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Pumice as an instrument for beak blunting in quail

Einsatz von Bimsstein zum Entschärfen des Schnabels bei Wachteln

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Introduction

For domesticated animals, when compared to wild ones, factors such as crowded living conditions and a monotonous environment may result in the excess stimulation of social interaction between them, leading to problems such as aggression, pecking and cannibalism (FRANÇOIS et al., 1998). Therefore, pecking can be associated with the accumulated effect of stress factors (DEFRA, 2005). In other words, pecking is a farming and welfare problem that causes suffering among animals (GENTLE and HUNTER, 1990; PETEK and MCKINSTRY, 2010). Severe pecking can create bare areas on the body and if the pecking of these areas continues, injuries and eventually cannibalism may develop, leading to high death rates in the flock (KEELING and WILHELMSON, 1997; KOPS et al., 2013). To minimise injuries, pain and stress related to aggression and pecking among birds, beak trimming has become standard practice in the egg industry (DENNIS and CHENG, 2012); however, beak trimming can cause acute and chronic pain. What is more, when this operation is performed haphazardly, by inexperienced people, or using the wrong or inadequate tools, it may result in the development of neuromas.

Beak trimming, which is performed to minimise injuries and deaths due to pecking, refers to the trimming of the half, one third, or one quarter of the beak. Either only the upper beak or both upper and lower beaks may be trimmed. Beak trimming is performed in many bird species, including chickens, turkeys, ducks and quail. Potential downsides include trauma during trimming, pain due to tissue and nerve damage after trimming, and loss of integrity of a living animal (CIVF, 2011). Selecting birds that are less inclined to pecking and subsequent cannibalistic behaviour, and improving the living conditions of the birds can minimise these problems. A study aimed at finding alternatives to beak trimming showed that the use of abrasive materials in the feeder was effective in shortening chickens' beaks and the method used did not affect behavioural and production parameters (ADAS, 2005). In addition, enriching the environment at an early stage can be effective in minimising pecking behaviour in the future (CHOW and HOGAN, 2005; TASKIN and KARADAVUT, 2016). To minimise cannibalism and its consequences for quail, it is recommended that beak trimming be performed on day 14 or 21, by trimming 1/3 of the beak (PIZZOLANTE et al., 2006; PIZZOLANTE et al., 2007; LAGANÁ et al., 2011). Mechanical, hot blade, electrical and infrared trimming are among the most commonly used methods for beak trimming. Although it varies according to the method used, in addition to acute pain, beak trimming is usually followed by a decrease in feed consumption and in growth (MARCHANT-FORDE et al., 2008 HONAKER and RUSZLER, 2004; KUENZEL, 2007; MARCHANT-FORDE et al., 2008). But now, in many places, beak trimming is entirely prohibited (VAN HORNE and ACHTERBOSCH, 2008). Sweden, Norway and Denmark have discontinued the practice of beak trimming. In Germany, Britain, and the Netherlands, there are ongoing public debates about the banning of such practices (SEPEUR et al., 2015).

Although it is difficult to completely eliminate pecking as it arises from multiple factors (DIXON, 2008), the use of non-surgical instruments instead of beak trimming would help prevent the negative welfare and economic effects of pecking (NORDQUIST et al.) 2011). Measures to prevent pecking include lowering the number of birds per cage, decreasing the intensity of light, and increasing the amount of cellulose and grit in the feed (RANDALL and BOLLA, 2008). In addition, it is reported that the quality of the farming environment affects animal behaviour (WOODCOCK and RICHARDSON, 2000). Animals kept in enriched environments tend to display more complex behaviour, less fear and fewer abnormal behaviours when compared to animals kept in monotonous environments (RENNER and ROSENZWEIG, 1987). Moreover, studies show that use of enrichment objects in cages improves animal welfare (TASKIN and KARADAVUT, 2016).

Pumice, which is a volcanic rock with various uses in different areas since ancient times, is abundant in Turkey, easy to transport and sterile (Sekeroglu and Sarica, 2011; Elmastas, 2012). Turkey and Italy lead the world in pumice and pumicite production (USGS, 2015). Turkey has about 40% of the world's pumice reserves, which totals about 18 billion m^3 (Yorukoglu and Ulusoy, 2014). The high SiO_2 content of pumice gives the rock an abrasive quality. Pumice has a Mohs hardness scale of 5–6 (Heibati et al., 2015). There are studies on the use of pumice as bedding material and feed additive (Sekeroglu and Sarica, 2011), but no study has been conducted on the use of pumice as a cage enriching and beak abrasion object. Therefore, this study examined the feasibility of using pumice for the purpose of beak abrasion and environmental enrichment.

Material and methods

Animals and housing

The experiment was conducted at the Poultry Unit of Agricultural Faculty, Ahi Evran University, following the approval of the Animal Experiments Local Ethics Committee (Official form date and number: 11.12.2015 and 4.9.2015). Six hundred one-day old female and male quail (*Coturnix coturnix japonica*) chicks with an initial average live weight of 9.19 ± 0.21 were used as subjects. The study was conducted using a factorial experimental design (2 plumage colours and 2 pumice applications, – and +) with randomised blocks. One factor was the plumage colour of the chicks, and the second factor was the presence or absence of pumice in the cages. The chicks were first divided into two groups on the basis of their plumage colour (L: 300 birds with light-coloured feathers, D: 300 birds with dark-coloured feathers), and then each colour group was randomly divided into two sub-groups, one of which was kept in cages containing pumice (n = 150) and the other in cages without pumice (n = 150), for 6 weeks. Each of these groups was further divided into 6 repetition groups consisting of 25 quail kept in the same compartment. Chicks were kept in three cages, each with 4 levels, and each level contained two compartments. These compartments had the dimensions of 50x50x35 cm. At the end of the study, live weights, beak lengths, beak widths, feather scores and cannibalistic injuries of the quail were measured. Chicks were kept in a poultry room maintained at 35°C on day 1 and reduced by 1°C per day until 22°C with 24 h illumination.

Throughout in the study (6 weeks), chicks were fed on a corn and soy based diet. Per kg diet included 230 g crude protein, 13.4 MJ ME, 5 g methionine and 12 g lysine. Feed and fresh water were provided for *ad libitum* intake. The initial live weights of the chicks were measured using an electronic scale with a sensitivity of 0.01 g. Sex identification of the quail was made after the third week on the basis of the colour of their breast feathers. In replicates, nearly the same number of males (12–13 males and 12–13 females) was present in the same cage. Feed and water were provided using plastic cups in the first two weeks, inside the cage divisions, and then using feeders and nipple drinkers.

Pumice treatment

At the end of two weeks, after removing these cups, white pumice stones (with dimensions of 5x10x2 cm) were placed in the cage compartments (L: 6 compartments, D: 6 compartments) of the treatment groups, fixed by ropes attached to the middle sections of the ceiling and the floor.

Measuring the feather and skin scores

Each bird was examined for feather loss and skin lesions. Feather and skin scores to assess cannibalism were adapted from the scoring method used by Bilcik and Keeling (1999). The quail were assessed after removing them from the cages one by one. Feather scoring was made by examining various regions as head, nape, throat, back, rump, belly, breast, wing primaries and wing coverts. A score of 5 indicated the worst condition, and a score of 0 indicated the best condition. The body index refers to the total score for each subject. Injuries on the skin were scored using a scale from 0 to 4, with 4 representing the worst and 0 representing the best condition. Both scores were applied only to live animals. The number of animals that died throughout the experiment was recorded. If the probable cause of death was cannibalism, this was also recorded. In all groups, the number of cannibalistic injuries and feather loss in different body regions were recorded. Birds that sustained serious injuries due to cannibalism were immediately removed from the group. Cannibalistic injuries were defined as bleeding injuries, as a result of pecking by other birds.

Measuring the beak and live weight

At the end of the experiment, the beak lengths and beak widths of the animals were measured using a digital calliper. Live weights were measured using a sensitive digital scale.

Statistical analyses

Prior to analysing data for continuous variables, the Kolmogorov-Smirnov test was used to see whether the assumption of normality was met, and Levene's test was used to see whether the assumption of homogeneity of variance was met. Normality assumption usually works for sample sizes over 30, and data for these variables were collected from a larger sample size in this study, meaning this assumption was also met. T-tests were used to examine differences between the control and treatment groups in terms of continuous variables such as live weight, beak length and beak width. To identify interaction effects, analysis of variance was used for a factorial experimental design with randomised blocks. Significance levels of $P<0.05$ and $P<0.01$ were used to test differences. To analyse categorical variables, the non-parametric Chi square test was used. Unlike continuous variables, categorical variables do not require making strict assumptions, and analyses to test the assumption of normality were not conducted. In addition, correlation analysis was conducted to examine the relationships between variables, and the direction and size of the relationships were analysed. For data analysis, the SPSS 21.0 software package was used (Ozdamar, 2013).

Results and discussion

Live weight

Effect of pumice + and pumice – on live weight of quail in cages is presented Table 1. In the L groups, the difference between the live weights of treatment (P+) and control (P-) groups was found to be significant ($P<0.05$) for females, but no significant differences were found in comparisons involving only males or entire flocks. Differences in the D groups paralleled those observed for the L groups. Significant differences were found in comparisons involving only females, but not in comparisons involving only males or entire flocks. The difference observed in comparisons involving females indicated that the treatment had a significant effect on females. There is no study directly comparable to the present one, but in a study where pumice was added to broiler rations between weeks 2 and 7, to make up 2–4% of the feed, treatment group animals were found to have higher live weight and lower mortality compared to control group animals (Chanahan et al., 2003). Conversely, the intervention did not have a significant effect on males. In comparisons among control groups and among treatment groups, no differences were found, either in single-sex comparisons or comparisons involving entire flocks. This indicates that the assignment of birds to control groups was successful. Lack of differences in comparisons among the treatment groups indicates that the treatment had a similar effect on males and females. The tables show that in both genotypes, groups that had pumice had higher live weights compared to the controls groups that did not have pumice in their cages. Laganá et al. (2011) observed that quail whose beaks were trimmed using cauterisation had lower live weight in the first period following trimming. A cauterised beak caused not only pain-related stress, but also decreased feed consumption, lowered weight gain resulted in higher levels of mortality. In the present study, however, the use of pumice for beak blunting did not have a negative effect on live weight.

Table 1. Effect of pumice on live weight of quail in cages (mean ± sd).

Einfluss von Bimsstein auf die Lebendmasse von Wachteln mit unterschiedlicher Gefiederfarbe (Mittelwerte ± SD)

Live weight (g)	Light feather				Dark feather				Probability		
	n	Pumice -	n	Pumice +	n	Pumice -	n	Pumice +	Colour	Pumice	Colour* Pumice
Female	76	170 ± 1.11ab	73	174 ± 4.87bc	77	169 ± 1.37a	74	174 ± 1.49c	0.016**	0.084	0.052
Male	74	162 ± 1.25	77	162 ± 1.29	73	162 ± 1.47	76	160 ± 1.49	0.088	0.190	0.097
Female+male	150	168 ± 2.12	150	164 ± 1.98	150	167 ± 1.46	150	165 ± 1.72	0.059	0.140	0.091

Different letters marked denote significant differences in treatments. **: ($P< 0.01$).
Pumice -n: control without pumice; Pumice +: treatment with pumice.

Beak width

In terms of beak width (Figure 1 a), in the L group, no difference was found between females, but significant differences were found in comparisons involving only males and entire flocks ($P<0.05$). In the D group, differences in the comparisons involving only females and entire flocks were not found to be significant ($P<0.05$), but the difference in the comparison involving only males was significant ($P<0.05$). This shows that in both treatment groups, the males' response to pumice was stronger, and their beak width decreased. Some decrease in beak width was in fact observed in all groups, but the decrease was statistically significant only in some groups. The relationship between beak width and live weight was strong and negative in females ($r = -0.426^{**}$), but weak and insignificant in males ($r = 0.152^{NS}$). This indicates that beak width in females is related to live weight. In comparisons of beak width among the control groups, no significant differences were found in comparisons involving single-sex groups or entire flocks; however, in comparisons among the treatment groups, differences in all comparisons were significant ($P<0.05$). The treatment affected the two groups differently, with its effect on the D group being larger than the effect on the L group.

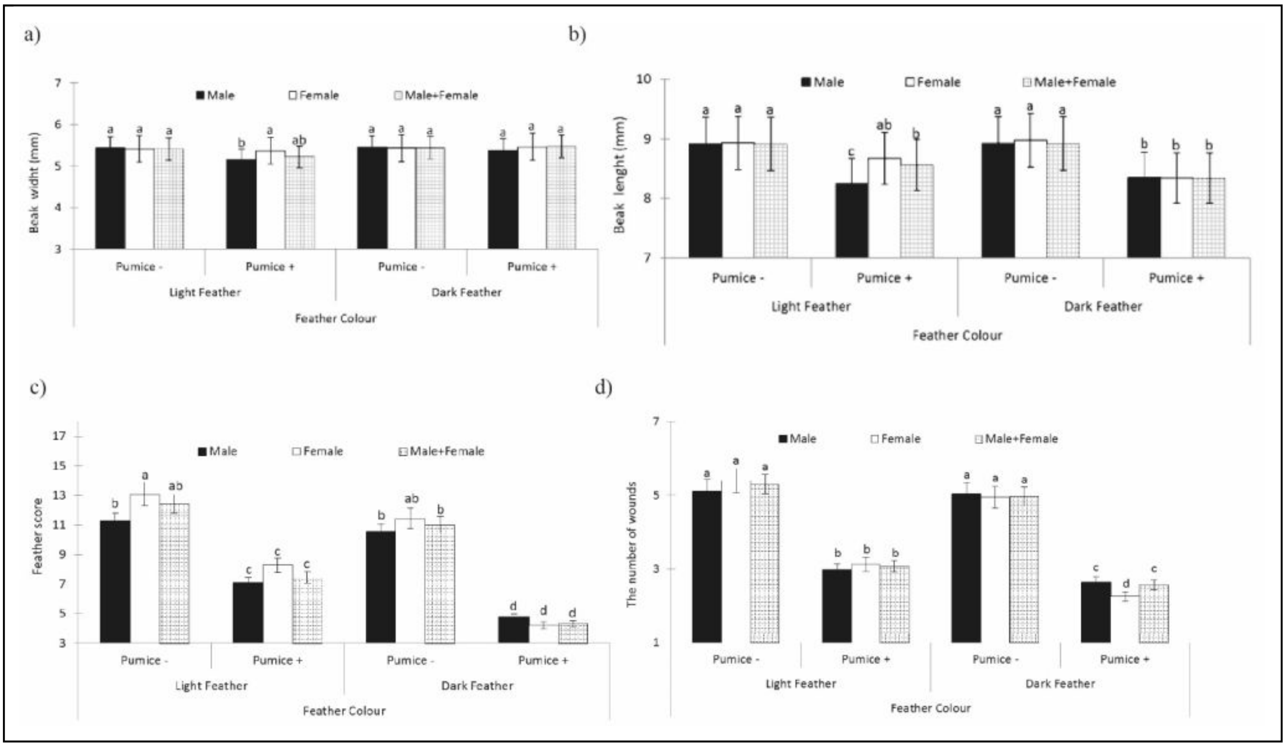

Figure 1. Beak width (a), beak length (b), feather score (c) and number of wounds (d) of female, male and female + male quail of two plumage colour lines kept in cages equipped with (P+) or without (P-) pumice (mean ± SD). Means with no common superscript letter differ significantly (*P*<0.05).

Schnabelbreite (a), Schnabellänge (b), Gefiedernote (c) und Anzahl Verletzungen (d) der männlichen, weiblichen sowie männlichen + weiblichen Wachteln zweier Farbschläge, die in Käfigen mit (P+) und ohne (P-) Bimsstein gehalten wurden (Mittelwerte ± SD). Mittelwerte mit unterschiedlichen lateinischen Buchstaben sind signifikant verschieden (P < 0,05)

Beak length

In terms of beak length (Figure 1 b), significant differences were found in the L group, both in single-sex comparisons and comparisons of entire flocks ($P<0.05$). Pumice was found to have a significant effect on the treatment group (P+) compared to the control group (P-), both among males, females and entire flocks. Similarly, differences in the D group were also significant ($P<0.05$), indicating that pumice treatment shortened beak lengths overall. In comparisons among control groups and among treatment groups, no differences were found.

This indicates that the effect of pumice in terms of shortening beak length was uniform in both groups. The relationship between beak length and live weight was found to be insignificant ($r = 0.131$). Taken together, these findings show that pumice treatment was the factor that shortened beak length.

Feather loss

In terms of feather loss (Figure 1 c), the difference between LP- and LP+, as well as the difference between DP- and DP+, was found to be significant ($P<0.05$). In both the females, males and entire flocks feather loss decreased significantly. This indicates that the change in the beaks of the animals following the pumice treatment prevents them from hurting each other, resulting in decreased feather loss (North and Bell, 1990; Sengul et al., 2015). Differences in the comparisons among the control groups were insignificant, indicating that the groups had very similar characteristics. The difference between LP+ and DP+ was significant, indicating that quail with different feather colours were affected by the pumice treatment differently. More specifically, the effect on the D groups was larger than the effect on the L group. There were significant and positive relationships between feather loss and live weight (r = 0.448**), and between feather loss and beak length (r = 0.388**). This is consistent with the finding that beak length and feather loss are positively related (Hartcher et al., 2015). In each replicate, nearly the same number of males were housed in the same cage, that is why the effect of mating on plumage was eliminated.

Injuries

Findings on injuries (Figure 1 d) were similar to the findings on feather loss. Differences in all comparisons involving LP- and LP+ were found to be significant ($P<0.01$). Similarly, differences between DP- and DP+ were also significant. In both L group ad D group quail, injuries in P+ treatment groups were significantly lower compared to control groups. This shows that pumice treatment has decreased injuries significantly. This effect is probably mediated via the effect of pumice on beak length, as a negative and significant relationship was detected between beak length and injuries (r = –0.483**). That is to say, shorter beak lengths are associated with fewer injuries. A similar, significant effect was also found between beak width and injuries. While comparisons involving the LP- and DP- control groups showed negligible differences, the differences among the LP+ and DP+ groups were significant. This shows that the effect of pumice on the DP+ group was larger than its effect on the LP+ group, with dark feathered quail having fewer injuries.

In quail faming, as with other poultry animals, aggressive pecking and injuries constitute an important welfare issue. Aggressive pecking among quail gives rise to problems, such as injuries, cannibalism, mortality and economic losses (Wechsler and Schmid, 1998). Results of the present study have shown that there were many injuries, especially in the control groups. However, pumice treatment was observed to result in fewer injuries in both colour types. This difference between the groups was found to be statistically very significant ($P<0.01$). These findings indicate that using pumice would decrease injuries and improve welfare among both colour types.

Conclusion

Overall, the findings of this study show that using pumice for long-term beak blunting is a viable alternative to beak trimming, which is a source of stress in animals. Groups kept in cages with pumice had shorter beak length, smaller beak width, less feather loss and fewer injuries, demonstrating the effectiveness of the method. These results show that use of pumice for beak abrasion improves animal welfare and results in an increase in the live weight of female quail.

Summary

This study was conducted to examine the effects of using pumice as a beak abrasion object for quail of different plumage colours. Six hundred one-day old female and male chicks with an initial average live weight of 9.19 ± 0.21 were used as the experimental subjects. The chicks were first divided into two groups on the basis of plumage colour (300 light-coloured (L) chicks and 300 dark-coloured (D) chicks), and then each colour group was randomly divided into two sub-groups, one of which was kept in cages containing pumice (P+) and the other in cages without pumice (P-), for a total of 6 weeks.

Results showed that, in terms of data on both sexes combined, pumice did not affect the live weight of quail. However, female quail in the LP+ and DP+ groups were found to have higher live weights compared to females in the LP- and DP- groups, and these differences were large and statistically significant ($P<0.01$). Beak lengths were also found to be significantly shorter in all P+ groups ($P<0.01$). This indicates that pumice had the effect of reducing the length of the beaks. In comparisons involving whole flocks (both sexes), beak width was found to be reduced in the LP+ group ($P<0.01$). It also was also reduced among the males of the LP+ and DP+ groups ($P<0.01$), but no difference was detected in the female groups. Feather pecking scores and cannibalistic injuries were lower in all P+ groups ($P<0.01$). These results indicate that the use of pumice for beak blunting lowers feather loss due to pecking and cannibalistic injuries and improves animal welfare.

Key words

Quail, behaviour, feather pecking, animal welfare, pumice, blunting

Zusammenfassung

Einsatz von Bimsstein zum Entschärfen des Schnabels bei Wachteln

Das Ziel der Studie war die Untersuchung der Eignung von Bimsstein zum Schnabelabrieb bei Wachteln. Hierzu wurden insgesamt 600 männliche und weibliche Eintagsküken mit einem durchschnittlichen Lebendgewicht von 9,19 ± 0,21 g verwendet, die von Wachtellinien mit unterschiedlicher Gefiederfarbe (300 hell (L), 300 dunkel (D)) stammten. Die Tiere jeder Linie wurden zufällig auf zwei Behandlungsgruppen verteilt: ohne Bimsstein (P-), mit Bimsstein (P+). Die Haltung war in Käfigen, die Versuchsdauer betrug 6 Wochen.

Das Anbieten des Bimssteins hat sich nicht auf das Lebendgewicht der Tiere ausgewirkt. Allerdings waren die Hennen der Behandlungen LP+ und DP+ deutlich schwerer als die Hennen der Behandlungen LP- und DP- ($P<0,01$). Die Schnäbel in den Gruppen mit Bimsstein waren kürzer als in den Gruppen ohne ($P<0,01$). Das deutet darauf hin, dass Bimsstein zu einem Schnabelabrieb führt. Die Wachteln der Gruppe LP+ hatten signifikant schmälere Schnäbel ($P<0,01$). Die Schnäbel der Hähne der Behandlungen LP+ und DP+ hatten ebenfalls schmälere Schnäbel ($P<0,01$), während dies bei den Hennen nicht der Fall war. In den Behandlungen mit Bimsstein wurden signifikant weniger Federpicken und Kannibalismus bedingte Verletzungen beobachtet ($P<0,01$). Dies deutet darauf hin, dass die Verwendung von Bimsstein zum Schnabelabrieb den Federverlust, bedingt durch Federpicken und Kannibalismus, vermindert und so das Tierwohl erhöht.

Stichworte

Wachtel, Verhalten, Federpicken, Tierschutz, Bimsstein, Blunting

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