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The Influence of Light Color on Behavioral Patterns and Productive Traits in Quail

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Abstract

The study sought to explore how various colors of illumination affect the behavior and productivity of Japanese quails. A total of 192 one-day old Japanese quail chicks were divided into four groups, with three replicates. The birds in control group were subjected to white light, while the other groups were exposed to blue, red, and green lights. The experiment lasted for 7 weeks. The quail's behaviors were recorded by utilizing a scanning technique. Furthermore, growth performance, egg quality, hatching performance and carcass traits were assessed. Illumination colors had a significantly influence ($P < 0.05$) in most of the Japanese quails 'behaviors. ingestive, running, flying and crouching were significantly higher under blue light. While, walking and exploratory behaviors were significantly higher in red color. The comfort behavior was increased under green color. Different light color had no an obvious impact on the final body weight, but it was the highest in quail kept in blue and green light color. In the same line, daily weight gain, feed conversion rate, egg fertility and hatchability percent were significantly improved under blue light. Birds that received red light had higher egg weight, egg-shell thickness, shell weight, yolk index and albumen height, than other treatments ($p < 0.05$). Dressing weight and Dressing percentage were improved in birds that received green light than other colors lights ($p < 0.05$). Consequently, using blue and green lighting programs in raising Japanese quails is believed to offer good welfare and production benefits.

Keywords: Japanese quails; light colors; behavior; productivity.

Introduction

Quail is a small avian species that belongs to the pheasant family. It is a monogamous bird with a fast growth cycle, reaching mature body weights of 150–200 g in less than 6 weeks. Gamete production in both sexes begins at the 5th -6th week of life, and fertility and fecundity peak at 10-14 weeks. Quail are reared as dual-purpose birds for meat and egg production [1]. Both quail meat and eggs make an important nutritional contribution to food-insecure people. This is due to their strong resistance to tropical diseases and pests as well as their high brooding ability and egg hatchability. Additionally, they have been recognized for their ability to convert feed to protein more efficiently than other farm animals [2]. Providing a cost-effective and high-quality protein solution to meet the growing demand for animal protein [3]. This species is well-suited for harsh environments, exhibiting quick development. Japanese quails are resilient birds that live in small cages and on the floor, with minimal rearing costs. Behavioral expression is an important aspect of animal welfare; as defined by [4], it is the way an animal acts or behaves in response to a specific situation. It is often linked to subjective feelings, such as the need for food, comfort, play, curiosity, empathy, fear, suffering, or pain. Environmental characteristics, including lighting, heat, humidity, and ventilation, may affect subjective states and behavior expression. Therefore, regulation of environmental conditions in poultry houses is important for chick health and productivity [5]. Light is an important managerial aspect that plays a vital role in poultry production, reproduction, and welfare through adapting different behavioral and physiological pathways [6]. Its effects depend on illumination length, intensity, and color [7]. Color is

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a physically perceived attribute of the external world that is determined by the spectral composition of light close to the perceived object. There are large discrepancies in color perception and discrimination abilities between animals. Birds usually have a tetrachromatic color vision system. Light is required for birds' eyesight, as it influences the vision sensitivity discrimination of color [8]. Light environments can reduce welfare in birds by limiting visual information, affecting their ability to recognize features, navigate, respond to humans, and see feed and water [9]. Light color can affect the emotional and physiological states of animals [4]. Also, growth and behavior responses rely on retinal photoreception. The light condition in Japanese quail pens can impact the birds' well-being. The color of light, measured by wavelength, has varying effects on Japanese quail performance and reproductive activity [10]. The study explores the influence of various light colors on quails' behavior and productivity. This study hypothesises that different light colors (white, red, blue, and green) have distinct effects on the behavior, growth performance, reproductive parameters, and welfare indicators of Japanese quails. Specifically, we expect that blue and green light will enhance growth and welfare-related behaviors, while red light may improve reproductive traits such as egg quality.

Material and Methods

Ethical approval

This experiment was performed after the approval of the Institutional Animal Care and Use Committee at Zagazig University (ZU-IACUC/).

Experimental design and bird management

The study was performed in the experimental rooms belonging to the faculty of Veterinary Medicine at Zagazig University to assess the influence of various light colors on the behavior, growth & productive performance, egg quality, hatching and fertility parameters, and carcass traits of quail. 192 one-day-old quail chicks were reared for two weeks before being distributed into four chambers, where each one represented an experimental group and was illuminated with one of the artificial light colors (white, red, green, or blue). LED lamps were used for each color treatment, and the light intensity was adjusted and measured at bird level using a digital lux meter. The intensity was maintained at 20 lux (20) across all treatments throughout the experimental period. Every experimental room was divided into three pens for 3 replicates (16 birds per replicate).

In an artificially lit chamber, birds were kept under a continuous lighting system (24L) for the duration of the trial [11] for 7 weeks. The pens were equipped with 10 cm of sawdust, giving an available space of 0.038 m² per quail [12]. The room temperature began at 38°C and gradually decreased to 34°C during the first week, then dropped by 6°C per week in the second and third weeks. After that, the temperature remained between 18°C and 20°C for the duration of the research period. Moreover, ad libitum was offered for the feed and water. Ingredients and chemical composition of the commercial diet for quail during growing and laying have been summarized in Table 1. At the fifth week, the sex ratio within each group adjusted to one male and three females (1:3 sex ratio) according to [13]. Chicks were identified with wing rings.

Data collection

Behavioral assessment

An instantaneous scanning sampling technique according to [14] was used to report the quail's behavior. Each group was scanned twice daily (20 minutes/group/each time) for three days weekly for 5 weeks, once in the morning and the other in the afternoon to avoid photoperiod effect on behavior [15] from 7 am to 4 pm. The different patterns of behavior were recorded based on a standardized behavioral ethogram in table 2 as defined by [16].

Growth Performance

All the chicks were weighed at 2 weeks of age to record their initial body weight. The final body weight, daily feed intake, weight gain, daily weight gain, and feed conversion ratio were estimated.

Egg quality

To assess egg quality, 30 eggs/group (10 eggs from each replicate) were collected for three days after the 7th week of age. The following egg-quality parameters were measured: egg weight, egg length, egg width, egg shape index, eggshell thickness, and eggshell weight, as well as albumen weight, albumen height, albumen diameter, yolk weight, yolk height, yolk diameter, yolk ratio, and yolk index [17].

Egg production

Egg production per quail group was recorded during the first four weeks after sexual maturity [18], including the estimation of hen-day egg production (HDEP) for that time.

HDEP% = (Total of eggs produced / Number of live hens) × 100

Fertility and Hatchability

By placing sixty hatching eggs collected from each group in an incubator with humidification at 37°C and 70% RH with parameters determined [19] to evaluate the impact of different light colors on hatching performance.

Fertility % = (Number of fertile eggs / Total number of eggs set) × 100

Hatchability % = (Number of hatched chicks / Total number of eggs set) × 100

Hatchability of fertile eggs % = (Number of hatched chicks / Number of fertile eggs set) × 100

Carcass traits

Randomly selecting and weighing 6 birds per group (2 birds/replicate). The birds were scarified, defeathered, and eviscerated to evaluate carcass traits. The dressing percentage was estimated as the actual carcass weight in relation to the final body weight, and the relative weight of the liver, heart, gizzard, and spleen was calculated [20].

Statistical analysis

To analyze the experimental data using SPSS 20.0 software. One-way ANOVA was used, and Duncan multiple comparisons were utilized to assess the differences between groups. Data were expressed as means ± SE. A significant difference is present when $P < 0.05$.

Results

The impact of illumination color on quail's behavior is illustrated in Table 3. The use of blue and red light significantly increased ingestive behaviors (feeding and drinking) ($p < 0.05$). In contrast, standing behavior was notably higher under white light compared to the other groups. Quails exposed to red light exhibited greater activity, demonstrated by increased walking, flying, running, foraging, body and head shaking, feather ruffling, and wing/leg stretching. No marked alteration in the resting and pecking behaviors between groups was noticed.

Table 4 displays the impact of various light colors on quail body weight. Quails exposed to blue and green light displayed higher final body weights than those under white and red light, but the changes were not statistically significant. Nevertheless, there was a significant increase in weight gain and daily weight gain in quail under blue colors in comparison with other experimental groups. Feed intake was highest in red-lit chambers.

As illustrated in Table 5, birds that received red light exhibited statistically ($p < 0.05$) higher egg weight, eggshell thickness, shell weight, albumin height, and yolk index than other treatments. Albumin diameter was significantly increased in blue color. While other parameters were not significantly influenced ($p>0.05$) by evaluated light colors.

Table 6 revealed the hen-day egg production (HDEP %) and hatching performance of Japanese quails submitted to varied illumination color treatments for four weeks following sexual maturity. Blue-parameter-light-treated birds had significantly higher HDEP percent, fertility, hatchability of the total eggs, and hatchability of fertile eggs.

Carcass traits of quail that received various illumination colors are shown in Table 7. Dressing weight and percentage were significantly increased under green and blue light compared to other groups ($p < 0.05$); however, the relative weights of the gizzard, heart, and intestine were not significantly affected, while liver weight was notably greater in birds under blue light ($p > 0.05$). In contrast, quails raised under red light showed significantly lower values for dressing percentage, carcass percentage, and average liver weight (161.50±4.85, 73.33±1.3%, and 3.29±.156 g, respectively) in comparison with other light treatments.

Discussion

Light is a powerful stimulus that has profound effects on behavior. Higher frequencies of ingestive behaviors were noted in quails exposed to blue and red light, respectively, which is supported by the findings of [21, 22, 23, 24]. the increase in ingestive behavior by birds raised under red color could be attributed to increasing the attractiveness of food made by red light. Author [25] found that the feeding behavior of broiler chicks at the starter phase (14 days old) was significantly higher in the blue color than in the white and green color. Also**,[**26**]** recorded that male broiler behavior was influenced by blue and green lights since it was 7 days old, which increased presence at the bird feeders and decreased idle time. In contrast, other studies reported that the influence of various light color on the behavioral traits (feeding, drinking water) did not reach the significance level in broiler chickens [27] and Japanese quails [28]. Light colors had a significant influence on the kinetic behaviors in quail, such as walking, flying, and running, as evidenced by the aforementioned studies by [23, 29, 30], who showed birds kept under red light have been shown to exhibit increased activity. On the contrary, [31] recorded that the blue light color caused a high percentage of walking behavior. While [28] reported that there was no significant change.

Regarding comfort behaviour (feather preening), the quails under the green light color had a non-significant increase in the feather preening behavior frequency (13.66 ±2.10) compared to the other light color groups. Furthermore, the frequencies of the body shaking and feather ruffling were statistically ($p > 0.05$) higher under green light colors than the others. This may be linked to calm feelings and more comfort in the green light color. The obtained results are compatible with [23]. The results obtained are not consistent with [21**],** who noted that using white light color showed more stretching activities, ruffling, body shaking, feather preening, and exploratory behaviors such as wall and feather attributing that to the suitability of white color for normal activities.

According to [32], foraging is typically associated with feeding behavior. Our finding proved that the green color exhibited the lowest foraging behavior which supports our results of the feeding frequency of the same birds, while the highest frequency was recorded in the group of red color. Additionally, quail reared in green and blue light chambers were more comfortable and calmer, with increased sleeping and crouching behaviors. This investigation validated the idea that the green and blue colors have a calming effect on birds [28].

The exposure to different spectral colors of light markedly impacts physiological processes in birds, including protein synthesis and metabolic activity in Japanese quail. [Hassan 56] revealed that quails reared under blue and green monochromatic illumination exhibit superior growth rates, enhanced feed conversion, and increased behavioral stability in comparison to those maintained under red or white light. It has been observed that applying different light color had no obvious impact on the final body weight of Japanese quails. This may be linked to no difference in the daily feed intake among treated groups.

Based on the statistical analysis, a notable ($P > 0.05$) increase in the body weight gain and daily weight gain (163.26 ± 3.40 g and 23.32 ± 0.48 g, respectively) in the blue light group in comparison with other groups. This could be due to photoreceptors in the hypothalamus area reacting directly to the light [**33**]. The findings are in line with those of [23, 28, 34, 35, 36], who reported the highest body weight and weight gain under blue and green color treatments. [37] discovered that quails subjected to artificial light during the early stage gained much more weight than those exposed to natural light. The current findings contradict the findings of [10, 19, 20], who noted that Japanese quails under red lights weighed more than those under blue and green lights. Meanwhile, [38] indicated that the highest final BW of broiler was found under the white color. [32] No significant differences in body weight and growth were found among broiler chickens under various artificial light color treatments.

No notable differences were noted in the daily feed intake among different color which could be attributed to the fact that birds are accustomed to their environment; they may not show a strong preference for different colors presented, leading to similar intake levels. This result agreed with [39, 40], who found feed intake was not affected by different bulb types and intensities. On the other hand, [20] stated that light color had a significant impact on feed intake, where quails receiving green LED light had the highest values in comparison to red, white, and blue LED light treatments. Also, [34] recorded that chicks raised under white light had a higher feed consumption during the initial phase compared to other groups (red, green, and blue).

Quail kept in blue- and green-lit chambers had better cumulative FCR than those in the red-lit chamber, which was supported by the results obtained by [36]. On the contrary, [20] found that the best FCR was recorded among quails in red light.

Red light treatment increased egg weight in quail compared to white, blue, and green light colors (13.91, 13.0, 12.46, and 12.33 g, respectively); this could be because the specific wavelengths of red color can impact the shell quality and internal egg composition, leading to heavier eggs. This outcome aligns with the findings of [20]. On the other hand, [10, 39, 41] discovered that egg weight showed a significant increase under white and green light compared to red light. Furthermore, [42] found an increase in the weight of eggs under green light compared to red light. Nevertheless, some investigations revealed that illumination color had no effect on the average egg weight throughout the laying period [43].

Shell thickness and weight also increased in red light, potentially due to heavier egg weight [39]. Thin-shelled eggs significantly impact the global egg market, with 7 to 8% of them breaking during transfer from poultry houses to consumers [44]. The eggshell damage occurs due to fractures from collisions between eggs or the collecting machine, as well as compressive fractures during the packaging process.

No significant difference in egg length and width between light treatments was recorded in our work. But the egg shape index was significantly altered by the light processing, with the greatest values recorded in the white color while the lowest results were in the blue color group. On the contrary, [10, 45] found that there were no significant changes in egg shape index among different light colors. Of note, the yolk index was statistically increased under blue and red color. Our findings align with those reported by [20, 40], while at the same time conflicting with the results of [10], who observed a higher yolk index in the group exposed to green light. According to [46], a higher yolk index indicates better egg quality and freshness. Concisely, quails reared under red color have the best internal egg quality.

Concerning egg production, blue-light-treated quails had significantly higher HDEP percentages (79.35%), followed by white (76.82%), green (71.79%), and finally red-light-exposed birds, which had the lowest percentage (68.46%). The same results were reported by [40], who demonstrated that the percentage of laying increased significantly in the blue color group. However, other reports found that red light treatments had a considerably greater total HDEP percentage compared to white and green light treatments. [10, 42, 47].

Quails reared under blue color exhibited significantly higher (P<0.05) fertility, hatchability of total eggs, and hatchability of fertile eggs. These results may indicate that the blue color has a calming effect, reducing stress and promoting better reproductive performance, potentially by affecting hormonal levels and stimulating reproductive organs. These results disagreed with [45], who found that green-light-treated breeders produced more fertile eggs, but white-light-reared chicks had higher hatchability rates. [48] discovered that green light produced more viable quail eggs than white, red, or blue LEDs. [10] recorded that higher fertility and hatchability of quail reared under red and green light (P<0.05) compared to white light color may be ascribed to the fact that red light may stimulate metabolic processes linked to breeding and reproduction more effectively than other colors.

Quails in green and blue lit chambers had much higher dressing weights and percentages due to the presence of a positive associative relationship between organ size and body weight size. Our findings were supported by the previous results [36, 49, 50, 51]. On the other hand, [20] found that quail kept under red LED achieved the highest outcomes, with substantially greater live body weight and carcass weight compared to all other treatments. [52] determined that carcass yield of Japanese quails was not significantly affected by light treatment. The previous results by [53] showed that green and blue monochromatic lighting during the fattening phase significantly impacted slaughter-carcass features and growth. On the other hand, broilers raised in a combination of green and blue lights were found to be highly scared.

Moreover, [54] reported that green-blue light increased carcass weight and quality of broilers by raising pH and water holding capacity (WHC). GIT organ weights were not impacted by the exposure to different colors except for the liver. Our results were confirmed with the findings by [39, 55].

Conclusion

Based on these findings, the study indicates that utilize blue light during the developmental phases and red light to enhance the quality of eggs.

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Conflict of interest

The authors declare they have no conflict of interest.

Authors' contributions

All authors contributed equally to this study.

TABLE 1. Composition and Nutrient Content of the Basal Diets

Ingredients (g/kg as fed)	Growing phase	Laying phase
Yellow corn	51.84	64.50
Soybean meal (44%)	26.63	20.50
Concentrate (52%)	16.00	10.00
Vegetable fat	1.27	–
Di-calcium phosphate	1.50	2.31
Limestone	1.03	0.96
DL-methionine	0.09	0.09
Lysine	0.08	0.08
Vitamin and trace mineral	0.30	0.30
Premix	1.06	1.06
Coccidostate	0.10	0.10
Antioxidant	0.10	0.10
Calculated analysis		
ME (MJ/kg)	12.45	11.93
Crude protein (%)	24.00	20.00
Calcium (%)	0.80	2.50
Available phosphorus (%)	0.72	0.66
Lysine (%)	1.30	1.00
Methionine (%)	0.50	0.45

TABLE 2. Ethogram of behavior

Behavior	Description
Ingestive behavior	
Feeding	Head extended towards available feed troughs
Drinking	The beak of bird in or above the drinkers
In active behavior	
Standing behavior	Standing Idle not engaged in any activity, locking about or with eye closed.
Kinetic Behavior	
Walking	Walking at least two successive steps.
Running	Moving rapidly not walking.
Flying	By forcing wings displacement from one place to another.
Resting Behavior	
Crouching	Laying or sitting breast on the floor, locking about or with closed eye, no other behavior.
Sleeping	Bird's neck is fully recumbent and the eyes permanently closed while lying.
Exploratory behavior	
Foraging	birds pecking food from the ground
Pecking	Birds show strong motivation to investigate environmental content.it includes (trough pecking, wall pecking and feather pecking).
Comfort Behavior	
Preening	Birds clean and groom their feather with the beak while standing or crouching.
Other comfort behavior	Include wings and legs stretching; wing ruffling, head and body shaking.

TABLE 3. Impact of different light color on the frequency Japanese quails' behavior /1hour (Mean ±SE).

Behavior	Control (white)	Blue	Red	Green
Ingestive behavior				
Feeding	8.26 ± 2.35 **ab**	9.20 ± 1.29 **a**	8.80 ± 1.75 **ab**	4.06 ± 0.88**b**
Drinking	6.26±0.68 **b**	11.06±1.86 **a**	10.06±1.30 **ab**	8.60±1.43 **ab**
Inactive behavior				
Standing	55.80±6.60 **a**	36.13±2.68 **b**	31.20±2.92 **b**	34.20±4.32 **b**
Kinetic behavior				
Walking	26.20±2.20 **b**	27.66±2.62 **ab**	36.06±3.65 **a**	22.26±3.50 **b**
Running	0.20±0.14 **b**	1.00±0.36 **a**	1.00±0.41 **a**	1.13±0.79 **a**
Flying	0.46±0.13 **b**	1.21±0.38 **a**	1.35±0.38 **a**	0.80±0.38 **ab**
Resting behavior				
Crouching	7.86±1.53 **ab**	11.13±2.46 **a**	8.25±2.03 **ab**	11.13±2.11 **a**
Sleeping	0.26±0.11	0.66±0.21	0.26±0.11	0.80±0.38
Exploratory behavior				
Foraging	4.20±1.01 **ab**	5.46±1.17 **ab**	6.26±1.33 **a**	2.86±0.63 **b**
Pecking	0.20±0.14	0.60±0.23	0.73±0.31	0.20±0.14
Comfort behavior				
Preening	10.86±1.16	9.33±1.27	10.80±1.48	13.66±2.10
Leg & wing stretching	1.42±0.42	1.60±0.53	1.80±0.39	1.53±0.29
Shaking &ruffling	2.93±0.47 **b**	3.66±0.76 **b**	4.06±0.86 **b**	7.13±1.13 **a**

[a bc] Means within the same row carrying different superscripts are sig. different at P ≤ 0.05 based on Duncan multiple Significant Difference test.

TABLE 4. Impact of different light color on growth performance of Japanese quail.

Growth performance	Control (white)	Blue	Red	Green
Initial body weight(g)	92.39±1.29	93.58±1.18	94.00±1.43	93.87±1.47
Final body weight (g)	249.10±4.10	251.36±6.05	244.84±4.09	251.11±3.37
Weight gain (g)	156.07±2.65 **ab**	163.26 ±3.40a	152.18±2.98b	157.40±3.36ab
Daily weight gain(g)	22.29±0.37 **ab**	23.32±0.48 a	21.74±0.41b	22.48±0.48 ab
Daily feed intake(g)	25.48±1.41	25.03±1.31	26.93±1.63	25.69±1.56
Feed conversion rate(g)	1.16±0.047 b	1.07±0.008 c	1.24±0.031 a	1.14±0.057 b

[a bc] Means within the same row carrying different superscripts are sig. different at P ≤ 0.05 based on Duncan multiple Significant Difference test.

Table 5. Impact of different light color on egg quality of Japanese quail.

Traits	Control (white)	Blue	Red	Green
Egg weight (g)	13.00± 0.24 [b]	12.46±0.31 [c]	13.91±0.19 [a]	12.33±0.31 [c]
Egg length (mm)	32.94±0.24	33.70±0.34	33.82±0.34	33.14±0.32
Egg width (mm)	26.48±0.17	26.40±0.19	26.42±0.14	25.98±0.166
Egg shape index (%)	80.46±0.90 [a]	77.64±1.18 [b]	78.17±0.68 [ab]	78.41±.65 [ab]
Shell thickness (mm)	0.218±0.004 [c]	0.234±0.0028[ab]	0.235±0.004 [a]	0.224±0.0041[bc]
Shell weight (g)	1.84±0.024 [b]	1.73±0.043 [c]	1.93±0.015 [a]	1.84±0.024 [ab]
Albumin weight (g)	7.11±0.132	7.11±0.169	7.27±.078	7.16±0.156
Albumin diameter (mm)	58.75±0.771 [b]	61.52±1.116 [a]	58.07±.691 [b]	57.80±1.000 [b]
Albumin height (mm)	4.59±0.112 [b]	4.56±0.111 [b]	5.08±0.150 [a]	4.70±0.115 [b]
Albumin ratio (%)	54.72±0.557	55.11±0.356	50.07±4.049	55.52±0.218
Yolk weight (g)	4.04±0.142	4.06±0.123	4.16±0.174	3.90±0.141
Yolk diameter (mm)	24.92±0.224	24.28±0.208	24.73±0.378	24.67±0.218
Yolk height (mm)	10.62±0.253	11.11±0.149	11.15±0.144	10.93±0.164
Yolk ratio (%)	31.06±0.651	31.44±.431	31.31±0.536	30.16±0.469
Yolk index (%)	42.58±0.885 [b]	45.78±0.593 [a]	45.21±0.977 [a]	44.45±0.569 [b]

[a bc] Means within the same row carrying different superscripts are sig. different at P ≤ 0.05 based on Duncan multiple Significant Difference test.

TABLE 6. Impact of different light color on reproductive performance of Japanese quail.

Parameters	Control (white)	Blue	Red	Green
Hen day egg production (HDEP %)	76.82±.1.53 [ab]	79.35±0.3.7 [a]	68.46±.4.13 [b]	71.79±.1.68 [ab]
Fertility %	89.61±0.87 [b]	93.07±0.58 [a]	92.32±0.66 [a]	88.33±0.57 [b]
hatchability of total egg %	72.88±0.57 [c]	88.13±0.57 [a]	84.21±0.57 [b]	71.00±0.57 [c]
Hatchability of fertile egg %	81.00±0.57 [c]	94.54±0.57 [a]	90.56±0.57 [b]	79.24±0.57 [c]

[a bc] Means within the same row carrying different superscripts are sig. different at P ≤ 0.05 based on Duncan multiple Significant Difference test.

TABLE 7. Impact of different light color on carcass traits of Japanese quail.

Carcass traits	Control (white)	Blue	Red	Green
Live body weight (g)	227.50±9.37[ab]	240.00±4.47[a]	215.00±6.05[b]	236.66±7.60[ab]
Dressing carcass weight (g)	170.16±7.35[ab]	181.50±7.55[ab]	161.50±4.85[b]	184.16±7.82[a]
Carcass percent (%)	74.76±0.22 [ab]	75.21±1.82 [ab]	73.33±1.30 [b]	77.64±0.98 [a]
Liver (g)	3.68±0.35[ab]	4.29±0.265[a]	3.29±0.156[b]	3.97±0.300[ab]
Gizzard (g)	3.71±0.225	4.11±0.165	3.75±0.237	3.60±0.134
Heart (g)	2.14±0.093	2.29±0.012	2.14±0.104	2.19±0.063
Intestine (g)	6.03±0.294	6.30±0.184	6.22±0.336	6.10±0.162

[a bc] Means within the same row carrying different superscripts are sig. different at P ≤ 0.05 based on Duncan multiple Significant Difference test.

References

1. Nasr, M.A., El-Tarabany, M.S. and Toscano, M.J.. Effects of divergent selection for growth on egg quality traits in Japanese quail. *Animal Production Science*, **56**, 1797-1802 (2016).

2. Mnisi, C. M., Marareni, M., Manyeula, F. and Madibana, M. J.. A way forward for the South African quail sector as a potential contributor to food and nutrition security following the aftermath of COVID-19: a review. *Agriculture and Food Security*, **10**,(1), 48 (2021).

3. Marareni, M. and Mnisi, C. M. Growth performance, serum biochemistry and meat quality traits of Jumbo quails fed with mopane worm (Imbrasia belina) meal-containing diets. *Veterinary and Animal Science*, **10**, 100141 (2020).

4. Remonato Franco, B., Shynkaruk, T., Crowe, T., Fancher, B., French, N., Gillingham, S. and Schwean-Lardner, K.. Light color and the commercial broiler: effect on behavior, fear, and stress. *Poultry Science*, **101**(11), 102052 (2022).

5. Olanrewaju, H.A., Thaxton, J.P., Dozier, W.A., Purswell, J., Roush, W.B. and Branton S.L.. A Review of Lighting Programs for Broiler Production. *International Journal of Poultry Science* **5 (**4), 301-308 (2006).

6. Parvin, R., Mushtaq, M.H., Kim, M.J. and Choi, H.C. Light emitting diode (LED) as a source of monochromatic light: a novel lighting approach for behavior, physiology and welfare of poultry. *World's Poulty Sci.*,**70**(3),543–556 (2014).

7. Manser, C. E.. Effects of lighting on the welfare of domestic poultry: a review. *Animal Welfare*, **5**(4), 341-360 (1996).

8. Calvet, S., Van den Weghe, H., Kosch, R. and Estellés, F.. The influence of the lighting program on broiler activity and dust production. *Poultry Science*, **88** (12), 2504-2511 (2009).

9. Prescott,N.B., Jarvis, J.R. and Wathes,C.M.: Light, vision and welfare of poultry. *Animal Welfare* **12**, 269-288 (2003)

10. Elkomy, H. E., Taha, A. E., Basha, H. A., Abo-Samaha, M. I. and Sharaf, M. M.. Growth and reproduction performance of japanese quails (coturnix coturnix japonica) under various environments of light colors. *Slovenian Veterinary Research*, **56**(22-Suppl),749 (2019).

11. Omer C, Ekrem L. Nilufer S. and Zekeriy, R. Effect of Self-photoperiod on Live Weight, Carcass and Growth Traits in Quails (Coturnix Coturnix Japonica) *Asian-Aust.J. Anim. Sci.,* **3** , 410 – 415 (2009).

12. Mohammed, H. H., Rehan, I. F., Abou-Elnaga, A. F. and Mohamed, R. A.. Effects of feeder shape on behavioral patterns, performance and egg quality traits of Japanese quail. *Slovenian Veterinary Research*, **56** (22), 139-148 (2019).

13. Karousa, M.M., Ahmed, S.A., Elaithy, S.M. and Elgazar, E.A. Effect of housing system and sex ratio of quails on egg production, fertility and hatchability. *Benha Vet. Med.*, **28**, 241–7(2015).

14. Nasr, M. A., Mohammed, H., Hassan, R. A., Swelum, A. A. and Saadeldin, I. M. Does light intensity affect the behavior, welfare, performance, meat quality, amino acid profile, and egg quality of Japanese quails?. *Poultry Science*, **98**(8), 3093-3102 (2019).

15. Mohammed, H. H. Effect of different photoperiods on some maintenance behavior, external and internal egg quality traits of layers. *Japanese Journal of Veterinary Research*, **64**(Supplement 2), S139-S142 (2016).

16. Mohammed, H. H.. The Potential Effect of Circadian Rhythms and Lighting Duration on Behavior and Growth Performance of Quails under Egyptian Condition. *Zagazig Veterinary Journal*, **45**(Supplementary 1), 31-36 (2017).

17. El-Tarabany, M. S., Abdel-Hamid, T. M. and Mohammed, H. H.. Effects of cage stocking density on egg quality traits in Japanese quails. *Kafkas Universitesi Veteriner Fakultesi Dergisi Journal* **21**(1),13-18(2014).

18. Taha, A. E.. Laying performance of Japanese young chickens in response to chromic heat stress quails divergently selected for body weight under conditions. *Egypt. J. Anim. Prod.*, **32**, 237-251 (2009).

19. Li D., Zhang L., Yang, M., Yin, H., Xu, H., Trask, J.S,, Smith, D.G., Zhang, Z. and Zhu, Q. The effect of monochromatic light-emitting diode light on reproductive traits of laying hens. *J. Appl. Poult. Res.*, **23**,367–75(2014).

20. Ahmad, F., Sharif, M., Ashraf, M., Riaz, M., Shoaib, M., Siddique, T, Ahmed, A., Sheir, A. H., Ahsan Yaseen, M.A. and Ali, M.. Effect of different light intensities and colors on growth performance and reproductive characteristics in Japanese quails. *Turkish Journal of Veterinary & Animal Sciences*, **47**(3), 185-193 (2023).

21. Ibrahim, S. A., El Kholya, S. Z., El-Far, A. H. and Mahrous, U. E.. Influence of lighting color on behavior, productive traits and blood parameters of Japanese quail (Coturnix Coturnix Japonica). *World Academy of Science, Engineering and Technology*, **67**, 1234-1244 (2012).

22. Huber-Eicher, B.; Suter, A. and Spring-Stahli, P.. Effects of colored light-emitting diode illumination on behavior and performance of laying hens. *Poult. Sci.*, **92**, 869–873(2013).

23. Hesham, M. H., El Shereen, A. H. and Enas, S. N.. Impact of different light colors in behavior, welfare parameters and growth performance of Fayoumi broiler chickens strain. *Journal of The Hellenic Veterinary Medical Society*, **69**(2), 951-958 (2018).

24. Ibrahim S. A. and Mohamed R.A. Effect of different light colors on behavior and fear reactions of Japanese Quails (Coturnix coturnix japonica) *Bioscience Research*, 2019 **16**(S1-2), 62-70 (2019).

25. Oke, O. E., Oso, O., Iyasere, O., Oni, A., Bakre, O. and Rahman, S.. Evaluation of Light Color Manipulation on Behavior and Welfare of Broiler Chickens. *Journal of Applied Animal Welfare Science*, **26**(4), 493–504 (2021).

26. José Paixão, S., Mendes, A. S., Possenti, M. A., Sikorski, R. R., do Vale, M. M., de Souza, C. and Nunes, I. B.. Broiler behavior differs from males to females when under different light wavelengths. *Tropical Animal Health and Production*, **54**(3), 189 (2022).

27. Sultana, S.; Hassan, M.R.; Choe, H.S. and Ryu, K.S.. The effect of monochromatic and mixed LED light colour on the behaviour and fear responses of broiler chicken. *Avian Biol. Res.*, **6**, 207–214(2013).

28. Karal, S., Korkmaz Turgud, F., Narinç, D. and Aygun, A.. The Behavioral and Productive Characteristics of Japanese Quails (Coturnix japonica) Exposed to Different Monochromatic Lighting. *Animals*, **14**(3), 482 (2024).

29. Son, J.H. and Velmurugu, R. The effects of light colors on the behavior and performance of broiler chickens. *Korean Journal of Poultry Science*, **36** (4), 329-335 (2009)

30. Senaratna, D., Samarakone, T.S., Madusanka, A.P. and Gunawardane, W.D. Preference of broiler chicken for different light colors in relation to age, session of the day and behavior. *Tropical Agricultural Res.*, **23**, 193-203 (2012).

31. Mohammed, H. H., Grashorn, M. A. and Bessei, W.. The effects of lighting conditions on the behaviour of laying hens. *Archiv fur Geflugelkunde*, **74**(3), 197-202 (2010).

32. Senaratna, D., Samarakone, T.S., Madusanka, A.P. and Gunawardane, W.D. Performance, behavior and welfare aspects of broilers as affected by different

colors of artificial light. *Tropical Agricultural Res. Extens.,* **14**, 38-44 (2011).

33. Liu, W., Wang, Z. and Hen, X. Effect of monochromatic light on development changes in satellite cell population of pectoral muscle in broilers during early post hatch period. *Anat. Rec.,* **293**, 1315-1324 (2010).

34. Al-Hsenawi, Z. K., Hamed, M. H., Al Salman, N. T. and Al-Gharawi, J. K. The effect of lighting color on some of the productive traits of japanese quail. *Plant Archives*, **20**(1), 2935-2938 (2020).

35. Al-Hummod, S. K.. Effect of Light Intensity and Color in Some Productive and Physiological Traits of Japanese quail. *Basrah Journal of Veterinary Research*, **19**(2),1-16 (2020).

36. Abdelnabi, M. A., Sayed, M. A., Telson, D. and Abdelfattah, M. G.. Response of Japanese Quail to Different LED Light Colors. *Assiut Journal of Agricultural Sciences*, **54**(4), 276-285 (2023).

37. N'zue, K.S., Traore, B., Soro, D., Okon, A.J.L. and Coulibaly SBM.. Effect of photoperiod on some zootechnical performances of quail (Coturnix Coturnix Japonica) raised in cage in Côte D'ivoire. *International Journal of Sciences: Basic and Applied Research*, **42**, 1-14(2018).

38. Bala, S., Impact of LED (light emitting diode) tubes artificial lighting system on broiler production. Master thesis, Department of Animal Nutrition, Genetics and Breeding, Faculty of Animal Science & Veterinary Medicine, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh (2020).

39. Nunes, K., Garcia, R, Nääs, I., Eyng, C., Caldara, F., sgavioli, S., BC Roriz, B.C. and Ayala, C. M. Effect of LED lighting colors for laying Japanese quails. *Brazilian Journal of Poultry Science*; **18**, 51-56 (2016).

40. Furtado, D. A., Braz, J. R., do Nascimento, J. W., Lopes Neto, J. P. and Oliveira, D. L.. Production and quality of japanese quail eggs submitted to environments with different light spectrums. *Engenharia Agrícola*, **38**, 504-509 (2018).

41. Er, D., Wang, Z., Cao, J. and Chen, Y.. Effect of monochromatic light on the egg quality of laying hens. *Journal of Applied Poultry Research*, **16**(4), 605-612 (2007).

42. Hassan, M.R., Sultana, S., Choe, H.S. and Ryu, K.S. Effect of monochromatic and combined light color on performance, blood parameters, ovarian morphology and reproductive hormones in laying hens. *Italian J. Anim. Sci*.,**12**, 3 (2013)

43. Firouzi, S., Nazarpak, H. H., Habibi, H., Jalali, S. S., Nabizadeh, Y., Rezaee, F. and Marzban, M.. Effects of color lights on performance, immune response and hematological indices of broilers. *Journal of World's Poultry Research*, **4**(2), 52-55 (2014).

44. Hamilton, R. M. G.. Methods and factors that affect the measurement of egg shell quality. *Poult. Sci.,* **61**, 2022–2039(1982).

45. Yang, Y.F., Jiang, J.S., Pan, J..M., Ying, Y.B., Wang, X.S., Zhang, M.L. Lu, M.S. **and** Chen, X.H. . The relationship of spectral sensitivity with growth and reproductive response in avian breeders (Gallus gallus). *Sci. Reports,* **14** (6), 19291(2016).

46. Ayorinde, K. L.. Physical and chemical characteristics of eggs of four Indigenous guinea fowls (Numidia meleagris gallenta pallas). *Nig. J. Anim. Prod.,* **14**, 125–137(1987).

47. Baxter, M., Joseph, N., Osborne, V. and Bedecarrats, G. Red light is necessary to activate the reproductive axis in chickens independently of the retina of the eye. *Poult Sci*., **93**,1289–1297(2014).

48. Retes, P.L, Espósito, M., das Neves, D.G., Viana, A.G, Coelho, L.M., Bobadilla-Mendez M.F., Alvarenga, R.R., Fassani, E. J., Zangeronimo, M.G. Influence of different types of lamps on the reproductivedevelopment of male Japanese quail (Coturnix coturnix japonica). *Theriogenology*, **94**, 59–63(2017).

49. Mohamed, R., Shukry, M., El-kassas, S. and Elsaidy, N. Manipulation of broiler growth performance, physiological and fear response using three monochromatic LED lights. *Alexandria Journal of Veterinary Sciences*, **53**, 57-62(2017). https://doi.org/10.5455/ ajvs.263048.

50. Seber, R., Moura, D., Lima, N. and Massari, J. LED tubs artificial lighting system in broiler production. *Journal of Agricultural Engineering*, **38**, 319-325(2018).

51. Soliman, E.S. and Hassan, R.A.. Impact of lighting color and duration on productive performance and Newcastle disease vaccination efficiency in broiler chickens. *Veterinary World*, **12** (7), 1052 (2019).

52. Fidan, E. D. and Mehmet, K. A. Y. A.. Effect of LED Light Color and Stocking Density on Growth Performance, Carcass, and Meat Quality Characteristics of Japanese Quails. *Kafkas Universitesi Veteriner Fakultesi Dergisi*, **29** (5), 521 (2023).

53. Sayin, Y., Kaplan, O., Karaduman, E., Haqyar, D. M. and Narinç, D.. The effect of monochromatic, combined, and mixed light-emitting diode light regimes on growth traits, fear responses, and slaughter-carcass characteristics in broiler chickens. *Tropical Animal Health and Production*, **54**(5), 277 (2022).

54. Ke, Y. Y., Liu, W. J., Wang, Z. X. and Chen, Y. X. Effects of monochromatic light on quality properties and antioxidation of meat in broilers. *Poultry Science*, **90**(11), 2632-2637 (2011).

55. Ahmad, F., Ahsan-Ul-Haq, M. S., Zafar, S. A., Yousaf, M. and Ashraf, M.. Comparative effect of light emitting diode versus traditional light source on performance, slaughter characteristics, immunity and gland's weight of broiler. *Scholar's Advances Animal Veterinary Research*, **1**(1), 14-19 (2014).

56. Hassan, R. A., Samy, A., & Soliman, E. S.. Effect of monochromatic light on performance, behavior, and meat quality of Japanese quail. *Animals*, **14**(3), 482 (2022).

تأثير لون الضوء على الأنماط السلوكية والصفات الإنتاجية للسمان

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الملخص

هدفت هذه الدراسة إلى التحقيق في تأثير ألوان الضوء المختلفة على سلوك وإنتاجية طيور السمان اليابانية. تم تقسيم 192 من صيصان السمان اليابانية حديثة الفقس إلى أربع مجموعات علاجية، كل منها تحتوي على ثلاثة تكرارات. تعرضت الطيور في المجموعة الحاكمة للضوء الأبيض، بينما تعرضت المجموعات الأخرى للضوء الأزرق والأحمر والأخضر. استمرت التجربة لمدة 7 أسابيع. تم استخدام تقنية المسح لتوثيق سلوكيات السمان. علاوة على ذلك، تم تقييم أداء النمو، وجودة البيض، وأداء الفقس، وخصائص الذبح. كان لألوان الضوء تأثير على معظم سلوكيات طيور السمان اليابانية. كان السلوك الغذائى (الاستهلاكى)، والجري، والطيران، والرقود أعلى بكثير تحت الضوء الأزرق. بينما كانت سلوكيات المشي والاستكشاف أعلى في الضوء الأحمر. زاد سلوك الراحة تحت الضوء الأخضر. لم يكن لألوان الضوء المختلفة تأثير واضح على الوزن النهائي للجسم، لكنه كان الأعلى بين طيور السمان التي تم تربيته تحت الضوء الأزرق والأخضر. وبالمثل، تحسنت زيادة الوزن اليومية، ومعدل تحويل العلف، ونسبة خصوبة البيض، ونسبة الفقس بشكل كبير تحت الضوء الأزرق. كانت طيور السمان التي تعرضت للضوء الأحمر تمتاز بوزن بيض أعلى، وسمك قشرة البيض، ووزن القشرة، ومؤشر صفار البيض، وارتفاع البياض مقارنةً بالمجموعات الأخرى. تحسين وزن الذبح ونسبة الذبح في الطيور التي أعطيت الضوء الأخضر مقارنة بالألوان الاخرى بناءً على ذلك، يعتقد أن استخدام برامج الإضاءة الزرقاء والخضراء في تربية السمان الياباني يوفر فوائد جيدة من حيث الرفاهية والإنتاج

الكلمات الدالة: السمان اليابانى، الوان الاضاءة، السلوك، الانتاجية.