R. Bras. Zootec., 54:e20240140, 2025
https://doi.org/10.37496/rbz5420240140

Non-ruminants
Full-length research article

Revista Brasileira de Zootecnia

Brazilian Journal of Animal Science
e-ISSN 1806-9290
www.rbz.org.br

Beak trimming using infrared, hot blade straight cut, and hot blade V-cut on laying hen production

Hitalo José Santos Barbosa[1], Jeniffer Godinho Ferreira Pimenta[1], Anna Rosa Chagas Abreu[1], Mariana Masseo Saldanha[1], Marcela Viana Triginelli[1], Bruno Teixeira Antunes Costa[1], Henrique Carneiro Lobato[1], Simone Koprowski Garcia[1], Itallo Conrado Sousa Araújo[1]*, Leonardo José Camargos Lara[1]

[1] Universidade Federal de Minas Gerais, Escola de Veterinária, Departamento de Zootecnia, Belo Horizonte, MG, Brasil.

***Corresponding author:**
italloconradovet@hotmail.com

Received: August 29, 2024
Accepted: December 16, 2024

How to cite: Barbosa, H. J. S.; Pimenta, J. G. F.; Abreu, A. R. C.; Saldanha, M. M.; Triginelli, M. V.; Costa, B. T. A.; Lobato, H. C.; Garcia, S. K.; Araújo, I. C. S. and Lara, L. J. C. 2025. Beak trimming using infrared, hot blade straight cut, and hot blade V-cut on laying hen production. Revista Brasileira de Zootecnia 54:e20240140.
https://doi.org/10.37496/rbz5420240140

Editors:
Ines Andretta
Cristiane Gonçalves Titto

ABSTRACT - This study investigated the effects of different beak trimming methods on the development, hematological parameters, cloacal temperature, beak length, egg quality, and laying performance of laying hens from 1 to 31 weeks of age. Nine hundred Lohmann White LSL-Lite laying hens were randomly assigned to three treatments based on beak trimming methods: infrared radiation, hot blade straight cut, and hot blade V-cut. Laying hens subjected to the hot blade V-cut method had lower feed intake, body weight gain, laying percentage, and egg mass compared with those subjected to the infrared method ($P \leq 0.05$), with no significant differences observed when compared to the hot blade straight cut method ($P > 0.05$). Additionally, hens subjected to the hot blade V-cut method produced eggs with lower specific gravity and Haugh unit ($P \leq 0.05$). Furthermore, the hot blade V-cut method was associated with higher mortality rates between one and six weeks of age. No significant treatment effects were observed on the weight of lymphoid organs or cloacal temperature ($P > 0.05$). Birds subjected to the hot blade V-cut method also exhibited shorter beaks at 31 weeks of age ($P \leq 0.05$). The hot blade V-cut method negatively affects birds' performance and increases early mortality, likely due to its aggressiveness, which may compromise the overall laying production performance.

Keywords: cannibalism, laying management, stress

1. Introduction

Beak trimming is a common practice in the poultry industry in Brazil, the European Union, and the United States. This procedure involves reducing the length of birds' beaks, primarily to prevent cannibalism and feather pecking. While beak trimming is widely used in commercial poultry production, it remains a contentious issue due to concerns about the pain and discomfort it may cause to the animals during and after the procedure (Spindler et al., 2016; Ben-Mabrouk et al., 2023). In some

European countries, such as Sweden, Finland, and Germany, the practice has been banned to promote animal welfare (Rodenburg et al., 2013; Bastos-Leite et al., 2016; Kliphuis et al., 2023).

Genetic improvement has been aimed at reducing cannibalism by increasing selection pressure for less aggressive and less pecking individuals. However, this trait has moderate heritability, making it difficult to select for the genetic component to reduce injurious behavior (Underwood et al., 2021). Despite the negative effects on welfare after treatment, beak trimming is still used in the egg industry to prevent and control cannibalism and all forms of feather pecking (Glatz and Underwood, 2021).

In view of these problems, new beak trimming methods have been developed aiming at reducing the suffering caused to birds by the conventional hot blade straight cut method while not increasing production costs. The hot blade method consists of two steps: cutting and cauterizing the beak between the seventh and tenth days of life and re-trimming the beak during the tenth week with beak cutting and cauterization (Oka et al., 2017). As an attempt to reduce the stress caused to chicks by the first step of the hot blade method, a new methodology was introduced that involves treating part of the beak with infrared radiation on the first day of life while birds are still in the hatchery. This method, in most cases, still requires a new hot blade cut during the tenth week of life due to beak growth after the first treatment (Santos, 2014). According to Gonçalves et al. (2010), stress caused by re-trimming may compromise the initial production of birds due to significant reductions in subsequent feed intake and, consequently, egg production.

Since egg production is often conducted in open houses with exposure to natural light, a single trimming whether by hot blade or infrared is usually insufficient to prevent cannibalism throughout the laying hen's life. Under these conditions, strain manuals recommend that birds with beaks trimmed by hot blade or treated with infrared radiation undergo a second trimming (Dekalb, 2009; Hendrix Genetics, 2020; Bovans, 2020; Hy-Line, 2020; Lohmann, 2021).

Another method used is the hot blade V-cut trimming, which involves making a V-shaped cut on the beak using a Verschuuren® beak trimmer. This technique is more severe than the conventional hot blade cut, eliminating the need for re-trimming at 10 weeks of age (Oka et al., 2017; Lohmann, 2021). The goal of this method is to reduce the number of beak trimmings from two to one. However, because it is a relatively new technique, little is known about its effects on the development, physiology, welfare, egg quality, and production parameters of laying hens.

The objective of the present study was to evaluate the effects of these three methods of beak trimming on the development, production, hematological analysis, cloacal temperature, beak length, organ weight, and egg quality of laying hens from the first day of age to initial period of egg production (17 to 31 weeks of age).

2. Material and methods

The current experimental protocol was approved by the Ethical Principles in Animal Experimentation Committee under protocol no. 318/2017. The laying chicks were reared in an experimental farm, located in the municipality of Igarapé, MG, Brazil (20°04'13" S, 44°18'06" W).

2.1. Experimental design, treatments, and management

The experimental design was completely randomized and consisted of three treatments defined by the beak trimming methods: infrared, hot blade straight cut, and hot blade V-cut, which differed in methodology, date of application, and number trimmings. Due to the high mortality caused by cannibalism in birds that are not beak-trimmed, poultry rearing this way is not yet a reality in intensive egg production in Brazil. Therefore, birds without beak trimming were not used in our study.

The infrared beak treatment method was performed on the birds using NovaTech® equipment on the first day of life while still in the hatchery and involved treating the beak 2 mm from the nasal orifice with light intensity of 50 nm and a glass mirror as a reflection material (Figure 1). Birds were re-trimmed in the tenth week, which consisted of cutting and cauterizing of the beak at 5 mm from the nasal orifice using the Lyon® manual debeaker, which performed vertical cutting movements with a straight blade at a temperature of 750 to 800 °C (Figure 1). Hot blade straight cut was performed on the 10th day of life, with beak cutting and cauterization 2 mm from the nasal orifice using a Lyon® manual debeaker, which performed vertical cutting movements with a straight blade at a temperature of 600 to 650 °C (Figure 2A). Birds were re-trimmed during the 10th week of life, which consisted of cutting and cauterizing the beak 5 mm from the nasal orifice with a blade temperature of 750 to 800 °C (Figure 2B). Hot blade V-cut trimming was performed on the 10th day of life, which involved V-shaped cutting and cauterization of the beak 1 mm from the nasal orifice using a Verschuuren® automatic debeaker with a blade temperature of 750 to 800 °C (Figure 2C). All beak-trimming procedures were carried out by trained and monitored teams throughout the process.

Figure 1 - Beak trimming with infrared at 1, 5, 10, and 15 days of age, respectively.

Figure 2 - Beak trimming with hot blade straight cut at the 10th day of age (2A), re-trimming at the 10th week of age (2B), and hot blade V-cut at the 10th day of age (2C).

Nine hundred Lohmann® White LSL-Lite laying chicks were housed in a conventional laying house equipped with curtains but without air conditioning. The chicks were assigned to one of three beak trimming methods (300 per treatment). Initial weights were recorded for each group, with average weights of 35.1 g for infrared radiation, 35.4 g for hot blade straight cut, and 34.9 g for hot blade V-cut. During the initial phase (1 to 14 weeks of age), the chicks were distributed according to a completely randomized design with three treatments and five replicates of 60 birds each. They were housed in 5 × 2 × 2 m boxes at a density of 6 birds/m^2. Initially, each box was equipped with a three-liter pressure drinker and small tubular feeders. At the third week, the pressure drinkers were replaced with pendulum-type drinkers, and the small feeders were replaced with larger ones. The lighting schedule consisted of 24 h of light during the first three weeks for warming, followed by natural light only until the 14th week. Starter (1–6 weeks), grower I (7–12 weeks), grower II (week 13 to the beginning of laying), and layer I diets were formulated according to the recommended ingredient values of Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

At 14 weeks, 360 pullets (120 per treatment) were selected and transferred to a California-type laying house without air conditioning. They were reallocated in a completely randomized design with the same three treatments and five replicates of 24 birds each. The pullets were housed in 60 cages (50 × 44 × 40 cm) with trough and nipple drinkers and feeders, maintaining a density of 336 cm^2/bird. From 15 to 31 weeks of age, the birds received 14 h of light per day. Feed and water were provided *ad libitum*.

2.2. Performance

Data on feed intake, feed conversion, and viability (Determined by 100 minus mortality), were obtained weekly during the initial (first to sixth weeks) and growth (seventh to 16th weeks) phases. Body weight and body weight gain were obtained at the end of each phase. Average feed intake was corrected according to bird mortality. Age at sexual maturity was considered when birds first laid an egg.

For the production phase (17th to 31st week), birds were weighed at the beginning and end to obtain body weight. Feed intake was evaluated weekly, while egg production and bird mortality were recorded daily. All eggs, except for double yolk, cracked, and dirty eggs, were weighed once a week after laying. The other parameters measured in this phase were feed conversion per dozen and per kg of eggs, egg mass, and number of eggs per housed bird.

2.3. Egg quality

At the end of the experiment, 50 eggs per treatment were randomly collected for internal and external analysis of egg quality. Thus, 25 eggs were destined for shell resistance analysis and 25 for analysis of the other quality parameters. Egg analyses were performed on the same day of collection. Haugh units (HU) were determined using an AMES model S-8400 micrometer. The proportions of yolk, albumen, and shell were determined from weights obtained with a precision analytical balance. Yolk coloration score was determined using a colorimetric fan (DSM YOLK COLOR FAN, 2005 - HMB 515488). Shell thickness was obtained from the average of three measurements performed in the equatorial, apical, and basal regions of the eggshell using a Digimes digital micrometer. Specific gravity was determined according to the Archimedes principle, which uses data of egg weight in air and the weight of water displaced by the egg when completely submerged. Shell strength values were obtained using a TA.X T2 Texture Analyzer.

2.4. Organ weight and hematological analysis

In the first, third, ninth, and eleventh weeks of life, five birds per treatment were selected with weights within a 5% margin above or below the average for each replicate. Birds were slaughtered by cervical dislocation and then bled to collect blood and organ samples. During the bleeding of each bird, 1.5 mL of blood was quickly collected with an Eppendorf tube with 10% EDTA anticoagulant to obtain whole blood. Whole blood was used to determine hematocrit and total plasma protein. Hematocrit reading was performed in a capillary by the micro-hematocrit method, and the determination of total plasma proteins was done by refractometry. All hematology analyses were performed on the same day of collection. Gizzard + proventriculus, liver, spleen, bursa of Fabricius, and thymus were removed, dried on absorbent paper, and weighed on a precision analytical balance, and their weights expressed as a percentage of bird live weight.

2.5. Cloacal temperature and beak length

Cloacal temperature was measured for five birds selected randomly per treatment, during the first, third, ninth, and eleventh weeks of life, with a Becton Dickison® digital clinical thermometer inserted in the cloaca for at least 2 min (Costa et al., 2012). At the end of the experiment, 25 birds were randomly selected per treatment to measure beak length (cm) from the outer tip of the nasal orifice to the tip of the beak with the aid of a digital caliper (Glatz and Runge, 2017).

2.6. Statistical analysis

All data were analyzed using the following fixed effect model:

$$Y_{ij} = \mu + T_i + e_{ij},$$

in which Y is the response variable, μ is the overall mean, T_i is the fixed effect of treatment (i = infrared, hot blade straight cut, hot blade V-cut), and e is the residual error.

The data were subjected to tests of normality, and homoscedasticity was verified by the Shapiro-Wilk test at P<0.05. Means were then subjected to analysis of variance (ANOVA) using the GLM procedure of SAS software (Statistical Analysis System, 2003), and when significant, averages were compared using Tukey's test at P≤0.05. Data that violated the principle of normality were evaluated using non-parametric statistics, analyzed by the Kruskal-Wallis test at P≤0.05.

3. Results

3.1. Performance during the initial and production phases

Chicks treated in the hatchery by the infrared method showed lower feed intake in the first week compared with birds from other treatments (P≤0.05). The evaluation of the feed intake that took place from the second to the seventh week of the bird's life demonstrated a higher value for infrared (P≤0.05), except for the seventh week, when it equaled straight cut trimming (P>0.05). On the other hand, feed intake was lower for most of this period for those birds subjected to the V-cut method, except for the third week, when it equaled the straight cut (P>0.05) (Table 1). From the eighth week onwards, intake did not change among methods (P≤0.05).

Table 1 - Weekly feed intake (g/bird/day) from the 1st to the 14th week of age of laying hens subjected to different beak trimming methods

Treatment	Week (1st - 14th week of age)						
	1st	2nd	3rd	4th	5th	6th	7th
Infrared	7.79b	16.15a	23.16a	29.05a	41.90a	42.89a	44.71a
Straight cut	8.97a	14.44b	21.30b	27.83b	40.20b	40.55b	42.14a
V-cut	9.23a	13.51c	20.66b	24.89c	36.78c	37.63c	37.81b
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SEM	0.55	0.89	0.88	0.55	0.55	0.53	2.10
	8th	9th	10th	11th	12th	13th	14th
Infrared	49.02	53.22	52.80	52.96	56.05	57.32	55.14
Straight cut	47.24	52.32	52.48	50.29	56.55	56.10	53.00
V-cut	43.17	51.58	51.49	53.36	53.70	56.46	53.78
P-value	0.11	0.06	0.76	0.88	0.25	0.33	0.23
SEM	2.01	3.35	3.01	4.50	4.48	2.28	3.49

SEM - standard error of the mean.
Results are the mean of five replicates, 60 hens per replicate.
a-c - Means within a column with different letters differ according to Tukey's test (P≤0.05).

Feed intake was 11.3% lower for the V-cut method when compared with the infrared and 6.8% lower compared with hot blade method (P≤0.05). Birds subjected to the V-cut trimming also had lower body weight and, consequently, lower body weight gain in the initial phase, compared with birds subjected to other methods (P≤0.05). The treatments had no significant effects on feed conversion during this stage (P>0.05). Viability from the first to the sixth week of age was lower in V-cut group compared with other treatments (P≤0.05).

In the growth phase (seventh to the fourteenth week of age; Table 2), feed intake, body weight, and viability were not affected by treatments; however, body weight gain and feed conversion for birds subjected to the V-cut method were higher than for birds subjected to the straight cut and infrared methods (P≤0.05). In the total growth period (Table 2), treatments did not affect feed intake, body weight, body weight gain, feed conversion, and viability (P>0.05).

Table 2 - Performance of laying hens in the initial (1st to 6th week of age), growth (7th -16th week of age), and total growth (1st - 16th week of age) phases subjected to different beak trimming methods

Treatment	Feed intake (g/bird)	Body weight (g)	Body weight gain (g)	Feed conversion ratio (g/g)	Viability (%)*
			Initial phase (1st to 6th week of age)		
Infrared	1,084.68a	491.36a	455.76a	2.38	99.67a
Straight cut	1,032.81b	473.88a	438.39a	2.36	99.67a
V-cut	962.09c	445.19b	409.48b	2.35	94.33b
P-value	<0.01	<0.01	<0.01	0.53	0.04
SEM	20.33	18.28	18.45	0.59	0.54
			Growth phase (7th to 16th week of age)		
Infrared	3,600.37	1,173.33	681.98b	5.28a	100.00
Straight cut	3,548.48	1,157.50	683.62b	5.19a	99.32
V-cut	3,579.71	1,169.17	723.97a	4.94b	100.00
P-value	0.61	0.52	<0.01	<0.01	0.36
SEM	102.28	88.92	15.88	0.10	0.88
			Growth phase total (1st to 16th week of age)		
Infrared	4,685.05	1,173.33	1,137.73	3.99	99.67
Straight cut	4,581.28	1,157.50	1,122.01	3.96	99.33
V-cut	4,541.79	1,169.17	1,133.45	3.88	96.33
P-value	0.07	0.52	0.53	0.22	0.33*
SEM	162.18	78.01	16.10	0.30	0.88

SEM - standard error of the mean.
Results are the mean of five replicates, 60 hens per replicate.
a-b - Means within a column with different letters differ according to Tukey's test (P≤0.05).
* Parameter subjected to Kruskal-Wallis test (P≤0.05).

During the production phase (Table 3), treatments had effects on average feed intake, percentage of egg production, egg mass, and body weight gain (P≤0.05). The birds subjected to the V-cut method had 5.4% lower feed intake and, consequently, approximately 13.9% lower body weight gain, 7.8% lower laying percentage, and 8.8% lower egg mass compared with birds subjected to the infrared method; however, both treatments did not differ from the hot blade method (P>0.05). Treatments did not affect egg weight, number of eggs per housed bird, conversion per dozen and kg of eggs, body weight, age of sexual maturity, and viability during the production phase (P>0.05).

Table 3 - Productive performance of laying hens subjected to different beak trimming methods in the production phase (17th to 31st week of age)

Variable	Treatment			P-value	SEM
	Infrared	Straight cut	V-cut		
Feed intake (g/bird/day)	88.14a	86.05ab	83.34b	0.01	2.46
Egg production (%)	66.76a	64.23ab	61.52b	0.03	3.26
Egg mass (g/bird/day)	35.85a	34.36ab	32.70b	0.01	1.11
Egg weight (g)	53.69	53.51	53.16	0.61	1.58
Number of eggs/housed bird	69.62	66.97	64.6	0.07	4.59
FCR (kg egg/12 eggs)	1.59	1.61	1.63	0.19	2.21
FCR (kg feed/kg egg)	2.25	2.30	2.33	0.07	2.03
Body weight (g)	1,473.55	1,448.84	1,427.50	0.06	1.88
Body weight gain (g)	300.22a	291.34ab	258.33b	0.02	28.39
Age of sexual maturity (days)	127.20	128.40	133.00	0.06	2.79
Viability (%)	97.5	99.17	100.00	0.10	2.72

FCR - feed conversion ratio; SEM - standard error of the mean.
Results are the mean of five replicates, 24 hens per replicate.
a-b - Means within a row with different letters differ according to Tukey's test (P≤0.05).

3.2. Egg quality

Eggs from birds subjected to the hot blade method had lower specific gravity (P≤0.05) when compared with those of the infrared method, although not differing from eggs of birds of the V-cut method (Table 4). Birds subjected to the hot blade method produced eggs with lower HU results when compared with birds subjected to the V-cut method (P≤0.05), but not differing birds subjected to infrared (P>0.05). There was no difference in the percentages of yolk, albumen, and shell among treatments (P>0.05), nor was there any difference among eggshell resistance, shell thickness, and yolk color (P>0.05).

Table 4 - Quality of eggs from laying hens subjected to different beak trimming methods (31st week of age)

Treatment	Variable							
	Specific gravity* (%)	Yolk (%)	Albumen (%)	Shell (%)	HU (%)	Eggshell resistance (kgf)	Shell thickness (mm)	Yolk color*
Infrared	1.099a	25.74	63.93	10.33	89.56ab	5.95	0.38	7.00
Straight cut	1.081b	25.67	63.88	10.45	87.03b	5.79	0.38	7.00
V-cut	1.090ab	25.39	64.33	10.28	91.65a	5.85	0.39	7.00
P-value	<0.01	0.76	0.67	0.72	0.03	0.83	0.33	0.23
SEM	0.41	3.88	4.02	1.23	1.53*	1.23	0.03	0.05

HU - Haugh unit; SEM - standard error of the mean.
Results are the mean of five replicates, five eggs per replicate.
a-b - Means within a column with different letters differ according to Tukey's test (P≤0.05).
* Parameter subjected to Kruskal-Wallis test (P≤0.05).

3.3. Organ weights

A difference in relative weight of gizzard + proventriculus was observed among treatments in the third week of life. Birds subjected to the infrared method had lower relative weight of gizzard + proventriculus when compared with birds subjected to the V-cut method (P≤0.05), but both methods were similar to the hot blade cut (P>0.05). There were no differences in relative weight of gizzard + proventriculus among treatments at all other ages (P>0.05).

A difference was observed for relative liver weight only in the ninth week of life for birds subjected to the infrared method (P≤0.05), with birds of both straight hot blade and V-cut methods having lower relative liver weights. There were no significant differences in relative liver weight among the different treatments for the other evaluated bird ages (P>0.05). The different beak trimming methods did not affect the relative weight of lymphoid organs for any of the evaluated ages (Table 5).

Table 5 - Relative weight of organs from laying hens subjected to different beak trimming methods at the 1st, 3rd, 9th, and 11th weeks of age

Treatment	Gizzard + Proventriculus (%)	Liver (%)	Spleen (%)	Bursa of Fabricius (%)	Thymus (%)
		1st week of age			
Infrared	6.64	4.53	0.17	0.29	0.53
Straight cut	6.36	4.62	0.20	0.30	0.59
V-cut	6.42	4.10	0.19	0.29	0.62
P-value	0.53	0.54	0.81	0.99	0.67
SEM	1.76	0.09	0.48	0.03	0.10
		3rd week of age			
Infrared	4.49b	3.49	0.17	0.44	0.65
Straight cut	4.87ab	3.53	0.17	0.42	0.62
V-cut	5.24a	3.53	0.24	0.53	0.56
P-value	0.02*	0.93	0.06	0.37	0.50
SEM	2.22*	0.07	0.14	0.15	0.28
		9th week of age			
Infrared	3.53	2.54a	0.27	0.21	0.71
Straight cut	3.69	2.32b	0.24	0.15	0.62
V-cut	3.55	2.31b	0.24	0.20	0.74
P-value	0.66	0.04	0.36*	0.20*	0.64*
SEM	1.55	0.09	0.11*	0.10*	0.38*
		11th week of age			
Infrared	3.41	1.83	0.20	0.14	4.95
Straight cut	3.55	1.83	0.19	0.20	5.31
V-cut	3.48	1.94	0.19	0.20	5.05
P-value	0.80	0.30	0.87	0.58*	0.85
SEM	1.87	0.55	0.15	0.14*	0.65

SEM - standard error of the mean.
Results are the mean of five replicates, one hen per replicate.
a-b - Means within a column with different letters differ according to Tukey's test (P≤0.05).
* Parameter subjected to Kruskal-Wallis test (P≤0.05).

3.4. Cloacal temperature, hematological analysis, and beak length

Treatments did not affect cloacal temperature, hematocrit, or total plasma protein at any of the evaluated ages (P>0.05) (Table 6). Beak length at week 3 was affected by the different treatments (P≤0.05). Birds subjected to the infrared method had the longest beaks, and those subjected to V-cut method had the shortest beaks, while those of the straight hot blade method had intermediate-length beaks (Table 7).

Table 6 - Cloacal temperature (°C), hematocrit (%), and total plasma protein (g/dL) of laying hens subjected to different beak trimming methods at the 1st, 3rd, 9th, and 11th weeks of age

Treatment	Cloacal temperature (°C)	Hematocrit (%)	Total plasma protein (g/dL)
	1st week of age		
Infrared	40.68	32.50	4.23
Straight cut	40.41	33.33	4.67
V-cut	40.40	34.33	4.60
P-value	0.55	0.35	0.09
SEM	1.22	5.38	1.63
	3rd week of age		
Infrared	41.03	34.33	3.37
Straight cut	40.90	34.17	3.40
V-cut	41.20	34.50	3.07
P-value	0.60	0.90	0.08
SEM	1.24	3.36	1.06
	9th week of age		
Infrared	40.84	32.50	3.83
Straight cut	41.05	32.83	3.83
V-cut	41.32	34.00	3.97
P-value	0.20	0.15	0.22*
SEM	1.08	4.00	1.75*
	11th week of age		
Infrared	41.53	32.83	3.73
Straight cut	41.35	34.00	3.73
V-cut	41.36	33.83	3.93
P-value	0.61	0.32	0.57
SEM	0.85	4.19	1.80

SEM - standard error of the mean.
* Parameter submitted to Kruskal-Wallis's test (P≤0.05).
Results are the mean of five replicates, one hen per replicate.

Table 7 - Length of the beak (cm) of laying hens subjected to different beak trimming methods at 31 weeks of age

Treatment	Length of the beak (cm)
Infrared	0.89a
Straight cut	0.84b
V-cut	0.68c
P-value	<0.01
SEM	0.01

SEM - standard error of the mean.
Results are the mean of five replicates, five hens per replicate.
a-c - Means within a column with different letters differ according to Tukey's test (P≤0.05).

4. Discussion

The results of this study highlight significant differences in performance, egg quality, and physiological parameters among laying hens subjected to different beak trimming methods. The V-cut method, designed to reduce the number of trimmings needed throughout the birds' lives, was associated with reduced feed intake, lower body weight gain, and decreased viability during the initial phase compared with the infrared and hot blade methods. These findings suggest that the V-cut method, despite its intended benefits, may impose greater stress on the birds, leading to poorer early performance outcomes.

These outcomes underscore the need for careful consideration when selecting beak trimming methods. Regardless of the method used, beak trimming can cause a reduction in feed intake and is associated with the presence of pain or discomfort, caused by damage to tissue, nerves, or receptors (Glatz and Underwood, 2021). Despite that, McKeegan and Philbey (2012) found no formation of neuromas or alterations to nociceptors in the beaks of birds that had been subjected to infrared beak trimming and concluded that the treatment does not cause chronic pain. It is important to emphasize that despite the long-term pain evaluation, these authors did not evaluate impact on feed intake and bird performance.

The reduced feed intake observed in the weeks following beak trimming for birds subjected to the V-cut method can be attributed to the greater depth of the cut, which causes a more pronounced impact on feed intake compared with other methods. Glatz and Underwood (2021) and Li et al. (2020) noted that hot blade trimming leads to reduced feed and water intake due to birds adjusting to their new beak shape, with pain being a more likely cause than behavioral changes. This pain can persist for up to five weeks post-trimming, as observed in the current study. Generally, the impact of beak trimming on feed intake and overall bird development is influenced by the extent of tissue removal and the age of birds, in which trimming in younger birds is more effective for the formation of neuromas (Cruvinel et al., 2022).

The results observed in the initial phase can be attributed to the pain caused by the procedure, which leads to reduced feed intake for several weeks. Ávila et al. (2008) noted that the V-cut method inflicts more significant damage to the beak due to its deeper cut, which can even injure the bird's palate. This damage is irreversible and necessitates a longer recovery period for feed intake to return to normal levels. Additionally, the V-cut method is associated with higher rates of neuroma formation, a condition that can persist into laying hen egg production phase (Schwean-Lardner et al., 2016).

In the growth phase, the lower weight gain and worse feed conversion observed for birds under the hot blade and infrared beak treatments can be explained by the handling stress caused by the re-trimming performed during the tenth week of life, resulting in lower feed intake in the week following the procedure. In general, beak trimming causes changes in the mechanoreceptors and nerve endings that existed in the beaks of birds, which increases sensitivity after the procedure, resulting in reduced feed intake (Li et al., 2020).

Despite the reduced intake, after the re-trimming, birds quickly recovered feed intake, returning to normality at the 12th week of age, a result similar to that obtained by Gonçalves et al. (2010). The use of shorter beaks can lead to greater sensitivity, especially after re-trimming, resulting in less feed intake and lower body weight (Pelícia et al., 2019).

During the total growth period, the longer beak length should be considered when using hot blade or infrared method, especially after re-trimming; however, there is a stress caused by the procedure, which leads to worse feed conversion. According to Araújo et al. (2000), birds with longer beaks in the rearing phase cause greater feed waste, which the authors attribute to particle selection, and thus worse feed conversion. According to Iqbal et al. (2019), beak length does not change feed intake, but beak-treated birds select fewer larger particles in feed.

In the production phase, V-cut trimmed birds had lower weight gain due to lower feed intake, which compromised egg production and, consequently, the egg mass produced. Even without re-trimming, the greater depth of the V cut method affects the initial development of birds as well as the performance in the production phase. Due to the need for increasing feed intake during the production phase to meet both productive and physiological needs, birds with shorter beaks may have difficulty consuming feed, with direct effects on productive performance. This contrasts with the findings of Vieira Filho et al. (2016), who compared hot blade and infrared methods and found no difference in productive performance of birds or in egg quality. Similar results were obtained by Petrolli et al. (2017), who found pullets subjected to the infrared method to have a higher body weight than those subjected to the hot blade method, and stated that, despite the similar development of the oviduct, greater body weight suggests a greater capacity to produce eggs for a longer time.

Egg specific gravity is an indirect measure of shell quality, with higher values indicating better quality (Feddern et al., 2017). However, even with differences in specific gravity, there were no differences in the thickness and resistance of the eggshell. Oka et al. (2017) compared different beak trimming methods and found lower eggshell thickness and resistance for eggs from birds subjected to the infrared method. The authors correlated the worsening of the thickness of the eggshell on the re-trimming, which caused a reduction in the weight associated with a reduction in feed intake during the following two weeks, affecting the absorption of mineral material essential for the formation of the eggshell.

According to the United States Department of Agriculture (USDA, 2000), low-quality eggs have HU values below 60, high-quality eggs have HU values between 60 to 72, and excellent-quality eggs have HU values above 72. Haugh unit values for the eggs evaluated in the present study were within the range considered excellent. Vieira Filho et al. (2016), who used infrared and hot blade methods with and without re-trimming for Lohmann LSL®, Hy line W36®, and Lohmann Brown® strains, did not observe differences in productive performance and egg quality. According to Pizzolante et al. (2007), the lower feed intake by severely beak-treated quail (half of the beak) does not affect egg quality.

The birds subjected to the infrared method had their beaks treated on the first day of life. These birds had more time under the effect caused by the beak treatment until the third week when compared with other treatments and, consequently, greater impact on feed intake in the first week and less stimulation of gizzard and proventriculus. According to Azis et al. (2019), stressful situations, such as food restriction for short periods, change the weight of the viscera and liver of birds. The greater liver weight for birds subjected to the infrared beak treatment during the ninth week of life can be explained by the possibility of a lower demand for glycogen to meet the immediate bodily demands for glucose in stressful situations (Scanes, 2016). The higher feed intake observed on beak-trimmed birds by infrared in the weeks prior to the evaluation may have reduced the physical demands supporting the increase of weight in this organ. The results of the present study differ from those of Petrolli et al. (2017), who did not observe differences in the weights of heart, liver, proventriculus, gizzard, small intestine, and bursa of Fabricius of birds subjected to infrared or hot blade methods.

The effects caused by beak trimming in the present study did not differ for relative weight of lymphoid organs at the ages evaluated, although it is clear that involution of lymphoid organs can occur during stress situations and after eight weeks of age (Ayman et al., 2020; Huralska et al., 2024). Results for cloacal temperature indicate that, regardless of the stress caused by the evaluated beak trimming methods, the birds have great adaptability and return to comfort or a state of homeostasis. Cloacal temperature is a very important physiological parameter for characterizing a condition of comfort or stress and helps in the detection of inflammatory processes (Silva et al., 2024; Vasconcelos et al., 2024).

Despite the stress induced by the beak trimming methods used in this study, hematocrit and total plasma protein levels remained unaffected and stayed within acceptable ranges. According to Horhoruw and Kewilaa (2024), normal hematocrit values in birds range from 35 to 55%, with values below 25% indicating anemia and above 55% indicating dehydration or polycythemia. Severe inflammatory processes can be detected by measuring total plasma proteins, which typically range from 3 to 6 g/dL in birds (Kaiser et al., 2022; Silva et al., 2007). In the present experiment, all groups consistently showed hematocrit and plasma protein values within expected ranges, suggesting that when beak trimming is performed correctly, it does not negatively impact these parameters.

Several factors, such as blade temperature, cut shape, and cauterization time, directly affect beak growth, which in turn influences bird development and egg production (Li et al., 2020). Shorter beaks may limit feed intake by birds, especially for laying hens as they already have low feed intake. These results differ from those found by Vieira Filho et al. (2018), who observed no difference between beaks of birds treated with infrared and those of birds treated by hot blade. However, Vieira Filho et al. (2016) and Oka et al. (2017) observed that laying hens subjected to infrared beak treatment had longer beaks lengths than did those subjected to the hot blade method, corroborating the findings of the present study.

5. Conclusions

The V-cut method, although designed to reduce the need for repeated trimmings, results in lower performance during initial phase compared with the infrared method, likely due to greater initial stress and deeper cut impact. Infrared trimming, while leading to slightly longer beaks, shows favorable results in maintaining feed intake and egg production without adverse effects on egg quality or physiological stress markers. These findings highlight the importance of selecting beak trimming methods that balance welfare considerations with optimal performance outcomes in laying hens.

Data availability

The entire dataset supporting the results of this study is available upon reasonable request to the corresponding author.

Author contributions

Conceptualization: Barbosa, H. J. S. and Lara, L. J. C. **Data curation:** Barbosa, H. J. S.; Pimenta, J. G. F. and Costa, B. T. A. **Formal analysis:** Barbosa, H. J. S. **Funding acquisition:** Lara, L. J. C. **Investigation:** Barbosa, H. J. S.; Pimenta, J. G. F.; Abreu, A. R. C.; Saldanha, M. M.; Triginelli, M. V.; Costa, B. T. A. and Lara, L. J. C. **Methodology:** Lara, L. J. C. **Project administration:** Lara, L. J. C. **Resources:** Lara, L. J. C. **Supervision:** Lara, L. J. C. **Visualization:** Garcia, S. K.; Araújo, I. C. S. and Lara, L. J. C. **Writing – original draft:** Barbosa, H. J. S.; Garcia, S. K. and Lara, L. J. C. **Writing – review & editing:** Lobato, H. C.; Araújo, I. C. S. and Lara, L. J. C.

Conflict of interest

The authors declare no conflicts of interest.

Acknowledgments

The authors acknowledge the Graduate Program in Animal Science of the Universidade Federal de Minas Gerais (PPGZ/UFMG, Belo Horizonte, MG, Brazil) for its support in conducting this research, and the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil) for providing scholarships.

References

Araújo, L. F.; Café, M. B.; Junqueira, O. M.; Araújo, C. S. S.; Mogyca, N. S. S. and Cunha, M. I. R. 2000. Diferentes níveis de debicagem para frangas comerciais. Ars Veterinaria 16:46-51.

Ávila, V. S.; Roll, V. F. B. and Catalan, A. S. S. 2008. Alternativas e consequências da debicagem em galinhas reprodutoras e poedeiras comerciais. Documentos, 128. Embrapa Suínos e Aves, Concórdia.

Ayman, U.; Alam, M. R. and Das, S. K. 2020. Age-related development and histomorphological observations of bursa of Fabricius in sonali chicken. Journal of Advanced Biotechnology and Experimental Therapeutics 3:20-28. https://doi.org/10.5455/jabet.2020.d103

Azis, A.; Berliana, B. and Afriani. 2019. Effects of feeding time restriction during the whole rearing period on the growth performance of broiler chickens. International of Journal of Poultry Science 18:14-20. https://doi.org/10.3923/ijps.2019.14.20

Bastos-Leite, S. C.; Gomes, J. V.; Alves, M. G. M.; Goulart, C. C.; Silva, J. D. B. and Medeiros, F. M. 2016. Desempenho produtivo e qualidade de ovos de poedeiras leves submetidas a diferentes níveis de debicagem. Acta Veterinaria Brasilica 10:110-115.

Ben-Mabrouk, J.; Mateos, G. G.; Corrales, N. L.; Juan, A. F.; Aguirre, L. and Cámara, L. 2023. Effect of beak trimming at hatch and oat hulls inclusion in the diet on growth performance, preference behavior for coarse particles and gastrointestinal tract traits of brown-egg pullets from 1–35 days of age. Animal Feed Science and Technology 306:115789. https://doi.org/10.1016/j.anifeedsci.2023.115789

Bovans. 2020. Bovans White Guia do produto. Available at: <https://www.bovans.com>. Accessed on: Aug. 28, 2020.

Costa, J. H. S.; Saraiva, E. P. and Santos, L. D. 2012. Efeito do ambiente sobre indicadores fisiológicos na produção de frangos de corte. Revista Verde de Agroecologia e Desenvolvimento Sustentável 7:54-58.

Cruvinel, J. M.; Montenegro, A. T.; Ouros, C. C.; Alves, K. S.; Ribeiro, G. C.; Santos, T. S.; Molino, A. B. and Garcia, E. A. 2022. Beak trimming in Japanese quails at initial phase is an alternative to reduce the negative effects of feather pecking. Acta Scientiarum. Animal Sciences 44:e54129. https://doi.org/10.4025/actascianimsci.v44i1.54129

Feddern, V.; Prá, M. C.; Mores, R.; Nicoloso, R. S.; Coldebella, A. and Abreu, P. G. 2017. Egg quality assessment at different storage conditions, seasons and laying hen strains. Ciência e Agrotecnologia 41:322-333. https://doi.org/10.1590/1413-70542017413002317

Glatz, P. and Runge, G. 2017. Managing fowl behaviour. Australian Egg Corporation, Sydney, Australia.

Glatz, P. C. and Underwood, G. 2021. Current methods and techniques of beak trimming laying hens, welfare issues and alternative approaches. Animal Production Science 61:968-989. https://doi.org/10.1071/AN19673

Gonçalves, F. M.; Gentilini, F. P.; Anciuti, M. A.; Lopes, D. C. N.; Peters, M. D. P.; Rutz, F.; Cardellino, R. A.; Manzke, N.; Xavier, E. G. and Zanusso, J. T. 2010. Administração de antibiótico em poedeiras semipesadas durante o processo de debicagem. Arquivos de Zootecnia 59:295-298.

Dekalb. 2009. Manual de manejo das poedeiras Dekalb White. Available at: <https://www.fcav.unesp.br/Home/departamentos/zootecnia/NILVAKAZUESAKOMURA/manual_dekalb_white.pdf >. Accessed on: Aug. 28, 2024.

Hendrix Genetics. 2020. Guia do produto Hisex Brown e White. Available at: <https://www.hisex.com>. Accessed on: Aug. 28, 2024.

Horhoruw, W. and Kewilaa, A. I. 2024. Hematological profile in free-range chickens at the age of 4, 8, 12 weeks. Advances in Social Humanities Research 2:731-7. https://doi.org/10.46799/adv.v2i5.241

Huralska, S. V.; Dyshliuk, N. V.; Zaika, S. S.; Hryshchuk, H. P. and Yevtukh, L. H. 2024. Morphological features of the poultry thymus. Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Veterinary Sciences 26:68-75. https://doi.org/10.32718/nvlvet11311

Hy-Line. 2020. Guia de manejo Hy-Line W-36, W-80. Available at: <https://www.hyline.com.br/produtos>. Accessed on: Aug. 28, 2024.

Iqbal, Z.; Drake, K.; Swick, R. A.; Perez-Maldonado, R. A. and Ruhnke, I. 2019. Feed particle selection and nutrient intake altered by pecking stone consumption and beak length in free-range laying hens. Animal Nutrition 5:140-147. https://doi.org/10.1016/j.aninu.2018.05.003

Kaiser, J. C.; Reider, H.; Pabilonia, K. L. and Moore, A. R. 2022. Establishment of biochemical reference values for backyard chickens in Colorado (*Gallus gallus domesticus*). Veterinary Clinical Pathology 51:577-584. https://doi.org/10.1111/vcp.13136

Kliphuis, S.; Manet, M. W. E.; Goerlich, V. C.; Nordquist, R. E.; Vernooij, H.; van den Brand, H.; Tuyttens, F. A. M. and Rodenburg, T. B. 2023. Early-life interventions to prevent feather pecking and reduce fearfulness in laying hens. Poultry Science 102:102801. https://doi.org/10.1016/j.psj.2023.102801

Li, J.; Chen, H.; Dai, C.; Sa, R.; Wang, Z.; Wang, J.; Su, H.; He, X.; Guo, X. and Jiang, R. 2020. Effects of beak trimming on the performance, beak length, behavior, and carcass traits of a local broiler breed reared in battery cages. Animal Science Journal 91:e13405. https://doi.org/10.1111/asj.13405

Lohmann. 2021. Lohmann LSL-Lite Management guide. Cage housing. North American Edition.

McKeegan, D. E. F. and Philbey, A. W. 2012. Chronic neurophysiological and anatomical changes associated with infrared beak treatment and their implications for laying hen welfare. Animal Welfare 21:207-217. https://doi.org/10.7120/09627286.21.2.207

Oka, C. H.; Bueno, L. G. F.; Souza, S. R. L.; Balan, J. A. O.; Silva, K. M.; Polycarpo, G. V. and Iwayama, L. H. 2017. Performance of commercial laying hen submitted to different debeaking methods. Brazilian Journal of Poultry Science 19:717-724. https://doi.org/10.1590/1806-9061-2017-0537

Pelícia, K.; Garcia, E. A.; Santos, T. A.; Santos, G. C.; Vieira Filho, A.; Silva, A. P.; Moreira, J.; Rabello, C. B. V. and Garcia, R. G. 2019. Beak trimming by infrared radiation of layers. Brazilian Journal of Poultry Science 21:eRBCA-2019-0618. https://doi.org/10.1590/1806-9061-2017-0618

Petrolli, T. G.; Petrolli, O. J.; Girardini, L. K.; Zotti, M. L. A. N.; Baggio, R. A. and Junqueira, O. M. 2017. Effects of laser beak trimming on the development of brown layer pullets. Brazilian Journal of Poultry Science 19:123-128. https://doi.org/10.1590/1806-9061-2016-0307

Pizzolante, C. C.; Garcia, E. A.; Saldanha, E. S. P. B.; Laganá, C.; Faitarone, A. B. C.; Souza, H. B. A. and Pelícia, K. 2007. Break trimming methods and their effect on the performance and egg quality of Japanese quails (*Coturnix japonica*) during lay. Brazilian Journal of Poultry Science 9:17-21. https://doi.org/10.1590/S1516-635X2007000100003

Rodenburg, T. B.; Van Krimpen, M. M.; Jong, I. C.; Haas, E. N.; Kops, M. S.; Riedstra, B. J.; Nordquist, R. E.; Wagenaar, J. P.; Bestman, M. and Nicol, C. J. 2013. The prevention and control of feather pecking in laying hens: identifying the underlying principles. World's Poultry Science Journal 69:361-374. https://doi.org/10.1017/S0043933913000354

Rostagno, H. S.; Albino, L. F. T.; Donzele, J. L.; Gomes, P. C.; Oliveira, R. F.; Lopes, D. C.; Ferreira, A. S.; Barreto, S. L. T. and Euclides, R. F. 2017. Tabelas brasileiras para aves e suínos: composição de alimentos e exigências nutricionais. 3.ed. UFV, Viçosa, MG.

Santos, T. A.; Garcia, E. A.; Pelícia, K.; Vieira Filho, J. A.; Silva, A. P.; Santos, G. C.; Molino, A. B.; Baldo, C. A. A. and Halliday, J. M. 2014. Debicagem por meio de radiação infravermelha e lâmina quente e seus efeitos no início de produção. In: Anais XII Congresso APA. Associação Paulista de Avicultura, Ribeirão Preto.

Scanes, C. G. 2016. Biology of stress in poultry with emphasis on glucocorticoids and the heterophil to lymphocyte ratio. Poultry Science 95:2208-2215. https://doi.org/10.3382/ps/pew137

Schwean-Lardner, K.; Annett-Christianson, C. B.; Rajendram, J. and Classen, H. L. 2016. Does age of hot-blade trimming impact the performance and welfare of 2 strains of White Leghorn hens? Journal of Applied Poultry Research 25:547-560. https://doi.org/10.3382/japr/pfw037

Silva, M. A. J. G.; Santos, L. M. D.; Ribeiro, J. C. D.; Barbari, M.; Becciolini, V.; Naves, L. P. and Ferraz, P. F. P. 2024. Spatial and temporal variability of enthalpy and its influence on the cloacal temperature of broilers. Agronomy Research 22:982-1000. https://doi.org/10.15159/AR.24.057

Silva, P. R. L.; Freitas Neto, O. C.; Laurentiz, A. C.; Junqueira, O. M. and Fagliari, J. J. 2007. Blood serum components and serum protein test of Hybro-PG broilers of different ages. Brazilian Journal of Poultry Science 9:229-232. https://doi.org/10.1590/S1516-635X2007000400004

Spindler, B.; Giersberg, M. F.; Andersson, R. and Kemper, N. 2016. Legehennenhaltung mit intaktem Schnabel – Übersichtsbericht zum aktuellen Stand aus praktisch-wissenschaftlicher Sicht. Züchtungskunde 88:475-493.

Underwood, G.; Andrews, D. and Phung, T. 2021. Advances in genetic selection and breeder practice improve commercial layer hen welfare. Animal Production Science 61:856-866. https://doi.org/10.1071/AN20383

USDA - United States Department of Agriculture. 2000. Egg grading manual. Agricultural handbook, 75. USDA, Washington, DC.

Vasconcelos, M. D. C.; Sousa, L. S.; Lopes, T. S. B.; Gonçalves, L. M.; Souza, A. B.; Avelar, N. M.; Oliveira, J. M. F.; Leme, F. O. P.; Lara, L. J. C. and Araújo, I. C. S. 2024. Impact of increased pre-start diet density on broiler chick behavior, corticosterone levels, and performance responses under cold stress during early life. Journal of Thermal Biology 124:103974. https://doi.org/10.1016/j.jtherbio.2024.103974

Vieira Filho, J. A.; Garcia, E. A.; Oba, E.; Santos, T. A.; Molino, A. B.; Silva, A. P.; Pelícia, K. and Paz, I. C. L. A. 2018. Production indicators and levels of corticosterone in pullets treated with beak-trimming protocols. Brazilian Journal of Poultry Science 20:63-70. https://doi.org/10.1590/1806-9061-2017-0560

Vieira Filho, J. A.; Garcia, E. A.; Oba, E.; Santos, T. A.; Silva, A. P.; Molino, A. B.; Paz, I. C. L. A. and Baldo, G. A. A. 2016. Índice produtivo e qualidade de ovos de galinhas poedeiras submetidas a diferentes métodos de debicagem. Pesquisa Agropecuária Brasileira 51:759-765. https://doi.org/10.1590/S0100-204X2016000600008