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The Effects of Sound (Frequency & Music) On Egg Production in Japanese Quail (*Coturnix Coturnix Japonica*) Under Laboratory Conditions

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Abstract: The purpose of this study is to investigate the effects of both music and frequency of sound on egg-damaging in Japanese quail under controlled environmental conditions. For integrative investigation of the effects of music and frequency on the complex interrelation between egg-damaging and sound, we measured egg yield and behaviour characteristics. 48 female and 8 male Japanese quails (*Coturnix coturnix japonica*) were randomly divided into two groups with two replicates. The experiments were carried in two phases. In the first phase of the study, individuals in the experimental group were exposed to classical music for 10 days to a total of 30 hours in a scheduled program. It is determined that the experimental results obtained from individuals in the experimental group of eggs, damaged egg / egg ratio is 1/17 as the lowest, 1/10 as the highest. This value is observed that 3 / 13 is the lowest, 5 / 7 is the highest in the control group. In the second phase, with specified time intervals subjects were exposed to different frequencies. Frequency experiments were carried out in 3 stages (500 Hz, 600 Hz and 400Hz). Whenever the effects of the frequencies and the time intervals on the subjects were examined, it is determined that the ratio of damaged eggs/ eggs is 1/16 as the lowest, is 2/16 as the highest, whence the eggs obtained from the individuals of experimental cages, listened to 600 Hz (Hertz) frequency for 60 minutes per a day. According to the results of these experiments, it is determined that quails exposed to 600 Hz frequency per day reduced the damaged egg ratio and have a positive impact on total egg weight.

Keywords: Quail, frequency, Classical music, Egg-damaging

Introduction

Nowadays, due to having high nutrition value, the demand for food of animal originated has been increasing. For this reason, available protein resources can't support the growing demand. In order to support these resources many studies aimed to increase productivity in manufacture have been done. Therefore, poultry has been one of the most important branches of animal husbandry especially in underdeveloped countries for being one of the alternative sources for animal protein foods (Cerit, 1997). Japanese quails are mostly kept in battery cages with the purpose of benefiting their eggs and meat (Jatoi et al 2013b).

There have been many studies on production performance in broilers (Altan et al 1998), quails (Sarıca 1998) and pheasants (Tepeli et al 2000). These studies are mostly focused on feed intake, feed conversion ratio, egg quality, effects of various environmental conditions as light, temperature, humidity and etc.

We aimed to investigate the effects of music and the frequency of sound on egg damaging behaviour in Japanese quail under controlled environmental conditions. For integrative investigation of the effects of music and frequency on the complex interrelation between egg-damaging and sound, we measured egg yield and behaviour characteristics.

Materıals and Methods

All experiments in this study were approved by the institutional Animal Experimentation Committee of Istanbul University Cerrahpasa Medical School (31653:07.12.2006). Care and handling of the animals were in accordance with the guidelines for Institutional and Animal Care and Use Committees. The current study has been carried out in accordance with the Declaration of Helsinki.

Animals and Housing

Experiments were performed on 48 female, 8 male Japanese quails at 6-weeks of age with a mean± SEM body weight of 245.9±3.1 g. This research was carried out in two laboratories under same environmental conditions except the factor "sound". Both laboratories' conditions were kept at 20°C±1 and relative humidity rate were adjusted as 37.4 %. Feed (quail pellet feed with 20 % Crude Protein and 2850 Kcal/kg Metabolic Energy) and water were provided ad libitum in all groups during the entire experimental period (Çoban et al 2008; Duve et al 2011).

Experimentation for sound factor 1: effects of classical music (flute concerto)

48 female and 8 male Japanese quails (*Coturnix coturnix japonica*) were randomly divided into two groups with two replicates in each group. Birds in Group 1 served as trial group including 12 female and 2 male Japanese Quails (in two replicates) and exposed to scheduled listening program as first two days 1h, second two days 2h, third two days 3h, fourth two days 4h and as the last, fifth two days 5h per a day.

Moreover, birds in Group 2 served as control including 12 female and 2 male Japanese quail (in two replicates) and not exposed to any sound as classical music.

Experimentation for sound factor 2: frequency of sound

In the second part of the experiment we investigated the effects of frequency of sound on Japanese quail. For this reason, we applied the frequency program to the trial group as: 500Hz-600Hz-400Hz in an order for 18 days with certain time intervals. No frequencies of sound applied to control group during the experiment.

Measurements and observations

Throughout the experimental protocol, the weight of individuals and their eggs in each group were daily measured with a high sensitive digital scale (Excell BH-600).
Eggs in every group were collected daily and the total, damaged and undamaged eggs were counted. Damaged egg ratio (%) was calculated as:

N_d/N_t

where N_d is the number of damaged eggs, N_t is the number of total eggs.

For behavioural analysis, various types of behaviour patterns were classified as stretching, water drinking, feeding, playing, stridulating and egg-laying of individuals were observed during the entire protocol (Vercellino et al 2012; Vercellino et al 2013).

Statistical Analysis

Values were reported as mean ± SEM. Statistical analysis was performed using GraphPad Prism version 5.0 for Windows (GraphPad Software, San Diego, CA, USA). Two-way ANOVA and Bonferroni Post Test were used to analyse the relationship between Total number of Eggs, Number of Damaged Eggs, the Ratio of Damaged Eggs and Egg Weight. A p-value of <0.05 was considered statistically significant.

Results and Discussion

Egg Performance in classical music experiment

Throughout the experiment processes, 124 eggs were obtained from the birds exposed to classical music listening programme. Only 4 of them were recorded as damaged. The damaged egg ratio for trial group is 0.03, however, 104 eggs were obtained from the controlled group with the damaged ratio 0.41 (Figure 1). In control group, mean value of DE/TE ratio was 0.42±0.06 and mean value for egg weight was 11.91±0.097 g. Minimum egg weight per day was 11.43g and 12.43g as maximum egg weight of group not exposed to classical music. In trial group exposed to classical music, minimum egg weight per day was 11.7 g, 12.35 g as maximum and mean value of egg weight was 12.08±0.073g (Table 1). According to the results of Bonferroni posttests, the relationship between total number of eggs and the ratio of damaged eggs is extremely significant in trial group ($p<0.001$) Also t the relationship between the number of eggs and the number of damaged eggs is significant however, egg weight is not related with the total number of eggs or damaged egg ratio ($p>0.05$).

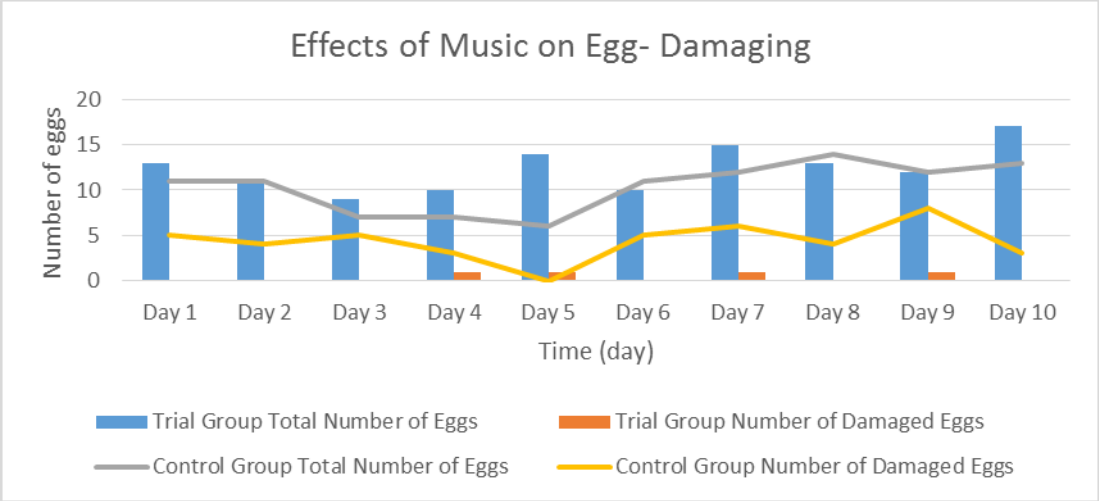

Figure 1. Effects of music on egg-damaging in two groups

Table 1. TE, DE, DE/TE and EW (g/individual/cage) ratio in two groups in music experiment

	Trial Group in Music Experiments				**Control Group in Music Experiments**			
	TE	**DE**	**DE/TE (%)**	**EW (g)**	**TE**	**DE**	**DE/TE(%)**	**EW (g)**
Min.	9	0	0	11.70	6	0	0	11.43
Max.	17	1	0.1	12.35	14	8	0.7	12.43
Mean±SEM	12.4±0.79	0.4±0.16	0.04±0.016	12.08±0.073	10.4±0.87	4.3±0.66	0.42±0.06	11.91±0.097

Egg Performance in frequency experiment

Totally 275 eggs were obtained from the birds exposed to scheduled frequency. 42 of them were recorded as damaged and the ratio for damaged eggs in trial group is 0.15. In control group 165 eggs were collected however, 50 of them were recorded as damaged eggs. The ratio for damaged eggs in this group were 0.30 (Figure 2). We calculated the mean value of DE/TE ratio as 0.166±0.034 and mean value for egg weight as 11.47±0.07 g in control group. Also in this group, minimum egg weight per day was recorded as10.8 g and 12.06 g as maximum egg weight. In trial group exposed to scheduled frequency (500-600-400Hz), minimum egg weight per day was 11.11, 12.14g as maximum and mean value of egg weight was 11.72±0.07 (Table 2). Bonferoni posttests results showed that the interactions between total number of eggs and the number of damaged eggs, between total number of eggs and the ratio of damaged eggs are significant ($p<0.001$), however egg weight is not related with the total number of eggs or damaged egg ratio ($p>0.05$).

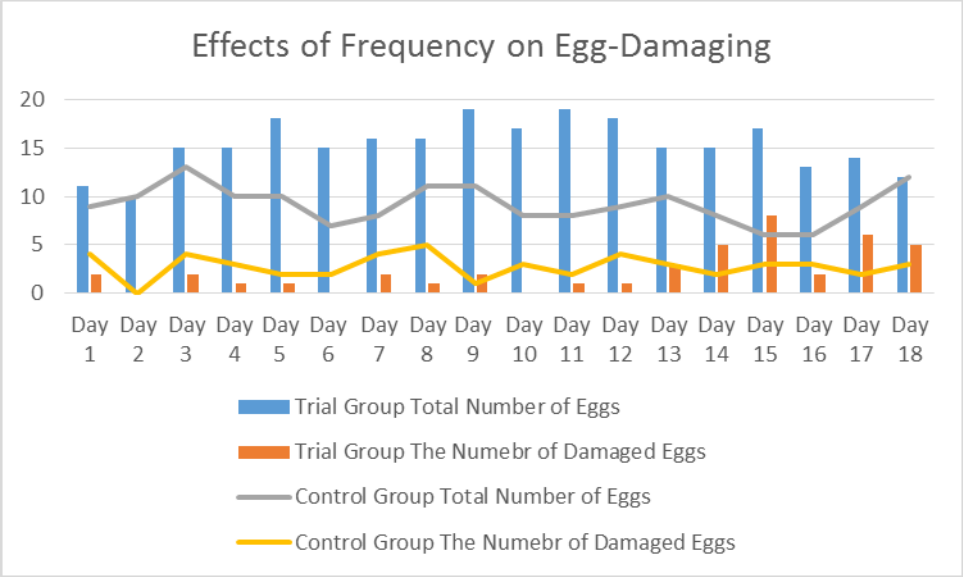

Figure 2. Effects of frequency on egg-damaging in two groups

Table 2. TE, DE, DE/TE and EW (g/individual/cage) ratio in two groups in frequency experiment

	Trial Group in Frequency Experiments				**Control Group in Frequency Experiments**			
	TE	**DE**	**DE/TE (%)**	**EW (g)**	**TE**	**DE**	**DE/TE (%)**	**EW (g)**
Min.	10	0	0	11.11	6	0	0	10.80
Max.	19	8	0.5	12.14	13	5	0.5	12.06
Mean±SEM	15.28±0.60	2.33±0.53	0.32±0.032	11.72±0.07	9.167±0.45	2.77±0.28	0.166±0.034	11.47±0.07

Behavioural Features

As behavioural features were compared between two groups; there was not a significant difference in wing stretching, drinking and playing in both groups ($p>0.05$). However, birds in trial group showed lesser feeding and egg laying and even no aggression behaviours such as shouting or stridulating ($p<0.05$ vs. control group) (Figure 3).

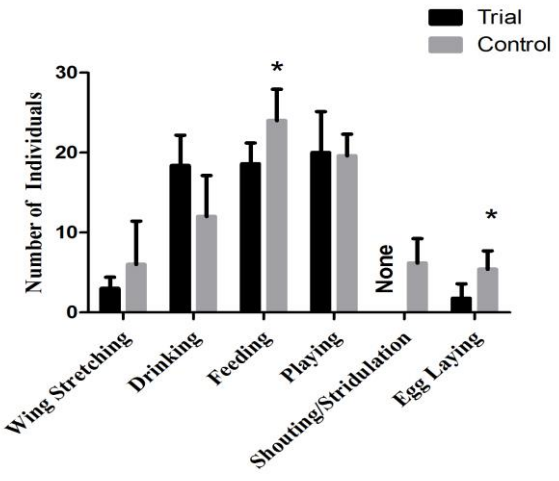

Figure 3. Behavioural features observed in trial and control groups

The result of the present study showed that the birds exposed to classical music had the most production of egg during exposition to classical music for 5h. The most remarkable point of this finding was that the production performance of this group is 100% and the eggs obtained from these birds were all undamaged. According to the analysis of total number of eggs, number of damaged eggs and the ratio of damaged eggs, it is determined that during the experimental progression, 0.31%of eggs obtained from the trial group were undamaged.

At the end of the frequency studies, birds exposed to certain frequencies had the most production of egg during exposition to a frequency of 600Hz. Mean number of eggs obtained from the period 600Hz was the highest according to other frequencies intervals applied in the same group and all of the frequencies intervals applied to the control group.

There have been many studies about the factors affecting on egg performance such as diets, feeding time, alternatives for feeding ingredients (Yıldırım & Öztürk, 2013; Ertaş et al, 2006; Tekeli et al, 2005; Karaoğlu et al, 2004; İpek et al, 2003 Bozkurt et al, 2001) , cage density (Kum &Kocaoğlu-Güçlü, 2006), age (Şeker et al, 2005), body weight (Jatoi et al, 2013a), egg weight, heat stress (Ertaş et al, 2006) and the environmental factor light. Mostly the studied environmental factor is seemed to be light. Many studies can be found on effects of light intensity, colour and photoperiod on birds and egg performance.

There have been less studies about the sound factor. Considering the values in this range of frequencies acoustic properties in the auditory system of Japanese quails were examined by Hill et al in 1980. As a continuation of this work, in 1980, Coles et al examined the cochlear physiology of Japanese quails considering the same range of frequencies. In addition to these researches, different kinds of behavioural studies (Türkyılmaz, 2006; Habib et al, 2007; Dent and Dooling, 2003; Brumm et al, 2003; Derégnaucourt and Guyomarc'h, 2003) were observed; but we couldn't find any research on sound factor as we did.

According to the observational results we are able to say that classical music is one of the most important stress reducing factor affecting on production performance in aviaries. In experimental group we noticed that the aggression behaviours as pecking feathers and eggs, preening, and cannibalism mostly between males were decreased, even not observed. We interpreted these results due to long term exposing classical music.

Conclusion

In conclusion, results of sound studies showed that classical music has positive effects on individuals in terms of total number of eggs and total egg weight of cage. Exposing to 600 Hz of frequency also affects positively total number of eggs. On the other hand, exposing to 400 Hz caused negative effects on egg quantity and reduced the egg production via the increase in number of damaged eggs. According to the results of frequency experiments, it is possible to say that value of frequency and the exposure time of frequency have significant effects on behaviour and reproduction in quails. Sounds under 600 Hz may be supported with classical music to improve production and decrease in stress factor in aviaries. We hope that this study will be pioneer to the future studies on the relationship among sound (frequency and music), aggression and stress in breeding farms.

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