Nig. J. Anim. Prod. 2019, 46(1):20 - 29
Nigerian Journal of Animal Production

Influence of sire on internal egg quality and linear body traits of Japanese quail raised in the humid tropical environment

Obi, O. C., Obike, O. M., Oke, U. K., Orji, A. C. and * Onunkwo, D. N.
College of Animal Science and Animal Production,
Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
***Corresponding author:** donunkwo1@gmail.com; +2348033388622

Abstract

A total of 270 pedigreed-hatched day old chicks of three strains of Japanese quail generated from a base population of 36 adultswere used in a randomized complete block design to estimate the influence of sire on the internal egg quality and linear body traits of the birds. Parameters measured were internal egg quality traits - albumen height, yolk height, albumen weight, yolk weight, albumen diameter, albumen length, yolk width, yolk length, yolk index, and haugh unit, and growth traits - body weight, thigh length, breast length, body length, keel length, wing length, and shank length. Results showed that linear body parameters were significant (P<0.05) except body weight at week 9. Panda white x Cinnamon brown (PWxCB) progenies out-performed the progenies of the other strains mainly at week 9. The PWxCB strain had the highest values in the following: body weight (159.30), thigh length (4.76), breast width (7.40), body length (11.94), keel length (6.77), and shank length (3.44). The haugh unit value was significantly (P< 0.05) different among the three strains mainly at week 8 with CBxCB strain having higher value of (89.07) followed by PWxCB strain (89.03). The phenotypic correlations between the linear body parameters and internal egg quality traits in Cinnamon brown x Cinnamon brown (CBxCB) strain were significant (P<0.01) in keel length and yolk weight (0.534) and between shank length and yolk weight (0.473) at week 9. For PWxCB strain, high significant (P<0.01) correlation were seen between shank lengthand albumen length (0.631) at week 8, body weight and yolk index at week 9. Silver brown x Cinnamon brown (SBxCB) strain also showed high positive significant (P<0.01) correlation between shank length and yolk weight (0.541), breast width and albumen weight (0.537) and between body length and albumen weight (0.625) at week 9. These positive correlations imply that by direct selection for any linear body trait for increased meat production, there will be a remarkable genetic improvement in the internal egg quality trait. It can be concluded that PWxCB is a strain of choice for improved growth and internal egg quality characteristics.

Keywords: Japanese quail, humid tropics, linear body traits, internal egg quality.

Introduction

The japanese quail was brought to Nigeria in 1992 (NVRI,1994). Quail have been raised all over the world for production, especially in the countries of Europe for meat and Far East for egg (Minviella, 2004). Like the chicken, Japanese quail belongs to the family Phasianidae. The newly hatched weigh 6-8 grams but grow rapidly and fully feathered at about 4 weeks of age. The adult male quail weighs about 100-130 grams (Mizutani, 2003). Males also have cloacal glands (a bulbous structure located at the upper- edge of the vent which secrets a white foamy material). This unique material is used to access the reproductive fitness of the males. The young male begins to crow at 5-6 weeks old. The adult females are slightly heavier than the males weighing from 120-160g (Ortlieb,2013).Distinct characteristics of the Japanese quail which include rapid growth, thus enabling the quail to be marketed for consumption at 5-6 weeks of age, early sexual maturity which result in short generation interval, disease resistance, less capital requirement,high rate of lay and much lower feed and space requirement than domestic fowl (Adeogun and Adeoye, 2004),have further given the birds advantage and attention from researchers in recent time. Linear body traits help in the comparison of growth in the different parts of the body. It has also been severally used to characterize strains and also predicts the live weight gain in livestock. A study on the effect of sire on internal egg quality and linear body traits may be of good help in the evaluation of both egg and meat production. The objective of the study was therefore to determine the influence of sire on the growth performance of the linear body traits and internal egg quality traits.

Material and methods

The experiment was carried-out at the Poultry Unit, Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria located at latitude 05^{0}29′N, longitude 07^{0}33′E and altitude of 122m above sea levels. Umudike lies within the humid rainforest Zone of West Africa, characterized by long duration of rainfall and short period of dry season with maximum and minimum temperature of 32°C and $^{22^{\circ}}$Crespectively. Relative humidity ranges from 50-95% depending on the season. The meteorological data were obtained from the Meteorological station of National Root Crops Research Institute, Umudike.

Acquisition and mating of base population

The breeding stocks were obtained from Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike. A base population of 36 adult Japanese quails comprising of nine female Cinnamom brown and three male Cinnamon brown, nine female Cinnamon brown and three male Panda white and nine female Cinnamon brown and nine male silver brown was used. The mating scheme is as illustrated thus: Male Cinnamon brown x Female Cinnamon brown, Male Panda white x Female Cinnamon brown, Male Silver brown x Female Cinnamon brown. The mating ratio was 1:3 that is, 1 sire to 3 dams. Each group was divided into three with 30 birds per replicate. The birds after mated produced fertile eggs, the eggs were held in eggs crates under room temperature with good ventilation. At the end of six days of egg collection, the eggs were set for pedigree hatching in a cabinet type of incubator at a temperature of 37.7°Cand 70% humidity. The eggs were turned not less than three times to prevent embryo adhesion to the shells. The eggs hatched between 16th -19th days. On hatching, chicks were given individual identities by placing them on separate brooding rooms according to their different strains. A total of 270 day-old chicks were produced. The chicks were brooded for three weeks under a continuous illumination. Caution was taken to prevent chicks from drowning in water troughs by filling the petri-dishes with pebbles. Old newspapers were firstly used as litter material followed by wood shaving. Thereafter; they were raised on deep litter under natural light. Ninety chicks per progeny type replicated into three groups of 30 chicks each were moved to their separate pens. The chicks were fed with commercial starter mash containing 21% crude protein and 2800kcalME/kg while at their laying stage, they were given commercial layers mash containing 16.5% crude protein and 2500kcalME/kg.Feed and water were given *ad libitum*.

Data collection and statistical analysis

The following linear body traits were taken weekly on the progenies generated with the aid of weighing scale in grams and measuring tapes in centimeter. Body weight (g) was determined early in the morning before feeding the birds with an electronic scale. Thigh length was taken from the beginning of the fibula to the hock joint.

Shank length was taken from the beginning of the hock joint to the last ring before the tarsa- metarsus digit. Breast width was taken from the point of depression to the sharp edge. Keel length was taken from the V- joint to the end of the sternum. Wing length was taken from the tip of the phalanges to the coracoids humerus joint. Body length was taken as the distance between the base of the neck and pygostyle. The egg quality parameters measured were albumen height, yolk height, albumen diameter, albumen length, yolk width, and yolk length determined in millimeters with the aid of vennier-caliper. Albumen weight and yolk weight were determined using the formula.

$$\text{Yolk index} = \frac{\text{Height of Yolk (mm)}}{\text{Yolk Width (mm)}}$$

Haugh Unit is the measure of egg –white or albumen quality. It was determined using the formula below (Haugh, 1937). Haugh Unit = $100 \text{ Log} (H + 7.57 - 1.7W^{0.37})$

Where, H = Albumen height in (mm) measured using Vennier-Caliper W= Observed weight of the egg in grams.

Data collected from the study were subjected to analysis of variance (ANOVA) in a randomized complete block design using SAS (2004) procedure and separation of means was done using Duncan′s Multiple Range Test (DMRT) according to Duncan (1955).The model is shown below

$$Y_{ijk} = \mu + b_i + s_j + e_{ijk}$$

Where,

Y_{ij} = Individual Observation

μ = Population mean

b_i = Main effect (hatch)

s_j = Main effect of strain of Sire

e_{ijk} = Experimental error assumed to be independently, identically, normally distributed with zero mean and homogenous variance

Pearson correlation analysis was carried out to determine the relationship among the internal egg quality traits and linear body parameters of the three strains.

Results and discussion

Effect of sire on linear body parameters of Japanese quail progenies at week 4, 8, and 9 is shown in Table 1. At week 4, all the linear body parameters were significantly ($P<0.05$) different except breast width and wing length. PWxCB showed the best record for linear body parameter at this week followed by CBxCB. At week 8, all the linear body parameters were significantly ($P<0.05$) different with PWxCB having superior performance compared to the other strains. At week 9, all the linear body parameters were significantly ($P<0.05$) different except body weight. PWxCB strain also had the best performance followed by CBxCB progeny. The result obtained in the present study showed that body weight revealed an increase as age of the birds increased, though not significantly different precisely at week 9. This is in accordance with the work done by Karimah (2000) who reported that growth trait of quail with respect to age is a function of feeding rate. Body length also revealed an increase as age increased. This also agreed with the work of Karimah (2000) which stated that body length increased gradually with an age for the first five weeks. The mean body weight of Japanese quails increased from 35.23 g at week 2 to 143.78 g at week 8 (Ojo *et al.,* 2014). The PWxCB progenies had the heaviest body weight (159.30 g) in week 9. Body length from this study showed a gradual increase with an age throughout the experiment (from week 4 to week 9). This also agreed with the work of Karimah (2000) which stated that body length increasegradually withage for the first five weeks. The findings of Karimah (2000) also, showed that shank length failed to describe the genetic variation in quail as age increased. This is in line with the present

Table 1: Effect of sire on linear Body parameters of the three strains of Japanese quail at week 4, 8, and 9

		Week		
STRAIN	PARAMETER	**4**	**8**	**9**
CBxCB	BW(g)	90.66[ab]	143.15[b]	152.86
	TL(cm)	4.05[a]	4.69[b]	4.71[a]
	BR(cm)	6.91	7.12[a]	7.31[b]
	BL(cm)	8.79[a]	11.60[b]	11.81[b]
	KL(cm)	4.16[c]	6.56[a]	6.64[b]
	WL(cm)	6.25	7.90[a]	7.89[a]
	SL(cm)	3.01[a]	3.32[a]	3.32[b]
PWxCB	BW(g)	91.45[a]	156.62[a]	159.30
	TL(cm)	4.10[a]	4.81[a]	4.76[a]
	BR(cm)	5.12	7.15[a]	7.40[a]
	BL(cm)	8.79[a]	11.81[a]	11.94[a]
	KL(cm)	4.56[a]	6.69[a]	6.77[a]
	WL(cm)	6.91	7.86[ab]	7.83[ab]
	SL(cm)	2.98[a]	3.34[a]	3.34[a]
SBxCB	BW(g)	88.32[b]	144.00[b]	154.10
	TL(cm)	3.91[b]	4.64[b]	4.58[b]
	BR(cm)	4.68	7.03[b]	7.17[c]
	BL(cm)	8.29[b]	11.36[c]	11.69[c]
	KL(cm)	4.24[b]	6.32[b]	6.46[c]
	WL(cm)	6.26	7.72[b]	7.71[b]
	SL(cm)	2.84[b]	3.24[b]	3.24[c]
SEM				
	BW(g)	0.59	2.40	1.51
	TL(cm)	0.02	0.02	0.01
	BR(cm)	0.53	0.02	0.02
	BL(cm)	0.04	0.04	0.02
	KL(cm)	0.02	0.03	0.03
	WL(cm)	0.02	0.03	0.03
	SL(cm)	0.01	0.01	0.01

[a,b,c] Means across rows differ significantly at ($p<0.05$); SEM= Standard error of mean.BW= body weight, TL=thigh length, BR=breast width, BL= body length, KL= keel length, WL= wing length, SL= shank length. CBxCB=Cinnamon brown x Cinnamon brown,PWxCB=Panda white x Cinnamon brown, SBxCB= Silver brown x Cinnamon brown

study but disagreed with Adeogun and Adeoye (2004) who reported that shank length increases as the bird increases in age. The wing length and shank length at week 9did not actually increase as the age increased; this may be attributed to the fact that they do not actually use their wing for incubation as compared to Muscovy (0bi *et al.,* 2018). The PW x CB recorded the highest value in the following linear body parameters: breast width, body length, keel length and shank length (7.40, 11.94, 6.77and 3.34) cm respectively at week 9.

Effect of sire on internal egg quality characteristics for the progenies of the three strains of Japanese quail at weeks 8, and 9are shown in Table2. Significant differences were observed among the internal egg quality traits of the various sire progenies across the weeks except for albumen weight, yolk height and yolk length (week 8), albumen height and haugh unit (week 9). Albumen weighthad a range of (4.85-5.50) g with Panda white strain

Table 2: Effect of sire on internal egg quality characteristics of three strains of Japanese quail at weeks 8, and 9

Week	Parameter	CB×CB	PW×CB	SB×CB	SEM
8	Albumen height(mm)	4.04[a]	4.04[a]	3.78[b]	0.04
	Yolk height(mm)	7.78	7.95	7.67	0.06
	Albumen weight(g)	5.08	4.93	5.03	0.06
	Yolk weight(g)	3.12[a]	3.00[ab]	2.98[b]	0.03
	Albumen diameter(mm)	25.27[a]	25.68[a]	23.58[b]	0.26
	Albumen length	40.03[b]	42.40[a]	39.00[b]	0.37
	Yolk width(mm)	16.80[a]	16.08[b]	15.63[b]	0.15
	Yolk length(mm)	18.83	18.43	18.42	0.10
	Yolk index	0.46[b]	0.50[a]	0.50[a]	0.01
	Haughunit(%)	89.07[a]	89.03[a]	87.76[b]	0.21
9	Albumen height(mm)	3.63	3.72	5.12	0.45
	Yolk height(mm)	7.83[a]	8.03[a]	7.48[b]	0.06
	Albumen weight(g)	4.85[b]	5.50[a]	5.00[b]	0.08
	Yolk weight(g)	3.20[a]	3.02[b]	2.96[b]	0.02
	Albumen diameter(mm)	25.10[a]	25.17[a]	22.75[b]	0.27
	Albumen length(mm)	42.93[a]	41.23[b]	39.13[b]	0.35
	Yolk width(mm)	15.92[b]	17.22[a]	16.27[b]	0.15
	Yolk length(mm)	19.23[b]	20.73[a]	19.72[ab]	0.22
	Yolk index	0.49[a]	0.47[b]	0.47[b]	0.00
	Haugh unit (%)	86.66	86.88	87.61	0.27

[a,b] Means across rows differ significantly at p<0.05; SEM = Standard error of the mean. CBxCB=Cinnamon brown x Cinnamon brown, PWxCB=Panda white x Cinnamon brown, SBxCB= Silver brown x Cinnamon brown

recording the highest value of 5.5g at week 9. This range is almost in close relationship with the report of Salawu *et al*. (2007) in Japanese quail. The yolk weight lies within the range of (2.96-3.20) g with CBxCB strain recording the highest value of 3.20g at week 9. This is low compared to (4.3-4.5)g reported by Salawu*et al*. (2007) but higher than 2.98g reported by Ijaiya *et al.* (2012). The yolk largely determines the nutritive value of the egg as a whole. The albumen height ranges from (3.63-5.12)mm. This almost agreed with Ijaiya *et al.* (2012) who reported a value of 4.35mm for albumen height in Japanese quail eggs. The yolk height ranges from (7.48-8.03) mm with the PWxCB strain having the highest value 8.03mm at week 9. This range is lower than 9.31mm reported by Ijaiya *et al.* (2012). The yolk index showed a decrease with the age of the hens apart from CBxCB strain. This is in agreement with Orhan *et al.* (2001) and Zita *et al.* (2009) who reported that the yolk index decreased with the age of the hens. All the strains used are capable to be used for quality egg production especially the CBxCB and PWxCB based on their haugh unit records (89.07 and 89.03) % respectively, followed by SBxCB strain (87.76) at week 8.

Table 3 shows the phenotypic correlations between internal egg quality and linear body traits in purebred CB x CB strain of Japanese quailat weeks 8, and 9. At week 8, statistically significant negative correlations (P<0.05, P<0.01) were found between body weight and albumen weight (-0.403), body length and yolk height (-0.460), thigh length and albumen length (-0.485) thigh length and yolk length (-0.474) while positive significant correlations(P<0.05) were seen in the associations between thigh length and haugh unit (0.456), keel length and albumen diameter(0.419), keel length and yolk length (0.450), keel length and yolk width

Table 3 Phenotypic correlations between internal egg quality traits and linear traits in Purebred CB×CB strain of Japanese quailat weeks 8, and 9

Week	Traits	BW	SL	TL	BRW	BL	KL	WL
8	AH(mm)	-0.037	-0.258	0.400*	0.017	0.027	-0.125	0.047
	YH(mm)	0.070	0.220	-0.204	0.182	-0.460*	0.352	-0.145
	AW(g)	-0.403*	0.112	-0.278	-0.212	-0.060	0.066	0.037
	YW(g)	0.142	-0.018	0.137	-0.111	-0.053	0.020	0.207
	AD(mm)	0.049	0.105	-0.171	-0.267	0.420*	0.419*	0.204
	AL(mm)	-0.266	0.216	-0.485**	0.098	-0.339	0.057	-0.247
	YWD(mm)	-0.031	0.175	-0.341	-0.011	-0.006	0.461*	-0.120
	YL(mm)	-0.319	0.070	-0.474**	-0.088	-0.349	0.450*	-0.218
	YI	0.077	0.004	0.145	0.132	-0.355	-0.139	-0.007
	HU(%)	0.012	-0.334	0.456*	0.115	0.093	-0.116	-0.012
9	AH(mm)	-0.233	0.224	-0.432*	-0.071	-0.255	0.138	-0.084
	YH(mm)	0.265	0.135	-0.099	-0.197	0.296	0.315	0.415*
	AW(g)	-0.471**	0.100	-0.347	-0.229	-0.106	0.366*	0.124
	YW(g)	-0.352	0.473**	-0.093	-0.111	0.221	0.534**	0.137
	AD(mm)	-0.158	0.290	-0.117	-0.167	0.347	0.229	0.018
	AL(mm)	-0.250	0.008	0.082	-0.216	-0.233	-0.258	-0.235
	YWD(mm)	0.157	0.176	-0.217	0.028	0.037	0.163	0.002
	YL(mm)	-0.134	-0.205	0.065	0.054	-0.318	0.038	-0.050
	YI	0.056	-0.057	0.106	-0.225	0.238	0.129	0.362*
	HU(%)	-0.234	0.313	-0.391*	-0.094	-0.196	0.117	-0.112

*correlation significant at 0.05 probability level; ** correlation significant at 0.01 probability level

AH= albumen height, YH= yolk height, AW= albumen weight,YW= yolk weight,AD= albumen diameter, AL= albumen length,YWD= yolk width, YL= yolk length, YI= yolk index, HU= haugh unit. BW=body weight, SL=shank length, TL=thigh length, BRW= breast width, BL=body length, KL= keel length, WL=wing length.

(0.461) and finally between body length and albumen diameter (0.420) at P<0.05. At 9 weeks, negative significant correlations (P<0.05, P<0.01) were found between body weight and albumen weight (-0.471), thigh length and haugh unit (-0.391), and thigh length and albumen height (-0.432), while positive significant correlations (P<0.05, P<0.01) were seen between keel length and albumen weight (0.366), wing length and yolk height (0.415), wing length and yolk index (0.362), keel length and yolk weight (0.366), shank length and yolk weight (0.473).

The positive correlations obtained in this study revealed that as linear body parameter increased there wasa corresponding improvement in the associated internal egg traits while the negative correlations found also indicate that improvementof either linear body or internal egg quality traits will lead to a decrease in a corresponding trait. Due to no or inadequate information on this type of phenotypic correlation in the available literature the work could not be compared with any author.

Table 4 presents the phenotypic correlations between internal egg quality traits and linear body traits in PWxCB strain of Japanese quail at weeks 8 and 9. At week 8, negative significant correlations (P<0.05, P<0.01) were found between body weight and yolk length (-0.396), body length and albumen weight (-0.456), wing length and albumen diameter (-0.614), wing length and albumen weight (-0.769), shank length and yolk length (-0.465), body weight and albumen weight (-0.560), body weight and albumen diameter (-0.574), while positive significant correlations

Table 4 : Phenotypic correlations between internal egg quality traits and linear body traits in PW×CB Strain of Japanese quail week 8, and 9

Week	Traits	BW	SL	TL	BRW	BL	KL	WL
8	AH(mm)	0.307	0.319	0.175	0.144	0.262	0.430*	0.183
	YH(mm)	0.210	0.009	-0.091	0.008	-0.117	0.156	0.025
	AW(g)	-0.560**	-0.225	-0.294	-0.084	-0.456*	-0.107	-0.769**
	YW(g)							
	AD(mm)	-0.574**	-0.266	-0.139	-0.056	-0.202	-0.285	-0.614**
	AL(mm)	0.410*	0.631**	0.334	-0.094	-0.105	0.459*	-0.044
	YWD(mm)	-0.045	-0.090	0.305	-0.169	0.099	0.018	0.119
	YL(mm)	-0.396*	-0.465**	-0.126	-0.285	0.035	-0.213	-0.068
	YI	0.133	0.022	-0.320	0.135	-0.139	0.054	-0.099
	HU(%)	0.355	0.294	0.183	0.090	0.290	0.391*	0.274
9	AH(mm)	-0.271	0.034	0.348	-0.260	-0.152	0.195	-0.290
	YH(mm)	0.113	-0.154	-0.166	-0.106	-0.472**	-0.110	-0.088
	AW(g)	-0.013	0.299	0.203	-0.410*	0.292	0.223	-0.057
	YW(g)	-0.354	-0.334	-0.043	-0.406*	-0.008	-0.219	0.022
	AD(mm)	0.166	-0.359	0.051	-0.271	-0.272	-0.381*	-0.229
	AL(mm)	0.019	-0.270	-0.065	-0.034	-0.359	-0.147	-0.314
	YWD(mm)	-0.488**	0.011	0.421*	0.011	-0.049	0.282	-0.074
	YL(mm)	-0.211	0.126	0.459*	-0.048	0.044	0.200	-0.254
	YI	0.488**	0.076	-0.473**	-0.093	-0.254	-0.297	0.022
	HU(%)	-0.263	-0.008	0.310	-0.144	-0.207	0.150	-0.215

* Correlation significant at 0.05 probability level; ** correlation significant at 0.01 probability level AH= albumen height, YH= yolk height, AW= albumen weight, YW= yolk weight, AD= albumen diameter, AL= albumen length,YWD= yolk width, YL= yolk length, YI= yolk index, HU= haugh unit..BW=body weight, SL=shank length, TL=thigh length, BRW= breast width, BL=body length, KL= keel length, WL=wing length.

(P<0.05, P<0.01) existed between body weight and albumen length (0.410), keel length and haugh unit(0.391), keel length and albumen length (0.459), keel length and albumen height (0.430), shank length and albumen length (0.631). At week 9, positive significant (P<0.05, P<0.01) correlationswere found between thigh length and yolk width (0.421), thigh length and yolk length (0.459), body weight and yolk index (0.488), while negative correlations (P<0.05, P<0.01) existed between breast width and albumen diameter (-0.410), body length and yolk height (-0.472), thigh length and yolk index (-0.473), body weight and yolk width (-0.488), keel length and albumen diameter (-0.381), and breast width and yolk weight (-0.406). The high correlation between each linear body trait and internal egg quality trait in PWxCB indicates the pleiotropic action of genes responsible for these characters. The practical implication of positive correlation between the traits is that, by direct selection for any one of them, genetic improvement in the others will be achieved as correlated responses if the relationship could translate to positive genetic associations. This also, reveals that as linear body traits increase for meat production, internal egg parameters becomes better in terms of quality while for

Table 5: Phenotypic correlations between internal egg quality traits and linear body traits in SB×CB Strain of Japanese quailat weeks 8, and 9

Week	Traits	BW	SL	TL	BRW	BL	KL	WL
8	AH(mm)	0.000	-0.114	-0.158	-0.059	0.035	0.086	0.377*
	YH(mm)	-0.309	0.239	0.131	-0.071	-0.121	-0.062	-0.087
	AW(g)	0.231	0.005	-0.098	0.024	-0.194	-0.054	0.065
	YW(g)	0.072	0.002	-0.049	0.050	-0.158	-0.204	-0.055
	AD(mm)	-0.112	-0.033	-0.240	-0.250	0.005	-0.079	0.107
	AL(mm)	0.353	0.038	0.149	0.218	0.014	-0.026	0.011
	YWD(mm)	-0.033	-0.111	0.101	0.285	0.257	0.042	0.461*
	YL(mm)	-0.079	0.290	-0.109	0.064	-0.155	-0.502**	0.170
	YI	-0.074	0.251	0.032	-0.229	-0.300	-0.140	-0.312
	HU(%)	-0.121	-0.157	-0.037	-0.045	0.188	0.138	0.384*
9	AH(mm)	0.025	0.114	0.023	0.327	0.002	-0.358	0.064
	YH(mm)	0.067	-0.270	0.213	0.462*	-0.078	-0.279	-0.014
	AW(g)	-0.036	-0.350	0.287	0.537**	0.625**	-0.079	0.205
	YW(g)	0.125	0.541**	-0.604**	-0.261	-0.215	-0.043	-0.177
	AD(mm)	-0.034	0.320	-0.020	-0.098	-0.349	-0.107	-0.499**
	AL(mm)	0.342	0.002	-0.393*	0.056	-0.043	0.192	0.051
	YWD(mm)	0.112	0.163	0.088	-0.071	0.072	0.257	-0.090
	YL(mm)	-0.060	0.297	-0.444*	-0.278	-0.238	0.091	-0.320
	YI	-0.079	-0.221	0.014	0.246	-0.105	-0.337	0.067
	HU(%)	-0.192	0.177	-0.200	-0.075	-0.242	-0.266	-0.130

* correlation significant at 0.05 probability level; ** correlation significant at 0.01 probability level AH= albumen height, Y H= yolk height, AW= albumen weight,YW= yolk weight ,AD= albumen diameter, AL= albumen length, YWD= yolk width, YL= yolk length, YI= yolk index, HU= haugh unit.BW=body weight, SL=shank length, TL=thigh length, BRW= breast width, BL=body length, KL= keel length, WL=wing length.

negative correlations as the linear body traits increase for meat production the quality of the internal egg parameters decreases .

The phenotypic correlations between internal egg traits and liner body traits of SBxCB strain of Japanese quailat weeks 8, and 9are indicated in Table 5. At week 8, significant positive correlations (P<0.05) were observed between wing length and albumen height (0.377), wing length and yolk diameter (0.461), wing length and haugh unit (0.384) while negative significant correlation (P<0.01) existed between keel length and yolk length (-0.502) only. At week 9, significant positive correlations (P<0.05, P<0.01) were observed between breast width and yolk height (0.462), body length and albumen weight (0.625), breast width and albumen weight (0.537), shank length and yolk weight (0.541) while a negative significant correlation (P<0.05, P<0.01) thigh length and yolk length (-0.444), thigh length and albumen length (-0.393), thigh length and yolk weight (-0.604), and between wing length and albumen diameter (-0.499). The high correlation between each linear body trait and internal egg trait in SBxCB strain shows the pleiotropic action of genes responsible for these characters. The implication is that by direct selection for any linear body traits for increase meat production, there will be a remarkable genetic improvement in the internal egg traits quality.

Conclusion

The study showed that Panda white sire recorded the highest value for body weight, thigh length, breast width, body length, keel length, and shank length. The linear body parameters showed increase as the age of the birds increased among progenies of the three sire lines. The positive correlations as observed in some parameters between egg quality traits and linear body parameters indicated that as egg quality traits were being improved for egg production there will be a concomitant improvement on the linear body parameters for better meat production. Since this attribute implies high reproductive efficiency and also will reduce cost of production, this will ensure high economic return in quail production enterprise mainly on PWxCB strain.

References

Adeogun, I. O. and Adeoye, A. A. 2004. Heritability and phenotypic Correlations of growth Performance traits in Japanese quails. *Livestock Research for Rural Development*, 16:67-73.

Duncan, D. B. 1955. Multiple range and multiple F-tests. *Biometrics*.11:1-42.

Ijaiya, A. T., Aremu, A., Adesiji, M. A., Egena, S. S. A. and Jiya, E. Z. 2012. Egg production and egg quality characteristics of Japanese quails (*Coturnixcoturnix japonica)* fed graded levels of cooked tallow (*Detarnummicrocarpuru)* seed meal *Sav. Journal of Agriculture 7 (2): 7-11.*

Karimah, A. S., Ahmed, R. S., Omary, A. and Kamal, S. 2000. Selection index alternatives for increased marketing body weight with minimum concomitant in body bones percentage recourse to tissue dissection on Japanese quail. Arch Tierz, Dummerstort, 43: 535-543.

Minvielle, F. 2004.The Future of Japanese quail for research and production. *World's poultry Science* Journal, 60: 8-13.

Mizutani, M. 2003. The Japanese Quail. www. Angrin.tri.govtw/apec 2003/chapter/pdf.

NVRI, 1994. Farmer training on quail Production and health management. National Veterinary Research Institute Von, Nigeria. Pg 44.

Orhan, H., Erensayin, C. and Aktan, S. 2001. Determining egg quality characteristics of Japanese quails (*Coturnix corturnix japonica*) at different ages. HayvansalUretim, 1: 44- 49.

Ojo, V., Fayeye, T. R., Ayorinde, K. L., Olojede. H. 2014. Relationship between weight and linear body measurement in Japanese quail (*Corturnixcoturnix japonica) Journal Science Resource, 6 (1): 175-183.*

Ortlieb, G. 2013.Raising Coturnix Quail.www.howtoraisequail.com/coturnixquail

Salawu, I. S., Orunmuyi, M. and Okezie, O. 2007.The use of Hotelling T^2 statistics in comparing the egg weight of quail, Brown strain of the commercial and Duck.*Asian Journal of Animal Sciences, 1(1): 53-56.*

SAS Institute 2004.The SAS system for windows.SAS Instistute. Inc., Cary N.C.

Zita, L., Tumova, E. and Stolc, L. 2009. Effect of genotype, age and interaction on egg Quality in brown- egg laying hens.*ActaVeterinaria Brno*, 78(1) 85-91.

Received: 12th August, 2018
Accepted: 9th February, 2019