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Using Beak Manipulations and Their Effects on Performance, Injury Responses and Some Physiological Traits in Japanese Quails Under Upper Egypt Conditions

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Abstract

The objective of this study was to investigate the impact of beak trimming on egg production, hematological parameters and physiological estimates of quails. Two hundreds and eighty eight quails included 3 groups with 8 replicates, 12 birds each replicate were used. The 1st group was designated as the untrimmed beak (UTB), while the 2nd and 3rd groups were underwent trimming (TB) and cauterization (CB) at one-third of the length of the beak at 15th, then re-trimmed and re-cauterized on the 56th day of life. The results demonstrated that quails in the treated groups exhibited significantly higher egg production and egg mass in comparison to the UTB group. Moreover, the treated groups exhibited reduced feed intake, enhanced feed conversion ratios, and elevated hatchability of fertile eggs relative to the UTB group. The TB group demonstrated the highest fertility rates compared to both the UTB and CB groups. Early embryonic mortality was significantly lower in the TB group, while the CB quails experienced less late embryonic mortality than their UTB group. Moreover, the shell %, yolk %, yolk index and eggshell thickness of eggs in the treated groups significantly affected compared with UTB group. Also, H/L ratio and testosterone hormone level in treated groups were significantly lower in comparison to UTB group. In conclusion, the trimming and cauterization of beaks in Japanese quails considerably reduced injury responses and enhanced their performance.

Keywords: Beak manipulation, egg production, injury responses, quails, physiological estimates

INTRODUCTION

Experts in the poultry industry have indicated that predation has led to significant economic losses and decreased the productivity of quails. Consequently, it became essential to identify solutions to address this issue and mitigate the associated losses. One recommended approach was beak trimming of young birds (Pizzolante et al. 2006). Overall, high-density housing Japanese quail during the breeding season can result in aggressive behaviors such as cannibalism and feather plucking among the birds (Cloutier et al., 2000). The bird's beak is a highly specialized organ with a rich supply of nerves, which can lead to a variety of anatomical, physiological, and biochemical changes in severed peripheral nerves and affected tissues after beak trimming (Kuenzel, 2007). The trimming of beak for several birds is performed as a strategy to reduce peck damage, feather pecking and mortality for laying hens and quails (Pizzolante at al., 2007, Khalil et al., 2015 and Ribe and Hinrichsen, 2017). The process of beak trimming in avian subjects includes the extraction of approximately 25% of the upper beak, or, in some cases, both the upper and lower beaks (Van Liere, 1995 and Glatz, 2004). Conventionally, four primary methods have been employed for beak trimming: mechanical, hot blade, electrical, and infrared techniques. In addition, alternative approaches such as chemical retardation, lasers, and freeze-drying have been explored, but these methods have not been successful use (Glatz, 2004). The practice of beak trimming in diverse avian species is influenced by a multitude of factors, including light intensity, environmental temperature, and the characteristics of the poultry housing, such as flock density and genetic lines (Hughes and Gentle, 1995). Improved flock uniformity, reduced feed waste, and better feathering are observed. The author suggests two beak trimmings during the pullet phase for quails: the first at 12 days, while the second between 30 and 35 days of age (Oliveira, 2002). The termination of beak is regarded as a stressful process that helps decrease cannibalism, feather pecking, egg pecking and broken eggs. However, information on the best trimming method for effective results is limited. Therefore, this study compared the effects of beak termination and cauterization of Japanese quail performance, hatchability, egg quality, and injury responses.

MATERIALS AND METHODS

The present experiment was conducted at the Poultry Farm, Faculty of Agriculture, Assiut University, Assiut, Egypt. Experimental Japanese quails birds were used according to Sohag Institutional Animal Care and Use Committee (Sohag-IACUC approval protocol: 6-13-2-2025-01).

Design of experiment and quail manipulations

Two hundreds and eighty eight Japanese quails, six weeks old, with 254 and 269g for males and females initial body weights, were divided into three groups with eight replicates each (12 birds per replicate) following a sex ratio of 1 male to 2 females. They were housed under standard management and hygiene conditions on littered pens in a rearing house before being moved to smaller pens measuring 57 cm in width, 40 cm in length, and 30 cm in height. The 1st group (UTB) served as untrimmed group. In the 2nd group (TB), the quails were trimmed one-third of beak length by using a LYON beak trimmer, while those in the 3rd group (CB) had their beaks cauterized to the same length. All males and females in treated groups were trimmed or cauterized at 15th days and retreated at 56th days of age. The pen was provided with stainless steel nipple drinker and a plastic trough feeder in the front. The quails were kept in a controlled environment with temperatures ranging from 22 to 28°C and humidity levels between 60 and 65%, receiving 16 hours of continuous light each day. They were provided ad-libitum access to a basal diet composed of 21% crude protein as well as 3050 Kcal ME/kg diet.

Measurements and observations Productive traits

All quails were weighed 8 weeks (beginning) and 24 weeks (end experiment) of age. Daily measurements were taken to weigh and record the eggs, while weekly assessments were made to track feed consumption. Egg mass was determined by multiplying egg number of by their weight. Total feed consumption was divided by egg mass to calculate the feed conversion ratio.

Incubation traits

Fertility and hatchability rates were assessed on a total of 840 quail eggs at two incubation intervals. In the first interval, 420 eggs (comprising 140 eggs from each of three groups) were incubated, followed by another 420 eggs (again, 140 eggs from three groups) during the second interval at 18th and 20th weeks of age. The quail eggs in different groups were collected over a period of 5 days, then kept at 18°C and 65%RH. They were weighed and marked prior to incubation, then subjected to incubator conditions of 37.8ºC and 55-60% RH for the first 14 days. From days 15 to 17 of incubation, then the relative humidity increased to 60-65%. At hatch day, the hatch and dead chicks were counted, where unhatched eggs were poked to categorize them as either infertile eggs or embryonic mortality according to Khalil et al. (2015). By dividing the number of hatched eggs by the total number of set eggs, and then multiplying the result by 100, the hatchability percentage for set eggs was calculated. In contrast, the number of hatched chicks were divided by the total number of fertile eggs was multiplied by 100 to determine the hatchability of fertile eggs (HFE). To determine the percentage of embryonic mortality, the number of dead embryos was divided by the total number of viable eggs at transfer, and the result was multiplied by 100 (Ayaşan, 2013).

Injury responses

An effective and straightforward distance scoring system was utilized to assess feather injury (Lambton et al., 2013). The area of neck, back and tail were scored on a scale of 0 to 4, with 0 meaning good feathering or minimal damage and 4 indicating severe feather damage with multiple bare patches and/or broken skin. In addition, the feathers of wing and tail were scored on a 0 to 4 scale, with 0 representing normal feathers and 4 showing total feather loss or breakage, along with the possibility of bleeding from delicate skin. To evaluate plumage quality, quails were chosen at random. Five quails were counted to the left, and the fifth quail was scored in both the range and slatted litter regions. Two quails were evaluated for cannibalism and vent scores, and ten quails from each area were assessed for plumage quality. The phenomenon of feather pecking was assessed by calculating the percentage of quails presenting with damaged feathers to the total number of quails examined.

Egg quality traits

At 16th weeks old, one hundred and twenty fresh eggs (3 groups × 8 replicates × 5 eggs) were analyzed to assess different quality traits of eggs. Both of length and width of the eggs was measured by using electronic caliper, while the yolk index, shell percentage, shape index, and Haugh unit were calculated (Carter, 1975 and Kul and Seker, 2004):

Shape index (cm) = width of egg / height of egg × 100

Egg yolk index cm = Yolk height/ yolk diameter× 100

Shell (%) = Shell weight/ egg weigh × 100

Haugh Unit =100 log(H+7.57-1.7W 0.37), where w = egg weight, H = thick albumen height.

Hematological variables

At 16 weeks of age, 48 blood samples were randomly collected from the brachial vein into heparinized tubes. The samples were taken from 24 males and 24 females, with each group comprising 16 quails (8 males & 8 females). The smears was employed by Wright stain. Granular and non-granular leukocytes were counted in one hundred microscopic fields and H/L ratio was calculated according to Gross and Siegel (1983). The plasma was collected after centrifugation at 4000r.p.m for 15 minutes and stored at -20°C until analysis. The level of testosterone hormone was determined using testosterone test kit (Biocheck, Inc., 323 Vintage Park Drive, Foster City, CA 94404). After 15 minutes, the absorbance was measured within using micro plate reader (Biotek ELX 808 IU) at

450 nm wavelength. Hemoglobin concentration was determined according to method of Drew et al. (2004).

Statistical analysis

One-way analysis of variance was performed on the data to determine beak trimming effect, employing the Generalized Linear Model procedure outlined in the SAS User's Guide (SAS 2004). Duncan's new multiple range test (Duncan, 1955) was used to determine significant differences between treatments.

RESULTS AND DISCUSSION

Quail performance

The results in Table 1 indicated that the FBW and egg production for manipulated quails were significantly ($p<0.05$) higher compared to the control group, while egg weight was not affected. Additionally, the egg mass for in treated quails was significantly ($p<0.05$) greater than that of the control group. The enhanced egg production observed in the manipulated quails may be due to an improvement in feed utilization, in addition to a reduction in mortality, which is indicative of a more docile behavioral pattern. Furthermore, the augmented quail body weight could be the result of an enhanced feed utilization, which renders the birds incapable of selecting feed ingredients, consequently preventing feed wastage (Pizzolante *et al*., 2007). The present findings are in accordance with those of Kuo et al. (1991), who observed that the egg production and egg mass of birds following beak termination of the upper area at the ½ level at 4 weeks of age demonstrated significant enhancement in comparison with those subjected to beak trimming at the ¼ level of the upper beak and the control group. These findings are inconsistent with those reported by Pizzolante et al. (2007) who observed a reduction in egg production in Japanese quails subjected to severe ½ beak trimming compared to those not subjected to beak trimming, as well as those trimmed to 1/3. The findings showed that the egg mass in the treated quails was significantly ($p<0.05$) heavier than that of the control group. This improvement may be due to improved egg number and feed intake, leads to in a lower feed conversion ratio. In a similar vein, the findings of Pizzolante et al. (2007) indicated that quails subjected to a beak trimming procedure that reduced the length by half exhibited a reduced egg mass compared to both untrimmed quails and those with a third of the beak trimmed. These results indicated a significant reduction in feed intake of the treated quails compared to untreated quails, while the feed conversion ratio demonstrated a significant increase ($P\leq0.05$). The observed changes in feed intake for beak trimmed quails may be to a reduction in the motivation of feed, which may in turn reflect the increasing pain perception in addition to discomfort caused by damage to the tissue and nerves as well as sensory receptors (Gentle, 1995). These results agreed with Blokhuis et al. (1987), who noted that beak trimming enhances feed conversion and reduced feed waste. Additionally, the infrared beak manipulation exhibited a significantly lower feed intake compared to those in the hot blade beak trimming. On the other hand, Leandro et al. (2005) showed that the lowest feed conversion ratio was observed in quails that had undergone trimming and cauterization at ⅓ and ⅔ of the beak compared to the non-trimmed quails. Referring to mortality rate (Figure 1), the results showed that the mortality rate quails in the control group were significantly higher than that of the treated quails. The higher mortality rate seen in the untreated quail might be the consequence of the males' more aggressive behavior, which could lead to cannibalism, increased damage reactions in different regions, and ultimately higher mortality. It's possible that the male quail's greater aggression, which leads to more damage reactions in different locations and cannibalism, is the cause of the higher mortality seen in the untreated birds. These findings are consistent with those of Oliveira (2002), who found that beak-trimmed quail performed better and had lower death rates than those exposed to less-than-ideal beak-trimming methods. In a similar vein, Pizzolante et al. (2007) discovered that quail beak trimming has been demonstrated to enhance performance and lower mortality, particularly at 14 or 21 days of age.

Fertility, hatchability and embryonic mortalities

The results in Table 2 showed that the hatchability of fertile eggs for quails produced from eggs in the TB and CB groups showed a significant ($P<0.05$) decrease compared to those in the UTB group, while the percentages of HSE (%) and piped eggs were unaffected. As evidenced in Table 2, the quail in control group exhibited the highest fertility percentage, while the treated groups demonstrated the lowest. These findings indicated that, in compared with the control however the group, percentages of embryonic mortalities (%) during mid-period and malposition were unaffected, early and late embryonic mortalities of quail embryos produced from treatment groups were considerably influenced. The results in Table 2 demonstrate a notable decline statistically significant ($P\leq0.05$) in the HFE (%) for chick quails in the treated groups compared with those in the UTB group, while the HSE (%) and piped eggs (%) remained unaffected. The trimmed quails group exhibited the highest fertility (%), while the control and cauterizing quails groups demonstrated the lowest percentages. These results in this study agreed with Khalil et al., (2015) they observed enhanced hatchability rates in the de-beaked quails compared with control and straw group. The quails in the control group aggressive behavior may have had a negative effect on the embryos viability by increasing the incidence of cannibalism, which may have contributed to the different embryonic mortalities. (Chang et al., 2009).

Egg quality traits

The trimming of the beak did not result in any statistically significant changes to the egg weight or egg shape index. The mean of yolk index for quails in the untreated quails (control) and trimming quails were significantly higher than that of the cauterizing quails. The Haugh units for treated quails significantly decreased than those produced by quails in the control group. The cauterized quail group exhibited a significantly ($p<0.01$) greater shell thickness compared to the trimming group. These results showed that the highest yolk (%) were recorded 32.54 and 31.81% in the cauterizing and trimming quails, while the lowest yolk (%) was recorded in the control group. The highest albumen (%) was obtained for untreated quails (control group), while the lowest percentage was observed in the cauterizing quails. Compared to the control and trimming groups, the cauterizing group's quail egg shell % was considerably ($p\leq0.01$) greater. These findings are consistent with those of Hassanien and Abdel-Wareth (2012), who found that the trimmed hens' albumen % was lower compared with control group, while the percentages of shell and yolk were significantly greater. The researchers also found that beak trimming had no effect on the Haugh unit. Similar findings were reported by Khalil et al. (2015), who discovered that eggs from the control and de-beaked groups had a high hatchability percentage while eggs from the sand and straw groups had a low fertility percentage.

Feather plumage (injury responses)

The feather scores of quail body regions are presented in Tables 4&5. The results showed a significant (p<0.001) difference in the feather score of the head, back, neck, tail, wing and leg between the different groups. Generally, the frequency of male copulation behavior, aggressive behavior among males, and forceful copulations with non-receptive females are some of the elements that generally contribute to the damage reactions (Stephanie et al., 2011 and Yamauchi et al., 2017). These behaviors were observed to be less prevalent in the manipulated quails compared to the un-manipulated quails. These results are similar to those of Bilcik and Keeling (1999), who found that birds that peck more often have feathers or body parts that are easier to touch, like the tail and back. Furthermore, Shinmura et al., (2006) found a substantial rise (p<0.05) in the overall feather score at various body regions in birds kept in furnished cages between 25 and 29 weeks of age (beak trimming). However, the increases in the neck and breasts well as tail feather scores were smaller in birds housed in furnished cages.

Hematological variables

Comparing the treatment and control groups, the hemoglobin concentration, white blood cell (WBC), and lymphocyte cell count in female quails were considerably (P<0.05) greater. The findings demonstrated that the WBC for treated quails was considerably higher than that of the untreated group, indicating the effect of beak manipulation on the hematological variables of male quails. The findings demonstrated that the alteration of the beak had no effect on the quails' mean hemoglobin and red blood cell counts. The treated quails, the H/L ratio, however, was considerably (P<0.05) lower than the control group. Generally, hemoglobin and red blood cell counts were generally unaffected by quail beak modification. The higher percentage of lymphocytes in female quails might suggest a stronger immunological response, whereas higher levels of heterophils might reflect the negative effects of beak trimming (Abdelfattah, 2018). As is well known, the H/L ratio in quails has been used as a gauge for assessing various stresses in birds (Mahmoud et al., 2013). The higher WBCs count, heterophil percentage and H/L ratio would suggest that aggressive conduct has a negative effect on lymphoid organ weights, which were markedly reduced in quails under the stressors of crowding and aggression. This might also be because less feed is being consumed, which reduces the amount of nutrients available for organ growth (Bartlett and Smith, 2003).

Testosterone hormone level

Concerning the impact of beak alterations on quail testosterone hormone levels (Figure 2). Comparing the birds in the treated quails to those in the untreated quails, the results showed a substantial drop in testosterone hormone concentrations. The decrease in aggressive behavior, especially between males and females, may be the cause of the testosterone hormone reduction seen in the treated quails (Hau et al., 2004). Consequently, feed consumption may improve, which would increase egg mass and output. These results corroborate those of Wingfield et al. (1990), who found that male quail testosterone levels, which peak during the breeding season, had a significant impact on Japanese quail behavior.

Table 1. Effect of beak manipulation on the egg production, feed intake and feed conversion ratio of Japanese quails

Groups	IBW (g)	FBW (g)	EN (no.)	TEN (no.)	EP (%)	EW (g)	EM (g egg/hen)	DFI (g/d)	FCR(g feed/g egg)
1st (UTB)	269.97	259.69[b]	4.16[b]	16.63[b]	67.77[b]	12.15	8.25[b]	37.35[a]	3.09[a]
2nd (TB)	269.88	280.77[a]	5.20[a]	20.80[a]	74.71[a]	12.32	9.21[a]	32.20[b]	2.62[b]
3rd (CB)	269.97	271.96[a]	5.42[a]	21.69[a]	74.34[a]	12.22	9.08[a]	31.01[b]	2.55[b]
SEM	3.52	3.38	0.27	0.94	1.91	0.06	0.24	0.83	0.06
P-Value	0.9998	0.0002	0.0119	0.0023	0.0298	0.2329	0.0232	0.0001	0.0001

[A, b] Means followed by different lowercase letters in the same row are significantly different (P≤0.05). SEM= standard error of the mean. UTB=Un-trimming beak group, TB= trimming beak, CB= cauterizing beak, IBW= Initial body weight, FBW= Final body weight, EN= Egg number, TEN= Total egg number, EP=Egg production, EW= Egg weight, EM= Egg mass (g egg/hen), DFI= Daily feed intake (g/bird/day), FCR= Feed conversion ratio (g feed/g egg)

Table 2. Effect of beak manipulation on the fertility, hatchability and embryonic mortality of Japanese quails

Groups	HSE (%)	HFE (%)	Fertility (%)	Piped egg (%)	Embryonic mortality (%)		
					EEM (%)	MEM (%)	LEM (%)
1st (UTB)	71.49	63.87[a]	83.69[b]	2.58	10.22[a]	3.99	16.91[ab]
2nd (TB)	67.86	57.70[b]	89.31[a]	2.99	7.02[b]	3.15	19.91[a]
3rd (CB)	67.61	56.27[b]	84.97[b]	1.53	9.59[ab]	2.86	14.09[b]
SEM	1.52	1.32	1.16	0.63	1.23	0.74	1.15
P-Value	0.3446	0.0219	0.0474	0.3769	0.0444	0.2594	0.0042

[A, b] Means followed by different lowercase letters in the same row are significantly different (P≤0.05). SEM= standard error of the mean. HSE= Hatchability of set eggs (%), HFE= Hatchability of fertile eggs (%), EEM (%)= Early embryonic mortality (0-7d), MEM (%)=Mid embryonic mortality (7-14d), LEM (%)= Late embryonic mortality (14-18d).

Table 3. Effect of beak manipulation on egg quality traits of Japanese quails

Groups	EW (g)	ESI (%)	EYI	Haugh units	SHT (mm)	Yolk (%)	Albumen (%)	Shell (%)
1st (UTB)	12.32	79.72	47.14[a]	91.98[a]	22.38[ab]	31.52[b]	59.51[a]	8.97[b]
2nd (TB)	12.42	77.99	47.34[a]	89.26[b]	22.08[b]	31.81[ab]	59.34[a]	8.85[b]
3rd (CB)	12.82	79.02	43.34[b]	88.00[b]	22.93[a]	32.54[a]	58.16[b]	9.29[a]
SEM	0.17	1.29	0.62	0.59	0.27	0.27	0.29	0.10
P-Value	0.1014	0.6378	0.0001	0.0001	0.0531	0.0265	0.0027	0.0094

[A, b] Means followed by different lowercase letters in the same row are significantly different (P≤0.05). SEM= standard error of the mean. EW= Egg weight, ESI= Egg shape index, EYI (%) = Egg yolk index (%), SHT= Shell thickness (mm),

Table 4. Effect of beak manipulation on injury responses of male Japanese quails

Groups	Head	Neck	Back	Wing	Tail	Leg
1st (UTB)	2.41[a]	2.22[a]	2.52[a]	2.41[a]	2.15[a]	1.48[a]
2nd (TB)	1.75[b]	1.66[b]	1.59[b]	1.41[b]	1.16[b]	1.09[b]
3rd (CB)	1.48[b]	1.13[c]	1.42[b]	1.29[b]	1.39[b]	1.06[b]
SEM	0.155	0.11	0.12	0.12	0.11	1.13
P-Value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

[A, b] Means followed by different lowercase letters in the same row are significantly different (P≤0.05). SEM= standard error of the mean.

Table 5. Effect of beak manipulation on injury responses of female Japanese quails

Groups	Head	Neck	Back	Wing	Tail	Leg
1st (UTB)	2.21[a]	2.04[a]	2.85[a]	2.10[a]	2.21[a]	2.31[a]
2nd (TB)	1.35[b]	1.38[b]	1.97[b]	1.35[b]	1.23[b]	1.30[b]
3rd (CB)	1.43[b]	1.26[c]	1.72[b]	1.22[b]	1.16[b]	1.24[b]
SEM	0.09	0.09	0.09	0.08	0.08	1.12
P-Value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

[A, b] Means followed by different lowercase letters in the same row are significantly different ($P \leq 0.05$). SEM= standard error of the mean.

Table 6. Effect of beak manipulation on hematological variables of Japanese quails

Groups	Male				Female			
	RBC ($\times 10^6/\mu L$)	WBC ($\times 10^3/\mu L$)	Hb (g/dL)	H/L ratio	RBC ($\times 10^6/\mu L$)	WBC ($\times 10^3/\mu L$)	Hb (g/dL)	H/L ratio
1st (UTB)	3.32	18.00[b]	12.50	0.39[a]	3.10	17.25[b]	11.75[b]	0.41[a]
2nd (TB)	3.74	23.25[a]	15.50	0.27[b]	3.55	23.25[a]	14.75[a]	0.30[b]
3rd (CB)	3.65	20.25[ab]	13.25	0.29[b]	3.31	22.50[a]	14.00[ab]	0.30[b]
SEM	0.157	1.316	1.203	0.020	0.257	1.373	0.798	0.016
P-Value	0.1667	0.0336	0.2102	0.0054	0.4732	0.0108	0.0383	0.0001

[A, b] Means followed by different lowercased letters in the same row are significantly different ($P \leq 0.05$). SEM= standard error of mean. UTB=Un-trimming beak group, TB= trimming beak, CB= cauterizing beak, HB= Hemoglobin.

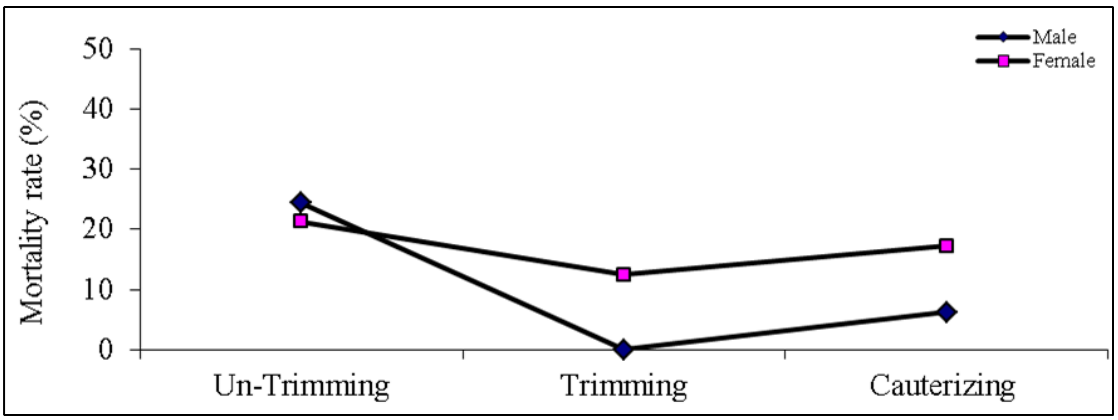

Figure 1. Impact of beak manipulation on mortality rate of male and female Japanese quails

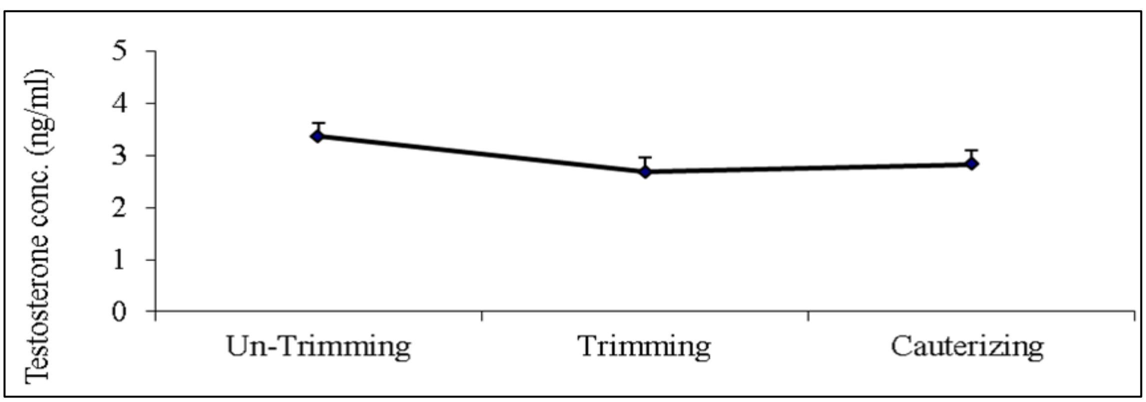

Figure 2 Impact of beak manipulation on testosterone hormone concentration of male Japanese quails

CONCLUSION

Given the above results, it can be assumed that the performance and physiological assessments of quails are positively impacted by the use of trimming and cauterizing methods at the one-third point of the beak's length. This is accomplished by lowering testosterone hormone levels, which lessens feather picking and aggressive behavior. Additionally, it has been shown that quail beak trimming and cauterizing significantly improve feed utilization, which lowers feed waste.

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