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Egg Pigment Pattern and Association Between Hen Bodyweight, Oviposition Interval, Egg-Weight and Hatchability in Japanese Quail.

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ABSTRACT: *A study was conducted to characterize egg pigment pattern in Japanese quail and to determine the association between egg shell pigment pattern, hen bodyweight, oviposition interval, average egg weight and hatchability of eggs. Mean weight of laying hens was 132.91±17.20 g. Shell colour varied from lightly spotted to heavily sandy spotted. There were marked difference among individuals for egg weight and pigment pattern. Hens' oviposition intervals ranged between 25.60±2.19 hours and 40.32±4.27 hours. Average weight of eggs and hatchability were 7.77 - 9.83g and 21.10-66.70%, respectively. Pearson correlation between hen bodyweight and egg weight was significant (p<0.05, r=0.576). There was a negative correlation between hen bodyweight and oviposition interval (r= -0.541). Estimates of correlation between egg weight and oviposition interval was low so also were the correlations between pigment pattern and hen's bodyweight or oviposition interval. A medium correlation was obtained between egg weight and hatchability of eggs (r= ~0.40). The present study suggests that egg pigment pattern is an hen specific trait. It is concluded that hens with good bodyweight and that produces heavy, highly pigmented eggs should be selected as breeders in hatching operations.*

Key words: Japanese quail, pigment pattern, oviposition interval, hatchability.

Introduction

Species or sub-species of the genus *cortunix* are found in almost all continents of the world (1). The birds are raised primarily for egg production in Japan and South-East Asia, while meat is the main product in Europe (2). Since its introduction into Nigeria in 1992, the bird has become increasing important for protein supply and as a therapeutic medicant. The remarkable increase in quail production has renewed research emphasis on factors influencing hatchability efficiency (3) and growth performance (4). According to 5, the multicoloured shell of quail eggs is primarily an adaptation to protect them from predators. In a recent study, 4 suggested the need to investigate the relationship between egg shell pigmentation and hatchability. A study carried out by 6 suggested that nutritional manipulation does not significantly influence the egg shell colour of individual quail even though it influenced the proportion of antioxidant (biliverdin) and prooxidant (proporphyrin) pigments in the shell. Another study by 7 on Chinese ring-necked phesant revealed that fertility was not significantly affected by shell colour but eggs with blue or tan eggs tend to have a significantly lower hatchability. A research conducted in chicken showed that eggs with a thick shell had higher hatchability compared with thin shelled eggs (8), possibly due to greater fertility and lower intermediate and late embryonic mortalities (9). The work of 10 on Yangzhou chicken revealed that, there is a significant correlation between shell colour and shell thickness, shell strenght and shell weight. 11 reported that pigmentation of the shell occurs approximately three-and-half hours before oviposition in *coturnix* laying on a 25 ï hour rhythm.

The objectives of the present work were to characterize the pigment pattern of Japanese quail eggs and to investigate the association between hen bodyweight, oviposition interval, average egg weight, egg shell pigment pattern and hatchability of quail eggs.

Materials and Methods

Data for this study were obtained from Japanese quail population *(Cotunix coturnix japonica)* obtained from the quail breeding unit of the University of Ilorin, Kwara state, Nigeria. Ilorin is located between the rainforest of the Southwest and Savannah grassland of Northern Nigeria. Its co-ordinates are latitude 8^{o} 24ôN and 8^{o} 36ôN and longitude 4^{o} 10ôE and 4^{o} 36ôE with an area of about 100 square kilometers (12). The total annual rainfall in Ilorin is about 1318mm with the mean temperature of 30^{0}C-33^{0}C (13).

Twenty four, eight-week old quails were housed in wooden wire mesh cages using a mating ratio of 1:1 (Ⅱ :ǀ). Water and a layers mash (containing 19% crude protein and 2700kcal energy) were supplied to birds *ad-libitum*. Laying performance of each hen was monitored over 49 sequential days to determine the frequency of lay (oviposition interval). Four randomly selected eggs from each bird were arranged on a vertical axis. Eggs from different hens were arranged in their order of visual pigment concentration and thereafter photographed. Eggs that were abnormal in shape, cracked, dirty or plain white were not used in the visual quantification as earlier proposed (3). Images were taken using a digital camera with 25 mega pixels of resolution and 2 x 25 W illumination. Each egg was photographed from one side, and then turned 180° to the other side and photographed again. A rectangular area known as the region of interest (ROI) was draw out of each side. The eggs from the hens were ranked in order of increasing pigmentation.

A total of two hundred and seven (207) out of 477 eggs laid by the hens were used to evaluate hatchability. Eggs collected from each hen were weighed individually and identified using pen marker before setting them in a kerosine operated manual incubator. Temperature of 35^{o}C and 60% humidity were maintained during the incubation period. Eggs were turned three times daily. On the 15^{th} day of incubation, eggs obtained from each hen were placed in different compartment to ensure adequate record of hatchability. Data collected on hatchability was described using percentages. A correlation analysis was used to determine the association between hen pigment pattern, bodyweight, oviposition time, average egg weight and hatchability of quail eggs.

Results

Plate 1 showed the variation in shell pigmentation among eggs produced by different hens. The result revealed that egg shell pigment pattern was highly consistent within females but remarkably different among individuals. Table 1 showed the hen bodyweight, pigment pattern of Region of Interest (ROI) and oviposition interval. Weight of laying hens ranged from 96.00 to 155.80 grammes (mean= 132.91±17.20). The egg shell pigment pattern varied from lightly spotted to heavily sandy spotted. The frequency of lay (oviposition interval) ranged between 25.60±2.19 and 40.32±4.27 hours. Most of the birds (58 percent) had oviposition interval of less than 30 hours. A comparison between

visual quantification and hatchability records showed that heavily pigmented eggs tends to have higher hatchability than lighly pigmented eggs (with an *r* value of 0.55). Table 2 showed the total number of egg laid, total egg weight, average egg weight and % hatchability for the laying hens. Average weight of eggs laid by the hens ranged from 7.77 to 9.83 g while hatchability of eggs ranged from 21.10 to 66.70 percent. Table 3 showed the result of Pearson correlation of egg egg pigment pattern with hen body weight and oviposition interval in Japanese quail. The r values showed that pigment pattern was poorly correlated with henôs bodyweight and oviposition interval. Table 4 showed the result of Pearson correlation of body weight, egg weight, oviposition interval and hatchability of eggs. The correlation between hen bodyweight and weight of egg was significant ($p<0.05$) in this study ($r=0.576$). There was a negative correlation between hen bodyweight and oviposition interval ($r= -0.541$).

Plate 1: Visual ranking of eggs produced by quail hens in order of increased pigment deposition

1,2,3,4.....12 represent bird number.

Table 1: Hen bodyweight, Shell colour of ROI and rate of lay (oviposition interval) in Japanese quail

Bird	Bodyweight (g)	ROI	Pigment pattern of ROI	Laying interval (hour)
1	110.0		Heavily dotted	38.72±16.25
2	125.8		Heavily dotted	32.24±6.80
3	140.5		Heavily dotted	27.20±1.79
4	151.0		Heavily sandy spotted	26.72±4.22
5	137.1		Heavily pigmented	36.40±12.52
6	137.8		Lightly sandy spotted	27.52±3.94
7	140.2		Heavily dotted	25.80±3.19
8	145.5		Lightly spotted	29.20±7.43
9	155.8		Heavily sandy spotted	25.60±2.19
10	134.6		Lightly sandy spotted	25.92±4.29
11	96.0		Heavily pigmented	40.32±4.27
12	120.6		Heavily spotted	32.24±6.80

ROI represents images of Region Of Interest taken using a digital camera with 25 mega pixels of resolution and 2 x 25 W illumination

Table 2: Total egg laid, total egg set, weight of egg set, average weightof egg set and hatchability of eggs in Japanese quail

Bird	Total number of eggs laid	Total number of eggs set	Total weight of egg set (g)	Average weight of eggs set (g)	% Hatchability
1	35	17	137.4	8.07±0.50	34.92
2	36	17	157.5	9.17±0.55	48.42
3	42	18	154.8	8.60±0.26	38.88
4	42	14	135.0	9.63±0.21	41.43
5	35	13	106.9	8.23±0.06	58.34
6	43	19	182.6	9.53±0.64	46.66
7	46	19	161.0	8.43±0.25	53.33
8	42	18	155.5	8.53±0.65	38.90
9	45	18	178.6	9.83±0.55	66.70
10	45	19	147.9	7.77±0.15	21.10
11	30	14	106.5	8.77±0.59	42.90
12	36	17	158.6	9.27±0.31	53.00

Table 3: Pearson correlation of body weight, Body weight (BWT), Egg pigment pattern (EPP), Oviposition interval (OVI) in Japanese quail.

	BWT	EPP	OVI
BWT	1	0.018	-0.541
EPP		1	0.152
OVI			1

Body weight (BWT), Egg pigment pattern (EPP), Oviposition interval (OVI)

Table 4: Pearson correlation of body weight, average egg weight, oviposition interval and hatchability in Japanese quail.

	BWT	AEW	OVI	HTY
BWT	1	.576(*)	-.541	.204
AEW		1	-.351	.390
OVI			1	.162
HTY				1

Correlation is significant at the 0.05 level (2-tailed). Body weight (BWT), average egg weight (AEW), oviposition interval (OVI), hatchability (HTY)

Discussion

The body weights of hens were comparable with the body weight of unselected quail hens reported by 14. Hensô body weights were however lower when compared with that of selected pureline in their study. The egg weight in the present study was lower than the egg weight of selected birds reported by 15. Hatchability of eggs in the present study was lower than 67.02-71.88% reported by 4 for Japanese quail eggs. The difference may be due to the interplay of one or more factors influencing egg hatchability efficiency such as genetic, egg characteristics (16), storage conditions (17) and incubation environment (18).

The present result agrees with the earlier report of 19 that sorting eggs on the basis of colour pattern is an accurate means of distinguishing eggs of individual hens in mixed clutches of *Cortunix*. With the help of image analysis, 20 observed that genetic effect is a major factor affecting the egg shell colour in broiler breeder. They further reported that shell colour and pattern of Japanese quail eggs were highly consistent within females. An investigation into the effect of nutrition on egg shell colour showed that nutritional manipulation does not significantly influence the egg shell colour of individual quail (6).

The poor correlation between pigment pattern and oviposition interval in the present study suggests that other mechanism beyond oviposition interval may be responsible for the difference between heavy and light pigmented quail eggs. The higher hatchability and egg weight of heavily pigmented eggs in this study agreed with the submission of 21 who observed that shell colour had significant effect on hatchability of fertile eggs. The higher hatchability of heavily pigmented eggs may be due to their higher shell thickness (8, 10), greater fertility and lower intermediate and late embryonic mortalities (9).

The significant correlation between hen weight and egg weight and the medium correlation between egg weight and hatchability suggest that only hens with relatively high bodyweight and eggs size should be selected as breeders in hatching operations. This is imperative as light weight hens also tend to have a longer oviposition interval.

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