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Environmental Enrichment Strategies and their Effects on Welfare Parameters in Japanese Quail (*Coturnix coturnix japonica*)

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ABSTRACT: Japanese quail (*Coturnix coturnix japonica*) are commonly reared in barren housing systems that may increase stress, aggression, injuries, and mortality, thereby compromising welfare and productivity. Although environmental enrichment has improved welfare in other poultry species, information on effective enrichment strategies for Japanese quail remains limited. This study evaluated the effects of environmental enrichment on welfare-related parameters in Japanese quail at 24 weeks of age. A total of 160 quail were randomly assigned to four groups: control (no enrichment), sand bath (T1), wooden perches (T2), and sand bath plus perches (T3). Feather condition and body condition parameters (wound score, bumble foot, footpad lesions, and claw length) were assessed. Overall feather score differed significantly (P<0.05), with sand-bath birds showing the highest scores, indicating improved plumage condition. Feather scores for individual body regions and body condition traits did not differ significantly among treatments, although more wounds were observed in control and perch-only groups. The results indicate that sand bath enrichment improves feather condition in Japanese quail and can be recommended as a practical welfare-enhancing strategy in quail production systems.

Keywords: Japanese quail, environment, production, scores.

INTRODUCTION

Poultry farming occupies a pivotal position among livestock-based vocations due to its enormous potential for rapid economic growth, particularly benefiting weaker sections of society. Over the past few decades, the poultry sector has transformed from a backyard venture into a dynamic agro-industry. Globally, approximately 20 wild and 70 domestic quail strains have been reported (Chang *et al.*, 2005), among which Japanese quail (*Coturnix coturnix japonica*) is the most popular due to its high efficiency in egg and meat production (Chang *et al.*, 2005; Lukanov, 2019). Quail production serves as an important supplement to chicken and duck production, meeting the increasing demand for poultry products. Quail eggs contribute about 10% of the global table egg market (Lukanov, 2019). In India, quail population constitutes about 0.91% of the total poultry population, while the poultry sector contributes 0.57% to the national GDP and approximately 16% to the livestock GDP, with a poultry population of 851.81 million showing a growth of 16.80% compared to the previous livestock census (Basic Animal Husbandry Statistics, 2019).

The ability of animals to express their natural behavioural repertoire is now widely recognized as a key component of animal welfare. When the housing environment fails to meet these behavioural requirements, poultry may develop behavioural and physical welfare issues (Bracke and Hopster 2006; Buller *et al.*, 2020; Dawkins, 2023). Environmental

enrichment (EE) involves modifying the birds' environment to promote natural behaviours, reduce stress, and improve overall welfare (Newberry, 1995; Laurence *et al.*, 2015). In poultry, feather condition and body condition are widely recognized as key indicators of welfare, reflecting health status, housing adequacy, and the ability to express natural behaviours (Broom, 1986). Feather scoring assesses plumage integrity, which may be affected by stress, feather pecking, and aggression, whereas body condition parameters such as wounds, footpad lesions, and claw length provide insight into housing design, bird activity, and social interactions. Poor feather or body condition not only indicates compromised welfare but also negatively affects thermoregulation, feed efficiency, and productivity.

Structural enrichments such as perches and dust-bathing substrates have been shown to encourage natural behaviours, reduce stress, and improve physical condition in poultry (Appleby, 1998; Olsson and Keeling 2005). Environmental enrichment reduces feather pecking, aggression, and fear-related behaviours, thereby enhancing feather and body integrity and overall performance (Jones, 2002; Dixon *et al*., 2010; Hartcher *et al*., 2015). Perching is an innate behaviour that, when supported by proper perch design, minimizes footpad and leg problems, while dust bathing maintains feather quality, regulates lipid levels, and controls ectoparasites (Shields *et al*., 2005). In Japanese quail, environmental enrichment has been reported to alleviate stress, improve behavioural welfare, and promote better physical condition (Laurence *et al.*, 2015).

Although environmental enrichment has been widely studied in chickens and other poultry species, limited information is available regarding its effects on Japanese quail under intensive rearing systems. Most previous studies have focused on production performance and egg quality, with comparatively fewer investigations addressing behavioural welfare indicators, physiological stress markers, immune responses, and health-related parameters simultaneously. Moreover, comparative evaluations of different enrichment materials under controlled experimental conditions are scarce. Therefore, there is a need for comprehensive studies assessing the integrated impact of environmental enrichment strategies on behavioural, physiological, and health welfare parameters in Japanese quail. Assessing feather and body condition scores provides a practical and reliable approach to evaluate the effectiveness of enrichment interventions. Therefore, the present study was undertaken to investigate the effects of perches and sand baths on feather and body condition parameters in Japanese quail, with the aim of developing management strategies to enhance quail health, productivity, and overall well-being.

MATERIAL AND METHOD

Entire length of the experiment was 19 weeks. In this experiment five-week-old 160 female grower Japanese quail were purchased and reared for subsequent enrichment trial .The four groups, which comprised of four replicates and 10 quails in each. Groups were named as Control, T_1, T_2 and T_3. T_1 group (sand enriched) birds in this group were provided with plastic circular tubs featuring an open surface area of 2826 cm² and a depth of 16 cm. The tubs were filled with premium play sand (sharp sand) to a depth of 12 cm. To ensure an adequate amount of sand for dust bathing, the sand was replenished daily, T_2 group (wooden perch enriched), this group was supplied with mobile, inverted "U"-shaped wooden perches. Each perch had a ground clearance of 30 cm and measured 80 cm in length. Wooden sticks with dimensions of 80 × 2 × 2 cm (length × width × height) were used for the construction, T_3 group (combination of sand dust and wooden perch), birds in this group had access to both sand dust and wooden perches for enrichment and control group.

The experiment commenced after a seven-day acclimatization period during which the birds were allowed to adapt to their new environment. All the Japanese quail birds were reared under similar managerial and hygienic conditions in a deep litter system of rearing with well-ventilated pens. The floor was thoroughly cleaned, disinfected, and dried before spreading the dry rice husk as bedding material. The rice husk was evenly spread in 6-8 cm thickness. Florescent tube lights (38 watts each) were fitted at appropriate heights to provide uniform lighting. A photo-scheduled program (16 hours light and 8 hours dark) was used throughout the experiment.

The Japanese quails in the various treatment groups were given free access to fresh and clean water. Basal diets were offered ad libitum, twice daily. Japanese quails were fed on a basal commercial diet from the start of the experiment until the end based on the requirements of Japanese quails outlined in NRC (1994).

At the age of 24 weeks, 20 Japanese quails were randomly selected from each treatment and examined for feather and body scores by the scoring system (Tauson *et al.*, 2005) assigned scores to the feather condition, body wounds, and bumble foot, while (Ekstrand *et al*., 1998) assigned scores to the footpad lesions. A measuring tape was used to measure the length of the claws on each foot's four toes. The mean claw length was determined by averaging the eight claw length measurements per hen (Hester *et al.*, 2013).

Table 1: Estimation of feather score.

Score	Feather loss/ plumage damage at different body regions. (head, neck, breast, back, wings and tail)
1	No feathers
2	Half feathers 2/3 loss
3	1/3 feather loss
4	Full feather coverage

Table 2: Estimation of body score.

Score	Body wound	Bumble foot	Footpad lesions
1	Severe damage	Severe damage	Severe hyperkeratosis
2	Mild damage	Mild damage	Mild hyperkeratosis
3	No lesions on the body	No lesions on the body	Normal feet

RESULTS

A. Environmental enrichment effect on Feather score of Japanese quail

Table 3 exemplify the mean feather score values for control, T_1, T_2 and T_3 groups, which were 3.75, 3.88, 3.72, and 3.80, respectively. These values were statistically significant ($P<0.05$) with T_1 group that recorded highest mean feather score. However, mean values for the individual parameters-neck, breast, vent, back, wings and tail were statistically insignificant.

B. Environmental enrichment effect on body score of Japanese quail

Table 4 stand for scored values for wound, bumble foot, foot pad lesion and claw length. Wound scores for various groups such as control, T_1, T_2 and T_3 were 2.69, 2.94, 2.69 and 2.88 and were statistically insignificant. The control and T_2 (enriched with perch) group had more wounds. Bumblefoot and Footpad scores did not vary among the groups. Claw length scores for control, T_1, T_2 and T_3 were 16.90, 16.83, 16.96 and 16.91 mm and were statistically insignificant.

Table 3: Environmental enrichment effect on feather score of Japanese quail.

Feather score parameters	Group				SEM	P Value
	Control	T_1	T_2	T_3		
Neck	3.81	3.94	3.75	3.94	0.08	0.335
Breast	3.81	3.88	3.94	3.75	0.09	0.516
Vent	3.69	3.94	3.69	3.63	0.11	0.200
Back	3.75	3.81	3.50	3.81	0.11	0.159
Wings	3.75	3.81	3.75	3.75	0.11	0.970
Tail	3.69	3.88	3.69	3.94	0.10	0.184
Mean	3.75^{ab}	3.88^{b}	3.72^{a}	3.80^{ab}	0.10	0.046

T_1 (sand bath); T_2 (perch); T_3(sand bath + perch)

^{abc}Means bearing different superscripts in a row differ significantly at ($P<0.05$)

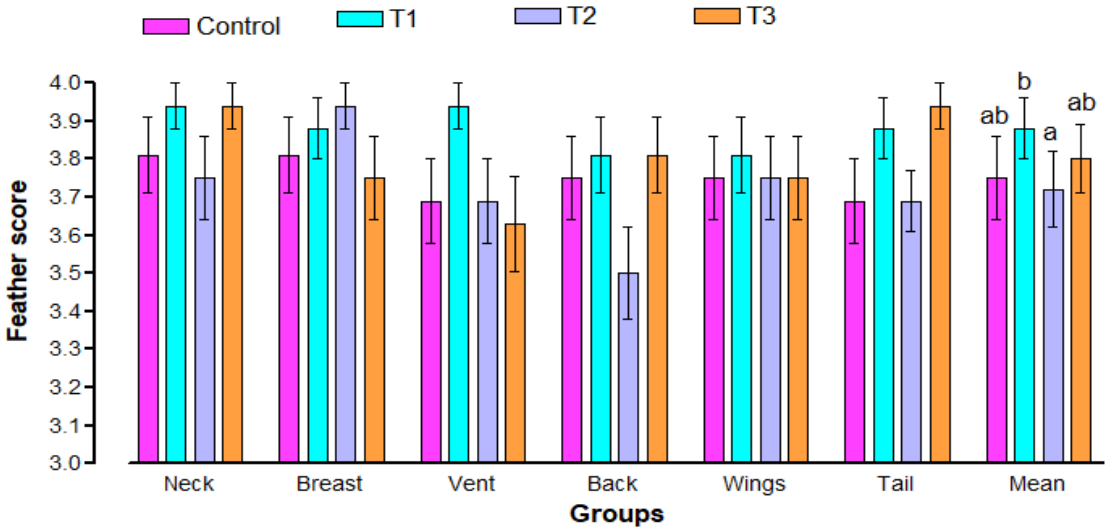

Fig. 1. Bars represent feather score at corresponding groups, along mean values.

Table 4: Environmental enrichment effect on body score of Japanese quail.

Variable	Week	Group				SEM	P Value
		Control	T_1	T_2	T_3		
Body score	Wound	2.69	2.94	2.69	2.88	0.10	0.184
	Bumblefoot	3.00	3.00	3.00	3.00	0.00	—
	Footpad lesions	3.00	3.00	3.00	3.00	0.00	—
	Claw length(mm)	16.90	16.83	16.96	16.91	0.27	0.990

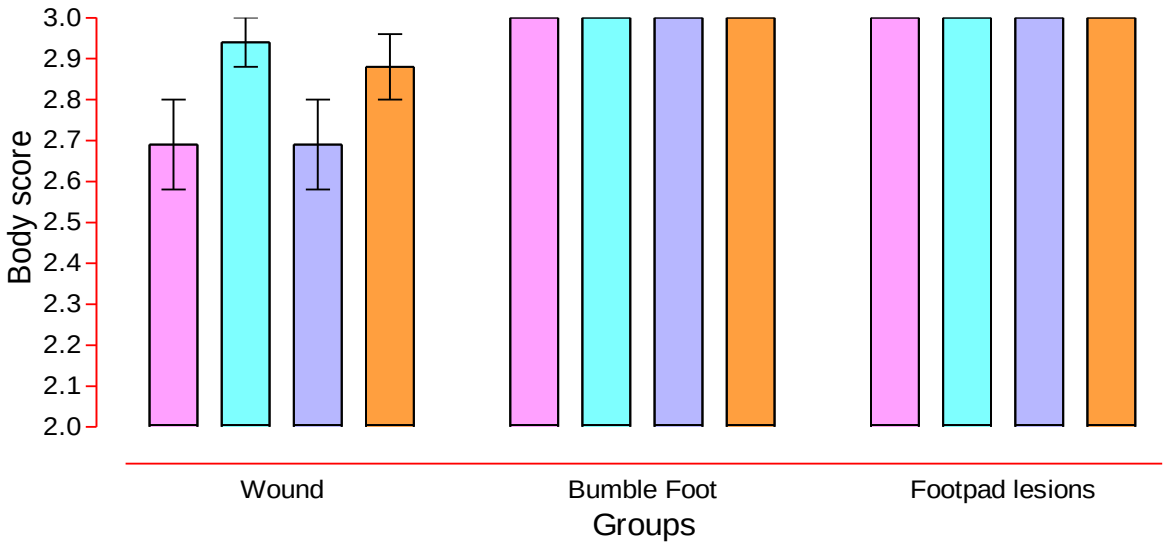

Fig. 2. Bars represent body score at corresponding groups, along with mean.

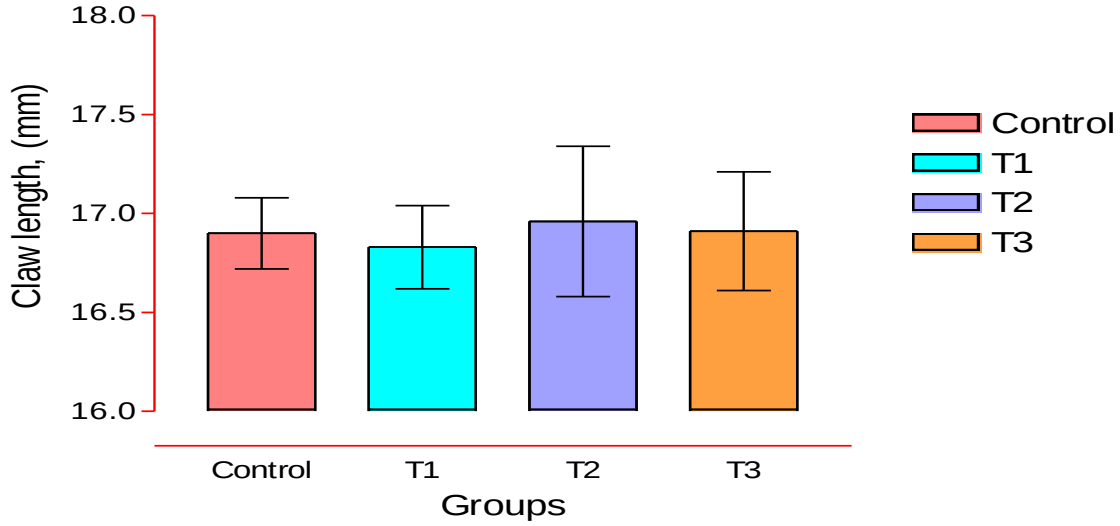

Fig. 3. Bars represent claw length of groups, along with mean of Japanese quail.
T_1 (sand bath); T_2 (perch); T_3(sand bath + perch).

DISCUSSION

The present study demonstrated that environmental enrichment significantly influenced the overall feather condition of Japanese quail. The mean feather scores were higher in the enriched groups, particularly in the sand bath group (T1), which recorded the highest feather score (3.88) compared to the control and other treatments. Although individual feather regions (neck, breast, vent, back, wings, and tail) did not show significant differences among treatments, the improvement in overall plumage condition suggests that enrichment reduced stress-related behaviours such as feather pecking and aggression. Feather condition is widely regarded as an important indicator of bird health and welfare, and improved feather scores reflect better physical and psychological well-being.

The findings of the present study are consistent with previous reports. Campo *et al.* (2008) observed improved feather condition in hens housed in enriched environments containing dust baths, perches, and foraging materials, attributing this improvement to reduced stress and increased opportunities for natural behaviours such as dust bathing and preening. Similarly, Tahamtani *et al.* (2016) reported enhanced feather scores in laying hens exposed to environmental complexity, likely due to stress reduction and improved behavioural expression. Mathkari (2022) also reported the positive influence of environmental enrichment on feather quality. Previous studies by Dixon *et al.* (2010); Hartcher *et al.* (2015) further support the beneficial role of enrichment in improving feather integrity. However, Rodenburg *et al.* (2013) highlighted that the effects of enrichment on feather condition are more extensively documented in laying hens than in broilers, indicating the need for species-specific studies such as the present investigation in Japanese quail. Toghyani *et al.* (2010) noted that bedding type affected locomotion, whereas the present results differed from Shields *et al.* (2005), who reported higher activity levels on sand bedding.

In contrast, body condition parameters, including wound incidence, bumble foot, footpad lesions, and

claw length, did not differ significantly among the treatment groups. Although the control and perch-only groups exhibited a higher incidence of wounds, the differences were not statistically significant. These findings suggest that environmental enrichment primarily improved behavioural welfare and plumage condition rather than gross physical condition traits under the present experimental conditions. The absence of significant differences in footpad lesions, bumble foot, and claw length may be attributed to the relatively short experimental duration, housing design, or low severity of floor-related challenges.

Comparable results have been reported by Campo *et al.* (2008), who found improved body condition in enriched housing systems due to reduced stress and enhanced behavioural opportunities. Tahamtani *et al.* (2016) also reported improved body condition in hens exposed to enriched environments, while Dixon *et al.* (2010) observed that opportunities for natural behaviours such as perching and dust bathing positively influenced bird physical health. Rodenburg *et al.* (2013) discussed differential responses in body condition traits between layers and broilers, suggesting that enrichment effects may vary depending on species and production systems.

Overall, the present findings indicate that environmental enrichment, particularly sand bath provision, is effective in improving feather condition and behavioural welfare in Japanese quail, while its influence on body condition traits was limited. These results highlight the importance of enrichment strategies in quail housing systems and support their adoption to enhance bird welfare and management outcomes.

CONCLUSIONS

The present study demonstrated that environmental enrichment, particularly the provision of sand baths and perches, positively influenced the overall feather condition of Japanese quail, with the sand bath group showing the highest mean feather score. Although feather scores for individual body regions did not differ significantly among treatments, the improvement in overall plumage suggests that enrichment can mitigate stress-related behaviours such as feather pecking. Body condition parameters, including wound incidence, bumble foot, footpad lesions, and claw length, were not significantly affected by enrichment, indicating that these interventions primarily improved behavioural welfare and plumage quality rather than gross physical condition. Overall, the findings highlight the potential of perches and sand baths as simple, practical, and cost-effective welfare-enhancing strategies for quail production systems. Their adoption is recommended in both intensive and small-scale quail farming to improve bird welfare and management outcomes.

FUTURE SCOPE

Further research is required to elucidate the molecular and physiological pathways responsible for the observed improvements in welfare, including the role of stress-related gene expression, immune regulation, and neuroendocrine responses. The interactions between environmental enrichment and other management factors such as stocking density, dietary strategies, and lighting programs should also be investigated to develop comprehensive welfare-oriented production systems.

Moreover, comparative studies across different quail strains, age groups, and housing systems (cage versus floor rearing) would be valuable in establishing species- and system-specific enrichment recommendations. Future investigations should also aim to develop standardized enrichment protocols and validated welfare assessment tools specifically tailored for Japanese quail production.

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Conflict of Interest. None.

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