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# Beak trimming in japanese quails at initial phase is an alternative to reduce the negative effects of feather pecking

**Jéssica Moraes Cruvinel[1*], Andressa Takahara Montenegro[1], Caio Cesar dos Ouros[1], Kauan de Souza Alves[1], Gabriela Costa Ribeiro[1], Tatiane Souza dos Santos[2], Andrea de Britto Molino[1] and Edivaldo Antônio Garcia[1]**

[1]Departamento de Produção Animal e Medicina Veterinária Preventiva, Faculdade de Medicina Veterinária e Zootecnia, Universidade Estadual Paulista 'Júlio de Mesquita Filho', Rua Prof. Doutor Walter Mauricio Correa, s/n, 18618-681, Botucatu, São Paulo, Brazil. [2]Departamento de Melhoramento e Nutrição Animal, Faculdade de Medicina Veterinária e Zootecnia, Universidade Estadual Paulista 'Júlio de Mesquita Filho', Botucatu, São Paulo, Brazil. *Author for correpondence. E-mail: jessicacruvinel@gmail.com

**ABSTRACT.** Regarding the lack of standardized methods for beak trimming to reduce feather pecking in Japanese quail, the present study aimed to compare two ages and 3 methods of beak trimming, evaluating the performance, egg quality and feather pecking. One-day-old Japanese quails (n = 770; 22 birds cage$^{-1}$), at the initial phase, and 36-day-old (n = 630; 18 birds cage$^{-1}$), at the production phase, were assigned to a completely randomized design, consisting of 7 treatments with 5 replicates. The treatments were: non-trimmed (NT), cauterization of approximately 1/3 at 14 days-of-age (CAUT 14) and at 28 days-of-age (CAUT 28), moderately trimmed to approximately 1/3 beak at 14 days-of-age (MOD 14) and at 28 days-of-age (MOD 28), severely trimmed to 1/3-1/2 beak at 14 days-of-age (SEV 14) and at 28 days-of-age (SEV 28). Data were analyzed using Minitab®. The results indicated that beak trimming methods applied did not influence the performance and egg quality. Quails subjected to MOD 28 and SEV (14 and 28) presented lower feed conversion per egg mass compared to NT. However, MOD 14 and SEV were more efficient in preventing feather pecking behavior.

**Keywords:** *Coturnix coturnix japonica*; feather pecking; welfare; egg quality.

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## Introduction

Leaders in egg production of Japanese quail (*Coturnix coturnix japonica*) are China, Japan, Brazil and France. In South America, Brazil leads the production, followed by Venezuela, Peru, Colombia and Bolivia (Bertechini, 2013). In these countries, there was a great progress in commercial exploitation due to advantages of Japanese quail farming (small size, precocity, high productivity, for example) and also because of favorable climatic conditions that these countries have, attributing encouraging economic results to this segment (Faitarone et al., 2005; Pizzolante et al., 2006).

However, as in poultry farming, Japanese quail may exhibit aggressive behavior between birds in the same cage, such as pecking, which often lead to feather pecking and cannibalism (Nicol et al., 2013; Hartcher et al., 2015; Struthers, Classen, Gomis, Crowe, & Schwean-Lardner, 2019). In order to reduce the manifestation of these behaviors, Japanese quail farmers also adopted beak trimming as a management practice (Laganá et al., 2011). Beak trimming is a procedure used in poultry industry with the purpose of reducing or inhibiting cannibalism, wounds associated with feather pecking, egg pecking, and leading to uniform feed intake due to reduced waste and selection of feed ingredients (Araújo et al., 2000; Acioli, 2012; Nicol et al., 2013). The method consists of cutting and cauterizing the beak using a cutting and hot blade, called debeaking.

Beak trimming is considered invasive and originates a series of focused discussions on animal welfare for the possibility of causing pain or loss of sensitivity of the beak. Lower feed intake after beak trimming, and subsequent reduction in bird growth, would indicate discomfort (Marchant-Forde, Fahey, & Cheng, 2010; Freire, Eastwood, & Joyce, 2011; Janczak & Riber, 2015). In view of these characteristics, new management techniques were developed to mitigate the potential negative effects, such as infrared beak treatment, which consists of the treatment of the beak by infrared radiation in the hatchery, with subsequent drop of the beak between 10 and 12 days of age of the birds, eliminating the cut with blade in the first weeks (Marchant-Forde et al., 2010; Hughes et al., 2020). Still, the same authors report that the effect of beak trimming on physiology, behavior, and production is sometimes contradictory, depending on the poultry farming environment, bird age, genetic predisposition, and type and severity of the cut.

In commercial Japanese quail farming, it is not common to perform beak trimming between six and eight days of age as in poultry farming, usually the producers carry out beak trimming between 10 and 21 days of age through cauterization (only cauterizing the beak, without cutting) or beak trimming (cutting and cauterizing the beak) with a second severe beak trimming at 28 days. Farmers justify this practice because beaks grow quickly and the quails are able to efficiently pluck feathers in the laying phase. It can also be done only a severe beak trimming at 21 or 28 days, evidencing the lack of standard in this management practice in Japanese quail farming.

In view of the above, we noticed many gaps in the scientific literature and in management practices in relation to the age and proportion of beak to be cut off in Japanese quail farming, so that it does not negatively influence the productive performance and welfare of these quails. Therefore, the purpose of this study was to compare two ages (14 and 28 days) and three beak trimming levels (cauterization, moderate and severe) in Japanese quail farming, evaluating performance in the initial and production phases, egg quality and plumage condition.

## Material and methods

### Experimental site and birds

The experiment was conducted in the facilities of the São Paulo State University, School of Veterinary Medicine and Animal Science, Botucatu, São Paulo, Brazil. The Teaching Area, Research and Production in Laying Aviculture, at an average altitude of 556 meters, 22°49'6.43' South latitude and 48°24'29.55' West longitude, from November 2016 to August 2017 and comprised the initial and production phases (ages between one day and 37 weeks). All the procedures used in this research were approved by the Committee on Animal Research and Ethics under protocol 142/2016-CEUA from this University.

All quails were subjected to the same management and feeding practices, except for beak trimming. Diets were formulated with corn and soybean according to the recommendations of Silva and Costa (2009), and the chemical composition of the ingredients used in the formula was estimated using the *Tabelas brasileiras para aves e suínos* (Rostagno et al., 2011). Water and feed were provided *ad libitum* during the experimental period and each cage was equipped with a nipple drinker and a trough feeder at the front of the cage. The lighting program in the initial phase was 24h light from day 0 to 4, and gradually reduced by 3h per week to a final light period of 12h, according to Murakami and Ariki (1998). The lighting program used during the production phase was 15h of daylight, controlled by a timer.

### Housing and experimental treatments

Maximum and minimum environmental temperatures during the experimental period were 19.5 and 28.9°C, respectively, with a relative humidity ranging from 50 to 65%. 770 Japanese quails (*Coturnix coturnix japonica*) d-old for the initial phase (1-35 old) were allocated in a housing equipped with 35 metal cages (50cm x 80cm x 35cm) with a density of 182 $cm^2$ $bird^{-1}$. The cage was the experimental unit for statistical analysis, using a completely randomized design, consisting of 7 treatments with 5 replicates of 22 birds each.

The treatments were as follows: non-trimmed birds (NT), birds with beaks trimmed by cauterization of approximately 1/3 at 14 days-of-age (CAUT 14), birds with beaks trimmed by cauterization of approximately 1/3 at 28 days-of-age (CAUT 28), moderately trimmed to approximately 1/3 beak at 14 days-of-age (MOD 14), moderately trimmed to approximately 1/3 beak at 28 days-of-age (MOD 28), and, finally, severely trimmed to approximately 1/3-1/2 beak at 14 days-of-age. (SEV 14), as well as severely trimmed to approximately 1/3-1/2 beak trimmed at 28 days-of-age (SEV 28). In trimming method by cauterization, there was only some beak wear against the hot blade, whereas the beak itself was not cut. In the other treatments, the used trimming method was conventional trimming by hot blade (Lyon® beak trimmer of 50/60 Hz and 70-210W, Lyon Technologies, Inc. Unified States of America) and the temperature of the blade was maintained at around 700°C, in order to meet the managements practiced in the avian industry.

The production phase comprised the period from 36 days to 37 weeks of age. Quails were transferred to production housing equipped with metal cages (100cm x 34cm x 16cm) provided with six internal compartments. These housed 18 quails per experimental unit (cages) with a density of approximately 189 cm² bird$^{-1}$, totaling 630 birds (7 treatments with 5 replicates per cage). In this phase, the same experimental design of the previous phase was adopted, however reducing the density to 18 birds per replicate.

### Beak length

Beak length before and after trimming, as well as the percentage of beak removed, are listed in Table 1.

Beak length was measured in six quails from each experimental unit before and after trimming at 14, 28 and at 35 days of age. At the end of the production phase (37th week), the length was measured in all birds of each cage. Measurements were taken with a digital caliper accurate to 0.001 mm, as proposed by Kuenzel (2007).

**Table 1.** Beak length of Japanese quail submitted to experimental treatments.

| Treatments | 14 days | | | 28 days | | |
|---|---|---|---|---|---|---|
| | Before | After | % beak removed | Before | After | % beak removed |
| NT | 6.35 | 6.35 | 0 | 7.43 | 7.43 | 0 |
| CAUT 14 | 6.40 | 4.20 | 34.40 | - | - | - |
| CAUT 28 | - | - | - | 7.94 | 4.92 | 38.00 |
| MOD 14 | 6.28 | 3.72 | 40.80 | - | - | - |
| MOD 28 | - | - | - | 8.02 | 4.91 | 38.80 |
| SEV 14 | 6.36 | 3.01 | 52.70 | - | - | - |
| SEV 28 | - | - | - | 7.94 | 4.37 | 44.96 |

*Beak trimming was performed using a Lyon® debeaker. NT: not trimmed; CAUT 14: cauterization of approximately 1/3 at 14 days; CAUT 28: cauterization of approximately 1/3 at 28 days; MOD 14: moderately trimmed with approximately 1/3 of the beak at 14 days; MOD 28: moderately trimmed with approximately 1/3 of the beak at 28 days; SEV 14: severely trimmed with approximately 1/3-1/2 of the beak at 14 days; SEV 28: severely trimmed with approximately 1/3-1/2 of the beak at 28 days.

### Performance and egg quality

Performance parameters evaluated at the end of the initial phase (35 days of age) were cumulative feed intake (g bird$^{-1}$), body weight (g), feed conversion (g g$^{-1}$), weight gain (g) and viability (%). These were also measured on the 3rd day after trimming.

During the production phase (Day 36 to 37 weeks of age), every week the following performance characteristics were evaluated: body weight (g), feed intake (g bird$^{-1}$ day$^{-1}$), egg production percentage (%); percentage of viable eggs (%); average egg weight (g); egg mass (g bird$^{-1}$ day$^{-1}$), feed conversion per dozen eggs (kg dozen$^{-1}$) and per mass (kg kg$^{-1}$), as well as viability (%).

Egg quality was also evaluated in four cycles of 28 days, started after peak production (9 weeks). In each cycle, one egg per cage of each treatment (n=5) was collected and analyzed for three consecutive days. The evaluated quality characteristics of eggs were the following: specific gravity (g cm$^{-3}$); eggshell breaking strength (kg f); percentage of yolk (%), eggshell (%) and albumen (%); eggshell thickness (mm) and eggshell weight per surface area (ESWAS) (mg cm$^{-2}$). For specific gravity, eggs were immersed in saline solutions ranging from 1,065 to 1,100 g cm$^{-3}$ density and with a gradient of 0.005 between them, with solutions prepared according to recommendations of Moreng and Avens (1990). For the eggshell breaking strength, a TAXT plus model texturometer (Stable, Micro Systems, Godalming, England), equipped with 10 mm (p 2$^{-1}$) probe and a test speed of 1mm/s was used. To evaluate the ESWAS, the following formula was used: ESWAS = [SW/ (3.9782 x EW0.7056)], where: SW = eggshell weight, EW = egg weight.

### Plumage condition and frequency of cannibalism

Visual inspection of all birds in each cage during the end of the initial phase (35 days) and at the end of the experimental period (37th week of age) was carried by the same observer to evaluate the number of birds with feather pecking in the dorsal region, the results were transformed to frequency. The feather-free area of the dorsal region in the quails was also measured with the aid of a ruler. For the frequency of cannibalism, daily inspections were made during all phases; cases where the birds presented wounds with visible traces of blood were considered to be cases of cannibalism.

### Statistical analysis

Data obtained in the experiment were tested by analysis of variance using the GLM (General Linear Models) procedure of the Minitab® software 18 (Minitab Statistical Software, 2017). Means were compared by Tukey's test at 5% significance. For the variable frequency of feather pecking, the chi-square test (non-parametric statistics) was used at 5% of probability. The standard error of mean was also calculated.

# Results

## Initial phase (1-35 days)

Table 2 lists the results of the performance of Japanese quails after 3 days of each trimming method during the initial phase. The beak trimming methods at the ages of 14 and 28 days did not affect the performance of quails during the analyzed period.

**Table 2.** Performance of Japanese quails at 14 and 28 days and three days after beak trimming.

| 14-17 days period | | | | | |
|---|---|---|---|---|---|
| Treatment | W 14 | W 17 | FI (14-17) | WG (14-17) | VIAB (14-17) |
| NT | 48.18 | 61.45 | 11.49 | 13.27 | 100 |
| CAUT 14 | 48.35 | 60.73 | 11.15 | 12.38 | 98 |
| MOD 14 | 49.34 | 59.72 | 10.10 | 10.38 | 99 |
| SEV 14 | 48.94 | 60.05 | 11.61 | 11.11 | 100 |
| SEM | 0.210 | 0.566 | 0.299 | 0.551 | 0.547 |
| p value | 0.226 | 0.743 | 0.282 | 0.248 | 0.547 |
| 28-31 days period | | | | | |
| Treatment | W 28 | W 31 | FI (28-31) | WG (28-31) | VIAB (28-31) |
| NT | 102.00 | 109.44 | 16.27 | 7.44 | 100 |
| CAUT 28 | 102.10 | 108.50 | 14.88 | 6.40 | 100 |
| MOD 28 | 103.75 | 110.75 | 16.10 | 7.00 | 99 |
| SEV 28 | 101.75 | 108.44 | 15.42 | 6.69 | 100 |
| SEM | 0.402 | 0.439 | 0.214 | 0.542 | 0.250 |
| p value | 0.592 | 0.213 | 0.065 | 0.931 | 0.418 |

NT: not trimmed; CAUT 14: cauterization of approximately 1/3 at 14 days; CAUT 28: cauterization of approximately 1/3 at 28 days; MOD 14: moderately trimmed with approximately 1/3 of the beak at 14 days; MOD 28: moderately trimmed with approximately 1/3 of the beak at 28 days; SEV 14: severely trimmed with approximately 1/3-1/2 of the beak at 14 days; SEV 28: severely trimmed with approximately 1/3-1/2 of the beak at 28 days. W14: weight before beak trimming (g), W17: weight three days after beak trimming (g), WG: weight gain (g), FI: Feed intake (g $bird^{-1}$ $day^{-1}$), VIAB: viability (%). SEM: standard error of the means. n=5 replicate cages per treatment group (22 quails $cage^{-1}$).

There was no difference in results of performance of Japanese quails between different experimental treatments during the initial phase (days 1-35) (Table 3). As no episode of cannibalism occurred during this phase, these data are not included here.

**Table 3.** Performance of Japanese quails submitted to experimental treatments in the period of 1-35 days.

| Treatment | WG (g) | FI (g $birds^{-1}$) | FCR | VIAB (%) |
|---|---|---|---|---|
| ND | 122.25 | 526.36 | 4.30 | 100.00 |
| CAUT 14 | 120.71 | 512.82 | 4.25 | 95.00 |
| CAUT 28 | 119.65 | 519.08 | 4.34 | 99.00 |
| MOD14 | 119.21 | 523.66 | 4.40 | 97.00 |
| MOD28 | 120.75 | 523.83 | 4.34 | 99.00 |
| SEV 14 | 120.88 | 520.91 | 4.31 | 97.00 |
| SEV 28 | 120.35 | 519.96 | 4.32 | 99.00 |
| SEM | 0.430 | 1.46 | 0.018 | 0.655 |
| p value | 0.655 | 0.204 | 0.524 | 0.445 |

NT: not trimmed; CAUT 14: cauterization of approximately 1/3 at 14 days; CAUT 28: cauterization of approximately 1/3 at 28 days; MOD 14: moderately trimmed with approximately 1/3 of the beak at 14 days; MOD 28: moderately trimmed with approximately 1/3 of the beak at 28 days; SEV 14: severely trimmed with approximately 1/3-1/2 of the beak at 14 days; SEV 28: severely trimmed with approximately 1/3-1/2 of the beak at 28 days. WC: body weight (g), FI: Feed intake (g birds-1), FC: Feed conversion ratio (g g-1) e VIAB: viability (%). SEM: standard error of the means. n =5 replicate cages per treatment group (22 quails cage-1).

## Production phase (36 days – 37 weeks) and egg quality

There was no effect of treatments on feed intake, egg production percentage, egg weight, egg mass and percentage of intact eggs (Table 4), as well as no episode of cannibalism at this phase, so data on cannibalism are not included. At the same period, there were differences in feed conversion per dozen eggs ($p = 0.040$), feed conversion per egg mass ($p = 0.012$) and viability ($p = 0.033$) between different treatments.

**Table 4.** Performance of Japanese quails submitted to experimental treatments during the production phase (day 36 -37wk).

| Treatments | FI (g bird$^{-1}$ day$^{-1}$) | EP (%) | EW (g) | EM (g bird$^{-1}$ day$^{-1}$) | FCR dz$^{-1}$ | FCR g$^{-1}$ | IE (%) | VIAB (%) |
|---|---|---|---|---|---|---|---|---|
| NT | 27.08 | 89.06 | 10.80 | 9.62 | 0.365 a | 2.81 a | 99.74 | 91.11 b |
| CAUT 14 | 26.15 | 88.55 | 10.83 | 9.59 | 0.354 ab | 2.73 ab | 99.77 | 94.44 ab |
| CAUT 28 | 26.97 | 89.98 | 10.81 | 9.73 | 0.360 ab | 2.77 ab | 99.86 | 92.22 ab |
| MOD14 | 26.67 | 88.20 | 10.82 | 9.54 | 0.363 a | 2.80 ab | 99.86 | 93.33 ab |
| MOD28 | 26.24 | 89.39 | 10.96 | 9.80 | 0.352 ab | 2.68 b | 99.88 | 93.33 ab |
| SEV 14 | 25.83 | 89.74 | 10.75 | 9.65 | 0.345 b | 2.68 b | 99.85 | 96.66 ab |
| SEV 28 | 25.93 | 88.28 | 10.73 | 9.47 | 0.352 ab | 2.74 ab | 99.83 | 98.89 a |
| SEM | 0.125 | 0.219 | 0.050 | 0.035 | 0.016 | 0.013 | 0.018 | 0.701 |
| p value | 0.063 | 0.128 | 0.161 | 0.206 | 0.040 | 0.012 | 0.128 | 0.033 |

[a,b] means followed by different letters in the same column are statistically different by the test of Tukey ($p < 0.05$). NT: not trimmed; CAUT 14: cauterization of approximately 1/3 at 14 days; CAUT 28: cauterization of approximately 1/3 at 28 days; MOD 14: moderately trimmed with approximately 1/3 of the beak at 14 days; MOD 28: moderately trimmed with approximately 1/3 of the beak at 28 days; SEV 14: severely trimmed with approximately 1/3-1/2 of the beak at 14 days; SEV 28: severely trimmed with approximately 1/3-1/2 of the beak at 28 days. FI: Feed intake, EP: egg production percentage, EW: egg weight, EM: egg mass, FC dz$^{-1}$: Feed conversion ratio per dozen of eggs, FC g$^{-1}$: Feed conversion ratio per egg mass, IE: percentage of intact eggs, VIAB: viability. SEM: standard error of the means. n=5 replicate cages per treatment group (18 quails cage$^{-1}$).

The SEV14 treatment provided lower feed conversion per dozen eggs compared to the treatments in which the birds' beaks were not trimmed or were moderately trimmed at 14 days (MOD 14). Quails subjected to MOD 28 and SEV 14 presented lower feed conversion per egg mass compared to NT. There were effects of treatments on viability during the production phase. Non-trimmed birds presented less viability compared to birds subjected to SEV 28, and did not differ from other treatments.

Table 5 lists data on the quality of eggs from Japanese quails subjected to the experimental treatments. No effect of treatments on egg quality was found.

**Table 5.** Eggs quality of Japanese quail submitted to experimental treatments.

| Treatments | ESG (g cm$^{-3}$) | STRENGTH (g kgf$^{-1}$) | YOLK (%) | ALB (%) | ES (%) | EST (mm) | ESWAS (mg cm$^{-2}$) |
|---|---|---|---|---|---|---|---|
| NT | 1.076 | 1,362.53 | 30.11 | 61.90 | 7.99 | 0.218 | 40.69 |
| CAUT 14 | 1.074 | 1,272.23 | 30.19 | 62.05 | 7.76 | 0.214 | 39.89 |
| CAUT 28 | 1.077 | 1,336.90 | 30.53 | 61.56 | 7.91 | 0.212 | 40.42 |
| MOD14 | 1.076 | 1,260.65 | 30.29 | 61.98 | 7.73 | 0.213 | 39.79 |
| MOD28 | 1.076 | 1,319.83 | 30.70 | 61.50 | 7.80 | 0.216 | 40.03 |
| SEV 14 | 1.078 | 1,366.65 | 30.13 | 61.83 | 8.04 | 0.220 | 40.97 |
| SEV 28 | 1.078 | 1,373.35 | 30.72 | 61.24 | 8.04 | 0.218 | 41.07 |
| SEM | 0.0038 | 15.59 | 0.131 | 0.134 | 0.045 | 0.0010 | 0.224 |
| p value | 0.0600 | 0.2937 | 0.7842 | 0.6766 | 0.3028 | 0.3052 | 0.6294 |

NT: not trimmed; CAUT 14: cauterization of approximately 1/3 at 14 days; CAUT 28: cauterization of approximately 1/3 at 28 days; MOD 14: moderately trimmed with approximately 1/3 of the beak at 14 days; MOD 28: moderately trimmed with approximately 1/3 of the beak at 28 days; SEV 14: severely trimmed with approximately 1/3-1/2 of the beak at 14 days; SEV 28: severely trimmed with approximately 1/3-1/2 of the beak at 28 days. ESG: specific gravity, STRENGTH: eggshell breaking strength, YOLK: percentage of yolk, ALB: percentage of albumen, ES: percentage of eggshell, EST: eggshell thickness, ESWAS: eggshell weight per area surface. SEM: standard error of the means. n = 5 replicate cages per treatment group (18 quails cage$^{-1}$).

## Beak length and feather pecking

Table 6 presents data on the length of beaks measured at 35 days of age and at the end of the production phase (37 weeks), the occurrence of feather pecking and the correspondent pecking area observed in Japanese quails subjected to experimental treatments. The birds' beaks trimmed at 28 days, regardless of the severity of beak trimming, had a larger beak size ($p < 0.001$) than those trimmed at 14 days when measured at 35 days and 37 weeks, and the beak growth was not significantly different between treatments ($p = 0.114$).

Quails with intact beak (NT), CAUT 28 and MOD 28 presented a higher frequency of feather pecking ($p < 0.001$) at the end of the experimental period (Table 6). The lowest plumage damage ($p = 0.001$; feather pecking area) were observed in birds beak-trimmed at 14 days and those with a severe beak trimming performed at 28 days in comparison to the NT. During the end of the initial phase (35 days), no damage was found in quail plumage, being present only in the production phase.

**Table 6.** Length of beak, frequency of feather pecking and feather pecking area in Japanese quail submitted to experimental treatments.

| Length of beak (mm) and feather pecking (%) | | | | | |
|---|---|---|---|---|---|
| Treatments | At 35 days | At 37 weeks | Growth (mm) | Feather pecking (%)* | Feather pecking area ($cm^2$) |
| NT | 8.54 a | 8.90 a | 0.36 | 29.11a | 11.71 a |
| CAUT 14 | 3.57 c | 4.54 de | 0.97 | 0.00 c | 0.00 b |
| CAUT 28 | 5.34 b | 6.52 b | 1.18 | 14.67 b | 6.31 ab |
| MOD 14 | 3.69 c | 4.98 d | 1.29 | 0.00 c | 0.00 b |
| MOD 28 | 5.15 b | 6.40 b | 1.25 | 25.30 ab | 5.28 ab |
| SEV 14 | 3.10 c | 4.00 e | 0.90 | 2.33 c | 1.30 b |
| SEV 28 | 4.79 b | 5.64 c | 0.85 | 3.53 c | 3.30 b |
| SEM | 0.298 | 0.208 | 0.231 | 5.489 | 1.542 |
| p value | 0.001 | 0.001 | 0.114 | < 0.001 | 0.001 |

[a,b,c,d,e] means followed by different letters in the same column are statistically different by the test of Tukey ($p < 0.05$). *Frequencies followed by different letters in the column differ from each other by the chi-square test ($p < 0.05$). NT: not trimmed; CAUT 14: cauterization of approximately 1/3 at 14 days; CAUT 28: cauterization of approximately 1/3 at 28 days; MOD 14: moderately trimmed with approximately 1/3 of the beak at 14 days; MOD 28: moderately trimmed with approximately 1/3 of the beak at 28 days; SEV 14: severely trimmed with approximately 1/3-1/2 of the beak at 14 days; SEV 28: severely trimmed with approximately 1/3-1/2 of the beak at 28 days. SEM: standard error of the means. n=5 replicate cages per treatment group (18 quails $cage^{-1}$).

# Discussion

In this study, similarly to Araújo et al. (2000) and Marchant-Forde et al. (2010), injuries resulting from feather pecking were not sufficient to demonstrate any detrimental effect on food intake, body weight and viability of quails during the days following the procedure (Table 2). In studies involving Japanese quails, carried out by Leandro et al. (2005), Pizzolante et al. (2006) and Laganá et al. (2011), treatments consisting of severe beak trimming at 18 days (2/3 cut); regardless of age (14 or 21 days) with 1/2 of the beak trimmed; and beak trimming at 21 days by cauterization with 1/3 of the beak trimmed, respectively, it was observed a reduction in feed intake and body weight of the beak-trimmed birds in relation to those not trimmed. These results were not observed in the present study (Tables 2 and 3), possibly because less invasive methods of beak trimming were used, which, consequently, were less traumatic than those applied by the above-mentioned authors.

The effect of beak trimming on birds is a result of multiple factors, among them the lineage, environment, housing density, lighting intensity, proportion of beak to be trimmed, the age at which beak trimming is performed and the operator's own handling techniques (Lee & Craig 1991; Rodenburg et al., 2013). In addition, there is a lack of standard for the beak trimming process, especially in Japanese quail farming. This contributes even more to the divergence of results between different studies.

The studies describe that when beak trimming is traumatic or occurs too late, a reduction in body weight gain can be observed in birds, as well as delays in sexual maturity and consequently impaired egg production (Gentle, 1986; Araújo et al., 2000; Lambton, Knowles, Yorke, & Nicol, 2015). Adequate body weight is determinant with respect to poultry productivity, as it influences egg production, weight and quality (Cunningham, 1992; Fahey, Marchant-Forde, & Cheng, 2007). Considering that body weight of quails was not affected by treatments in the initial phase (1-35 days), even in the treatments in which beak trimming was carried out at 28 days (Table 3), we can conclude that these treatments also did not reduce the performance during the production phase (Table 4). Similarly, Laganá et al. (2011) did not observe any effect of treatments (non-beak-trimmed, trimmed with 1/3 of beak cut and trimmed by cauterization) performed at 21 days in the egg-laying rate, weight, and mass per dozen eggs. It is worth noting that in the present study the differences observed in the feed conversion per dozen eggs and egg mass (Table 4) may have resulted from a greater waste of feed by the not-beak-trimmed birds (NT), which induce a higher feed conversion compared to MOD 28 and SEV 14 treatments.

Cauterization is considered by the authors, from the point of view of practical management (Laganá et al., 2011), to be more traumatic due to intense stress, since it is a slower method than trimming with simultaneous cutting and cauterization of the beak (conventional method), with no effect detected between the different methods for beak trimming used in the present study. The results found in the laying phase demonstrate a negative effect on the viability of quails compared to SEV 28. However, no cannibalism was found, since this behavior was not verified during the experimental period.

Leandro et al. (2005) and Laganá et al. (2011) reported that the methods of beak trimming did not influence the specific gravity, yolk, albumen and shell percentage of Japanese quail eggs. These results were expected, considering that there were no differences in feed intake and egg weight (Table 5), indicating that nutrient intake was not influenced by treatments, which allowed egg quality to be maintained, and also that the beak trimming itself has low potential to influence egg quality characteristics.

Beak growth at the end of the initial phase in relation to the end of the experimental period (Table 6) shows that the average growth of the beak (32 weeks interval) was approximately one millimeter, that is, starting from 35 days of age, the growth of the beak was minimal. Japanese quails showed a maximum growth rate at around 21 days of age, but have low capacity for tissue growth after 35 days, as there is a greater retention of nutrients for development of the reproductive tract and for egg production (Silva & Costa, 2009).

Animal welfare is a central theme in the discussion of animal production and the effect of beak trimming in laying hens has been extensively debated (Rodenburg et al., 2013; Struthers et al., 2019; Hughes et al., 2020). As addressed in the introduction section, its effects on birds are contradictory in view of the various breeding and management factors, for example. In the context of this controversy, an important study by the Beak Trimming Action Group [BTAG] (2015) demonstrated that a ban on beak trimming in European Union countries could not be introduced in breeding systems (alternative or conventional), as it cannot be reliably demonstrated (commercial conditions) that all layers can be managed without the need for beak trimming, without a greater risk to their welfare than that caused by cutting the beak itself.

During the initial phase (1-35 days), no damage was observed on quail plumage, being present only in the production phase. For the latter, we can point out the stress associated with the egg production phase and the quail's beak length as a trigger to the manifestation of feather pecking, as shown by Riedstra and Groothuis (2002); Freire et al. (2011); Lambton et al. (2013). Thus, birds that were not beak-trimmed or that were beak-trimmed late in their life had greater damage to the plumage because they had larger beaks, except for those whose beaks were severely trimmed at 28 days (SEV 28), because in this case, the proportion of the removed part of the beak was larger (Table 6). Bearing this in mind, and taking into account the mentioned aspects of welfare, the techniques that allow control of the cut during beak trimming procedure and facilitate the handling practice, it is evident that beak trimming with a moderate cut and removal of approximately 1/3 at 14 days of age (MOD 14) was efficient in preventing feather pecking without causing potential injuries to the animals.

Although there was no record of wounds from cannibalism and possible influence on productive performance during the present study, feather pecking has been identified as one of the most significant concerns for commercial production (Riedstra & Groothuis 2002; Nicol et al., 2013; Kaesberg et al., 2018). In addition to having impact on the welfare of birds, feather pecking may result in lower performance due to reduced egg production, increased mortality from cannibalism and increased energy demand for maintaining body temperature (Cunningham, 1992; Cheng, 2006; Blokhuis et al., 2007), which undoubtedly generate economic losses, especially in cold seasons or regions. Feather pecking may have its own motivational antecedents, suggesting that there is a possible influence of various factors (environmental, social pressure and genetic). Even with several studies on this topic, the main reasons for this phenomenon remain unclear, and the commonly accepted way of preventing these problems is still through adjustments in beak trimming procedures.

## Conclusion

Under the conditions of this study, methods for beak trimming applied at 14 and 28 days of age did not influence the performance of Japanese quails at the initial phase and the production phase. There was also no effect on egg quality. Finally, moderate beak trimming carried out at the age of 14 days, as well as severe trimming performed at 14 and 28 days of age were more efficient in preventing feather pecking, without harming the welfare of Japanese quails.

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