Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 162 (2022) 56005-56009

ISSN: 2229-712X

Japanese quail (*Coturnix coturnix japonica*) raised on a Deep Litter System in Nigeria: Egg Quality traits

W.A Oriade[1], C. A Chineke[1], O.S Omoleye[2], F.B Adebayo[2] and K.J Morakinyo[3]

[1]Animal Breeding and Genetics Unit, Department of Animal Production and Health, Federal University of Technology, P.M.B 704 Akure, Nigeria.

[2]Animal Reproductive and Environmental Physiology Research Unit, Department of Animal Production and Health, Federal University of Technology, P.M.B 704 Akure, Nigeria.

[3]Animal Production and Management Research Unit, Department of Animal Production and Health, Federal University of Technology, P.M.B 704 Akure, Nigeria.

ARTICLE INFO

Article history:
Received: 21 November 2021;
Received in revised form:
17 January 2022;
Accepted: 27 January 2022;

Keywords
Egg quality,
Japanese quail,
Deep Litter,
Phenotypic Correlation.

ABSTRACT

The objective of this study was to determine the internal and external quality characteristics of quail eggs and the effect of egg weight and body size on these traits. For this investigation, one hundred thirty-two eggs were obtained from 120 Japanese quails grown on a deep litter system. Egg Weight (EW), Egg Length (EL), Egg Width (EWT), Yolk Height (YH), Yolk Diameter (YD), Albumen Length (AL), Albumen Height (AH), Yolk Weight (YW), Shell Weight (SW), Shell Thickness (ST), and Albumen Diameter (AD) were all measured, and Egg Surface Area (ESA), Unit Surface Shell Weight (USW), Egg Index (EI), Shell Ratio (SR). According to the findings, age significantly affected egg weight, body weight, yolk diameter, shell weight, egg surface area, and unit surface shell weight (P<0.05). However, all other parameters were not affected by age (P>0.05). Furthermore, increasing egg weight had a negative effect on egg shape index and egg yolk ratio. Most of the internal egg quality traits studied were negatively affected by increasing the eggshell ratio.

Introduction

Japanese quail, the smallest farmed avian species (Panda and Singh 1990) is getting more important for commercial egg and meat production. It has marked advantages such as fast growth, early sexual maturity, high rate of egg production, short generation interval and short incubation period. The average age at onset of laying for Japanese quail is 6-8 weeks (Reddish *et al.*, 2003) and with proper care, quail hens can lay up to 280 -300 eggs in their first year. In the last years, it has been observed in the poultry breeding that the quails were benefited as much as hens both for their meats and eggs, therefore, commercial quail breeding have become widespread (Altinel *et al.*, 1996). Although, meat production was considered more commonly, the egg breeding became more important in some countries such as China. Besides, the productivity and quality of the breeding eggs have an overall significance for the continuity of the flocks and for an economical breeding (Sogut *et al.*, 2001). The quail egg is prized as a dietary and healing food for man and several health benefits of quail egg have been reported in literature due to the essential nutrients they contain (Troutman, 2012) Moreover, external and internal quality traits of the eggs are significant in the poultry breeding for their influence on the yields features of the future generations, breeding performances, quality and growth of the chicks (Altinel *et al.*, 1996). In numerous researches related to the aforementioned subjects, it has been reported that the external and internal quality traits of the eggs in both hens and quails had significant effects on the hatchability of incubated and fertile eggs and weight, and development of the chicks. (Nordstrom and Ousterhout 1982; Narahari *et al.*, 1988; Peebles and Marks, 1991).

There are various methods used in the assessment of egg shell quality. The most commonly used methods are specific gravity, shell deformation, shell thickness and the shell rate of the total egg (Thompson and Hamilton, 1982). In some researches, the egg weight is said to have a direct relation with the eggshell quality which has a positive correlation with the shell thickness (Stadelman, 1989) and shell weight (Choi *et al.*, 1983; Poyraz, 1989). It is also mentioned by some other researchers that the shell thickness has an effect on the shell stiffness (Buss, 1982; Thompson *et al*., 1981). Although the internal and external quality traits especially in the eggs of hens, as well as the correlation between these traits were studied in a number of researches in previous years (Narahari *et al*, 1988), the number of researches covering such qualities in the quails, especially the phenotypic correlation among these traits were relatively less (Hamilton, 1982). The mean value of Haugh units (UH), indicator of egg freshness was 57. 4. Quails maintained at low density (20 birds per cage) had significantly highest egg weight and egg width than those kept at density of 25 birds per cage. The opposite has been observed in terms of UH and proportions of eggshell, albumen and yolk (Ouaffai *et al.*, (2018). This study was aimed to provide useful information on the egg qualities of Japanese quail (*Coturnix coturnix japonica*) raised in a commercial (natural) production system with which farmers in south western Nigeria could be encouraged to go into commercial Japanese quail production

Material and Methods

Experimental Materials

The experimental birds, one hundred and twenty (120) Japanese quail were purchased from the National Veterinary Research Institute (NVRI), Vom, Jos, Plateau State at their Ikire outstation, Osun State branch.

Experimental Diets

Two (2) experimental diets were formulated and prepared in the Nutrition Laboratory of the Federal University of Technology, Akure. One the starter diet and the other the layer diet.The basal and proximate compositions of the experimental diets are shown in tables 1 and 2 respectively.

Tables 1. Basal composition of the experimental diet (%)

Ingredients		
	Starter diet	**Layers diet**
Maize	59.16	54.81
SBM	35.17	21.07
Fish meal (65 %)	1.6	2.1
Oyster shell	1.6	8.4
Methionine	0.22	0.21
Lysine	0.16	0.21
Broiler premix	0.24	--
Salt	0.24	0.25
Bone	1.6	2.1
Wheat offal	--	2.1
Layers premix		0.25
Total	100	100

SBM = Soya beam meal.

Table 2. Proximate composition of the experimental diets

Nutrients		
	Starter diet	**Layers diet**
Metabolizable energy	2829.6	2696
Crude protein	19.76	18
Ether extract	3.8	3.90
Crude fiber	3.36	2.91
Lysine	1.3	0.9
Methionine	0.6	0.42
Calcium	0.9	3.7
Phosphorus	0.45	0.35
Nutrients	Starter diet	Layers diet
Metabolizable energy	2829.6	2696
Crude protein	19.76	18
Ether extract	3.8	3.90
Crude fiber	3.36	2.91
Lysine	1.3	0.9
Methionine	0.6	0.42
Calcium	0.9	3.7
Phosphorus	0.45	0.35

*The metabolizable energy is in kcal while others are in percentages.

Experimental Layout

Performance characteristics were monitored from week 4 till week 6. One hundred and thirty-three (133) eggs were used for the experiment. The experiment lasted for twenty-two (22) weeks.

Egg Analysis

The eggs were weighed. The width and length was measured. After these, the eggs were broken on a table with a glass cover on which the yolk weight, length and height, albumen length and weight. The shells were gently washed and allowed to dry for 24 hours before shells weight were taken. The sharp and blunt parts of the eggs shell were measured and the average thickness was obtained. From these measurements shape index, albumen index, albumen index, shell ratio, albumen ratio, yolk index, yolk ratio, albumen weight and haugh unit were calculated for.

The formulae of the parameter calculated for on egg qualify traits include:

❖Egg surface area (s) = $3.97821W^{2.75056}$

Where W = Egg weight.

❖ Unit surface shell weight (mgl/cm^2) = egg wt./egg surface area.

❖Shape index (%) = [width (cm)/height (cm)]x 100

❖Shell ratio (%) = (shell/egg weight) x 100

❖Albumen index (%) = [Albumen height/ (Albumen length + Albumen width 1/2] x 100

❖Albumen ratio (%) = (Albumen weight/Egg weight) x 100

❖Yolk index (%) = (Yolk height/yolk diameter) x 100

❖Yolk ratio (%) = (Yolk weight/egg weight) x 100

❖Albumen weight (g) = egg weight- (yolk weight + shell weight)

❖Haugh unit (Hu) = 100 log ($H+7.57-1.7W^{0.37}$)

Where H= Albumen height (mm) and W= Egg weight (g)

Statistical Analysis

Data collected were subjected to one-way analysis of variance-ANOVA model for completely randomized design (CRD), using the general linear procedure of SAS (2012). Significant differences between means were separated using the Duncan Multiple Range Test. Correlation analysis was also used to determine the relationship between external and internal egg quality traits for each plumage variety using the same procedure of SAS (2012).

RESULTS

Table 3.Means and standard error of egg quality traits

Parameter	Mean	Standard error
Standard error	9.06	0.11
Body weight	Body weight	1.08
Egg length	2.96	0.01
Egg width	2.35	0.009
Yolk height	0.93	0.06
Yolk diameter	2.30	0.01
Albumen length	2.99	0.007
Albumen height	0.76	0.02
Yolk weight	2.91	0.06
Shell weight	0.76	0.009
Shell Thickness	0.40	0.16
Albumen diameter	3.00	0.0007
Egg Surface Area	20025.90	559.46
Unit surface Shell weight	0.0001	3.45
Egg index	27.7	1.70
Shell ratio	8.82	0.44
Albumen index	9.60	0.37
Yolk index	40.57	2.59
Yolk ratio	32.03	0.65
Albumen weight	0.54	0.009
Albumen ratio	59.24	0.71
Haugh Unit	172.01	0.50

Effect of Age on Egg Quality Traits

Table 4 shows that age had a significant ($P<0.05$) influence on egg weight, body weight, yolk diameter, shell weight, egg surface area, and unit surface shell weight. All other parameters, however, were not significantly influenced by age ($P>0.05$)

Table 4. Duncan Multiple Range Test for Egg Quality traits

Parameter			**Age (weeks 10 – 22)**		
	10	**13**	**16**	**19**	**22**
Egg weight	9.22^{ab}	856^{a}	9.21^{ab}	9.70^{a}	9.68^{a}
Body weight	156.50^{a}	160.08^{ab}	159.83^{ab}	163.02^{ab}	169.56^{a}
Egg Length	2.90^{a}	2.90^{a}	2.98^{a}	3.06^{a}	3.04^{a}
Egg Width	2.36^{a}	2.32^{a}	2.37^{a}	2.41^{a}	2.39
Yolk height	0.81^{a}	0.88^{a}	1.11^{a}	0.89^{a}	0.86^{a}
Yolk diameter	2.31^{ab}	2.23^{b}	2.36^{ab}	2.43^{a}	2.91^{ab}
Albumen length	3.00^{a}	2.99^{a}	2.97^{a}	3.00^{a}	3.00^{a}
Albumen height	0.69^{a}	0.72^{a}	0.88^{a}	0.80^{a}	0.78^{a}
Yolk weight	2.93^{a}	2.66^{a}	3.12^{a}	2.86^{a}	3.06^{a}
Shell weight	0.77^{ab}	0.76^{ab}	0.72^{a}	0.78^{ab}	0.83^{a}
Shell Thickness	0.24^{a}	0.81^{a}	0.22^{a}	0.20^{a}	0.21^{a}
Albumen diameter	3.00^{a}	3.00^{a}	3.002^{a}	3.00^{a}	3.00^{a}
Egg Surface Area	20744^{ab}	17659^{b}	20539^{ab}	23296^{a}	23664^{a}
Unit surface Shell weight	0.00012^{ab}	0.00014^{a}	0.00012^{ab}	0.00010^{b}	0.00011^{ab}
Egg index	25.84^{a}	32.52^{a}	25.94^{a}	24.89^{a}	24.92^{a}
Shell ratio	8.45^{a}	10.22^{a}	7.91^{a}	8.05^{a}	8.66^{a}
Albumen index	8.63^{a}	9.00^{a}	11.08^{a}	9.99^{a}	9.76^{a}
Yolk index	35.39^{a}	39.80^{a}	47.41^{a}	39.09^{a}	38.32^{a}
Yolk ratio	31.81^{a}	30.65^{a}	34.05^{a}	29.52^{a}	31.57^{a}
Albumen weight	0.55^{a}	0.52^{a}	$0,53^{a}$	0.60^{a}	0.57^{a}
Albumen ratio	59.73^{a}	59.47^{a}	58.03^{a}	62.42^{a}	59.76^{a}
Haugh Unit	170.38^{a}	172.41^{a}	173.49^{a}	171.37^{a}	171.11^{a}

Means with different superscript along the rows significantly different ($P < 0.05$) and means with the same superscript along the rows are not significantly ($P > 0.05$) different.

Table 5. Phenotypic correlation among internal and external egg quality traits

	EW	**EL**	**EWT**	**YH**	**YD**	**AL**	**AH**	**YW**	**SW**	**ST**	**AD**	**ESA**	**USW**	**EI**
EW	1.00	0,65	0.66	0.05	0.42	0.04	0.08	0.30	0.53	-0.01	0.02	0.93	-0.81	-0.64
EL		1.00	0.50	0.08	0.31	0.31	0.05	0.27	0.40	-0.03	0.06	0.71	-0.70	-0.20
EWT			1.00	0,07	0.35	0.04	0.09	0.28	0.42	0.01	0.00	0.73	-0.66	-0.13
YH				1.00	0.01	0.02	0.04	0.06	-0.07	0.004	0.008	0.05	-0.07	-0.01
YD					1.00	-0.13	-0.001	0.28	0.29	-0.02	-0.04	0.46	-0.41	-0.13
AL						1.00	0.04	-0.009	-0.02	0.008	0.007	0.06	-.0.04	0.001
AH							1.00	0.05	0.03	-0.04	0.008	0.09	-0.10	-0.02
YW								1.00	0.15	0.006	0.02	0.32	-0.30	-0.10
SW									1.00	0.22	0.03	0.57	-0.52	-0.18
ST										1.00	-0.008	-0.02	0.00	-.007
AD											1.00	0.02	-0.04	-0.01
ESA												1.00	-0,89	-0.35
USW													1.00	0.15
EI														1.00
SR														
AI														
YI														
YR														
AW														
AR														
HU														

EW = Egg Weight, EL = Egg Length, EWT = Egg Width, YH = Yolk Height, YD = Yolk Diameter, AL = Albumen Length, AH = Albumen Height, YW = Yolk Weight, SW = Shell Weight, ST = Shell Thickness and AD = Albumen Diameter, ESA = Egg Surface Area, USW = Unit Surface Shell Weight, EI = Egg Index, SR = Shell Ratio, AI = Albumen Index, YI = Yolk Index, YR = Yolk Ratio, AW = Albumen Weight, AR = Albumen Ratio and HU = Haugh Unit

Phenotypic Correlations among internal and external egg quality traits

Table 5 shows a strong positive correlation between egg weight, length, width, surface area, and albumen weight. The egg weight, unit surface shell weight, and shell ratio had a strong negative association. In addition, there was a significantly positive relationship between yolk height and yolk index. The yolk weight, shell thickness, albumen diameter, and shell weight had a positive but low correlation.

Although there was a positive correlation between egg weight and shell weight, there was a negative correlation between egg weight and shell thickness.

Additionally, there are significant correlations between egg weight and shell ratio. There was also a negative correlation between egg length and shell thickness. The yolk index and albumen index had a low but favourable correlation.

Discussion

Effect Age on Egg Quality Traits

It is conceivable that variations in quail age resulted in changes in body weight, egg weight, yolk diameter, and shell weight

Phenotypic correlations among internal and external egg quality traits

Because there is a positive association between egg weight and egg length, egg width, egg surface area, and albumen weight, selecting high egg weight improves all of the above criteria. The statistically significant but negative phenotypic correlation value (-0.64) found between egg weight and egg shape index agrees with Iscan and Akcan (1995) findings in hen eggs and Ozcelik (2002) findings in quail eggs, respectively. This result was also in line with Kul and Seker's findings (2004). The statistically significant association identified between egg weight and shell weight agrees with Kul and Seker's findings (2004). The findings of Kul and Seker (2004) were refuted by a negative association between egg weight and shell thickness. The significant positive link established between shell weight and shell thickness, on the other hand, is consistent with Poyraz's (1989) findings. The shell ratio in whole eggs was found to have an inverse relationship with egg weight growth in this study. That is, it shrank. Ozcelik (2002) and Kul and Seker's research results supported this claim (2004). Kul and Seker reported a similar conclusion of a negative association between albumen weight and yolk (2004). Despite this, a positive association between haugh unit and yolk ratio was found in this study, which was opposed by Kul and Seker's findings (2004) Akbas *et al*.(1996) discovered a statistically significant phenotypic correlation between yolk height(0.48) and albumen height(0.52), as well as albumen height and haugh unit (0.97).

It was discovered in this study that there was an increase in egg weight and a drop in the yolk ratio as a result of the phenotypic correlation discovered between the egg's internal and external quality attributes. Most internal egg quality variables tested showed statistically significant declines as the eggshell ratio increased. Except for the yolk ratio, which exhibited a positive connection with the shell ratio in Ozcelik's (2002) research, the results were consistent with his findings. According to the findings of this study, almost all internal quality aspects of the egg were changed at positively significant levels based on the change in egg weight. According to the findings of this study, when yolk weight increases, albumen weight decreases.

Conclusion

The egg weight had a negative relationship with the egg shape index and the thickness of the shell but a positive interaction with the shell weight. The yolk ratio was also found to correlate with egg weight negatively. It was revealed that as the eggshell ratio increased, most of the interior egg quality features studied showed statistically significant declines. The results of this study, which included some internal and external quality traits of quail eggs, will be helpful to other researchers studying Japanese quail breeding and the improvement

Reference

Akbas, Y. O.altan and C. kocak (1996). Effects of hen’s age on external and internal egg quality characteristics.Turk. J. Anim. Sci., 20: 455-480.

Altinel, A., H. Gunep,T. Kirnuzibayrak,S.G. Corcki and T. Bilal (1996).The Studies on egg quality characteristics of Japanese quails. J. Fac Vet. Univ. Istanbul, Turkey 22:1:203-213.

Buss, E. G. (1982).Genetic differences in avian eggshell formation Poult. Sci., 61:2048-2055.

Choi, J. H., W. J. kang, D. H. Baik and H. S. Park (1983).A study on some characteristics of fractions and shell quality of the chicken egg. Korean J. Anim Sci., 25:651-655.

Hamilton, R. M.G. (1982).Methods and factors that affect the measurement of egg shell quality poult. Sci. 61: 2022-2039.

Iscan, K. M. and A. Akan (1995): The relationship between the egg weight and the egg-weighted egg mass of broiler parent eggs. J. Central Amim. Res. Inst., 5.49-52

Kul, S and Seker I. (2004): Phenotypic Correlation between some External and Internal egg quality traits in the Japanese quail (*Coturnix Coturnix japonica*). Int.J. Poult. Sci., 3: 400-405.

Narahari, D., K. Abdul-Majev, A. Thangavel, N. Ramamurty, S. Visunathan, B. Malian, B. Murgananda and V. Sunrara Osu (1988): Traits influencing the hatching performance of Japanese quail eggs. Br. Poult. Sci. 29:101-112.

Nordstron, J.O. and L.E. Ouserhoult(1982).Estimation of shell weight and shell thickness from egg specific gravity and egg weight. Poult. Sci., 61:1991-1995.

NVRI (1994).National Veterinary Research Institute,Vom, FarmerTraining and Quail Production and Health Management, pp.44.

Ouaffai, A.; Dahloum, L.; Fassih, A.; Milagh, M. and Halbouche, M. (2018): Growth, egg-laying and egg quality performance in Japanese quail (Coturnix coturnix japonica). Arch. Zootec. 67 (258): 168-176.

Ozcelik, M., (2002).The phenotypic correlations among some external and internal quality characteristics in Japanese quail eggs. Vet. J. Ankara Univ., 49:67-72.

Panda B and Singh R.P. (1990).Development in processing quail. World’s ponltry Science Journal 46:219-234.

Peebles, E. D and H. L. Marks (1991).Effects of selection for growth and selection diet on egg shell quality and embryonic development in Japanese quail. Poult. Sci., 70: 1471-1480.

Poyraz. O.(1989). kabuk kalitisi ile ilgili yumu-ta Ozelilaleri arosindaki fenotipik Korelasy. J. Lalahan livest. Rese list., 29:66-79.

Reddish JM, Nestor KE,Lilburn. MS.(2003). Effect of selection for growth on onset of sexual maturity in randombred and growth- selected lines of Japanse quail. Poultry Science 82:187-191.

Sogut, B., M. Sary, O.Kalpak, H. Inciand, E. Babacanoglu (2001).Dogu Anadolu Kanatil Yetistirisiligi sempozyumu 21-24 Mayis, Yuzzuneu Yil University, Van.,197-203.

Stadelman, W. J. (1986.).The preservation of quality in shell eggs. In W. J. Stadelman. O.J. Cotteril (Eds), Egg Science and

Technology. Avi Publishing company inc. wesport, Connecticut, U. S. A.
Thompson, B. K., R. M. G.Hamilton and P. W. Voisey (1981). Relationships among various egg traits relating to shell strength among and within five avian species Poult. Sci., 60: 2388-2394
Thompson, R. and R. M G. Hamilton (1982).Comparison of precision and accuracy of the floatation and Archimedes methods for measuring the specific gravity of eggs. Poult. Sci., 61:2388-2394.
Troutman, C. (2012). What are the benefits of quail? Retrieved online on 11/09/2013 http://www.ehow.com/list_6671158_benefits-quail-eggs_.html#page=1
SAS (Statistical Analysis Systems Institute)(2012). SAS/STAT User's Guide: SAS Institute Inc., SAS Campus Drive, Cary, NC, USA