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ANIMAL PRODUCTION

Laying parameters of meat quails breeders submitted to lighting programs at growing phase

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ABSTRACT: When applied at growing phase, lighting program aims to obtain quails with body weight and physiological maturity suitable for the beginning of laying. This study evaluated lighting programs at growing phase on performance, sexual maturity and egg quality of meat quail breeders (*Coturnix coturnix*) at laying phase. From 7 to 49 days of age, 300 female meat quails were subjected to three lighting programs (natural, intermittent and continuous), with 5 replicates of 20 birds each. At 49 days of age, 240 quails were transferred to a shed, maintaining the same experimental conditions. Meat quails submitted to continuous and intermittent lighting programs had higher weight of reproductive system and lower ages for first egg production and to reach 50% of egg production ($P < 0.05$). Quails submitted to natural lighting had lower feed intake from 49 to 70 and 71 to 92 days of age and worse feed conversion up to 114 days of age. Continuous and intermittent lighting programs resulted in more precocious quails compared to natural lighting program. Quails submitted to natural lighting at growing phase presented lower egg production during all periods, not differing for birds submitted to continuous and intermittent programs from the second period (71 to 92 days of age). Intermittent and continuous lighting result in better feed conversion of breeding quails up to 114 days and a higher percentage of laying (49 to 136 days), reducing the number of days to produce the first egg and to reach 50% of laying, in relation to natural lighting.
Key words: *Coturnix coturnix,* photoperiod, sexual maturity, eggs.

Parâmetros de postura de codornas de corte reprodutoras submetidas a programas de luz na fase de crescimento

RESUMO: Quando aplicado na fase de crescimento, o programa de luz visa obter codornas com peso corporal e maturidade fisiológica adequados para o início da postura. Este estudo avaliou programas de iluminação na fase de crescimento sobre o desempenho, maturidade sexual e qualidade dos ovos de codornas de corte reprodutoras (*Coturnix coturnix*) na fase de postura. Durante o período de sete a 49 dias de idade, 300 codornas de corte fêmeas foram submetidas a três programas de iluminação (natural, intermitente e contínuo), com cinco repetições de 20 aves cada. Aos 49 dias de idade, 240 codornas foram transferidas para um galpão, mantendo a mesma distribuição experimental e submetidas às mesmas condições. As aves submetidas aos programas de iluminação contínuo e intermitente na fase de crescimento apresentaram maiores peso relativo do sistema reprodutivo e consequentemente menores idades para produção do primeiro ovo e para atingir 50% da produção de ovos ($P < 0.05$). As aves que receberam apenas iluminação natural apresentaram menor consumo de ração nos períodos de 49 a 70 e 71 a 92 dias de idade e pior conversão alimentar até 114 dias de idade. Os programas de iluminação contínua e intermitente na fase de crescimento resultaram em codornas mais precoces quando comparados as aves submetidas ao programa de iluminação natural. Codornas submetidas a programa de luz natural na fase de crescimento apresentaram menor produção de ovos durante todos os períodos, não diferindo das aves submetidas a programas contínuos e intermitentes a partir do segundo período (71 a 92 dias de idade). A iluminação intermitente e contínua na fase de crescimento resulta em melhor conversão alimentar de codornas reprodutoras até 114 dias e maior percentual de postura (49 a 136 dias), reduzindo o número de dias para produzir o primeiro ovo e atingir 50% de postura, em relação a iluminação natural..
Palavras-chave: *Coturnix coturnix*, fotoperíodo, maturidade sexual, ovos.

INTRODUCTION

Several environmental factors act in controlling the physiological functions of birds, and the light is the one that has the greatest influence on reproductive activity (GONGRUTTANANUN & GUNTAPA, 2012). The main effect of light stimulation in birds is to anticipate the age at which they reach sexual maturity, and this modulation is not produced by light intensity, but rather by the duration of the lighting period, which alters the age of production of the first eggs (LEWIS et al., 2004). In this sense, light manipulation has been an effective tool in the management of poultry intended for egg

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production at all stages of breeding (EL-SABROUT et al., 2022). According to GEWEHR & FREITAS (2007), among the effects of light on egg production, it is possible to highlight the possibility of advance or delay the onset of laying, influencing the production rate, improving egg shell quality, optimizing egg size and maximize feed efficiency.

When applied at growing phase, lighting program aims to obtain birds with body weight and physiological maturity suitable for the beginning of egg production. Thus, lighting programs have been designed to control weight gain and age for sexual maturity and ensure egg production within normal range during the posture cycle (YURI et al., 2016). Considering that natural lighting can result in insufficient photoperiod, different lighting programs have been proposed in order to provide satisfactory conditions for the sexual maturity of birds. The continuous lighting program is based on a photoperiod of the same length throughout the bird's life, to allow uniform access to feeders during the day, with 23 hours of light and 1 hour of darkness being commonly employed (GORDON, 1994). However, continuous exposure to lighting can result in an immunologically deficient bird (ABO-AL-ELA et al., 2021), with intermittent lighting based on repeated cycles of light and dark over a 24-hour period being proposed.

At first, meat quails require a smaller number of hours of light, as this will suppress the effect of light on early sexual maturity and reduce the amount of fat in the carcass (RAMANKEVICH et al., 2020). BOON et al. (2000) evaluated the effect of photoperiod on sexual development in meat quails and observed that in the longer photoperiods greater weight gain were obtained and sexual maturity was stimulated with the laying of the first egg at 45 days of age.

In this sense, it is observed for meat quail breeders, information on the amount of daily light that ensures the start of their reproductive life at the appropriate age is scarce. In addition, the external and internal quality of egg can also be altered from the lighting programs, which effects may also extend on embryo viability and incubation hatchability (HEGAB & HANAFY, 2019). According to TANURE et al. (2009), broiler breeders beginning the laying phase with weight below recommended, it is observed smaller eggs with greater thickness and smaller eggshell porosity, characteristics that result in lower rates of hatchability and survival.

Given the above, the aim of the present study was to evaluate the effects of lighting programs at growing phase on performance, sexual maturity and quality of eggs of female meat quails at laying phase reared in equatorial region.

MATERIALS AND METHODS

The quails were sexed by the cloacae reversal method and purchased from a commercial incubator at one day of age. On the first day the birds were weighed and based on live weight they were selected and distributed in the experimental plots with same initial weight (8.80 g). From 1 to 7 days of age, the birds were housed in boxes (100 cm x 150 cm) with floor covered by wood shavings (8 cm high), equipped with a tray feeder and a pendular drinker. The heating during the first week was accomplished using 60-Watt incandescent lamps. From the second week, tubular feeder was used and the birds were submitted to three different lighting programs: natural, intermittent and continuous.

The natural lighting program consisted of 12 h and 30 min of natural light and 11 h and 30 min without artificial lighting during the night. The intermittent lighting program consisted of 18 h of light and 6 h of dark, with the light period composed of 12 h and 30 min of natural light and 5 h and 30 min of artificial light intercalated by dark periods of 1 h and 30 min. In the continuous lighting program, the birds were subjected to 23 h of constant light, being 12 h and 30 min of natural light, 10 h and 30 min of artificial light and 1 h of dark.

The experimental shed was subdivided into three parts according to the treatments, and the partitions were made of 150-micron thick black tarps and placed in a pulley system, which allowed the curtains to be closed and opened to provide the amount of light for each program so as not to interfere with the lighting of the other treatments. Independent lighting systems were installed in the three parts of the shed and driven by timer. White lamps (7W) were used to provide a lighting level of 15 lux at birds' height. The verification of the level of lighting was carried out using an electronic light meter (Minipa - MLM-1020, Brazil) in the range of 20 to 20000 lux.

At 49 days of age, 240 females were transferred to the production shed, maintaining the experimental design, with three treatments and five replicates of 16 birds. Four cages per replicate were used with four females per galvanized wire cage with dimensions of 33 cm x 23 cm x 16 cm, equipped with trough type feeders and nipple type drinkers. The mean weight of the quails at the time of transfer was 275.89 g; 307.46 g; 317.33 g for natural, intermittent and continuous quails, respectively. The experimental period was divided into four periods of 21 days, which the birds were submitted to the same lighting program (14 hours light transfer and 30 minutes a week increase until reaching 16 hours constant light) and received the same diet based on corn and soybean meal (Table 1), formulated according to the nutritional recommendations proposed by SILVA & COSTA (2009) and feed composition values proposed by ROSTAGNO et al. (2017).

To evaluate the development of reproductive system of quails at the end of growing phase, 2 birds per replicate were selected based on the average weight of each plot and slaughtered for removal the ovary and oviduct, which were weighed in a semi-analytical balance. The evaluation of sexual maturity was performed by counting the days for the laying of the first egg by the birds of each replicate and reach 50% of laying. Egg production was measured from the growing phase.

During the production phase, in each period, the feed provided and the leftovers were weighed, determining the feed intake (g/bird/day). The eggs were collected daily, and one day a week all the eggs of each plot were identified, weighed and analyzed for percentage (%) of egg yolk, albumen and shell, Haugh Unit, specific gravity (g/cm³) and shell thickness (mm). From the consumption data and egg production it was determined laying rate (% / bird / day), egg weight (g), egg mass (g / bird / day) and feed conversion (g feed / g of eggs produced).

Eggs were weighed to calculate the specific gravity (SG) according to procedures described by FREITAS et al. (2004). After SG determination, the eggs were broken to determine albumin height and Haugh Unit (HU), according to the equation: $HU = 100 \log (H + 7.57 – 1.7 W^{0.37})$, where: H = albumen height (mm) and W = egg weight (g). After measuring the height of the albumen, the yolk was separated and weighed, obtaining the yolk percentage in relation to egg weight. The eggshells were separated, washed, dried and weighed in a semi-analytical balance with a precision of 0.01g to obtain the shell percentage. The percentage of albumen was obtained by the difference, where: % albumen = 100 - (% yolk + % shell). To determine the eggshell thickness, shell fragments were removed from the major, minor and equatorial

Table 1 - Percentage and nutritional composition of quail diet at laying phase.

Ingredients	Quantity (%)
Corn	51.970
Soybean meal (45%)	36.500
Soy oil	2.270
Bicalcium phosphate	6.970
Calcitic limestone	1.160
Common salt	0.530
DL-Methionine	0.210
L-Lysine	0.130
L-Treonine	0.110
Mineral and vitamin supplement[1]	0.150
Total	100.00
----------Nutritional and energetic composition calculated----------	
Metabolizable energy (kcal kg−1)	2900
Crude protein (%)	22.000
Calcium (%)	3.250
Available phosphorus (%)	0.390
Sodium (%)	0.230
Digestible lysine(%)	1.150
Digestible methionine + cystine (%)	0.830
Digestible threonine (%)	0.800
Digestible tryptophan (%)	0.190

[1]Composition per kg of product: vitamin A, 9000000.00 UI; vitamin B1, 2000.00 mg; vitamin B12, 15.00 mcg; vitamin B2, 6000.00 mg; vitamin B6, 8000.00 mg; vitamin D3, 25000000.00 UI; vitamin E, 20000.00 UI; vitamin K3, 25000.00 mg; biotin, 100.00 mg; niacin, 35000.00 g; folic acid, 1500.00 mg; pantothenic acid, 12000.00 mg; copper, 20.00 g; iron, 100000.00 g; iodine, 2000.00mg; manganese, 130000.00 g; selenium, 250.00 mg; zinc, 130000.10 g.

regions of the eggs to measure the thickness of the eggshell in each of these regions. The thickness of the shell was considered as the average of the thicknesses obtained in the three regions of the eggshell.

Data were submitted to analysis of variance by SAS (Statistical Analysis System, University Edition), considering 3 lighting programs (natural, intermittent, continuous) at growing phase in a completely randomized design with repeated measure (49 to 70, 71 to 92, 93 to 114 and 115 to 136 days of age), according to the model: Yijk = μ + τi + eik + βj + (τβ)ij + ijk, where Y_{ijk} = Value observed according to lighting program i (i = natural, intermittent or continuous), at phase j and on repeat k; μ_Y = population mean; τi = effect of lighting program i; eik = residue (a) of the plot; (τβ)ij = effect of the interaction of lighting program i with phase j; ε_{ijk} = experimental error associated with the observed Y_{ijk} value, at subplot level. The means were compared by the Student-Newman-Keuls test at 5% probability.

RESULTS AND DISCUSSION

At 49 days of age, meat quail breeders submitted to intermittent and continuous lighting programs presented higher relative weight of reproductive system when compared to those submitted to natural lighting program (Table 2). Similarly, the birds submitted to intermittent and continuous lighting at growing phase presented lower age of first egg laying and age to reach 50% of production in relation to those that received only natural light. In this sense, quails submitted to the natural light program had a lower reproductive system weight, resulting in a greater number of days for laying the first egg and for reaching 50% of production. The age at the first egg has been used to characterize the sexual maturity of birds and can be influenced by several factors such as genetics, chronological age, body weight and the adopted lighting program. According to BOON et al. (2000), the supply of short photoperiods inhibits or delay sexual maturity in meat quails, and it was observed that female quails submitted to 15-hour daily illumination had first egg laying at 45 days of age, while those receiving only 6 hours of daily light reached sexual maturity only at 115 days.

Thus, the observed difference, both for the age of the first egg and to reach 50% egg production, can be associated to the development of reproductive system of meat quails submitted to the greater number of light hours in the intermittent and continuous programs in relation to those submitted to natural light, since these were lighter at 49 days of age and presented lower development of the reproductive system, being related to the lower weight at the beginning of the experimental period. According to GEWEHR et al. (2005), when the neuroendocrine system of birds perceives that the duration of photoperiod is sufficient to initiate the reproductive process, signaling of the hypothalamus to secrete gonadotropic releasing hormone (GnRH), the adenohypophysis is stimulated to produce gonadotrophic hormones. In laying hens, luteinizing hormone (LH) and follicle stimulating hormone (FSH) promote ovarian development and control the follicular hierarchy, so when there is a decrease in the amount of light in the final growing period, there will be an increase in the age necessary for the birds to reach the sexual maturity, delaying the beginning of laying and reducing the total egg production in a given period of time (YURI et al., 2016).

Regarding the influence of lighting program, it was observed that, during the periods of 49 to 70 and 71 to 92 days of age, the meat quails submitted to natural light presented lower feed intake than those submitted to the other programs (Table 3), while birds submitted to intermittent and

Table 2 - Relative weight of reproductive system, age at first egg and age at 50% egg production of meat quails submitted to different lighting programs at growing phase.

Lighting programs	Relative weight of reproductive system (%)	Age at first egg (days)	Age at 50% egg production
Natural	2.36 B	55.00 A	73.40 A
Intermittent	9.72 A	39.00 B	50.20 B
Continuous	10.03 A	37.40 B	50.00 B
SEM	3.09	2.23	3.52
P value	0.0001	0.0023	0.0063

SEM: standard error mean. Means followed by different letters in the column differ by the Student-Newman-Keuls test at 5% probability.

Table 3 - Performance of meat quails in laying periods submitted to different lighting programs at growing phase.

Age (A), days	Lighting program (LP)			Mean	SEM	Effect	
	Natural	Intermittent	Continuous			A	LP
Feed intake (g)							
49 to 70	28.13bB	31.61aA	30.16aB	29.96			
71 to 92	29.14bB	32.59aA	32.03aA	31.25			
93 to 114	33.06aA	32.27aA	32.31aA	32.54			
115 to 136	32.39aA	31.85aA	33.09aA	32.44	0.95	**	**
Mean	30.68	32.08	31.90				
Laying percentage (%)							
49 to 70	15.84bC	78.15aC	81.506aB	38.50			
71 to 92	49.82bB	82.54aB	81.980aB	71.44			
93 to 114	82.55bA	86.35aA	86.854aA	85.25	2.60	**	**
115 to 136	82.27bA	86.59aA	87.300aA	85.39			
Mean	57.62	83.41	84.410				
Egg weight (g)							
49 to 70	12.21	12.52	12.17	12.30C			
71 to 92	12.49	12.59	12.60	12.56BC			
93 to 114	12.43	12.72	12.99	12.71B	0.37	**	NS
115 to 136	13.34	13.14	13.20	13.27A			
Mean	12.62	12.74	12.74				
Egg mass (g)							
49 to 70	1.94bC	9.79aC	9.92aB	7.22			
71 to 92	6.22bB	10.39aB	10.33aB	8.98			
93 to 114	10.26bA	10.98aA	11.28aA	10.84	0.48	**	**
115 to 136	10.98aA	11.38aA	11.52aA	11.29			
Mean	7.33	10.63	10.76				
Feed conversion							
49 to 70	16.34aA	3.23bA	3.05bA	7.54			
71 to 92	4.72aB	3.13bAB	3.10bA	3.65			
93 to 114	3.22aB	2.93bBC	2.86bA	3.00	2.03		
115 to 136	2.95aB	2.80aC	2.87aA	2.87		**	**
Mean	6.812	3.028	2.973				

SEM: standard error mean. NS: not significant. Means followed by different letters, lowercase in the row and upper case in the column, differ by the Student-Newman-Keuls test at 5% probability.

continuous program did not differ among themselves in all periods. In relation to laying periods, for birds submitted to natural lighting program at growing phase (1 to 49 days), it was observed a lower feed intake in the periods from 49 to 70 and 71 to 92 days in relation to the subsequent periods, which did not differ. Birds submitted to continuous program presented lower feed intake from 49 to 70 days of age, while quails submitted to intermittent light did not present significant differences among laying periods.

The results obtained for feed intake can be attributed to the weight of meat quails at the beginning of laying period and to growth during the production cycle until the bird reaches physiological maturity (EL-SABROUT et al., 2022). Thus, birds with lower body weight at the end of growing phase (49 days) presented lower feed intake at the beginning of the laying cycle, and later, when submitted to lighting program at laying phase (16 hours of light), presented compensatory weight gain, with similar feed consumption similar to birds that reached maturity at earlier age. For laying percentage, in all periods, meat quails submitted to continuous and intermittent lighting at growing produced more eggs than those submitted to natural lighting program. Regarding the effect of laying period, it was observed that laying percentage reached the same level of production from the third period for all birds, remaining similar at fourth laying period. Meat quails submitted to intermittent and continuous light reached the peak egg production at third period (93 to 114 days of age), with production around 86%. However, the birds submitted to natural light seem to have not reached the peak or did not reach the level of production obtained for the birds submitted to the other light programs, since in the third and fourth periods the daily production was around 82% and there were no increasing from the third to the fourth period (115 to 136 days of age), which could indicate an increase in production with the advancing age, until reaching the same level of production of birds from other lighting programs. These results are similar to those reported by BOON et al. (2000), who observed that quails submitted to longer photoperiods presented greater weight gain and sexual maturity was stimulated.

The difference in egg production of meat quails submitted to different lighting programs reflects the influence of this on the sexual maturity of birds, which compromised egg production at the beginning of laying phase (MOHAMMED et al., 2019). Conversely, increasing production with the advancing age can be seen as a normal characteristic of laying hens and breeders (BAIN et al., 2016), in which daily production increases with age until reaching the peak of egg production and, after maintenance of production for a period, is reduced until reaching the level that is no longer economically viable, and birds should be discarded.

The weight of the eggs was not influenced by the lighting programs. However, there was a significant difference between laying periods, with higher egg weight due to an increase in the age of birds. Normally laying hens produce small eggs and the egg weight increases as the bird ages, associated with the growth of birds until they reach physical and physiological maturity, which coincides with the peak of production age (MENEZES et al., 2012). Conversely, after the peak, there will be an increase in the number of intervals between ovulations, when the same amount of yolk from the hepatic synthesis is deposited in smaller numbers of follicles, contributing to the increase of yolk size and egg weight (CUI et al., 2020).

Although meat quails submitted to natural lighting program had lower mean body weight at the end of growing phase and lower feed intake in the first period of egg production, the mean egg weight did not differ in relation to the birds of the others light programs. Thus, the absence of difference in mean egg weight may be associated with the possibility that eggs to obtain the average egg weight of birds subjected to natural light were produced by the few birds that had reached adequate weight to start egg laying, after the light stimulus of laying phase, which can be reinforced by the low laying percentage of these birds in the first evaluated period (49 to 70 days of age).

For egg mass, significant difference was observed between the periods, so that the mass increased with the advancing age and remained constant from the periods of 93 to 114 and 115 to 136 days. Among the programs, it was observed that quails submitted to natural light produced less egg mass in relation to other programs until the period of 93 to 114 days of age, compared to birds from other two evaluated lighting programs. The egg mass produced by birds submitted to continuous or intermittent light did not vary significantly in all periods. The effects observed for egg mass reflect the results observed for egg production and egg weight.

The results for feed conversion reflect those obtained for feed intake and egg mass production. Birds submitted to natural light presented worse feed conversion in relation to the other programs, due to late egg production. Thus, only from 115 days of age the birds submitted to natural light presented similar feed conversion to the birds of other lighting programs. However, quails that received intermittent light during growing phase showed an improvement in feed conversion with the advancing age of birds, differing statistically in all periods. For quails that were subjected to continuous light, the results were similar in all evaluated periods, with values similar to quails submitted to intermittent lighting program, not differing from this in the evaluated periods.

Although no effect of lighting programs was observed, it was noted effect of laying period for all egg quality variables (Table 4). For yolk percentage, it was observed that eggs of meat quails from 49 to 70 days of age had lower values, differing statistically when compared to other periods, which did not differ statistically among them. According to ABUDABOS (2020), young birds mobilize less fat for yolk formation, which may compromise embryonic viability. In turn, the percentage of albumen and egg shell decreased with the age of bird, observing higher values for the period from 49 to 70 days of age, differing from the other periods (71 to 92, 93 to 114 and 115 to 136 days of age) and these did not differ statistically among themselves.

The HU values were not influenced by lighting program received by birds at growing phase, but a significant difference was observed for different laying periods. The eggs of birds from 49 to 71 and 71 to 92 days of age had higher values of HU in relation to other periods, not differing among them; however, from 93 to 114 days of age a reduction in

Table 4 - Egg quality of meat quails in laying periods submitted to different lighting programs at growing phase.

Age (A), days	Lighting program (LP)			Mean	SEM	Effect	
(days)	Natural	Intermittent	Continuous			A	LP
Albumen (%)							
49 to 70	62.74	64.15	63.30	63.39A	0.73	**	NS
71 to 92	62.52	62.67	62.63	62.61B			
93 to 114	62.13	62.12	62.19	62.14B			
115 to 136	62.16	62.16	62.56	62.28B			
Mean	62.39	62.76	62.67				
Yolk (%)							
49 to 70	29.26	28.02	28.88	28.72B	0.63	**	NS
71 to 92	29.56	29.32	29.39	29.42A			
93 to 114	29.54	29.44	29.44	29.42A			
115 to 136	29.95	29.89	29.65	29.83A			
Mean	29.34	29.17	29.58				
Shell (%)							
49 to 70	8.31	8.43	8.36	8.37A	0.34	**	NS
71 to 92	7.81	7.96	7.78	7.85B			
93 to 114	7.99	7.99	7.81	7.39B			
115 to 136	7.92	8.00	7.96	7.96B			
Mean	8.01	8.10	7.98				
HU							
49 to 70	94.40	94.60	95.01	94.67A	0.91	**	NS
71 to 92	94.66	94.97	94.41	94.68A			
93 to 114	92.85	92.32	93.04	92.14B			
115 to 136	91.33	91.47	92.97	91.92C			
Mean	93.34	93.31	93.86				
Specific gravity (g cm^{-3})							
49 to 70	1.081	1.082	1.080	1.081A	0.002	**	NS
71 to 92	1.072	1.073	1.075	1.074B			
93 to 114	1.067	1.069	1.069	1.068C			
115 to 136	1.069	1.068	1.070	1.069C			
Mean	1.073	1.073	1.073				
Egg shell thickness							
49 to 70	0.216	0.222	0.218	0.218A	0.007	**	NS
71 to 92	0.214	0.214	0.208	0.212B			
93 to 114	0.200	0.202	0.200	0.200C			
115 to 136	0.198	0.200	0.198	0.198C			
Mean	0.207	0.209	0.206				

SEM: standard error mean. NS: not significant. HU: Haugh unit. Means followed by different letters, lowercase in the row and upper case in the column, differ by the Student-Newman-Keuls test at 5% probability.

UH value was observed. Younger meat quails (49 to 70 days old) had the highest values for specific gravity of eggs, followed by quails from 71 to 92 days of age, and similar effect for egg shell thickness, with a higher thickness in the period of 49 to 70 days when compared with other periods.

The quality of albumen, measured from HU values, as well as their quantity, are important characteristics for the supply of protein and water to the embryo. In addition, the quality of albumen is directly related to the diffusion of gasses inside the egg, so that the denser the albumen the more difficult the diffusion will be. On the other hand, the specific gravity of eggs presents direct relation with the percentage of shell, being used as indirect method in the determination of egg shell quality and its conductance. In this context, the highest values of albumen quality and egg shell percentage, from

49 to 70 days of age, can be seen as an indication for lower viability of these eggs in the incubation, corroborating with TAN et al. (2022), who stated that the low hatching of eggs produced at the beginning of reproductive phase of birds would be related to the greater thickness of the shell and higher density of the albumen, which would imply in the lower loss of humidity and damaging the gas exchanges. According to the same authors, regardless the adopted lighting program, from 71 days of age, the meat quail eggs would have better hatchability conditions.

The absence of significant effects of different photoperiods during growing phase on egg quality shows that the variation in the amount of light provided has a greater influence on egg production, both commercial and quails, without influencing the internal and external quality of eggs (MOLINO et al., 2015). Thus; although later studies on the effects of lighting programs on the embryonic viability and hatchability of meat quail eggs are needed, from the results obtained, it can be inferred that the intermittent lighting program, offering 18 hours light (natural + artificial) promotes energy saving while maintaining the performance and quality of eggs at the beginning of the production cycle.

CONCLUSION

It is concluded that; although there is no effect of lighting on egg quality, intermittent and continuous lighting programs result in better feed conversion of breeding quails up to 114 days of age and a higher percentage of laying during the evaluated period (49 to 136 days), with a consequent effect on sexual precocity and a reduction in the number of days to produce the first egg and to reach 50% of laying, in relation to natural lighting.

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DECLARATION OF CONFLICT OF INTEREST

The authors have no conflicts of interest to declare that are relevant to the content of this article.

AUTHOR´S CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved of the final version.

BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

The experimental procedures followed the protocols approved by Ethics Committee on Animal Research (CEUA 56/2016) of Universidade Federal do Ceará (UFC).

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