

The effect of ultraviolet light application on hatchability parameters of Japanese quail eggs (*Coturnix coturnix japonica*)

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This study was carried out for investigating the effect of ultraviolet light application on hatchability parameters of Japanese quail eggs. The eggs were collected from quails at 15-18 wks of age and were stored at 15- 18 °c for the periods of 4, 7 and 10 days. Eggs were investigated under UV light (365 nm long wave) for determining whether they are really clean or not. If the UV light showed homogenized color of orange - red on the cuticle of eggs, then they were accepted as clean eggs. The control group consisted of eggs that were not selected with UV light. The effect of storage period on hatchability of fertile eggs and hatchability of total eggs was found significant ($P<0.01$). Hatchability of fertile eggs was found significant in eggs that were selected depending on UV light application ($P<0.01$).

Keywords: Ultraviolet light; breeder egg; hatchability results; Japanese quails

Introduction

Many studies have been conducted on the chemical disinfection of hatching eggs alternative to formaldehyde. (Whistler and Sheldon 1989, Sheldon and Brake 1991, Scott 1993). A new application that has started to be used at the selection of hatching eggs for research is UV light application. (Stanley *et al.*, 2003). Scanning electron microscope in the evaluation of properties of cuticle caused the eggs to lose hatching characteristics.

The ability of UV light to kill bacteria on eggshell surfaces has been well known (Coufal 2002). Ultraviolet (UV) radiation, produced by the sun, is a natural component of our environment. Ultraviolet radiation at 254 nm is used for killing various types of microorganisms, such as bacteria, yeasts, molds, fungi and viruses (Hogsetle 1999).

UV light treatment of eggshells has been shown to be effective at reducing aerobic microbial counts, counts of yeasts and molds and inoculated *Salmonella typhimurium* populations on eggshells (Kuo *et al.*, 1997). Under UV illumination, the cuticle emits an orange- red fluorescence, which can be evaluated based on its presence, color, intensity and distribution of the fluorescence. UV light can be used to identify and remove eggs that have shell surface defects not visible under white light (Stanley *et al.* 2003). UV light can prevent the unnecessary use of formaldehyde on eggs assumed to be clean, especially the harmful effects of formaldehyde, which is widely used today, on human health and embryo will be prevented.

The objectives of the current investigations are (a) to develop a method of high-intensity UV irradiation for hatching eggs suitable for use at a commercial broiler breeder facility, (b) to evaluate its effectiveness against aerobic microorganisms and pathogenic organisms, such as *Salmonella* and *E. Coli* on the shells of broiler hatching eggs, and (c) to determine the effects of UV light on the cuticle of the egg and resulting effects on hatchability (Coufal *et al.*, 2002). Ultraviolet light application is a fast and easy method that is used at the evaluation of the cuticle characteristics of eggs large in number

without damaging the embryo. Thus, it helps to evaluate the cuticle characteristics of eggs large in number before they are put in the hatchery. (Stanley *et al.*, 2003).

As a result of the above reasons, the aim of this study is to determine the effects of ultraviolet light application on the hatching results.

Material and Method

In this study 546 quails were used that were reared at the chick breed cage until at the age of 6 weeks. In trial, 12 males and 24 females were reared into pens. In the cage breed system, the chicks were allocated in chick breed cages with an area of 50x60 cm² in which the floor was covered with plastic material which measured. Plastic materials on the floor of cage were taken away from the cages after the 2. week. The water need of the quails in the cages was provided by nipple drinkers.

The lighting schedule was 14 h of light during the grower period and 16 h light during the laying period. The chicks received pelleted broiler starter diet (20.0% CP and ME 3000 MJ/kg of diet) between the 1st and 4th week. A laying diet (21.0% CP and ME 2650 MJ/kg of diet) was administered at the rest of the period. Fertile eggs were collected from breeders at 15-18 week of age and the trial was carried out. All eggs were stored for 4, 7 and 10 days at a constant temperature of 15-18 °C in the egg storage.

In order to be able to understand whether the eggs assumed to be clean are really clean, the eggs were investigated under the UV light. The eggs were accepted to be clean when the UV light formed a homogeneous orange-red distribution on the cuticle, the remaining that did not exhibit complete distribution constituted the ultra violet dirty group. The control group was selected among the eggs that were not chosen by the UV application. The experiment was carried out in 3 replicates and all of trays contained 30 eggs that each one was evaluated as one replicate.

In the treatment, observations obtained from total 36 trays were used. The eggs that were not hatched at the end of the hatching period were all broken and investigated macroscopically for the embryonic development and the embryo death ages and fertility rates were determined. In the trial, hatching characteristic such as fertility, hatchability of fertile eggs hatchability of total eggs, early term embryonic mortality, late term embryonic mortality were determined.

The trial was a randomized-block factorial design. The Minitab (1991) program was used for the evaluation of statically analyses and the Duncan's multiple range test was used for the determination of differences between groups.

Results

The effect of storage period and the level of stain on the fertility, hatchability of fertile eggs and hatchability of total eggs are presented in Table 1. The effect of storage period on the hatchability was significant ($P < 0.01$) and the prolonged storage period decreased the hatchability of fertile eggs.

Similarly the prolonged storage period decreased the hatchability of total eggs. The highest hatchability of fertile eggs (%88.27) and hatchability of total eggs (%79.55) were obtained from the eggs that were stored for 4 days. The lowest hatchability of fertile eggs (84.15%) and hatchability of total eggs (76.63%) were obtained from the eggs that were stored for 10 days.

The effect of UV on the fertility, hatchability of fertile eggs and hatchability of total eggs was found to be significant. As the level of stain increased, the hatchability of fertile eggs and hatchability of total eggs decreased statistically.

The hatchability of fertile eggs and hatchability of total eggs were 91.73% and 83.15% respectively at UV clean group and 80.93% and 73.93% at the control group. The lowest results were observed at the UV stain group (85.93% and 78.54%).

Table 1. The effect of Storage and UV on the fertility, hatchability of fertile eggs, hatchability of total eggs, early and late term embryonic mortality of the experimental groups ($\bar{X} \pm \text{SEM}$)

Treatment	Fertility	Hatchability of fertile eggs	Hatchability of total eggs	Early term embryonic mortality	Late term embryonic mortality
Storage (Day)	N.S	**	**	**	N.S
4	90.00 $\pm$ 1.8	88.27 $\pm$ 1.9 ^a	79.55 $\pm$ 2.2 ^a	6.49 $\pm$ 1.9 ^b	5.25 $\pm$ 0.5
7	92.17 $\pm$ 1.8	86.23 $\pm$ 1.9 ^b	79.44 $\pm$ 2.1 ^a	8.13 $\pm$ 1.9 ^{ab}	5.63 $\pm$ 0.5
10	91.00 $\pm$ 1.8	84.15 $\pm$ 1.8 ^c	76.63 $\pm$ 1.7 ^b	9.87 $\pm$ 2.0 ^a	5.97 $\pm$ 0.6
UV Hatching Egg selection	N.S	**	**	**	N.S
UV Stain	91.17 $\pm$ 1.8	85.93 $\pm$ 1.9 ^b	78.54 $\pm$ 1.9 ^b	8.14 $\pm$ 1.9 ^b	5.86 $\pm$ 0.5
UV Clean	90.67 $\pm$ 1.8	91.73 $\pm$ 2.2 ^a	83.15 $\pm$ 2.3 ^a	3.18 $\pm$ 1.4 ^c	5.09 $\pm$ 0.5
Control	91.33 $\pm$ 1.8	80.93 $\pm$ 1.4 ^c	73.93 $\pm$ 1.7 ^c	13.17 $\pm$ 2.5 ^a	5.90 $\pm$ 0.5
Sub group	N.S	N.S	N.S	N.S	N.S
4xuv Stain	90.00 $\pm$ 1.8	87.80 $\pm$ 1.9	79.44 $\pm$ 2.1	5.72 $\pm$ 1.9	6.48 $\pm$ 0.6
4xuv Clean	89.00 $\pm$ 1.7	94.0 $\pm$ 2.4	83.67 $\pm$ 2.4	2.74 $\pm$ 1.3	3.26 $\pm$ 0.4
4xcontrol	91.00 $\pm$ 1.9	83.00 $\pm$ 1.3	75.53 $\pm$ 1.9	11.00 $\pm$ 2.4	6.00 $\pm$ 0.5
7xuv Stain	92.50 $\pm$ 1.9	86.00 $\pm$ 1.8	79.55 $\pm$ 2.2	8.30 $\pm$ 1.9	5.70 $\pm$ 0.6
7xuv Clean	91.00 $\pm$ 1.7	91.40 $\pm$ 2.3	83.17 $\pm$ 2.5	3.10 $\pm$ 1.3	5.50 $\pm$ 0.5
7xcontrol	93.00 $\pm$ 1.9	81.30 $\pm$ 1.5	75.60 $\pm$ 1.7	13.00 $\pm$ 2.4	5.70 $\pm$ 0.6
10xuv Stain	91.00 $\pm$ 1.7	84.20 $\pm$ 1.9	76.63 $\pm$ 1.6	10.40 $\pm$ 2.1	5.40 $\pm$ 0.5
10xuv Clean	92.00 $\pm$ 1.9	89.80 $\pm$ 1.9	82.62 $\pm$ 1.9	3.70 $\pm$ 1.4	6.50 $\pm$ 0.7
10xcontrol	90.00 $\pm$ 1.7	78.50 $\pm$ 1.5	70.65 $\pm$ 1.4	15.50 $\pm$ 2.6	6.00 $\pm$ 0.6

a,b,c; Values within columns with no common letter differ significantly $P < 0.05$ $P < 0.01$

The effect of storage period and level of stain on the early term embryonic mortality and late term embryonic mortality are given in Table 1. The prolonged storage period increased the early term embryonic mortality significantly ($P < 0.01$).

The early term embryonic mortality was determined to be 6.49%, 8.13 and 9.87 for the groups that were stored for 4, 7 and 10 days, whereas the percentage of late term embryonic mortality was 5.25%, 5.63 and 5.97 respectively for the same storage periods. The effect of UV on the early term embryonic mortality was found to be significant ($P < 0.01$). The early term embryonic mortality was 3.18% at UV clean group whereas it was 13.17% and 8.14% at the control group and UV stain group, respectively.

The lowest the early term embryonic mortality and the late term embryonic mortality were observed at the eggs that were stored for 4 days (6.49%, 5.25%). The highest mortality percentages were observed at the UV stain group (8.14%, 5.86%).

Discussion

The hatching eggs should be incubated for four days to obtain the best hatchability of fertile eggs.

In this study, the best storage period was determined to be four days. In addition, it was observed that as the period of storage increased, the hatchability of fertile eggs and hatchability of total eggs decreased. This result is parallel to the statements of Scott (1933), Funk (1934) and Anonymous (1991). Furthermore, the prolonged storage period provided to the early embryonic mortality to increase. The best result was observed in the UV clean group.

This result is similar to those of Stanley *et al* (2003), UV clean eggs had much more hatchability than UV stain and control groups. The portability and low-cost of the UV light may provide an easy method for hatchery men to screen cuticle quality of large numbers of eggs without affecting their ability to be set, which is not true with other methods of evaluating cuticle quality.

As expected, in this study cuticle prior to setting appeared to have a positive effect on the hatchability of the eggs. As a result of this study it can easily be determined whether the large number of hatching eggs are really clean or not by using UV light.

Therefore it can be suggested that the effect of UV hatching egg selection should be examined with these treats in details. More details studies directed towards applying different UV long wave over the eggs are needed in order to increase the hatchability an incubation success via in UV in the future.

References

- ANONYMOUS. (1991) The Cobb Breeder Management Guide, The Cobb Breeding Company Ltd., East Hanningfield, Chelmsford, Essex.
- BALL, R.F., V. LOGAN and J.F. HILL. (1975) Factors affecting the cuticle of the egg as measured by intensity of staining. *Poultry Science*, **54**: 1479-1484.
- BOHREN, B.B., CRITTENDEN, L.B and ANDKING, R.T. (1961) Hatching time and hatchability in the fowl. *Poultry Science*, **40**: 620.
- CHAVES, C. (2003) Evaluation of a method of sanitation of broiler hatching eggs. *Poultry Science*, **82**: 754-759.
- CLARENBURG, A. and ROMIJ, N.C. (1954) The effectiveness of fumigation with the formaldehyde-potassium permanganate and the influence on the hatchability. Proceedings of the 10th world's poultry congress: 214-217.
- FUNK, E.M. (1934) Factors influencing hatchability in the domestic fowl. *Missouri Agricultural Experiment Station Bulletin*, **334**:1-22.
- HOGSETLE, A.J. (1999) Effects on commercial broiler chicks of constant exposure to uv from insect traps. *Poultry science*, **78**: 324-326.
- SCOTT, H.M. (1933) The effect of age on holding tempera on hatchability of turkey and chicken eggs. *Poultry science*, **12**: 49-51.
- COTT, T.A. (1993) Screening sanitizing agents and methods of application for hatching eggs. I. environmental and user friendliness. *The Journal of Applied Poultry Reserch*, **2**: 1-6.
- SHELLDON, B.W. and BRAKE, J. (1991) Hydrogen peroxide as an alternative hatching egg disinfectant. *Poultry Science*, **70**: 1092-1098.
- STANLEY, W.A., HOFACRE, C.L., FERGUSON, N., SMITH, J.A. and M. RUANO, M. (2003) evaluating the use of ultraviolet light as a method for improving hatching egg selection. *Journal Of Applied Poultry Research*, **12**: 237-241.
- WHISTLER, P.E. and SHELDON, B.W. (1989) Bacterial Activity, eggshell conductance and hatchability effects of ozone versus formaldehyde disinfection. *Poultry Science*, **68**: 1074-1077.