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Research Article

Impact of Different Ambient Temperatures on Egg-Laying and Hatching Parameters in Japanese Quail

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Abstract

The objective of this study was to determine the impact of different ambient temperatures on egg production, fertility, embryonic mortality, and hatching parameters in Japanese quail. Sixteen weeks old male and female Japanese quail were assigned to 10 cages as 1 male and 5 females. Quails were housed in a poultry yard belonging to the Faculty of Agriculture. Quails were reared under 16 hours' light and 8 hours' dark photoperiod. During the study, water and food were freely available as ad-libitum. Regularly egging five-layer cages were selected and their laying and hatching performances were compared for three weeks when there were highest differences in average room temperatures (22.38 ± 0.21; 23.10 ± 0.04 and 23.76 ± 0.18°C). Changes in weekly mean ambient temperatures did not affect egg weights, egg mass, weekly egg laid/hen, and weekly egg weight/hen. Fertility and hatching rates were also not significantly changed (P>0.05). Lower ambient temperature (22.38°C) caused a significant reduction in hatchability and increment in embryonic mortality as compared with the 23.10°C group. It is possible to postulate from the data presented here that the best room temperature for hatchability and lower embryonic mortality in Japanese quail, is around 23°C.

Keywords: Egg, fertility, hatchability, hatching, quail

Farklı Çevre Sıcaklılarının Japon Bıldırcınlarının Yumurtlama ve Çıkış Parametrelerine Etkisi

Öz

Bu çalışmanın amacı farklı çevre sıcaklıklarının yumurta verimi, döllülük, embriyonik mortalite ve çıkış parametrelerine etkisini Japon bıldırcınlarında ölçmektir. On altı haftalık erkek ve dişi Japon bıldırcınları, Ziraat Fakültesi tavukçuluk işletmesinde, 1 erkek 5 dişi olmak üzere 10 ayrı kafes gözüne konuldular. Çalıma boyunca bıldırcınlar 16 saat ışıklandırma ve 8 saat karanlık döngüsüne maruz bırakıldılar. Çalışma boyunca su ve yiyecek devamlı serbestçe mevcuttu. Düzenli yumurtlayan beş kafes seçilerek yumurtlama ve çıkış performansları haftalık ortama sıcaklık değerleri arasındaki farkların en yüksek olduğu üç hafta (22.38 ± 0,21; 23.10 ± 0,04 ve 23,76 ± 0,18°C) karşılaştırıldılar. Haftalık ortalama sıcaklık değişimleri yumurta ağırlığını, yumurta kitlesini ve bıldırcın başına haftalık yumurta verimini etkilemedi. Döllülük ve çıkış oranları da önemli seviyede değişmedi (P>0,05). Düşük çevre sıcaklığı (22.38°C) çıkış gücünde ve embriyo mortalitesinde "23.10°C" ye kıyasla, önemli seviyede azalmaya neden oldu. Mevcut veriler yardımıyla bıldırcınlarda en iyi çıkış gücü ve en düşük embriyonik mortalite için en uygun sıcaklığın 23°C civarında olduğunu söylemek mümkündür

Anahtar Kelimeler: Bıldırcın, çıkış gücü, çıkış, döllülük, yumurta

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1 Introduction

Japanese quail (Coturnix japonica) is a domestic bird belonging to the order Galliformes and the family Phasianidae. Quails have been farmed for commercial egg and meat production since 1900 [1]. Its meat and eggs are sources of animal protein with high biological value due to their lower caloric content [2]. In addition, quails have important advantages such as they are growing fast, reaching sexual maturity early, being resistant to disease, producing a high number of eggs, having short generation intervals, and having a short incubation period [3]. These advantages rendered the Japanese quail to be used as an important experimental animal for scientific research mainly in universities, after World War II [1]. Recently, quail have been accepted as model animals in large-scale genetic studies and as well as in studies investigating reproductive endocrinology and behaviour [1, 4]. Presently, quail farming is expanding and creating new jobs and income in all stages of the industry [5].

Temperature is one of the environmental factors affecting the performance of quails. It has been reported that an increase in temperature has a major impact on egg-laying, egg weight, and egg mass [6]. The thermoneutral zone, for laying quails, is between 18 and 22 ºC [6]. It has been reported that exposing the quail to 34°C from 12:00 to 16:00h caused a decrease in egg weight, while there was no difference in fertilization rate as compared with that of quail exposed to 25°C [7]. According to a study, exposing quail eggs to a high temperature of around 30°C reduced hatching and increased mortality rates [8]. High temperature can also decrease egg production [9].

The impact of temperature on egg-laying performance and hatchability is quite clear but, the majority of studies in this area were mainly done on chickens and the majority of them generally focused on the effect of temperatures outside of the thermoneutral zone. It is quite possible that the ambient temperatures within limits of the thermoneutral zone in the room, where cages are placed, may have also an impact on egg-laying and hatching performances. Therefore, the main aim of this study was to monitor the impact of different room temperatures, within the limits of the thermoneutral zone, on egg-laying and hatching parameters in Japanese quail.

2 Material and Methods

2.1 Quails, grouping, and feeding

This study was conducted within the coverage of BAP project no: 19401124. Birds were treated in accordance with the animal right comity act no 5199, published in 25509 numbered formal State paper on 01 July 2004. The related certificate was obtained from the School of Agriculture (Certificate no: 2019/2-004).

Sixteen weeks old male (n= 10) and female (n= 50) Japanese quail (Coturnix japonica) were placed into 10 cages as 1 male and 5 females. Quails were housed under a 16-hour light and 8-hour dark photoperiod (16L:8D) in the poultry-yard belonging to the Faculty of Agriculture. During the course of the study, water and food were freely available providing 20% crude protein, 2900 kcal/kg metabolic energy, 2.5% calcium, and 0.35% available phosphorus. Along

the eight weeks of experimental period, regular five-layer cages were chosen and their egg production and hatching performances were compared for three weeks during which the weekly average room temperature differences were the highest (22.38 0.21; 23.10 0.04; and 23.76 0.18°C). Daily room temperatures were recorded using a digital thermometer, installed within the room.

2.2 Measurements of egg mass, egg weight, weekly egg laid/hen, and egg weight/hen

All were calculated by formulas as written below.

2.2.1. Egg mas (g/quail/day)

[(weekly egg produced per quail) *The mean weight of an egg (g)]/7

2.2.2. Weight of an egg

The total daily egg weight per cage/Number of eggs laid per cage.

2.2.3. Weekly egg laid/hen

The weekly number of eggs collected from a cage/Number of hens in that cage.

2.2.4. Weekly egg weight per hen

Total weekly egg weight of a cage/The number of hens in that cage.

Eggs were weighed daily by using a scale with a sensitivity of 0.01gr.

2.2.5. Egg collection and storage

From Monday to Sunday, eggs were daily collected, and stored in a cupboard (YMK-FN-685722, Qualitec) for a week and then incubated on Mondays. The temperature and humidity within the cupboard were set to 15ºC and 75%.

2.2.6. Incubation

Every week on Mondays at 7 pm, eggs were incubated using an incubator (T960 S, Cimuka). The number of eggs collected and incubated each week was displayed in Table 1. The temperature and humidity were set to 37.7ºC and 55% for two weeks. After the two weeks, eggs were transferred in a hutching machine (T960 H, Cimuka), in which temperature and humidity were set to 37.2ºC and 70% for 3 days.

Table 1. The number of eggs collected and incubated each week

Weeks	Number of Eggs Collected	Number of Eggs Incubated
Week-I (22.38 ± 0.21°C)	150	138
Week-II (23.10 ± 0.04°C)	149	141
Week-III (23.76 ± 0.18°C)	157	157

2.2.7. The measurement of the number of infertile eggs, fertile eggs, and hatched eggs

After the completion of the hatch, the shells of hatched eggs were counted to determine the number of hatched eggs. The number of infertile eggs and the number of not hatched eggs bearing an embryo were determined after breaking the eggs. The eggs not bearing an embryo were accepted as unfertilized. The number of fertile eggs is determined as below.

Hatched eggs: H

Number of eggs bearing an embryo: E

Number of fertile eggs (F): H + E

2.2.8. Determination of fertility, hatching rate, and hatchability

The number of eggs accepted as fertile: F

The hatched number of eggs: H

Embryo bearing not hatched eggs: E

Number of eggs incubated: I

F = H + E

Fertility (%) = (F/I) x100

Hatching rate eggs (%) = (H/I) x 100

Hatchability (%) = (H/F) x100

2.2.9. Determination of embryonic mortality (%)

Embryonic mortality is measured according to the formula below

The number of counted fertile eggs: F

The number of counted hatched eggs: H

Embryo mortality (%) = ((F-H)/F) *100

2.2.10. Statistical analysis

Data were analysed by analysis of variance (ANOVA) using Minitab statistical software. Pairwise comparisons were carried out according to the Tukey test, with 95% confidence intervals.

3 Results and Discussion

Egg-laying performances and hatching traits were displayed in Tables 2 and 3. Changes in weekly mean ambient temperatures did not affect egg weights, egg mass, weekly egg laid/hen, and weekly egg weight/hen (Table 2, P>0.05). Fertility and hatching rates were also not significant (P>0.05). Lower ambient temperature (22.38°C) caused a significant reduction in hatchability and increment in embryonic mortality as compared with the 23.10°C group (Table 3, P>0.05).

Table 2. The effect of ambient temperature on egg laying parameters

	Mean ambient temperatures (°C)			
Measured parameters	**22.38 ± 0.21**	**23.10 ± 0.04**	**23.76 ± 0.18**	**P-Value**
Egg weight (gr)	11.27 ± 0.19^{A}	11.33 ± 0.21^{A}	11.64 ± 0.20^{A}	0.948
Egg mass (gr/hen/day)	9.65 ± 0.81^{A}	9.68 ± 0.89^{A}	10.05 ± 0.35^{A}	0.910
Weekly egg laid/hen	6.00 ± 0.50^{A}	5.96 ± 0.49^{A}	6.20 ± 0.23^{A}	0.915
Weekly egg weight/hen	67.58 ± 5.70^{A}	68.15 ± 6.27^{A}	70.38 ± 2.44^{A}	0.919

*Data displayed as Mean ± Standard error of the mean
*Data with different superscripts in the same line are statistically different

Table 3. The effect of ambient temperature on hutching traits

	Mean ambient temperatures (°C)			
Measured parameters	**22.38 ± 0.21**	**23.10 ± 0.04**	**23.76 ± 0.18**	**P-Value**
Fertility rate (%)	99.39 ± 0.61^{A}	84.06 ± 7.63^{A}	86.18 ± 8.81^{A}	0.259
Hatching rate (%)	93.56 ± 1.37^{A}	73.55 ± 8.18^{A}	83.61 ± 9.90^{A}	0.208
Hatchability (%)	91.78 ± 0.64^{B}	97.63 ± 1.59^{A}	95.65 ± 2.00^{AB}	0.053
Embryo mortality (%)	8.22 ± 0.64^{A}	2.37 ± 1.50^{B}	4.35 ± 2.00^{AB}	0.053

*Data displayed as Mean ± Standard error of the mean
*Data with different superscripts in the same line are statistically different

In this study, we have not seen important differences in egg weight and egg mass due to the changes in temperatures. In a study on brown hens exposed to either 26 °C or 30 °C for 28 days. Egg production, egg weight, and egg mass did not change by thermal treatment [10]. In this study, the animal species, and applied temperatures all were different from the study [10] but, we have also not found notable differences in egg production, egg weight, and egg mass.

Studies on hens report a reduction in egg production at high temperatures. According to one of them, egg production is maximum at 23 °C for commercial line brown hens and maximum at 24 °C for White Leghorns, while egg production was reduced in both breeds at 30 °C [11].

In another study, groups of 18 white Leghorn hens were housed in each of three climatic chambers with light schedules of 14L:10D. One was maintained at a constant temperature of 23.9 °C, the second was cycled between 15.6 and 37.7 °C (mean 26.7 °C), and the third was cycled between 21.1 and 37.7 C (mean, 29.4 °C). It was reported that egg weight was significantly reduced by mean temperatures of 26.7 and 29.4 °C in cycling chambers as compared with those raised under 23.9 °C. Keeping the hens at a constant temperature of 23.9 °C, resulted in the production of significantly heavier eggs [12].

In another study, 52 weeks old laying hens were raised in three temperatures, either normal temperature (22°C) or heat stress considered being moderate (27°C) or severe (32°C) for 42 days. Egg production kept numerically low in hens exposed to 32°C as compared with those raised under 22 and 27°C. Egg mass and egg weight are consistently low in hens exposed to 32°C as compared with those raised under 22 and 27°C [13]. According to another study, continuous exposure of laying quails to 32 °C decreased laying rate and egg mass [14].

From these studies, it is clear that higher temperatures around 30°C or over have an adverse effect on egg production, egg weight, and egg mass. Here, we exposed the quails to lower ambient temperatures of 22.38, 23.10, and 23.78. All these temperatures are within the limits of the thermoneutral zone, and that was the reason why we have not seen significant differences in egg weight and egg mass ($P>0.05$). In this study, no differences in fertility and hatching rates have been seen between the quail groups exposed to different ambient temperatures. In a study, Japanese quails were exposed to 25°C (control) or 34°C (heat) from 12:00 to 16:00 and the fertility rate did not change due to the temperature, while egg weight decreased in quails exposed to 34°C [7]. Even though the temperatures we applied were different from the temperatures applied by [7], we have the same results.

In this study, lower ambient temperature (22.38°C) caused a significant reduction in hatchability and increment in embryonic mortality as compared with the 23.10°C group. Temperature over 23.10° (23.76 °C) also caused a reduction in hatchability and increment in mortality as compared with the 23.10°C group but, the differences were not significant ($P>0.05$). It is quite unlucky that we could not find relevant data from the literature to compare with the results obtained from this experiment.

4 Conclusion

Although the temperatures applied did not change egg weight and egg mass, but were enough to cause changes in hatchability and embryo mortality. It is possible to postulate from the data presented here that the best room temperature for hatchability and for lower embryonic mortality in egg-laying Japanese quail, is around 23°C.

Ethics in Publishing

There are no ethical issues regarding the publication of this study.

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