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Sire influence on reproductive, performance characteristics and growth traits in three strains of Japanese quail raised in the humid tropics

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Abstract

A total of 270 pedigreed-hatched day old chicks of three strains of Japanese quail generated from a base population of 45 adult Japanese quails were used to estimate the influence of sire on the hatchability and growth performance of the birds. Japanese quail strains used were Cinnamon Brown x Cinnamon Brown (CBxCB), Panda White x Cinnamon Brown (PWxCB) and Silver Brown x Cinnamon Brown (SBxCB). The experiment was a randomized complete block design. Parameters measured include: fertility and hatchability traits, growth performance traits and linear body parameters. The results showed that, average percentage range of fertility (71.64-75.76 %), hatchability (50.08-57.17%), dead in germ (55.00-69.08%), dead in shell (11.20-18.225%) were significantly (P <0.05) better in Pander White (PW) sired progeny while number piped (13.06-20.11 %), brooding (3.00-4.6 %) and rearing (1.00-1.33 %) mortalities showed no significant difference (P>0.05) among the three sired progeny. The work also revealed that final body weight (153.79-159.78 g), daily weight gain (2.10- 2.19 g), daily feed intake (24.59-25.48 g), and feed conversion ratio (11.65-11.93) showed no significant difference (P>0.05) among the three sired progeny. The lower feed intake obtained in this experiment suggests that the feed given to these birds were able to meet up their dietary energy requirement. Panda White sired progeny gave the best feed conversion ratio. For the linear body parameters, PWxCB strain had higher thigh length (4.76 cm), breast width (7.44 cm), body length (12.09 cm), keel length (6.79 cm), and shank length (3.34 cm). The results indicate that Panda White sired progeny should be selected for better hatchability and growth performance for enhanced breeding program in the study area.

Keywords: *Sire, reproduction, hatchability, morphometric traits, growth performance, Japanese quail.*

Description of Problem

Quail have been raised all over the world for production, especially in the countries of Europe for meat and Far East for egg [1]. The Japanese quail was brought to Nigeria in 1992 [2]. 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 [3]. 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 can be 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 male weighing from 120-160 grams [4].

The Japanese quail (*Coturnix coturnix japonica*) is the smallest avian species being farmed for egg and meat [5] and it is becoming increasingly important in the Nigerian poultry industry. Japanese quail has the potential to serve as an excellent and cheap source of animal protein[6], apart from being used as a laboratory animal [7; 8]. Despite their small body size, they play an essential role in commercial production because their egg is of high quality. Quail egg is rich in protein, vitamins, essential amino-acids, phospholipids, saturated and unsaturated fatty acids. Linear body traits help in the comparison of growth in the different parts of the body [9] They have also been severally used to characterize strains and also predict the live weight gain in livestock [9]. Hatchability is an important trait indicating the number of fertile eggs as well as embryonic survival. Growth and hatchability parameters have been widely reported in Guinea fowl [10] while such information is very scanty for Japanese quail in literature. A study on the effect of sire on hatchability and growth characteristics is essential in the evaluation of both egg and meat production in Japanese quail. The objective of the study was to determine the influence of sire on hatchability and growth parameters of the three strains of Japanese quails.

Materials 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 122 m 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 temperatures of 32^{0}C and 22^{0}C, respectively. Relative humidity ranges from 50-95%. 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 comprising of Cinnamon Brown, Panda White and Silver Brown were obtained from the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike. The base population of 45 adult quails had 12 females each of the strain and 9 Cinnamom Brown males. The mating scheme is as indicated below:

Cinnamon Brown (Male) x CinnamonBrown (Female)
Panda White (Male) x Cinnamon Brown (Female)
Silver Brown (Male) x Cinnamon Brown (Female)

The mating ratio was 1:4 that is, 1 sire to 4 hens. The birds mated naturally. Eggs were collected daily and held in eggs crates under room temperature with good ventilation. At the end of 6 days of egg collection per week, the eggs were set for pedigree hatching in a cabinet type of incubator at a temperature of 37.7^{0}C and 70 % humidity. The eggs were turned a minimum of 3 times to prevent embryo adhesion to the shells. The eggs hatched between 16^{th} -19^{th} day. On hatching, chicks were given individual identities by placing them on separate brooding rooms according to their different sire lines. A total of 106 day-old chicks were produced by CBxCB, PWxCB produced 100 and SBxCB produced 100. The chicks were brooded for three weeks under required brooding condition, care 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. After brooding, 90 chicks from each sire line were selected and replicated into three groups of 30 chicks each. The chicks were fed with commercial starter mash containing 21% CP and 2800 metabolizable energy while at their laying stage, they were given commercial layers mash containing 16.5% CP and 2500 metabolizable energy Feed and water were given *ad libitum*.

Data Collection and Statistical Analysis
Growth rate

The following growth traits were taken on weekly basis on the progenies generated with the aid of weighing scale in grams and measuring tapes in centimeter.

Body weight was determined with an electronic sensitive 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. Measurements were taken early in the morning before the birds were fed.

Growth performance traits
Feed intake

This was taken as the difference between the total feed given daily and the left- over on the following day in grams.

Weight gain

This was calculated as the final weight at the end of the week minus the initial weight at the beginning of the week.

Feed conversion ratio

This is a measure of an animal's efficiency in converting feed mass into increased body mass.

Feed conversion ratio was calculated as gram feed over gram- weight gain.

$$FCR = \frac{\text{Feed Consumed (g)}}{\text{Weight gain (g)}}$$

Hatchability traits:

Hatchability traits measured were as follows:

Fertility of egg (%) =

$$\frac{\text{Number of fertile eggs}}{\text{Number of eggs set}} \times \frac{100}{1}$$

Hatchability (%) =

$$\frac{\text{Number of chicks hatched}}{\text{Number of fertile eggs set}} \times \frac{100}{1}$$

Dead in germ (%) =

$$\frac{\text{Number with dead embryo}}{\text{Number of chicks hatched}} \times \frac{100}{1}$$

Dead in shell (%) =

$$\frac{\text{Number with dead in shell}}{\text{Number of chicks hatched}} \times \frac{100}{1}$$

Number of chicks piped: This was determined by checking for those eggs that cracked but the chicks did not emerge.

Mortality (%) =

$$\frac{\text{Number of dead birds} \times 100}{\text{Number of birds at housing}}$$

Data collected from the study were subjected to analysis of variance (ANOVA) in a randomized complete block design using SAS [11] procedure and separation of significant means was done using Duncan Multiple Range Test (DMRT) according to Duncan [12]. The model is shown below:

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

Where,

Y_{ijk} = Individual observation

μ = Population mean

b_i = Effect of 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 (iind($0,\sigma^2$)).

Results and Discussion

Table 1: Effect of sire on fertility and hatchability of the three strains of Japanese quail

Parameter	CB×CB	PW×CB	SB×CB	SEM
Fertility%	71.64^{b}	75.76^{a}	72.30^{ab}	1.36
Hatchability %	54.08^{ab}	57.17^{a}	50.41^{b}	3.79
Dead in germ %	69.08^{a}	55.00^{b}	61.51^{ab}	10.28
Dead in shell %	11.20^{b}	12.22^{b}	18.25^{a}	3.24
Piped %	13.06	15.56	20.11	2.90
Brooding mortality %	4.67	3.00	3.33	0.47
Rearing mortality %	1.33	1.00	1.00	0.13
Laying mortality %	0.00	0.00	0.00	0.00

^{a,b} Means across rows did differ significantly at (P<0.05); SEM= Standard error of mean. CBxCB=Cinnamon Brown x Cinnamon Brown, PWxCB=Panda White x Cinnamon Brown, SBxCB= Silver Brown x Cinnamon Brown.

The effect of sire on fertility and hatchability traits as well as mortality rate of the three strains of Japanese quail is shown in Table 1. The average percentage fertility, hatchability, dead in germ and dead in shell were significantly (P<0.05) different among the strains while nt compositions: implications for rearing mortality and laying mortality showed no significant difference (P>0.05) among the 3 strains. The percentage fertility observed for the strains in this study agreed with the range of 66.70 – 85.8 % reported by [13] with the PWxCB recording highest fertility percentage of 75.76 %. The result obtained also agreed with [10] who had reported percentage fertility range of 70.58 -73.19 in Guinea fowl. The values were however higher than the values reported by [14] and [15]. The percentage hatchability range of eggs (50.41 – 57.17 %) reported among the three strains was lower than that reported by [16], who gave a range of 63.0-79.0 %. The difference in results may be due to rate of laying and pre-incubation storage [17] as well as strain. The result showed that PWxCB had the best fertility and the least mortality from brooding to laying stage. Therefore, PWxCB is suited for breeding purposes followed by SBxCB and then CBxCB. The results imply high reproductive efficiency and this will reduce cost of production and ensure high economic returns in quail production enterprise. Hatchability is one of the pre-requisites for the better propagation of any breed. [18] reported 71.16% hatchability in quail on the basis of fertile eggs. Variation in germ cells mortality may be due to poor storage, unbalanced nutrition, stressful condition the parent stock was exposed to, little cracking of egg shell, or any other fault in incubation and hatching require-ments and equipment.

Table 2: Effect of sire on growth performance of the three strains of Japanese quail

Parameter	CB×CB	PW×CB	SB×CB	SEM
Initial body weight (g)	6.90	6.69	6.64	0.06
Final body weight (g)	153.79	159.78	154.30	1.45
Daily weight gain g/day	2.10	2.19	2.11	0.29
Daily feed intake g/day	24.59	25.48	25.17	0.32
Feed conversion ratio	11.72	11.65	11.93	0.29

^{a,b}Means across rows did not 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

The effect of sire on growth performance of the three strains of Japanese quail is presented in Table 2. The growth performance indices showed that final body weight, daily weight gain, daily feed intake and feed conversion ratio were not significantly (P>0.05) different among the three strains of Japanese quails. The non significant (P>0.05) difference in final body weight and daily weight gain could be an indication that adult quails are capable of maintaining their body weight at constant rate [8; 19]. The daily feed intake obtained among the 3 strains in the present study was low compared to 29.84 g reported by [20]. The lower feed intake in this current research could be attributed to the fact that the feed given to these birds were able to meet up with their dietary requirement.

Sire effect on linear body parameters of the three strains of Japanese quail at weeks 2, 6 and 10 is indicated in Table 3. At week 2, all the linear body parameters were significantly (P<0.05) different except body weight and thigh length. PWxCB showed the best record for linear body parameter at this week followed by CBxCB. At week 6 all the linear body parameters were significantly (P<0.05) different except body weight and wing length with PWxCB having superior performance compared to the other strains. At week 10, all the linear body parameters were also significantly (P<0.05) different except body weight. PWxCB also had the best performance followed by CBxCB.

From the results obtained in this study, body weight (BW) increase as age of the birds increased, though not significantly different in all the weeks. This is in accordance to the work done by [21] who reported that growth trait of quail with respect to age in body weight is a function of feeding rate . [22] reported that mean body weight of Japanese quails increased from 35.23 g at week 2 to 143.78 g at week 8. PWxCB progenies had the heaviest body weight (159.78 g) in week 10. Body length (BL) also revealed an increase as age increased. This also agreed with the work of [21] which stated that body length (BL) increase gradually with age for the first five weeks. Body length from the present study showed a gradual increase with age from week 2 to week 10. The values obtained for shank length, thigh length and keel length were in agreement with the report of [23] for Japanese quail. These authors reported that shank length increases as the bird increases in age. The findings of [21] showed that shank length failed to describe the genetic variation in quail as age increased. [22] gave a range of

2.31 to 2.96 cm for shank length between weeks 2 and 8. The wing length and the shank length at week 10 in this study did not actually increase as the age increased; this may be attributed to the fact that they do not actually use their wing for incubation. PWxCB recorded the highest values for breast width, body length, keel length and shank length (7.44, 12.09, 6.79, 3.34) cm, respectively at week 10.

Table 3: Effect of sire on linear Body parameters of the three strains of Japanese quail at weeks 2, 6 and 10

Sire line	Parameter	2	6	10
CBxCB	BW(g)	35.30	124.57	153.79
	TL(cm)	3.19	4.56^{b}	4.69^{b}
	BR(cm)	3.95^{a}	6.95^{a}	7.37^{b}
	BL(cm)	6.62^{a}	10.90^{b}	12.02^{b}
	KL(cm)	3.03^{b}	6.35^{a}	6.64^{b}
	WL(cm)	2.91^{b}	7.58	7.89^{a}
	SL(cm)	2.39^{a}	3.29^{a}	3.32^{b}
PWxCB	BW(g)	34.94	124.97	159.78
	TL(cm)	3.17	4.72^{a}	4.76^{a}
	BR(cm)	3.92^{a}	6.91^{a}	7.44^{a}
	BL(cm)	6.65^{a}	11.24^{a}	12.09^{a}
	KL(cm)	3.22^{a}	6.27^{a}	6.79^{a}
	WL(cm)	3.03^{a}	7.74	7.83^{ab}
	SL(cm)	2.30^{b}	3.30^{a}	3.34^{a}
SBxCB	BW(g)	35.18	119.95	154.30
	TL(cm)	3.15	4.44^{c}	4.59^{c}
	BR(cm)	3.50^{b}	6.72^{b}	7.21^{c}
	BL(cm)	6.24^{b}	10.76^{b}	11.93^{c}
	KL(cm)	3.08^{b}	5.99^{b}	6.47^{c}
	WL(cm)	2.94^{b}	7.65	7.71^{b}
	SL(cm)	2.28^{b}	3.18^{b}	3.29^{c}
SEM				
	BW(g)	0.12	1.22	1.45
	TL(cm)	0.01	0.02	0.01
	BR(cm)	0.03	0.02	0.01
	BL(cm)	0.04	0.04	0.01
	KL(cm)	0.02	0.04	0.03
	WL(cm)	0.01	0.03	0.03
	SL(cm)	0.02	0.01	0.00

^{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

Conclusion and Applications

1. PW sire line had the best fertility and hatchability percentage as well as the lowest mortality rate from brooding to laying stage.
2. PW strain recorded the highest value for body weight, thigh length, beast width, body length, keel length, and shank length.
3. The linear body parameters showed increase as the age of the birds increase

among progenies of the three sire lines.
4. PW sire line is a strain of choice for breeding purposes followed by CB and SB sire lines in the study area.

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