ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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International Journal of Poultry Science 10 (11): 876-878, 2011
ISSN 1682-8356
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Hatching Characteristics of Japanese Quail Eggs in a Tropical Environment

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Abstract: A study to evaluate hatching characteristics of incubated Japanese quail eggs in Nigeria was conducted. A total of 1,116 eggs were incubated in 3 batches in a still-air kerosene incubator. The results showed that mean early and late embryonic mortality on the basis of fertile eggs were 18.59±1.85 and 9.89±1.31%, respectively. Mean fertility, hatchability of fertile eggs, hatchability of total eggs set and weight of newly hatched chicks were 85.41±1.25%, 71.52±1.94%, 61.31±1.93% and 6.47±0.10 g, respectively. Hatching chick weight was found positively and significantly ($p<0.001$) correlated with egg weight ($r = 0.96$), egg length ($r = 0.79$) and egg width ($r = 0.74$). Generally, there was negative correlation between embryo mortality (Early and Late) and external egg quality traits considered. It was concluded that the Japanese quails used in this study have high reproductive efficiency and the still-air kerosene incubator used is recommended for use in rural areas where electricity is irregular or not available to hatch quail eggs.

Key words: Kerosene incubator, fertility, embryo mortality, hatchability, hatch weight

INTRODUCTION

The Japanese quail was introduced to Nigeria only in 1992 (NVRI, 1994). The purpose was to diversify the poultry sub-sector and help supplement domestic chicken production through massive quail farming by Nigerian farmers. Since then, quail farming have been growing in popularity in Nigeria as the years goes by.

The reproductive performance of Japanese quail is important in the overall management of the flock. Fertility, hatchability and embryo mortality are important indices for producing chicks from a breeding flock. Fertility is affected by different factors such as mating ratio, parental age, rate of laying, climatic and environmental conditions (KulenKamp *et al*., 1973). Hatchability of fertile eggs in avians generally and in Japanese quail in particular is affected by different factors such as parental age, rate of laying and pre-incubation storage (Chahil *et al*., 1975). Screenivasaiah and Joshi (1987) reported a range of 63.0-79.0% for hatchability percentages in Japanese quail. Embryo mortality can be regarded as a direct fitness trait that reduces reproductive efficiency thereby increasing production cost. The capacity of the chick to hatch is superficially a simple characteristics. Nevertheless, in biological terms it is an extremely complex process. Failure to hatch is due to infertility in some cases, while in others the Zygote forms but fails to develop and eventually dies for a wide variety of reasons (Falconer and Mackay, 1996). Lower hatchability can be observed in a flock if embryo mortality is higher and fertility is lower. Embryo mortality as high as 28.84% has been observed in quails (Farooq *et al*., 2001). Variations in embryonic mortality may be due to poor holding period, unbalanced nutrition, stressful conditions the parent flock was exposed to, or any other fault in incubation and hatching requirements or equipment. Any major abnormality in the physical character of the egg can lead to a collapse in its main physiological function of providing the best conditions for the developing embryo (Narushin and Romanov, 2002).

The objective of this study was to determine the hatching characteristics of Japanese quail eggs using locally fabricated kerosene incubator in a tropical environment.

MATERIALS AND METHODS

The experiment was carried out at the poultry unit of the faculty of Agriculture Research and Teaching farm, Kogi State University, Anyigba, Nigeria. Anyigba lies between longitudes 5° 15[1] and 7° 54[1]Nand Latitude 5° 45[1] and 8° 45[1] East of the equator. It is located in the Southern guinea savanna ecological zone of Nigeria. The mean annual rainfall is 1,808 mm. Average monthly temperature varies from 17-36.2°C. Relative humidity is moderately high and varies from 65-85% throughout the year. The natural day length of Anyigba is 12-13 hrs and the area enjoys an average of 4.00 and 8.2 hrs of sunshine daily (Amhakhian, 2009).

One hundred and twenty Japanese quails were used for egg collection. Birds were mated at a ratio of one male to three females in each cage. They were mated at six weeks of age, but eggs for incubation were only collected when the birds were at least nine weeks of age. The birds were fed formulated breeders diet containing 18% crude protein and 2707 kcal/kg of feed (Dafwang, 2006). Feed and water were provided *ad libitum*.

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Egg collection: Eggs were collected twice (8 am and 5 pm) a day and each egg was given individual identification. The daily collections were accumulated for 6 days. The eggs were held in egg crates under room temperature with a ceiling fan over the eggs to provide some cooling effects. Data on egg weight, length and width were recorded prior to setting eggs in the incubator. At the end of 6 days of egg collection, the eggs were set horizontally for pedigree hatching in a still air kerosene incubator at a temperature of 37.4-38°C and relative humidity of 60%. The procedure for incubation using the still-air kerosene incubator was as described by Daikwo (2011).

Three batches of pedigree - hatched quail chicks were obtained at three weekly intervals between hatches. A total of 1, 116 eggs made up of 371, 374 and 371 eggs for batches 1, 2 and 3, respectively were incubated.

Traits measured: After hatching, chicks were weighed and immediately transferred to the brooding room. The unhatched eggs were broken to investigate fertility and embryo mortality. Embryo mortality was recorded at early and late stages. Fertility was determined as the proportion of fertile eggs to the number of eggs set. Hatchability of fertile eggs was estimated at the proportion of chicks hatched from fertile eggs. Hatchability of set eggs was calculated as the proportion of the number of chicks hatched out of the total number of eggs set. Embryo mortality (Early or late) was obtained as the proportion of dead embryos out of the number of fertile eggs.

Statistical analysis: Prior to analysis the data on fertility, hatchability and embryo mortality percentages were transformed using arcsine transformation. After analysis, means were retransformed to the original values. Wherever the hatch effects were significant, these effects were corrected before analysis. Data were subjected to one way analysis of variance to test hatch effect using the following linear model:

$$Y_{ij} = \mu + H_i + e_{ij}$$

Where

Y_{ij} = Observed value in i^{th} hatch
μ = Common mean
H_i = Effect of the i^{th} hatch (1, .. 3)
e_{ij} = Residual random error.

All data were analysed using the SPSS 14.0 (2004) software.

RESULTS AND DISCUSSION

Table 1 shows the hatching performance of Japanese quail eggs. The average percentage fertility, early embryo mortality, late embryo mortality, hatchability of fertile eggs and hatchability of total eggs set were 85.41±1.25, 18.59±1.85, 9.89±1.31, 71.52±1.94 and 61.31±1.93%, respectively. The mean hatching chick weight was 6.47±0.10 g. The percentage fertility reported in this study falls within the range of 66.70-85.80% reported by Sachdev *et al.* (1985). It was however higher than the values reported by Blohowiak *et al.* (1984) and Aboul-Hassan *et al.* (1999). Since this bird is highly fertile, Japanese quail could be utilized efficiently in meat production enterprises. The percentage hatchability of fertile eggs reported agrees with the findings of Screenivasaiah and Joshi (1987) and El-Fiky *et al.* (1996). Farooq *et al.* (2001) and Khurshid *et al.* (2004) reported Lower percentage hatchability on the basis of total eggs set (58.8% and 55.14%, respectively) than the values estimated in this study. The higher hatchability in the present study could be due to better fertility than that reported by Farooq *et al.* (2001) and Khurshid *et al.* (2004). Farooq *et al.* (2001) reported higher early and lower late embryo mortality in Japanese quails than the present findings. The higher early embryo mortality reported in this work could probably be due to poor holding period and fluctuating temperatures in the kerosene incubator. Farooq *et al.* (2001) reported higher weight of the new born chick (8.06 g) in Japanese quail than the present findings. The smaller weight of the newly hatched chicks in the present study was attributable to smaller egg weight than that reported by Farooq *et al.* (2001).

Table 1: Hatching characteristics of Japanese quail eggs

Trait	Mean±SE	CV (%)
Fertility (%)	85.41±1.25	13.93
Early embryo mortality of fertile eggs (%)	18.59±1.85	94.47
Late embryo mortality of fertile eggs (%)	9.89±1.31	126.06
Hatchability of fertile eggs (%)	71.52±1.94	25.77
Hatchability of total eggs set (%)	61.31±1.93	29.80
Hatching chick weight (g)	6.47±0.10	13.91

Table 2 presents the phenotypic correlations between external egg traits and hatching egg traits in Japanese quail. There was significant ($p<0.001$) correlation between hatching chick weight and egg weight, hatching chick weight and egg length, hatching chick weight and egg width and between hatchability of set eggs and egg weight. Positive and significant ($p<0.05$) correlation was also found between egg weight and percentage fertility. Early embryo mortality was found negatively correlated with egg weight and egg length, but positively correlated with shape index. This agrees with the findings of Khurshid *et al.* (2004). Results of the present study suggest that increase in egg weight and egg length will result in a decrease in both early and late embryo mortalities. Results of the study also suggests an increase in hatchability with increase in egg weight; which is similar to the findings of Shanaway (1994) and Khurshid *et al.* (2004) who reported improvement in hatchability with increase in egg weight of Japanese quails. Increase in egg weight will significantly lead to improvement in percentage fertility of the Japanese quail

Table 2: Correlations between external egg traits and hatching characteristics of Japanese quail

	Hatching characteristics					
External egg quality	EEM	LEM	HFE	HSE	FTY	HCN
Egg weight	-0.05	-0.24*	0.21	0.27***	0.24*	0.96***
Egg length	-0.09	-0.17	0.20	0.20	0.08	0.79***
Egg width	0.04	-0.16	0.07	0.09	0.09	0.74***
Egg shape index	0.14	-0.01	-0.13	-0.10	0.01	0.03

* = (p<0.05); *** = (p<0.001) ; EEM = Early Embryo Mortality; LEM = Late Embryo Morality; HFE = Hatchability of Fertile Eggs; HSE = Hatchability of Set Eggs; FTY = Fertility; HCN = Hatching Chick Weight

eggs. The significant correlation between hatching chick weight and egg weight, egg length and egg width may be indicative of the fact that increase in these external egg traits may result in an increase in the weight of the new born chick. The result also suggests that care should be taken to select normal shaped eggs because abnormally shaped ones may create problems during incubation.

Conclusion: The high percentage fertility and hatchability coupled with low early and late embryo mortalities reported in this study for Japanese quail imply high reproductive efficiency of the Japanese quail. High reproductive efficiency will reduce cost of production and ensure high economic returns in quail production enterprise.

The still-air kerosene incubator (Fabricated by the National Veterinary Research Institute, Vom, Plateau State, Nigeria) used in this study proved satisfactory in hatching Japanese quail eggs. Therefore, the use of this incubator for hatching quail eggs is highly recommended in rural areas or urban centres where supply of electricity is irregular or non-existent.

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