.17 [a]	1682.78 [a]
	P3	72.91	67.56	5.35	23.24	22.47 [b]	1764.83 [a]
SEM		**0.34**	**0.31**	**0.13**	**0.18**	**0.22**	**143.76**
Sig.		**NS**	**NS**	**NS**	**NS**	*****	******
Effect of interaction (LxP):							
L1	P1	72.83	67.13	5.69	22.62	22.86	1263.01 [b]
	P2	72.18	66.87	5.31	22.92	23.10	1496.14 [ab]
	P3	73.08	67.71	5.37	22.90	22.77	1587.48 [ab]
L2	P1	72.55	67.10	5.46	23.51	22.22	1035.45 [b]
	P2	73.01	67.54	5.48	22.98	23.24	1869.42 [a]
	P3	72.74	67.41	5.32	23.59	22.17	1942.19 [a]
SEM		**0.48**	**0.44**	**0.18**	**0.26**	**0.32**	**203.30**
Sig.		**NS**	**NS**	**NS**	**NS**	**NS**	******

[a ,b,c,d] Means in the same column followed by different letters are significantly different ($P \leq 0.05$)
NS : Not significant * Significant ($P \leq 0.05$) ** Significant ($P \leq 0.01$).

significantly ($P \leq 0.05$) difference due to crud protein level on serum creatinine concentration. In this respect, birds fed P3 diet had significantly ($P \leq 0.05$) high serum creatinine concentration compared to birds fed P_1 diet. These results are inagreement with, Falts *et al.* (1988), who concluded that there were no significant differences in blood constituents, total protein, albumen and globulin among birds reared under different light regimes.

Table 8 : Means and standard errors of serum blood constituents of Muscovy ducklings in the summer season as affected by lighting system, crude protein level, and their interactions

Item		Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	A/G	Creatinine (mg/dl)	Total cholest. (mg/dl)	HDL cholest. (mg/dl)	Triglyc (mg/dl)
Effect of lighting system (L):									
L1		6.40	3.17	3.23	0.99	0.60	161.68	54.74	103.97
L2		6.36	3.13	3.24	0.97	0.62	151.50	55.99	123.38
SEM		**0.15**	**0.07**	**0.10**	**0.03**	**0.03**	**5.92**	**3.83**	**8.37**
Sig.		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Effect of crud protein level (P):									
	P1	6.41	3.20	3.21	1.01	0.53 [b]	161.16	51.01	119.14
	P2	6.56	3.22	3.34	0.97	0.64 [ab]	156.58	57.08	115.20
	P3	6.17	3.02	3.15	0.96	0.66 [a]	152.04	58.00	106.68
SEM		**0.18**	**0.09**	**0.12**	**0.03**	**0.04**	**7.25**	**4.70**	**10.25**
Sig.		**NS**	**NS**	**NS**	**NS**	*****	**NS**	**NS**	**NS**
Effect of interaction (LxP):									
L1	P1	6.27	3.12	3.15	1.01	0.56	158.53	53.63	96.52
	P2	6.64	3.30	3.34	0.99	0.63	156.19	58.25	108.06
	P3	6.29	3.08	3.20	0.97	0.60	170.34	52.35	107.33
L2	P1	6.56	3.28	3.28	1.01	0.50	163.78	48.39	141.76
	P2	6.47	3.14	3.33	0.95	0.65	156.97	55.92	122.34
	P3	6.06	2.96	3.10	0.95	0.72	133.75	63.65	106.04
SEM		**0.26**	**0.13**	**0.17**	**0.04**	**0.05**	**10.25**	**6.64**	**14.50**
Sig.		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

[a,b,c,d] Means in the same column followed by different letters are significantly different (P ≤0.05)
NS: Not significant * Significant (P ≤0.05)

Economical efficiency (%):

The live body weight and feeding cost are generally considered the most important factors involved in achievement of maximum efficiency values of live body weight. The results of economical efficiency (Table 8) showed that ducks exposed for L_1 (natural day light) was economically achieved the best economical efficiency (EE, %) as compared with L_2 (22 hours light:2 hours dark). Using high protein P_3 in diets of ducks with lighting programs L_1 recorded the best economical efficiency of ducks when compared to the other treatment groups during the whole experimental periods. These results are in agreement with Gordon,(1994) who concluded that using short photoperiods results in lower production costs .

Table 9 : Economic efficiency of Muscovy ducklings in the summer season as affected by lighting system, crude protein level and their interactions.

Items		Feed intake (Kg)	Feed cost (LE)[1]	Light cost (LE)	Total cost (LE)[2]	LBW (Kg)	Total return (L.E)[3]	Net return (L.E)	EE (%)[4]	REE %
Effect of lighting system (L):										
L1		11.57	37.83	0.00	63.05	3.80	83.60	20.55	32.59	100
L2		12.29	40.14	0.50	67.73	3.83	84.22	16.49	24.34	75
Effect of crud protein level (P):										
	P1	12.29	39.09	0.00	65.15	3.73	82.16	17.01	26.11	100
	P2	12.09	39.52	0.00	65.87	3.82	84.02	18.15	27.56	105
	P3	11.38	38.16	0.00	63.60	3.89	85.55	21.95	34.51	132
Effect of interaction (LxP):										
L1	P1	11.69	37.22	0.00	62.03	3.72	81.85	19.82	31.95	100
	P2	11.80	38.59	0.00	64.32	3.83	84.15	19.83	30.84	96
	P3	11.22	37.64	0.00	62.73	3.85	84.80	22.07	35.18	110
L2	P1	12.89	40.96	0.50	69.10	3.75	82.47	13.37	19.35	61
	P2	12.39	40.44	0.50	68.23	3.81	83.89	15.66	22.95	72
	P3	11.53	38.68	0.50	65.30	3.92	86.29	20.99	32.14	101

1- L.E. = Egyptian pound.
2- According to the local market price of 1 kg LBW = 22 L.E. at the experimental time.
3- Feed cost was calculated as 60 % of the total cost.
4- Economic efficiency, EE (%)= Net return (L.E) / Total cost(L.E)*100.

Conclusively, from these results , it could be concluded that natural day light during summer season had negative effects on productive performance for Muscovy ducks, but dietary high CP levels (23%) could be used to maximize and improved body weight body, weight gain, feed intake, feed conversion ratio, as well as, economical efficiency, during summer months.

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تأثير فترة الإضاءة ومستوي البروتين علي الإنتاج والكفاءة الاقتصادية للبط المسكوفي خلال موسم الصيف

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تهدف هذه الدراسة إلي معرفة تأثير استخدام ثلاث مستويات من البروتين الخام منخفض ٢١ ، ١٧ ، ١٦ والمتوسط (٢٢ ، ١٨ ، ١٧) والعالي (٢٣ ، ١٩ ، ١٨ %) للمراحل البادي والنامي والناهي علي التوالي كذلك برنامجان للإضاءة الأول ضوء النهار الطبيعي واستكمال الاثنين وعشرون ساعة باضاءة صناعية والثاني ٢٢ ساعة إضاءة صناعية في اليوم والتداخل بينها علي معدل الأداء وصفات الذبيحة وقياسات الدم والكفاءة الاقتصادية للبط المسكوفي خلال فصل الصيف وقد استخدم في هذا البحث عدد ١٨٠ كتكوت بط مسكوفي عمر يوم واحد حتي ١٢ أسبوع من العمر ووزن البط فردياً.ووزع عشوائياً بالتساوي إلي ٦ مجاميع بكل مجموعة٣ مكررات وبكل مكررة ١٠ طيور .

كانت النتائج المتحصل عليها كما يلي :

١) البط الذي تغذي علي عليقةعالية البروتين أعطت أعلي معدل فى وزن الجسم الحي والفرق في وزن الجسم عند مقارنتها بمستوي البروتين المنخفض أو المتوسط.
٢) زاد وزن الجسم الحي والفرق في وزن الجسم معنويا بالتداخل بين ضوء النهار الطبيعي والمستوي العالي للبروتين عند ١٢ أسبوع ومن صفر حتي ١٢ أسبوع.

٣) المجاميع التي تم تربيتها مع ضوء النهار الطبيعي أو المستوي العالي من البروتين أو كلاهما معاً استهلاك غذاء أقل وتحسن معامل التمويل الغذائي بالمقارنة بباقى المجاميع.

٤) هناك تـأثير معنوى لمستوى البروتين و برنامج الاضاءة على معدل استهلاك البروتين ودليل معدل الاداء وكفاءة تحويل .البروتين الي لحم و ايضا هناك تاثير معنوى للتداخل بين مستوى البروتين و برنامج الاضاءة على معدل استهلاك البروتين ودليل معدل الاداء فى نهاية التجربة بينما لم يتأثر معنويا كفاءة تحويل البروتين الي لحم بهذاالتداخل .

٥) أظهرت النتائج أن أعلى عائد إقتصادى كان للمعاملة ذات المستوى العالي من البروتين في ضوء النهار الطبيعى.

التوصية: نستخلص من النتائج بأن التغذية على المستوى العالي من البروتين فى ضوء النهار الطبيعى كان له تأثير إيجابى على معدل الأداء و الكفاءة الاقتصادية للبط المسكوفى النامى .