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Short Communication

Effect of Photostimulation Age on Egg Quality and Hatching Traits in Japanese Quail

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Abstract: The timing of sexual maturity in birds is crucial for reproductive success and is significantly influenced by light exposure. This study aimed to investigate the effect of age at photostimulation on egg quality and hatching traits in quails. A total of 300 quails (75 males and 225 females) were divided into 15 replicates and randomly assigned to one of three treatments (age at photostimulation: 30, 35, and 40 days). The birds were housed in specially designed cages and received 16 hours of light stimulation at the respective ages. Egg quality and hatching traits were evaluated from the 5th to the 12th week of age. Results showed no significant differences in egg weight, shell thickness, or Haugh unit scores among the different ages of light stimulation. Fertile egg production and hatchability were also not significantly affected by the age of photostimulation. However, significant differences were observed in the occurrence of dead embryos and hatchling weights among the different age groups exposed to light stimulation. Birds stimulated at the 35th day had a lower incidence of dead embryos and higher hatchling weights compared to those stimulated at the 30th and 40th days.

Keywords: egg weight; hatchability; Haugh unit; sexual maturity

1. Introduction

Egg production and sexual maturity depend upon genetically determined minimum chronological age, minimum body weight, proper feed intake, and an increase in the day length [1]. Desired egg size can be attained by using photostimulation as a tool. The early light stimulation generally improves the number of eggs but reduced egg weight. On the other hand, later light stimulation results in fewer eggs with more egg weight. So, the lighting demands can be customized to meet the specialized market egg size [2]. The proper lighting system has a very strong influence on egg number, egg size, bird's livability, and profitability as egg production has a direct relation to the changes in day length to which the pullets are exposed [1].

In egg production, factors such as light intensity, wavelength, duration, source, and the age at which photostimulation occurs are crucial [3]. It has also been suggested that once the bird has started egg production, the focus should be to increase the light duration to balance the period of photo refractoriness [4]. In fully or semi-confined housing, daylight plays a crucial role in developing a lighting program for egg production. Artificial light is used to compensate for shorter day lengths [5]. Studies have assessed the use of light stimulation to enhance egg size. Harms et al. [6] reported a non-significant increase in egg weight among commercial laying hens that received light stimulation at 22 weeks of age compared to those stimulated at 18 weeks of age. On the other hand, Ernst et al. [7] stated that egg weight can be increased by delaying maturity with an appropriate lighting program. The experiment conducted by Lein and Yaun [8] yielded similar results. Birds were photo stimulated at 20 and 22 weeks of age, revealing significant differences in parameters such as age at first egg, age at 20% and 50% hen day, pre- and post-peak egg

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production. In the same study, it was further observed that there existed significant differences in total egg production, several fertile eggs, and feed/dozen eggs.

Quail is a valued bird in the poultry industry because of its distinctive characteristics, such as disease resistant, early sexual maturity, high egg production, and minimal space requirements for housing [9]. Quail farming started in Pakistan in the early 70's but could not flourish due to various reasons from which the most important being the managemental aspects. Among the array of management practices, light management stands as fundamental [10]. The literature lacks a comprehensive manual for raising Japanese quail, covering ideal weights for each phase, nutritional needs, lighting management, and other essential aspects [11].

Achieving sexual maturity at the right age and weight is paramount for reproductive success, and this study aimed to contribute to this objective. Therefore, the present study has been planned with the basic objective to evaluate photostimulation time on egg quality and hatching traits of Japanese quail.

2. Materials and Methods

2.1. Study Birds, Treatment Groups, and Housing Management

The study was carried out at the Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore. A total of 300 quails (75 males and 225 females) were divided into 15 replicates, with each replicate consisting of 5 males and 15 females. The quails were randomly assigned to one of three treatments (age at photostimulation: 30, 35, and 40 days) following a completely randomized design and were followed from the 5th to the 12th week of age. The birds were housed in specially remodeled, French-made multi-deck cages measuring 30×20×15 cm, which provided separate compartments for breeding, feeding (20% CP, 2900 Kcal/kg), and egg collection. These cages were placed in a well-ventilated, octagonal quail house measuring 33×12×9 ft.

Upon hatching, the birds received 24 hours of light for the first 3 days. From the fourth day until the intended age for photostimulation, they were given 8 hours of light per day. Subsequently, the birds received light stimulation at the ages of thirty, thirty-five, and forty days, respectively, with a duration of 16 hours.

2.2. Egg Quality cand Hatching Traits

Shell thickness was measured using a micrometer screw-gauge (MI-TUTOYO; 5C687, Japan). Yolk index was calculated using the formula:

$$\text{yolk height (mm) / yolk width (mm)} \times 100$$

Haugh unit was calculated using the formula:

$$100@\log\ [H + 7.57 - 1.7 \times W\text{^}0.37]$$

where H = albumen height in mm, W = egg weight (g).

For hatching traits, fertile eggs, hatchability, dead embryos, and failed-to-pip percentages were calculated as percentages of the total eggs set in the incubator. Hatchling weight was recorded using an electrical weighing balance capable of measuring up to 0.05 g.

2.3. Statistical Analysis

The data were analyzed using the one-way ANOVA technique applying the General Linear Model procedure in SAS [12]. Pairwise comparisons of least-square means were conducted using Fisher's LSD test with statistical significance at $p \leq 0.05$.

3. Results and Discussion

The results on egg quality and hatching traits are presented in Table 1. There was no significant difference in egg weight among the three different ages of light stimulation (30th, 35th, and 40th day; $p > 0.05$). The average egg weight was 12.93 g (Table 1). Likewise, the stimulation at different ages did not influence the eggshell thickness during pre-peak production ($p > 0.05$). The average eggshell thickness was 0.18 mm. There are limited studies on quails to compare with the current results; however, studies on other poultry birds have shown a negative impact with the increase in photoperiod. Backhouse et al. [13] conducted a study in which birds were exposed to constant photoperiods ranging from 10 to 16 hours starting at 3 days of age and found that eggshell thickness decreased significantly by 0.57 mg/cm^2 for each one-hour increase in photoperiod. Additionally, Haugh unit scores were similar for all the three different ages of light stimulation during pre-peak production ($p > 0.05$). The average Haugh unit score was 96.98 (Table 1).

Table 1. Egg quality and hatching traits of Japanese quail photo stimulated at different ages.

Traits	Age at Photostimulation Means [1] ± SE			P-value
	30 days	35 days	40 days	
Egg weight (g)	13.18 ± 0.14	13.01 ± 0.39	12.61 ± 0.15	0.319
Yolk index	46.29 ± 1.24	46.70 ± 1.05	44.43 ± 0.96	0.304
Shell thickness (mm)	0.18 ± 0.001	0.18 ± 0.001	0.18 ± 0.001	0.226
Haugh unit score	98.16 ± 0.63	97.88 ± 0.52	96.90 ± 0.58	0.285
Fertile egg (%)	96.24 ± 1.75	94.04 ± 1.36	95.90 ± 1.37	0.554
Hatchability (%)	75.99 ± 2.94	82.92 ± 3.31	85.83 ± 2.36	0.085
Dead embryo (%)	13.66 ^{a} ± 2.48	7.58 ^{b} ± 1.64	5.97 ^{b} ± 0.77	0.023
Hatchling weight (g)	7.80 ^{a} ± 0.09	8.66 ^{b} ± 0.04	8.14 ^{c} ± 0.02	< 0.001

[1] Means with different letters in the same row are statistically different ($p \leq 0.05$). SE: standard error of the means.

No significant differences were observed in fertile egg production among the three different ages of light stimulation ($p > 0.05$). This lack of difference could be attributed to the experimental conditions, where all replicates in the three treatment groups had equal ratios of males and females belonging to the same age group. None of the males in any replicate received any special reproductive treatment, and all replicates had equal access to feed and water. Therefore, it can be concluded that photostimulation had a non-significant impact on fertility. Similarly, there were no significant differences observed in hatchability among the three different ages of light stimulation (Table 1; $p > 0.05$). However, the group with photostimulation on the 30th day had lower hatchability.

The age at photostimulation significantly influenced the percentage of dead embryos (Table 1; $p = 0.023$). Birds photo stimulated at the 35th and 40th days of age had 6.08% and 7.7% a lower dead embryo compared to those stimulated at the 30th day of age, respectively. Similarly, photostimulation had a significant effect on hatchling weights (Table 1; $p < 0.001$). Birds stimulated on the 30th day had lowest Hatchling weight (7.8 g) followed by the birds stimulated at 40th day (8.14 g) and 35th day of age (8.55 g; Table 1).

These findings are consistent with previous literature suggesting that early photostimulation may not always improve egg production in broilers [14]. In line with current results, Lewis et al. [15] found that broiler birds exposed to a 14-hour photoperiod reached maturity approximately 5 days earlier and produced more eggs. However, some of these eggs were too small for hatching. Additionally, the study did not find significant differences in maturity between conventionally grown birds subjected to increasing or decreasing day lengths or those maintained on a 14-hour photoperiod.

The current study shows that while photostimulation can cause early sexual maturity in quails, it may lead to negative effects such as decreased hatchability and lower hatchling weights. This highlights the need for optimum management of photostimulation in quail production to increase embryo survivability and hatchling weights. Further research could explore the specific mechanisms behind these effects to better inform photostimulation management practices in quails.

5. Conclusions

The study demonstrates that age at photostimulation does not significantly impact egg quality and hatching traits in quails. However, it does influence the occurrence of dead embryos and hatchling weights. These findings contribute to our understanding of the reproductive biology of quails and may help in optimizing photostimulation protocols for improved reproductive success in quail production.

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