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Feeding time under performance and eggs quality of quails in production

Horário de arraçoamento sobre o desempenho e a qualidade de ovos de codornas em produção

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SUMMARY

In order to evaluate the performance and egg quality of quails on different time feeding, One hundred ninety two Japanese quail (*Coturnix coturnix japonica*) at 24 weeks of age were distributed in a completely randomized design with two replications and twelve treatments eight birds each. The treatments consisted of two different times of feeding at 6h and 16h. The performance was evaluated by the feed intake (g/bird/day), egg production (%), egg mass (g), feed conversion per egg mass (kg/kg), feed conversion per dozen eggs (kg/dz) and viability (%). The egg quality was evaluated by the eggshell thickness (mm), percentage of albumen, yolk percentage and average egg weight (g). The feeding time at 16h favored the performance of Japanese quails at 26 and 34 wk of age considering egg production, egg mass and average egg weight. Thus, it is recommended to feed the quails at times that coincide with the highest egg laying intensity, which ranges from 16 to 19h.

Keywords: eggshell thickness, feeding management, japanese quails

RESUMO

Com o objetivo de avaliar o desempenho e a qualidade de ovos de codornas arraçoadas em diferentes horários na produção, foram utilizadas 192 codornas japonesas com 24 semanas de idade, distribuídas em um delineamento inteiramente casualizado com dois tratamentos e doze repetições de oito aves cada. Os tratamentos corresponderam a dois horários de arraçoamento: 6:00h e 16:00h. Para o desempenho foram avaliados: consumo de ração (g/ave/dia), produção de ovos (%), massa de ovos (g), conversão alimentar por massa de ovos (kg/kg), conversão alimentar por dúzia de ovos (kg/dz) e viabilidade (%); para qualidade dos ovos foram avaliados: espessura de casca (mm), porcentagem de albúmen, porcentagem de gema e peso médio dos ovos (g). O horário de arraçoamento influenciou o desempenho e a qualidade de ovos de codorna.O horário de 16 horas apresentou melhores resultados em todos os ciclos testados, exceto os ciclos que apresentaram maior temperatura, quando a qualidade dos ovos produzidos e o desempenho foram favorecidos peloarraçoamento realizado às 6 horas da manhã. Dessa forma recomenda-se o arraçoamento às 16 horas para codornas que não estejam submetidas às condições de estresse calórico.

Palavras-chave: espessura da casca, manejo alimentar, codornas japonesas

INTRODUCTION

The production of egg from japanese quail has grown considerably in the last few yearsas recorded by the increase in consumption that jumped from 13 egg quails/inhabitant/year in 2010 (BERTECHINI, 2012) to 27 egg quails/inhabitant/year in 2015 (MARQUES & ANTUNES, 2015).
The Japanese quail have behavioral and physiological differences when compared to the chickens. For instance, egg synthesis in quails may take 18-20 hours (PINTO et al., 2003), whereas it takes around 24 hours in chickens (FIUZA et al., 2006). Eggshell synthesis also occurs at different periods of the day: in chickens, it usually occurs during the night, while in Japanese quails, during the day (HASSAN et al., 2003). Consequently, laying period is concentrated in the morning in chickens and in the afternoon (15-19h) in quails (PIZZOLANTE et al., 2007).
The eggshell quality can be affected by the feedingtime, levels of calcium in the diet, bird age and also by the environmental temperature, a situation which was investigated by Hassan et al. (2003), they tested different feeding times for breeding quails 44-60 weeks old, in Egypt in maximum daytime temperature of 36°C to 26°C and night. These authors observed that birds fed between 6h and 14h showed a reduced body weight, reduced egg production and eggshell quality when compared with birds fed between 14h and 22h (HASSAN et al., 2003).
Feeding time stimulates feed intake. The noise and movement generated may act as a habituation factor, i.e., birds get used to these stimuli increasing their feed intake. Based on this, studies has been maderelating the effect of feeding time with the different nutrient levels of diets on both internal and external egg quality (WALDROUP & HELLWING, 2000; ÁVILA et al., 2005). In this context, it is aimed to develop a study to evaluate the performance and egg quality of quails subjected to two different feeding times during the production phase.

MATERIAL AND METHODS

The experiment was carried out in the experimental poultry house of the Poultry Sector of Universidade Federal Rural of Rio de Janeiro (UFRRJ) between October and December of 2012. A 78-day experimental period was applied, including 15 days of adaptation of the birds to the feeding time and the remaining 63 days divided in three 21 day periods, when performance and egg quality were evaluated.
One hundred ninety two Japanese quails (*Coturnix coturnix japonica*) with 24 weeks of age were used. Birds were housed in a shed of brick cemented with type windows tipper only one side of the house devoid of ventilators and nebulizers, with dimensions of 14.5 m long x 6 m wide, covered with clay tiles. Birds were housed in galvanized-iron battery cages (100 cm wide x 33 cm deep x 15 cm high). Water and feed were offered *ad libitum* in trough feeders and nipple drinkers. A 16h lighting program was adopted. House temperature was daily recorded in the morning and in the afternoon using a maximum-minimum thermometer.The experimental feed was formulated to supply the nutritional requirements of Japanese quails according to Rostagno et al. (2011) (Table 1).

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Table 1. Percentage and calculated composition of experimental diet of quail in production phase

Ingredients	(%)
Ground Corn	53.130
Soybean meal	34.381
Limestone	6.689
Wheat meal	1.819
Soybean oil	1.742
Bicalcium Phosphate	1.053
DL-Methionine, 99%	0.518
Salt (NaCl)	0.251
L-LysineHCl	0.171
Vitamin Supplement[1]	0.100
Mineral Supplement[2]	0.100
Choline chloride	0.040
Antioxidant (BHT)	0.01
Total	100.00
Calculated composition	
Crude Protein (%)	20.800
Metabolizable energy (kcal/kg)	2800
Calcium (%)	2.950
Available Phosphorus (%)	0.308
Methionine + Digestible Cysteine (%)	1.076
Digestible Lysine (%)	1.133

Composition per kg of product: Vitamin A (min) 7.500.000 UI; vitamin D3 (min) 2.500.000 UI; vitamin E (min) 1.200 mg; vitamin K3 (min) 1.200 mg; vitamin B1 (min) 1.500 mg; vitamin B2 (min) 5.500 mg; vitamin B6 (min) 2000 mg; vitamina B12 (min) 12.000 mcg; niacin 35 g; calcium pantothenate (min) 10 g; biotin (min) 67 mg; Composition per kg of product 2: Iron (min) 60 g; copper (min) 13 g; manganese (min) 120 g; zinc (min) 100 g; iodine (min) 2.500 mg; selenium (min) 500 mg.

Birds were distributed according to a completely randomized experimental design into two treatments with 12 replicates of eight birds each. Treatments consisted of two feeding times: one group of birds was fed only at 6h (T1) and the other group was fed only at 16h (T2).

Performance was evaluated by the feed intake, egg production, egg mass, feed conversion ratio per egg mass and per dozen eggs, and viability. Feed intake was weekly determined. Egg production was calculated by dividing the total number of eggs laid per treatment during each 21-d period. Egg mass, feed conversion ratio per kg egg and Feed conversion ratio per dozen eggs was calculated by dividing total feed intake per treatment (in kg) per 21-d period by the number of dozen eggs laid in the same period. Viability was calculated as the ratio between the numbers of birds alive at the end of the experiment relative to the initial number of birds per treatment, and expressed as a percentage.

Egg quality was evaluated in periods of 21 days at the Animal Products Laboratory of the Animal Science Institute of UFRRJ. The egg quality evaluated parameters were average egg weight, percentage of yolk, albumen and eggshell and bark thickness. In each evaluation, 108 eggs were collected per treatment for three consecutive days. All measurements, except for eggshell thickness, were made on the day eggs were collected. Average egg weight was obtained by a 0.01g-precision digital scale. Eggs were broken and yolks were separated from the albumen and weighed in a 0.01g-precision digital scale to calculate yolk and albumen percentages. Eggshells were dried and their thickness measured in two points at the egg equator, using a caliper (Mitutoyo). Eggshell thickness values express the average of those two measurements. Measurements of temperature and humidity were recorded daily by a thermometer and a digital thermo-hygrometer, both located at a central point of the shed. At the end of the experimental period, the averages recorded within the production cycles were recorded.

The data were submitted to the analysis of variance with time-repeated measures using the GLM procedure of SAS (9.0) to determine the effect of feeding time over the productive cycles. Previously, the data were analyzed for the presence of outliers, heteroskedasticity, normality of studentized errors of residuals and homogeneity of variances (LITTELL et al., 2002). The sources of variation of the model were: the feeding time T (1 degree of freedom -DF), the productive cycle C (2 DF), the interaction T x C (2 DF), the random effects of the nested R (T) (22 DF) and the interaction C x R (T) (44 DF). In case of significance the means were compared by the Tukey test. In all analyzes the significance was declared at 5%

RESULTS AND DISCUSSION

In the table of results the mean values were presented at each feed time (6h or 16h) and evaluation cycle (26 to 28, 29 to 31 and 31 to 34 weeks of production), the standard error of the mean and the coefficient of variation for each variable (Table 2).

Table 2. Average of the temperatures recorded during the three cycles evaluated

Item	Temperature		
	Cycle 1	Cycle 2	Cycle 3
Morning	22°C	23°C	26°C
Afternoon	30°C	34°C	36°C

Performance results of the Japanese quails submitted to different feeding time during the three productive cycles are shown in Table 3. Feed intake was not influenced by the different feeding time in quails (P> 0.05). These results disagree with those found by Waldroup & Hellhig (2000) and Hassan et al. (2003) who observed higher feed intake at the times when the highest intensity of laying occurs, which in the case of quails is in the afternoon. Petek et al. (2006) observed lower feed intake in quails that received restricted feedings between two times (morning and afternoon, 9h and 17h) compared to birds that received whole day feeding.

Egg production showed that there was a significant interaction between the productive cycle and the feeding time so that in the second (29 to 31 weeks of age) and in the third cycle (32 to 34 weeks of age) the quails that were fed at 16h produced more eggs compared to those that were fed at 6h. Hassan et al. (2003) and Pizzolante et al. (2007) observed greater production of quails eggs in the afternoon, at 16h, coinciding with the time of greater posture intensity, than in quails ranging from 16h to 17h. Studies with commercial laying hens and broiler breeders reported that the formation of eggs is influenced by several factors, including the pattern (speed and quantity) of feed intake, so that birds were fed in the afternoon and had laid eggs early in the day consumed more and higher velocity than those who had not laid eggs earlier in the day (DUNCAN & HUGHES, 1975; SAMARA et al., 1996). The literature justifies this behavior by the fact that the period in which the egg is to be formed as well as at the time of laying, the nutritional requirement of the birds increases, since they require calcium to form the shell, vitamin A and fats for the formation of the yolk, in addition to proteins and other nutrients from the feed provided and that are necessary to form the constituents of the next egg and to maturation of the next follicle within the follicular hierarchy, thus reducing the proportion of immature follicles and consequently increasing egg production (HASSAN et al., 2003). In agreement with the results of the present study Hassan et al. (2003) observed an increase in egg production in Japanese quail breeders only in the afternoon.

Table 3.Performance of japanese quails fed on different times of the day

Variable/ Cycle (Weeks)	Feeding Time		SEM	CV (%)	Pvalue		
	6h	16h			Cycle (C)	Time (T)	C x T
Feed Intake (g)							
26 to 28	27.83	27.63					
29 to 31	30.47	29.00	0.44	4.10	>0.05	>0.05	>0.05
32 to 34	26.67	27.99					
Egg production (%)							
26 to 28	83.33[Aa]	83.42[Aa]					
29 to 31	80.60[Bb]	86.08[Ab]	0.08	3.87	<0.05	<0.0001	<0.01
32 to 34	78.33[Bb]	83.67[Aa]					
EggMass (g)							
26 to 28	9.75[Bb]	10.18[Aa]					
29 to 31	9.83[Ab]	11.21[Aa]	0.32	3.86	<0.01	<0.0001	<0.001
32 to 34	9.71[Bb]	10.56[Aa]					
Feed conversion (g/g)							
26 to 28	2.93[Aa]	2.95[Aa]					
29 to 31	2.79[Aa]	2.55[Bb]	0.02	4.17	<0.0001	<0.001	<0.001
32 to 34	2.67[Ab]	2.57[Ab]					
Feed conversion (g/dozen)							
26 to 28	0.25[Aa]	0.24[Ba]					
29 to 31	0.24[Aa]	0.25[Aa]	0.001	3.94	<0.05	>0.05	<0.01
32 to 34	0.25[Aa]	0.26[Aa]					
Viability (%)							
26 to 34	97.11	97.18	-	5.13	>0.05	>0.05	>0.05

Means followed by the same letter, uppercase, in the rows, or lower case, in the columns do not differ. (Multiple comparisons of the least squares means, for the effect of the Cycle x Time (CxT) interaction, by Tukey's test). n = 12 replicates of 8 birds per Feeding time.

Egg mass showed significant interaction between production cycle and feeding time so that birds that were fed at 16h produced eggs with higher mass compared to eggs produced by quails fed at 18h in the first and second productive cycle, indicating that the higher productivity was accompanied by an increase in egg mass, in the cycles in which there was also greater production in the time of 16h. Viability was not influenced by the feeding times (P>0.05). There was significant interaction (P <0.05) between the productive cycle and the different feeding times for feed conversion per gram of feed only in the second productive cycle (29 a 31 weeks old) so that the quails that were fed at 16h, converted better in comparison to those that were fed at 6h. This result deserves to be highlighted, because in this time and in this cycle the eggs with the largest mass were produced in relation to the others.

There was no interaction of treatments on the feed conversion per dozen of eggs. These results are in agreement with Leandro et al. (2006); they did not observe improvements in feed conversion by egg mass in Japanese quails when they were submitted to the calcium supply between morning and afternoon.

Table 4 shows the results of the quality of Japanese quail egg submitted to different feeding times.

Table 4. Average egg weight, albumen and yolk percentages and eggshell thickness of Japanese quails fed at different times

Parameter cycle (Weeks)	Feeding time (h)		SEM	CV(%)	P value		
	6h	16h			Ciclo (C)	Hora (H)	P x H
Average egg weight (g)							
26 to 28	11.46^{Bb}	11.78^{Aa}					
29 to 31	11.35^{Bb}	11.85^{Aa}	0.04	1.99	>0.05	<0.01	<0.01
32 to 34	11.81^{Aa}	11.64^{Aa}					
Yolk (%)							
26 to 28	31.69^{Aa}	31.83^{Aa}					
29 to 31	31.24^{Aa}	31.07^{Aa}	0.14	3.38	<0.05	>0.05	<0.05
32 to 34	31.07^{Aa}	30.65^{Ba}					
Albumen (%)							
26 to 28	60.46	60.28					
29 to 31	60.93	61.23	0.13	1.50	>0.05	>0.05	>0.05
32 to34	61.23	61.11					
Eggshell (%)							
26to 28	7.63	7.88					
29 to 31	7.84	7.71	0.03	3.41	>0.05	>0.05	>0.05
32 to 34	7.71	7.91					
Eggshell thickness (mm)							
26 to 28	$0,200^{Aa}$	$0,200^{Aa}$					
29 to 31	$0,194^{Bb}$	$0,204^{Aa}$	0.92	3.51	<0.05	<0.05	<0.05
32 to 34	$0,204^{Aa}$	$0,202^{Aa}$					

Means followed by the same letter, uppercase, in the rows, or lower case, in the columns do not differ. (Multiple comparisons of the least squares means, for the effect of the Cycle x Time (CxT) interaction, by Tukey's test). n = 12 replicates of 8 birds per Feeding time..

Average egg weight was affected ($p<0.05$) by feeding times. Japanese quails fed at 16h produced heavier eggs during the first and second cycle than those fed at 6h. This results is supported by literature reports (HASSAN et al., 2003; PIZZOLANTE et al., 2007) that feeding in the afternoon promotes higher availability of the nutrients required for the synthesis of the next egg, and may also allow the synthesis of heavier eggs (WALDROP & HELLHIG, 2000; SPRADLEY et al., 2008). Pizzolante et al. (2007), did not find any effect of feeding time on average egg weight of quails in final phase of production when fractioning calcium between the morning and afternoon meal. Ávila et al. (2005) obtained heavier eggs when feeding broiler breeders twice daily.

Yolk percentage was higher ($P<0.05$) in the third cycle in the eggs of Japanese quails fed at 6h. However, there was no effect of the treatments on the percentage of albumin and eggshell. Ávila et al. (2005) disagree with this work because they obtained greater weight of the eggs produced by broiler breeders fed in the afternoon and attributed this effect to the increase of the albumen weight. Eggshell thickness was influenced (P<0.05) by feeding time in the second cycle. Eggs produced by quails fed at 16h presented a larger eggshell thickness than eggs produced by the quails fed at 6h. This result is supported by the literature (HASSAN et al., 2003; PIZZOLANTE et al., 2007), who mention better shell quality in eggs produced by quails at times that coincide with the highest posture intensity in this species ranging from 16 and 19h. According to Hassan et al. (2003) eggs from japanese quails fed only in the afternoon (between 14 and 22h) presented better eggshell quality.

The feeding time at 16 hours favored the performance of quails raised between 26 and 34 weeks of ageand the average weight of the eggs. Thus, it is recommended the feeding of this bird at times that coincide with the highest egg laying intensity, which in quail ranges from 16h to 19h.

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