Shahid Bahonar University of Kerman
Agricultural Biotechnology Journal
Iranian Biotechnology Society
Print ISSN: 2228-6705 Online ISSN: 2228-6500

Effects of ultraviolet-B supplementation on productive performance, egg quality, and eggshell microbial traits in Japanese quail

Alfred S. Karomy
Department of Animal Production, College of Agriculture, University of Basrah, Iraq. E-mail: alfred.solaka@uobasrah.edu.iq

Huda Falih Saad
*Corresponding author. Department of Animal Production, College of Agriculture, University of Basrah, Iraq. E-mail: Huda.falih@uobasrah.edu.iq

Alice Louis Yousif
Department of Natural products Researches, Center of Technical Research, Northern Technical University, Mosul, Iraq. E-mail: mti.lec151.alice@ntu.edu.iq

Salah Mahdi Alsudany
Department of Animal Production, College of Agriculture, University of Basrah, Iraq. E-mail: salah.mohsen@uobasrah.edu.iq

Bashar Falih Zaqeer
Department of Animal Production, College of Agriculture, University of Basrah, Iraq. E-mail: bashar.zageer@uobasrah.edu.iq

Sabah Kadhum Al-hummod
Department of Animal Production, College of Agriculture, University of Basrah, Iraq. E-mail: sabah.kadhum@uobasrah.edu.iq

Abstract

Objective

The purpose of this study was to assess how ultraviolet-B (UVB) radiation added to the lighting program impacted productive performance during the rearing stage, laying performance, egg quality properties, and eggshell microbial properties in Japanese quail (Coturnix japonica).

Materials and methods

One hundred and eighty-one-day-old quail chicks were randomly allocated to four experimental treatments with three replications in each treatment and 15 birds in each replication. The control group of birds was only exposed to a basal LED lighting program. The other three groups received supplemental narrowband UVB (305-315 nm) for 60, 90, or 120 minutes per day. Philips TL 20W/01 RS lamps mounted 40 cm above the birds were used. The UVB irradiance at bird level was maintained at 25 ± 2 μW/cm² using a calibrated UV radiometer, and the cumulative daily

UVB exposure dose differed according to treatment duration. Growth performance characteristics were measured at the rearing stage and the female quails were later measured for the age of first egg, hen day egg production, egg weight, egg mass, feed ratio, and livability. To identify external and internal egg quality traits, representative samples of eggs were taken to identify shape index, shell weight, shell percentage, shell thickness, yolk index, albumen index, and Haugh unit traits. Microbiological procedures were done by swabs to determine Eggshell microbial contamination.

Results

The findings showed that productive performance, laying efficiency, shell quality, and eggshell hygienic status were better with UVB supplementation than with the control treatment, where the response was most favorable in birds exposed to UVB treatment at 90 min/day. The final body weight, hen-day egg production, egg mass, shell thickness, shell percentage, albumen index, and Haugh unit in the quails in 90 min/day treatment were higher. While, eggshell microbial counts were lower, and the feed conversion ratio was better.

Conclusion

The results imply that moderate UVB exposure could be an effective management strategy to enhance production efficiency and eggshell hygienic quality among indoor Japanese quail systems.

Keywords: egg production, eggshell microbial load, Japanese quail, lighting program, UVB

Paper type: Research paper.

Citation: Karomy, A. S., Saad, H. F., Yousif, A. L., Alsudany, S. M., Zaqeer, B. F., & Al- Al-hummod, S. K. (2026). Effects of ultraviolet-B supplementation on productive performance, egg quality, and eggshell microbial traits in Japanese quail. *Agricultural Biotechnology Journal,* 18(3), 535-550.

Agricultural Biotechnology Journal, 18(3), 535-550. DOI: 10.22103/jab.2026.27224.1907

Received: March 28, 2026. Received in revised form: May 02, 2026.

Accepted: May 03, 2026. Published online: May 30, 2026.

Publisher: Shahid Bahonar University of Kerman & Iranian Biotechnology Society.

Introduction

Livestock production in general and domestic chicken production in particular plays a vital socio-economic role for people living in low-income countries of Africa and Asia (Mohamadinejad et al. 2024; Khezri et al., 2025; Mohammadabadi et al., 2025a). Domestic chickens are widely distributed avian species around the world, due to their short generation interval and adaptability in a wide range of agro ecologies (Mohammadifar and Mohammadabadi, 2017; Khabiri et al. 2025; Mohammadabadi et al., 2025b). The domestic chickens provide high quality protein and income for the poor rural households and are the most widely kept livestock species in the world (Mohammadabadi et al. 2010; Mohammadifar and Mohammadabadi, 2018; Mohammadabadi et al., 2024). This is due to the presence of the valuable traits of chicken like disease resistance, adaptation to harsh environments and ability to utilize poor quality feeds (Shahdadnejad et al. 2016; Khabiri et al. 2023; Mohammadabadi et al., 2025c). Japanese quail is a significant poultry species in research and commercial production due to its fast growth, early sexual maturation, short generation time and a comparatively high laying capacity. During a long-term laying experiment, the age at first egg was found to be 38.9 days and age at 50% egg production at 45.3 days, which proved that Japanese quail is suitable in short-cycle egg production experiments (Narinc et al., 2013; Al-Tamimy et al., 2025). One of the factors that have the most impact on the production of avians is light (Pap et al., 2024; Saad et al., 2024). In addition to visible light, ultraviolet wavelengths have also been of interest since birds have the ability to perceive UV radiation, and UVB, in particular, helps in the formation of endogenous vitamin D3. Vitamin D 3 is directly connected to metabolism of calcium and phosphorus, skeletal integrity and eggshell calcification. An extensive survey of the application of ultraviolet light to poultry has determined that UVB can have positive effects on physiology, welfare, and desired production characteristics, but the extent of the response is highly dose, time, and production-specific (Tabeekh *et al*., 2017; Rana & Campbell, 2021; Liu et al., 2023). Evidence from laying hens supports the biological plausibility of beneficial UVB effects. Wei et al. (2020) reported that UVB-LED supplementation increased bone mineral density and egg production in caged laying hens during the later phase of lay, especially under moderate exposure. By contrast, Rana et al. (2023) reported only minimal effects of supplemental ultraviolet light on egg production and egg quality during early lay, highlighting that UV responses are not universally linear and depend on age and physiological stage. External and internal characteristics such as the egg dimensions, shell weight, shell percentage, shell thickness, yolk index, albumen index, and Haugh unit are used to assess egg quality in Japanese quail. These are the indices that are well-established, popular in the quail studies (Sari et al., 2016). Eggshell microbial contamination is also applicable in hygienic and food-safety aspects, and can be assessed by shell-surface sampling with subsequent microbiological culture methods, as has been reported in quail and poultry studies (Nowaczewski et al., 2013; Karomy et al., 2019). Although there is an increase in research interest in UVB treatment in poultry, integrated research on growth performance, laying performance, egg quality and eggshell microbial characteristics in Japanese quail is very limited. As such, the current research was aimed at examining how incorporation of ultraviolet-B radiation in the lighting regime affects productive performance, egg production traits, egg quality characteristics, and eggshell microbial traits in Japanese quail.

Materials and methods

Experimental site: The experiment was conducted at the poultry house of the Department of Animal Production, College of Agriculture, University of Basra, Iraq.

Experimental birds and design: A total of 180 one-day-old unsexed Japanese quail chicks were randomly assigned to four experimental treatments, each comprising three replicates of 15 birds. At sexual maturity, the birds were sexed, and laying performance together with egg quality traits was evaluated according to the actual number of healthy females available within each replicate. After sexing at sexual maturity, the average number of healthy females per replicate was recorded and used as the experimental unit for laying-performance analyses.

Experimental treatments: The birds were put into 4 lighting conditions which aimed at testing the response of Japanese quail to graded daily UVB radiation whilst keeping a shared basal LED lighting program.T1: Basal LED lighting alone (control), T2: Basal LED light + 60 min/day UVB light., T3: Basal LED light + UVB exposure during 90 min/day.T4: Basal LED lights + UVB 120 min/day. The graded design was chosen on the basis of dose dependent poultry UVB responses which might not increase forever as time passes, but may reach a physiological optimum (Rana & Campbell, 2021).

Lighting system and UVB source: The visible-light schedule of basic lighting was subjected to all birds with LED lamps. Philips UVB lamps (Philips Lighting, Eindhoven, the Netherlands; Model: TL 20W/01 RS) which are a narrowband UVB source with a peak of 311 nm and a range of 305-315nm were used to provide supplemental UVB radiation. The lamps were mounted at a constant height of 40 cm above the birds. The UVB irradiance at bird level was maintained at 25 ± 2 µW/cm² using a calibrated UV radiometer, and the cumulative daily UVB exposure dose differed according to treatment duration. In addition to the basal LED lighting program, birds in T2, T3 and T4 were exposed to UVB radiation 60, 90 and 120 min/day, respectively. The technical lamp specifications were checked with the official product sheet of the manufacturer.

Feeding program: The rearing phase involved feeding of birds with a normal starter-grower diet, which was designed to support the nutritional needs of growing quail. The laying diet was introduced to the onset of lay, female birds to help them produce eggs and build strong shells. Ad libitum water and feed were given during the experiment. During the experiment, room temperature was maintained at 24-26°C with relative humidity of 55-65%. Ventilation and management conditions were kept uniform across treatments.

Experimental periods: The experiment consisted of two phases. 1- Rearing phase: 1-42 days of age and Laying phase: 43-70 days of age. After the rearing period, birds were sexed, and healthy females were kept in the treatment structure where they were subjected to the laying-performance and egg-quality analysis. This time matches the early sexual maturity of Japanese quail (Narinc et al., 2013).

Productive performance measurements during the rearing phase: Body weight was recorded individually at the beginning and end of the rearing phase.

$$\text{Body weight gain (g/bird)} = \text{Final body weight} - \text{Initial body weight}$$

Feed intake was calculated on a replicate basis as the difference between feed offered and feed refused, divided by the number of birds.

$$\text{Feed conversion ratio (FCR)} = \text{Feed intake (g)} / \text{Body weight gain (g)}$$

$$\text{Livability (\%)} = (\text{Number of live birds} / \text{Initial number of birds}) \times 100$$

Laying performance measurements: The following traits were measured during the laying phase: age at first egg (day), hen-day egg production (%), average egg weight (g), egg mass (g/hen/day), feed intake during lay (g/hen/day), feed conversion ratio per egg mass, and livability (%).

$$\text{Hen-day egg production (\%)} = (\text{Number of eggs produced} / [\text{Number of live hens} \times \text{Number of days}]) \times 100$$

$$\text{Egg mass (g/hen/day)} = [\text{Hen-day egg production (\%)} \times \text{Average egg weight (g)}] / 100$$

$$\text{FCR (g feed/g egg mass)} = \text{Feed intake (g/hen/day)} / \text{Egg mass (g/hen/day)}$$

Egg quality measurements: Representative eggs were collected during the laying phase for external and internal quality assessment. Egg length and egg width were measured using a digital caliper.

$$\text{Shape index (\%)} = (\text{Egg width} / \text{Egg length}) \times 100$$

Shells were washed, dried, and weighed.

$$\text{Shell percentage (\%)} = (\text{Shell weight} / \text{Egg weight}) \times 100$$

Shell thickness was measured at the broad end, equator, and narrow end, and the mean value was used.

For internal quality traits:

$$\text{Yolk index (\%)} = (\text{Yolk height} / \text{Yolk diameter}) \times 100$$

$$\text{Albumen index (\%)} = [\text{Albumen height} / ((\text{Albumen length} + \text{Albumen width})/2)] \times 100$$

$$\text{Haugh unit (HU)} = 100 \log_{10} (H + 7.57 - 1.7W^{0.37})$$

Where, H is albumen height (mm) and W is egg weight (g). These equations and egg-quality indices are consistent with published Japanese quail egg-quality studies (Haugh, 1937; Sari et al., 2016).

Eggshell microbial test: Freshly laid eggs were collected aseptically from each treatment for microbiological examination of the eggshell surface. Eggshell contamination was assessed using a sterile swab method. Sterile cotton swabs moistened with buffered peptone water were used to sample a standardized area of the shell surface. The swabs were then transferred into sterile dilution tubes, homogenized, serially diluted, and plated onto appropriate microbiological media. The following microbial parameters were determined: total aerobic bacterial count, coliform count, and Escherichia coli count. Microbial counts were expressed as log10 CFU/eggshell. This shell-surface microbiology approach is consistent with published studies on quail eggshell contamination and provides a quantitative estimate of the microbial load present on the eggshell surface (Nowaczewski et al., 2013; Northcutt et al., 2022).

Statistical analysis: Data were analyzed using one-way ANOVA under a completely randomized design (CRD) using SAS software. Differences among treatment means were compared using Duncan's multiple range test at $P \leq 0.05$.

Results

Growth performance during the rearing phase: Supplemental UVB enhanced growth performance as compared to the control (Table 1). Body weight gain and final body weight improved in UVB-treated birds with the best response being witnessed in the 90 min/day treatment. The feed conversion ratio was significantly better in all UVB groups than in control but there was minimal influence on the feed intake. It is a biologically plausible pattern since the poultry UVB literature suggests that the effects on the physiological aspect of vitamin D and mineral metabolism are more consistent than the impact on voluntary feed intake itself (Rana & Campbell, 2021).

Table 1. Effect of UVB lighting on growth performance of Japanese quail during the rearing phase (1-42 d)

Trait	T1 Control	T2 60 min	T3 90 min	T4 120 min	SEM	P-value
Initial body weight (g)	8.60	8.58	8.61	8.59	0.03	0.996
Final body weight (g)	176.9 b	184.7 a	189.8 a	186.6 a	2.37	0.020
Body weight gain (g)	168.3 b	176.1 a	181.2 a	178.0 a	2.35	0.018
Feed intake (g/bird)	593.5	597.6	600.2	601.1	4.58	0.446
Feed conversion ratio	3.53 a	3.39 b	3.31 b	3.38 b	0.05	0.013
Livability (%)	95.6	97.8	97.8	97.8	0.95	0.338

Values are presented as means of three replicates per treatment. Means within the same row bearing different superscript letters differ significantly at $P \leq 0.05$. T1 = basal LED lighting only; T2 = basal LED lighting + UVB exposure for 60 min/day; T3 = basal LED lighting + UVB exposure for 90 min/day; T4 = basal LED lighting + UVB exposure for 120 min/day. SEM = standard error of the mean. FCR = feed conversion ratio.

Laying performance: UVB exposure advanced the onset of lay and improved laying performance relative to the control group. The 90 min/day treatment yielded the highest hen-day egg production, average egg weight, and egg mass, together with the best feed conversion ratio per egg mass (Table 2). The 120 min/day treatment remained superior to the control but did not surpass the 90 min/day treatment, which agrees with the broader observation that UVB responses may plateau once an effective exposure range is reached (Wei et al., 2020; Rana et al., 2023).

Egg quality traits: The data of egg-quality indicated that shell-related variables were improved in UVB- exposed birds (Table 3). The highest shell weight, shell percentage, and shell thickness were observed in the 90 min/day group whereas yolk index, albumen index, and Haugh unit were also increased with UVB exposure. Such effects are physiologically reasonable since UVB is associated with the synthesis of vitamin D and the use of calcium, which are directly applicable to the shell formation. Even the indices chosen are common in Japanese quail egg-quality work (Sari et al., 2016).

Eggshell microbial traits: UVB supplementation was associated with lower eggshell microbial counts compared with the control treatment (Table 4). This effect may be related to indirect improvements in shell integrity and environmental hygiene rather than a direct germicidal effect of UVB radiation. The control treatment recorded the highest total aerobic bacterial count, coliform count, and E. coli count, indicating a greater microbial burden in the absence of UVB treatment.

Table 2. Effect of UVB lighting on laying performance of Japanese quail during the laying phase (43-70 d)

Trait	T1 Control	T2 60 min	T3 90 min	T4 120 min	SEM	P-value
Age at first egg (d)	44.5 a	43.2 b	42.4 b	42.8 b	0.42	0.011
Hen-day egg production (%)	78.6 c	83.0 b	85.9 a	83.8 ab	1.04	0.007
Average egg weight (g)	11.44 b	11.72 ab	11.95 a	11.82 ab	0.10	0.031
Egg mass (g/hen/day)	8.99 c	9.73 b	10.27 a	9.91 ab	0.17	0.006
Feed intake (g/hen/day)	29.6	29.9	30.1	30.2	0.21	0.398
FCR/egg mass	3.29 a	3.07 b	2.93 b	3.05 b	0.06	0.016
Livability (%)	95.0	97.1	97.1	97.1	1.00	0.452

Values are presented as means of three replicates per treatment. Means within the same row bearing different superscript letters differ significantly at $P \leq 0.05$. T1 = basal LED lighting only; T2 = basal LED lighting + UVB exposure for 60 min/day; T3 = basal LED lighting + UVB exposure for 90 min/day; T4 = basal LED lighting + UVB exposure for 120 min/day. SEM = standard error of the mean. FCR = feed conversion ratio; egg mass = hen-day egg production × egg weight / 100.

Table 3. Effect of UVB lighting on egg quality characteristics of Japanese quail eggs.

Trait	T1 Control	T2 60 min	T3 90 min	T4 120 min	SEM	P-value
Shape index (%)	77.8	78.1	78.4	78.2	0.28	0.355
Shell weight (g)	1.03 b	1.09 a	1.13 a	1.10 a	0.02	0.017
Shell percentage (%)	9.02 b	9.31 a	9.48 a	9.32 a	0.08	0.010
Shell thickness (mm)	0.195 b	0.204 a	0.210 a	0.206 a	0.003	0.008
Yolk index (%)	44.0 b	45.4 a	46.1 a	45.7 a	0.47	0.020
Albumen index (%)	8.13 b	8.65 a	8.92 a	8.74 a	0.14	0.018
Haugh unit	86.4 b	88.1 a	89.7 a	88.6 a	0.68	0.014

Values are presented as means of three replicates per treatment. Means within the same row bearing different superscript letters differ significantly at $P \leq 0.05$. T1 = basal LED lighting only; T2 = basal LED lighting + UVB exposure for 60 min/day; T3 = basal LED lighting + UVB exposure for 90 min/day; T4 = basal LED lighting + UVB exposure for 120 min/day. SEM = standard error of the mean. Shape index (%) = egg width / egg length × 100; shell percentage (%) = shell weight / egg weight × 100; yolk index (%) = yolk height / yolk diameter × 100; albumen index (%) = albumen height / average albumen diameter × 100; Haugh unit was calculated according to the standard Haugh equation.

In contrast, all UVB-treated groups showed lower microbial counts than the control treatment. The lowest total aerobic bacterial count was observed in the 120 min/day treatment, whereas the lowest coliform and E. coli counts were recorded in the 90 min/day treatment. Overall, the 90 min/day treatment showed the most consistent reduction across the microbial traits, suggesting that moderate UVB exposure may provide the most balanced and effective improvement in eggshell hygienic status under indoor production conditions.

Table 4. Effect of UVB lighting on eggshell microbial traits of Japanese quail eggs

Trait	T1 Control	T2 60 min	T3 90 min	T4 120 min	SEM	P-value
Total aerobic bacterial count (log10 CFU/eggshell)	6.06 ± 0.04 a	5.18 ± 0.04 b	5.17 ± 0.03 b	4.30 ± 0.01 c	0.12	0.005
Coliform count (log10 CFU/eggshell)	5.25 ± 0.04 a	4.23 ± 0.02 b	3.30 ± 0.02 c	4.74 ± 0.03 ab	0.10	0.004
E. coli count (log10 CFU/eggshell)	5.00 ± 0.02 a	4.00 ± 0.01 b	3.00 ± 0.02 c	4.65 ± 0.03 ab	0.11	0.006

Values are presented as means ± SEM of three replicates per treatment. Means within the same row bearing different superscript letters differ significantly at $P \leq 0.05$. T1 = basal LED lighting only; T2 = basal LED lighting + UVB exposure for 60 min/day; T3 = basal LED lighting + UVB exposure for 90 min/day; T4 = basal LED lighting + UVB exposure for 120 min/day. Microbial counts are expressed as log10 CFU/eggshell.

Discussion

Its current results show that the inclusion of UVB radiation in the lighting system positively affected productive performance during the rearing period, egg laying performance, several egg quality characteristics, and that it decreased eggshell microbial load in Japanese quail. Generally, there was the highest level of consistency in the biological response of the bird to UVB exposure of 90 min/day, which implied that the effect of the UVB exposure was dose-dependent and not necessarily linear. This observation is in line with the general poultry literature, which suggests that UVB has the ability to impact vitamin D-related physiology, mineral metabolism, skeletal status, and targeted production characteristics, yet the intensity of the effect varies based on exposure time, physiological stage, and production environment (Rana & Campbell, 2021). The improvement in body weight gain and feed efficiency in UVB-treated birds may be explained by enhanced endogenous vitamin D3 synthesis. Improved vitamin D status likely increased calcium and phosphorus utilization, thereby supporting skeletal growth and metabolic efficiency. Results showed increase in calcium and phosphorus absorption and skeletal growth, as well as the metabolic efficiency. In indoor production systems, with little or no natural UV exposure, supplemental UVB can enhance the biological efficiency of mineral utilization without necessarily leading to significant alterations in feed consumption. This interpretation is useful in understanding why the treated birds in the current study had a higher growth efficiency and feed conversion ratio despite the minor differences in the feed consumption of the treatments. This is biologically possible in light of the poultry UV literature, which has stressed the physiological significance of UVB on the skeletal health and mineral metabolism (Rana & Campbell, 2021). The positive effect of UVB supplementation on laying traits, especially the decrease in age at first egg and the rise in hen-day egg production, average egg weight and egg mass, can also be attributed to an improved physiological preparedness and mineral equilibrium. Japanese quail has been reported to be sexually mature early and literature has indicated that the first egg is produced at a very tender age and this species is very sensitive to environmental interventions during the rearing to lay stages (Narinc et al., 2013; Karomy et al., 2019). Better mineral metabolism and collectively physiological stability may help in this regard to aid earlier reproduction initiation and more effective laying. The current trend thus seems physiologically reasonable and in line with the idea that UVB treatment may be particularly effective in cases where the birds are kept in the indoor environment with no exposure to natural light. A rather significant finding of the current research was that the treatment of 90 min/day tended to be more responsive compared to the 120 min/day one. Such an outcome should be highlighted since it implies that the response to UVB when productive is not proportional to exposure time. Instead, the evidence is that there is at least some effective or near-optimal exposure range, and additional exposure might not contribute any further biological value. This reading is in close agreement with published poultry evidence that UVB responses may be non-linear and that optimum exposure time may play a significant role in attaining positive effects. In laying hens, moderate daily UVB has been linked with better production related outcomes under certain conditions, but subsequent research in later production stages showed smaller effects, which supports the notion that the reaction is only conditional but not universal (Wei et al., 2020; Rana et al., 2023). The positive change in shell weight, shell percentage and shell thickness is one of the most biologically persuasive results of the current research. Calcium metabolism is critical in the formation of eggshells and vitamin D is a key factor in the absorption, mobilization and deposition of calcium. Thus, the optimisation of shell-specific features in birds that were UVB-treated is a strong indicator to the idea that UVB exposure enhanced the use of minerals and calcification of shell. The practicality of this outcome lies in the fact that improved shell strength may reduce economic losses associated with egg breakage, and at the same time help enhance the hygienic quality by offering a more effective physical barrier. Mechanistic association between UVB, vitamin D pathways and mineral metabolism is so strong that the shell response can be more directly defensible than other variables of egg-quality (Rana & Campbell, 2021). The positive shifts in the yolk index, albumen index, and Haugh unit could be indicators of an overall increase in physiological status and reproduction efficiency in the UVB-treated birds. These characteristics however should be taken more carefully than those of shell. In contrast to shell calcification, which is directly associated with the calcium metabolism and vitamin D physiology, the internal egg quality is affected by a more diverse range of interacting factors, such as the age of the birds, their physiological condition, the conditions of egg handling, and changes associated with the storage. Therefore, the present experiment has shown an improvement which is biologically acceptable but which may indicate an improved collectively reproductive performance but the evidence base of the direct UVB effects on albumen and yolk quality is not as consistent as that of skeletal or shell-related responses (Rana et al., 2023; Sari et al., 2016). Another important finding of the present study was the reduction in eggshell microbial load in the UVB-treated groups. Lower total aerobic bacterial counts, coliform counts, and E. coli counts may be explained through both direct and indirect mechanisms. From a direct standpoint, ultraviolet radiation is known to reduce microbial survival on exposed surfaces. From an indirect standpoint, improved shell structure and better environmental hygiene around the birds may have reduced the persistence and retention of contamination on the eggshell surface. Published studies on quail eggshell microbiology confirm that shell contamination can be quantified reliably and that contamination levels vary according to handling conditions, storage status, and hygienic management (Nowaczewski et al., 2013; Northcutt et al., 2022). The decrement in eggshell microbial load reported in the current study correlates with a prior report that indicated eggshell microbiology to environmental and hygienic actions. Sharma et al. (2022) found that microbiology of eggshells in laying hens was influenced by the housing environment. Eroglu et al. (2025) also found that the avian egg microbial loads were lower with shell sanitation treatments. The relatively high microbial values recorded in the present study may also reflect differences in sampling procedure, sampled surface area, and unit of expression, as microbial contamination was quantified as log10 CFU per eggshell rather than as isolation frequency or contamination per unit area. Accordingly, the lower microbial counts observed in the UVB-treated groups likely reflect a combined effect of improved shell integrity and reduced microbial pressure in the production environment. The future research should thus aim at perfecting the interaction among irradiance, daily exposure duration, lamp placement, and bird age as well as observe longer production duration to determine whether the positive effects on laying efficiency, shell quality, and eggshell hygiene are sustainable. Although significant differences were detected among treatments, further studies with larger sample sizes are recommended to confirm the consistency of the observed responses. A limitation of the present study is that circulating vitamin D3 concentration and calcium metabolism biomarkers were not measured. Therefore, the proposed physiological mechanisms remain indirect and should be confirmed in future studies.

Conclusion: Incorporating UVB radiation into the lighting system of Japanese quail improved growth performance during rearing, enhanced laying performance, improved several egg-quality characteristics, and reduced eggshell microbial load compared with the control treatment. Among the tested exposure periods, 90 min/day produced the most favorable collectively response, although the lowest total aerobic bacterial count was recorded at 120 min/day. Overall, the results support the practical value of optimized UVB supplementation as an environmental management strategy for improving productivity and eggshell hygienic quality in indoor Japanese quail production systems.

Author contributions

Conceptualization: A. S. K. and H. F. S.; methodology: A. L. Y. ; software: S. M. A.; validation: B. F. Z., S. K. A. and A. S. K.; formal analysis: H. F. S. ; investigation: A. L. Y.; resources: S. M. A. ; data curation: B. F. Z.; writing-original draft preparation: S. K. A.; writing-review and editing: A. S. K. ; visualization: H. F. S.; supervision: H. F. S.; project administration: H. F. S.; funding acquisition: H. F. S. All authors have read and agreed to the published version of the manuscript.

Acknowledgements

The authors thank the Department of Animal Production, College of Agriculture, University of Basrah, Iraq and Department of Natural products Researches, Center of Technical Research, Northern Technical University, Mosul, Iraq for technical and laboratory support, and all those who helped complete this project.

Funding

This research is supported by the Department of Animal Production, College of Agriculture, University of Basrah, Iraq and Department of Natural products Researches, Center of Technical Research, Northern Technical University, Mosul, Iraq and self-funding. This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Data availability

The data presented in this study are available from the corresponding author upon reasonable request.

Ethical considerations

All experiments involving birds were done in compliance with the ethical standards of the College of Agriculture, University of Basra, Iraq and were cleared by the appropriate institutional committee.

Conflict of interest

The authors declare no conflict of interest.

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مجله بیوتکنولوژی کشاورزی
شاپا چاپی: ۲۲۲۸-۶۷۰۵ شاپا الکترونیکی: ۲۲۲۸-۶۵۰۰
دانشگاه شهید باهنر کرمان
انجمن بیوتکنولوژی ایران

اثرات مکمل‌یاری با اشعه فرابنفش B بر عملکرد تولیدی، کیفیت تخم و ویژگی‌های میکروبی پوسته تخم در بلدرچین ژاپنی

آلفرد اس. کارومی

دانشکده کشاورزی، دپارتمان تولید دام، دانشگاه بصره، عراق. رایانامه: alfred.solaka@uobasrah.edu.iq

هدی فالح سعد

*نویسنده مسئول: دانشکده کشاورزی، دپارتمان تولید دام، دانشگاه بصره، عراق. رایانامه: Huda.falih@uobasrah.edu.iq

آلیس لوئیس یوسف

مؤسسه مهندسی ژنتیک و زیست فناوری، دانشگاه بغداد، بغداد، ۱۰۰۱۱، عراق. رایانامه: mti.lec151.alice@ntu.edu.iq

صلاح مهدی السودانی

دانشکده کشاورزی، دپارتمان تولید دام، دانشگاه بصره، عراق. رایانامه: salah.mohsen@uobasrah.edu.iq

بشار فلیح زغیر

دانشکده کشاورزی، دپارتمان تولید دام، دانشگاه بصره، عراق. رایانامه: bashar.zageer@uobasrah.edu.iq

صباح کاظم الحمد

دانشکده کشاورزی، دپارتمان تولید دام، دانشگاه بصره، عراق. رایانامه: sabah.kadhum@uobasrah.edu.iq

تاریخ دریافت: ۱۴۰۵/۰۱/۰۷ تاریخ دریافت فایل اصلاح شده نهایی: ۱۴۰۵/۰۲/۳۰ تاریخ پذیرش: ۱۴۰۵/۰۲/۳۱

چکیده

هدف: هدف این مطالعه ارزیابی تأثیر افزودن تابش فرابنفش B (UVB) به برنامه نوری بر عملکرد تولیدی در مرحله پرورش، عملکرد تخم‌گذاری، ویژگی‌های کیفیت تخم و خصوصیات میکروبی پوسته تخم در بلدرچین ژاپنی (*Coturnix japonica*) بود.

مواد و روش‌ها: تعداد ۱۸۰ جوجه بلدرچین یک‌روزه به‌صورت تصادفی در چهار تیمار آزمایشی با سه تکرار در هر تیمار و ۱۵ پرنده در هر تکرار تقسیم شدند. گروه شاهد تنها در معرض برنامه نوری پایه LED قرار گرفت. سه گروه دیگر مکمل UVB باریک‌باند (۳۰۵-۳۱۵ نانومتر) را به مدت ۶۰، ۹۰ یا ۱۲۰ دقیقه در روز دریافت کردند. برای این منظور از لامپ‌های Philips TL 20W/01

RS که در ارتفاع ۴۰ سانتی‌متری بالای پرندگان نصب شده بودند استفاده شد. شدت تابش UVB در سطح پرنده با استفاده از رادیومتر UV کالیبره‌شده روی ۲۵ ± ۲ میکرووات بر سانتی‌متر مربع حفظ شد و دوز تجمعی روزانه UVB بسته به مدت تیمار متفاوت بود. ویژگی‌های عملکرد رشد در مرحله پرورش اندازه‌گیری شد و سپس در بلدرچین‌های ماده سن اولین تخم‌گذاری، درصد تولید روزانه تخم، وزن تخم، توده تخم، ضریب تبدیل غذایی و زنده‌مانی بررسی گردید. برای ارزیابی صفات خارجی و داخلی کیفیت تخم، نمونه‌های نماینده‌ای از تخم‌ها انتخاب و شاخص شکل، وزن پوسته، درصد پوسته، ضخامت پوسته، شاخص پوسته، شاخص زرده، شاخص آلبومن و واحد هاو اندازه‌گیری شدند. همچنین برای تعیین آلودگی میکروبی پوسته تخم از روش سواب‌گیری استفاده شد.

نتایج: یافته‌ها نشان داد که عملکرد تولیدی، کارایی تخم‌گذاری، کیفیت پوسته و وضعیت بهداشتی پوسته تخم در تیمارهای دارای UVBنسبت به گروه شاهد بهتر بود و بهترین پاسخ در پرندگانی مشاهده شد که روزانه ۹۰ دقیقه در معرض UVB قرار داشتند. وزن نهایی بدن، تولید روزانه تخم، توده تخم، ضخامت پوسته، درصد پوسته، شاخص آلبومن و واحد هاو در تیمار ۹۰ دقیقه در روز بالاتر بود. همچنین شمار میکروبی پوسته تخم کاهش یافت و ضریب تبدیل غذایی بهبود پیدا کرد.

نتیجه‌گیری: نتایج این مطالعه نشان می‌دهد که قرارگیری متوسط در معرض UVB می‌تواند به‌عنوان یک راهبرد مدیریتی مؤثر برای بهبود کارایی تولید و کیفیت بهداشتی پوسته تخم در سیستم‌های پرورش بلدرچین ژاپنی در محیط بسته مورد استفاده قرار گیرد.

کلمات کلیدی: بار میکروبی پوسته تخم، برنامه نوری، بلدرچین ژاپنی، تولید تخم، UVB

نوع مقاله: پژوهشی.

استناد: آلفرد اس. کارومی، هدی فالح سعد، آلیس لوئیس یوسف، صلاح مهدی السودنی، بشار فلیح زغیر، صباح کاظم الحمد (۱۴۰۵). اثرات مکمل‌یاری با اشعه فرابنفش B بر عملکرد تولیدی، کیفیت تخم و ویژگی‌های میکروبی پوسته تخم در بلدرچین ژاپنی. *مجله بیوتکنولوژی کشاورزی*، ۱۸(۳)، ۵۳۵-۵۵۰.

Publisher: Shahid Bahonar University of Kerman & Iranian Biotechnology Society.