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Effects of crossbred sires of normal feather Rhode Island Red on different dams of Nigerian indigenous chickens for fertility, hatchability and early growth performance

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ABSTRACT

The study was designed to evaluate the effects of fertility hatchability and early growth performance on crossbred sire chickens of normal feather Rhode Island Red of different dams of Nigerian indigenous chickens. A total number of 120 birds was used for this study which comprises of 20 normal feather Rhode Island Red crossbred sires and 25 each of normal feather , frizzled feather, naked neck and Fulani ecotype dams. The progenies produced from these were normal feather Rhode Island Red Fulani ecotype (NFRIR x FE), normal feather Island Red normal feather (NFRIR x NF), normal feather Rhode Island Red frizzled feather (NFRIR x FF) and normal feather Rhode Island Red naked neck (NFRIR x NN) chickens. Data were collected on fertility, hatchability traits and growth performance (body weight BW, body length BL, keel length KL, shank length SL, Thigh length TL, wing length WL, feed intake FI, weight gain (WG) and feed conversion ratio FCR characteristics of the birds. Results indicated that NFRIR x FF birds had more of fertility (88.24 %) whereas NFRIR x FE chickens had more hatchability (93.75 %). The growth performance traits revealed significant (P<0.05) effects of highest value of 1360.99 g, 17.31 cm, 14.84 cm, 18.99 cm, 19.78 cm, 28.90 cm and 55.42 g for BW, BL, KL, SL, TL, WL and WG, respectively were recorded for NFRIR x NN chickens than its counterparts NFRIR x NF, NFRIR x FF and NFRIR x FE chickens. It can be concluded that frizzled feather and naked neck dams should be used in breeding programme that involved other Nigerian indigenous chicken dams for their improved fertility, hatchability and growth performance traits.

Keywords: Crossbred sires, Nigerian indigenous chicken dams, Rhode Island Red, Fertility, Hatchability, growth performance

1. INTRODUCTION

The Nigerian indigenous chicken are characterized by slow growth and nevertheless they possess major gene that assist in early adaptation to the environment as these gene cause a reduction in tropical heat stress (Peters, 2005). According to Amao (2017a), it is imperative to utilize indigenous chickens in parent stock development for better adaptability and productivity. Genetic improvement of indigenous breed of livestock is very valuable because of high adaptability to harsh environment condition of climate and disease compared with exotic breed (Ajayiand Agaviezor, 2016). Crossbred progenies of chicken are often superior to purebred in term of growth rate, meat quality, body weight and feed conversion (Masic and Khalifah, 2011).

Cross breeding of the indigenous chicken with fast –growing commercial bird will make full use of natural selection for resistance and artificial selection foe productivity in exotic chicken (Adebambo *et al*., 2010). The optimal crossbred animal would have higher growth rate, feed conversion efficiency, reproductive and carcass performance but to increase the genetic potential of indigenous chicken and planned breeding program is a demand of time or time consuming.

There are been rapid increase in the numbers of farmer's keeping chicken parents and grandparents type in Nigeria (Amao, 2017b). Unfortunately, in Nigeria, poor fertility and hatchability rate among other factors constitute the major threat of performance of the industry. Fertility is an important parameter in chicken and reflect the total actual reproductive capacity of females and males expressed by their ability when mated together to produce offspring. An egg is said to be infertile when it fail to show any evidence of developing embryo (Miazi *et al*., 2012).Fertility is the ability to reproduce and it determines the number of offspring that can be obtained from a given number of eggs and fertility is expressed as the percentage of egg fertilized and it is judged by candling or microscopy. Hatchability on the other hand, is a trait of economic important in the chicken industry because it has a strong effect on chick output (Wolc *et al*., 2010). It is influenced by a number of factors such as egg weight, turning of egg, storage, humidity, shell, strength, egg size and genetic factors within the chicken keep. The ability of the embryo to successfully escape from the shell is called hatchability.

Growth trait is very important economic traits in chickens' production, and is controlled by complex gene. In poultry, growth rate and mature body weight are highly related to circulatory growth hormones level (Anthony *et al*., 2005). Animal growth involves increase in size and change in functional capabilities of the various tissue and organ of animal from conception through maturity (Adeleke *et al.,* 2010). The growth performance of chick is an important trait to be considered in meat and egg types' chicken development. Growth is normally accompanied by an orderly sequence of maturation changes and involves accretion of protein and increase in length and size not just an increase in body weight (Adedeji *et al*., 2015a). The aim of this study is to assess the effects of crossbred sire of normal feather Rhode Island on different dams of Nigerian Indigenous chickens for fertility, hatchability and growth performance especially in the southern Guinea savanna environment of Nigeria aims in improving the Nigerian indigenous chickens.

2. MATERIALS AND METHODS

Experimental site

The study was carried out at the Poultry Unit of Teaching and Research Farm, Emmanuel Alayande College of Education, Oyo, Oyo State, Nigeria and Oyo lies on the longitude 3^05^1 east of the green which meridian and latitude 7^05^1 North eastwards from Ibadan, the capital of Oyo State. The latitude is between 300 and 600 meter above sea level. The latitude is between 300 and 600 meter above sea level. The mean annual temperature and rainfall are 27^0C and 1,165mm respectively. The vegetation of the area is Southern guinea savannah zone of Nigeria (Amao, 2018a).

Experimental Birds and Management

Total of 120 birds were obtained for this study which comprises of normal feather Rhode Island Red crossbred sires and Nigerian local chickens of normal feather, frizzle feather, Fulani ecotype and naked neck were all procured from existing population in the Breeding and Genetics unit of Teaching and Research Farm, Emmanuel Alayande College of Education, Oyo. Oyo State, Nigeria. Twenty (20) Normal feather Rhode Island Red crossbred sires and one hundred (100) Nigerian local chickens (25 normal feather, 25 frizzled feather, 25 Fulani ecotype and 25 naked neck) dams were maintained in the ratio 1:5 to obtained eggs of normal feather Rhode Island Red crossed respectively to frizzle feather, normal feather, naked neck and Fulani ecotype dams. Each of the chicks produced were properly identified a wing tagged made of industrial galvanizer aluminum and the birds were reared under the intensive management system in a deep litter system.

Experimental Feed and Feeding

The sires were fed *ad-libitum* with commercial breeder mash containing 17.5% crude protein and 2700kcal/kg Metabolizable Energy while the dams were also fed commercial layers mash containing 16% crude protein and 2800kcal/kg Metabolizable Energy. Clean water was also supplied *ad-libitum*. Medications and vaccinations were done as required by procedure of Adedeji *et al.* (2014).

Experimental Mating

Artificial Insemination (AI) was adopted in mating the hens. The message technique was used to collect semen from the cocks of frizzled feather and frizzled feather Rhode Island Red birds. The semen collected was inseminated immediately into a doughnut shape in the left vent of the hens. This was done twice weekly in the evening. For each hen 0.1ml of undiluted semen was used for insemination each time.

The mating procedure is as follows:

Normal feather Rhode Island Red (sire) x Frizzle feather (dam): $NFRIR_s$ x FF_d

Normal feather Rhode Island Red (sire) x Normal feather (dam): $NFRIR_s$ x NF_d

Normal feather Rhode Island Red (sire) x Naked neck (dam): $NFRIR_s$ x NN_d

Normal feather Rhode Island Red (sire) x Fulani Ecotype (dam): $NFRIR_s$ x FE_d

Egg Collection and Incubation

Eggs from artificial inseminated hens were collected pedigree along genotype lines and stored in a cool room at 25°C to 26°C for five days before the eggs were taken to the hatchery for incubation. The eggs were set in a cabinet type incubator at a commercial hatchery. The eggs were set along the genotype lines at a temperature between 27-39°C and a relative humidity of 55-56% for eighteen days, then the temperature was then increased to 29-40°C and a relative humidity of 70-75% from nineteenth day to hatching time. The eggs were also turned automatically through 90° in the incubator.

Candling Process

Candling was carried out on the 18th day of incubation for the identification of fertile eggs, and clear eggs. The process was carried out in a dark room using a candler fixed with a neon fluorescent tube. The eggs were placed on the candler for easy penetration of light through the eggs and the eggs were viewed against the source of light. The fertile eggs were seen to be densely clouded and opaque with network of veins indicating development of embryo within the eggs while the infertile eggs were translucent under the light. Number of infertile and embryonic mortality was recorded. After candling, the fertile eggs were transferred into the hatching tray according to the breeds into the hatchery unit and spent three days. After the chicks hatched, they were leaved in the hatchery until 90% were dried. On the 21st day, the numbers of hatched chicks including the normal, weak, abnormal chicks and dead chicks after hatch were recorded.

Housing and Management of Chicks

All chicks resulting from each genotype were properly identified by wing tagged with an industrial galvanized aluminum tags at the wing web at day-old. All the birds were raised under the same intensive management system. The day old chicks were transferred to a separate and previously disinfected brooders pen. Every batch was brooded for six weeks period. The chicks were fed with a commercial chicks mash that supplied 22% Crude Protein and 2900kcal/kg Metabolizable Energy up to 6 weeks of age. Thereafter, they were fed with commercial grower's ration that supplied 16% Crude Protein and 2800kcal/kg Metabolizable Energy from six to twenty weeks of age, clean and cool water was supplied *ad-libitum* while medication and vaccination were done as at when due as described by Adedeji *et al.*, (2014).

Data Collection

(a) Fertility and Hatchability

Data were obtained on the following parameters when the birds were at twelve weeks of laying; average egg weight, number of egg set per genotype, number and percentage of fertile eggs, number and percentage of infertile eggs, number of eggs hatched, fertility percentage, hatchability percentage using the formula below:

$$\% \text{ fertility} = \frac{\text{Number of fertile eggs}}{\text{Number of egg set}} \text{ x } 100$$

The eggs hatched and hatchability was calculated thus:

$$\% \text{ hatchability} = \frac{\text{Number of chicks hatched}}{\text{Number of fertile egg}} \text{ x } 100$$

(b) Growth Traits

Data were obtained for early growth traits from 20 each of the progenies produced form different crosses involving normal feather Rhode Island Red crossbred sires and different dams of Nigerian indigenous chickens on the body weight (g), body length (cm), keel length (cm) and shank length (cm) from day-old and this were carried out on a weekly basis for 20 consecutive weeks as described by Amao and Ojedapo, (2016).

Body Weight (g): The body weight was measured with sensitive scale from day-old to twenty weeks.
Body Length (cm): The body length was measured with the tailoring tape rule. The body length was from the wing joint to the vent region.
Chest Girth (cm): This was measured as the region of breast expansion when positioned vertically with the aid of tailoring tape rule. The chest girth is in between the crop and the keel.
Shank Length (cm): It was taken as the length of the tarso-metatarsus from the hock joint to the metatarsal pad. It was measured by the tailoring tape.
Thigh length (cm): Distance between the hock joint and the pelvic joint with aids of by tailoring tape rule.
Keel length (cm): This is taken as the length of the keel bone from the V- joint to the end of the sternum with tailoring tape.
Wing length (cm): This was measured as the distance between the tip of the phalanges and coracoids humerus joint with the use of tape rule in (cm).

(c)Growth Performance

Body weights, feed intake, average daily gain and feed to gain ratio were monitored from 20 selected birds of each genotype from day-old to 20 weeks of age. These were obtained through the below procedures described by Amao and Ojedapo (2016)

Body weight Gain (g): This was measured with the use of an electronic kitchen scale with maximum capacity of 20kg or 200g.
Feed Intake (g): The feed left over were subtracted from feed given and the value divided by total number of birds daily.

$$\text{Feed intake (g)} = \frac{\text{Feed given to the birds-feed left over}}{\text{Total number of birds}}$$

Daily Weight Gain (g): This is the difference in body weight values between two consecutive measurements were divided by the number of days to obtain the daily body weight gain.

$$\text{Daily weight gain(g)} = \frac{\text{Recent body weight-Previous body weight}}{\text{Number of days}}$$

Feed Conversion ratio: This was calculated as the ratio of daily weight gain to daily feed intake within each measurement period.

$$\text{FCR} = \frac{\text{Daily feed intake}}{\text{Daily weight gain}}$$

Data Analysis

All data obtained were subjected to one-way analysis variance in a completely randomized design using the procedure of general linear model of SAS (2009) and significant means were separated with the same procedure of SAS (2009).

The below model was adopted

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

Where

Y_{ij} = individual observation

μ = overall mean

β_i = Fixed effect of i^{th} genotype (1, 2, 3, 4)

e_{ij} = experimental errors which is evenly distributed.

3. RESULTS

The results of the estimations of fertility and hatchability traits of Normal feather Rhode Island Red (NF x RIR) crossbred sires on different dams of Nigerian indigenous chickens is presented in Table 1. Normal feather Rhode Island Red crossbred mated with Fulani Ecotype (NFRIR x FE) chickens had the highest number of eggs set (200) while Normal feather Rhode Island Red crossbred mated with Naked neck (NFRIR x NN) birds had lowest value of 140 eggs as number of eggs set. Out of the number of eggs sets for each of the genotypes, NFRIR x FE birds laid more of fertile eggs (160) than Normal feather Rhode Island Red crossbred mated with Frizzled Feather (NFRIR x FF) chicken (150), Normal feather Rhode Island Red crossbred mated with normal feather(NFRIR x NF) birds (130) and NFRIR x NN (120). The NFRIR x FF chickens had the highest percentage number of fertile egg (88.24%) while NFRIR x FE birds had lowest number of 80.00 as percentage number of fertile eggs. Among the number of eggs set for each of the genotypes, NFRIR x FE chickens had more of infertile eggs (40) than NFRIR x NF (20) and NFRIR x FF (20) and NFRIR x NN (20). The NFRIR x FE birds had more percentage number of infertile eggs (20.00 %) than other genotypes. For all the number of eggs sets for each of the genotypes, NFRIR x FE chickens had the highest number of hatched eggs (150) than NFRIR x FF (120), NFRIR x NF (120) and NFRIR x NN (100).

Table 1 Estimation of fertility and hatchability traits of crossbred sires on different dams of Nigerian indigenous chickens

Parameters	NFRIR x FE	NFRIR x NF	NFRIR x FF	NFRIR x NN
No of eggs set	200	150	170	140
Fertile eggs	160	130	150	120
Fertile (%)	80.00	86.67	88.24	85.71
Infertile	40	20	20	20
Infertile (%)	20.00	13.33	11.76	14.29
Hatched eggs	150	120	120	100
Hatched (%)	93.75	92.31	80.00	83.00
Dead in shell	10	10	30	20
Dead in shell (%)	06.25	07.69	20.00	16.67

NFRIR x FE = Normal feathered Rhode Island Red crossbred crossed to Fulani ecotype, NFRIR x FF = Normal feathered Rhode Island Red crossbred crossed to frizzled feather, NFRIR x NF = Normal feathered Rhode Island Red crossbred crossed to normal feather chickens, NFRIR x NN = Normal feathered Rhode Island Red crossbred crossed to naked neck chickens.

Table 2 revealed that most of the growth performance traits were significantly ($P<0.05$) affected by different chicken genotypes. The body weight of Normal feather Rhode Island Red crossbred mated with normal feather(NFRIR x NF) birds(1360.99 g) were significantly ($P<0.05$) highest than that of Normal feather Rhode Island Red crossbred mated with Fulani Ecotype (NFRIR x FE) chickens (1245.82 g), Normal feather Rhode Island Red crossbred mated with normal feather(NFRIR x NF) birds (1220.66 g) and Normal feather Rhode Island Red crossbred mated with Naked neck (NFRIR x NN) birds (1201.72 g). Similarly, body length, keel length, shank length, thigh length and wing length of NFRIR x NN chickens were significantly ($P<0.05$) highest than othergenetic stocks involved. It is noteworthy to remark that keel, shank and thigh lengths decrease ($P<0.05$) progressively from NFRIR x NN chickens via more for NFRIR x NF to NFRIR x FF chickens. However, traits such as feed intakes (98.24 – 100.01 g) and feed conversion ration were not affected (P>0.05) by differences in genotypes.

Table 2 Mean values and standard errors of growth performance traits as affected by different genotype of chickens

		Genotypes			
Parameter	N	NFRIR x FE	NFRIR x FF	NFRIR x NF	NFRIR x NN
Body Weight (g)	180	1245.82±14.58[b]	1201.72±12.42[d]	1220.66±13.17[c]	1360.99±13.17[a]
Body length (cm)	180	16.46±0.51[b]	15.04±0.45[b]	15.21±0.47[c]	17.31±0.97[a]
Keel Length (cm)	180	12.16±0.21[c]	11.86±0.19[c]	12.74±0.21[b]	14.84±0.41[a]
Shank length (cm)	180	17.89±0.20[b]	17.86±0.15[b]	17.52±0.17[b]	18.99±0.13[a]
Thigh length (cm)	180	17.37±0.15[b]	17.22±0.14[b]	17.12±0.17[b]	19.78±0.11[a]
Wing length(cm)	180	24.96±0.54[c]	26.25±0.50[b]	25.60±0.47[c]	28.90±0.97[a]
Feed intake (g)	180	98.24±0.93	98.35±0.54	99.99±0.47	100.01±0.69
Weight Gain (g)	180	53.53±3.22[b]	40.11±2.23[d]	51.42±1.94[c]	55.42±1.34[a]
FCR	180	10.93±0.03	10.89±0.04	10.92±0.14	10.90±0.14

[abcd]Mean along the same row having different superscripts are significantly (P<0.05) different.
NFRIR x FE = Normal feathered Rhode Island Red crossbred crossed to Fulani ecotype chickens, NFRIR x FF = Normal feathered Rhode Island Red crossbred crossed to frizzled feather chickens, NFRIR x NF =Normal feathered Rhode Island Red crossbred crossed to normal feather chickens, NFRIR x NN = Normal feathered Rhode Island Red crossbred crossed to naked neck chickens.

4. DISCUSSION

(i) Fertility and Hatchability performance Traits

The pattern of fertility and hatchability performance traits in this present study that indicated significant difference among the genotypes involved was in accordance with the studies of Amao (2019); Adedeji *et al.* (2015b) and Adeleke *et al.* (2011). These authors reported that significant differences in the fertility and hatchability traits and these traits were linked with differences in the genetic background of the chickens involved in their different studies. Amao (2019) found significant variations among backcrossed chickens involving Nigerian indigenous birds and Rhode Island Red chickens. Adedeji *et al.*(2015b) reported significant variations among pure and crossbreds F1 chickens progenies. Adeleke *et al.* (2011) also found significant influences among Nigerian local chickens. The superiority in the fertility and hatchability traits showed by NFRIR x NF birds were in the line with the findings of Amao, (2017b) who reported a surpassed fertility and hatchability performance for genetic individual with normal feather gene. Lemlem and Tesfay (2010) found higher fertility and hatchability traits for indigenous chickens than their counterpart exotic poultry breeds. Rozempolska *et al.* (2010) reported that for all traits of fertility and hatchability were least affected by service sires and service sires effect is small both in absolute and relative terms. However, Adeleke *et al.* (2011) reported that among genotypes in their study frizzled feathered genotype had better fertility and hatchability traits which were comparable to this present finding. Ajayi and Agaviezor (2016) also concluded that birds with normal feather genes were better in terms of fertility and hatchability traits than other genes of normal feather and naked neck chickens. Adedeji *et al.* (2015b) claimed that normal feather genes were superior in terms of fertility and hatchability traits which contradicted the present findings. Alem (2014) claimed that chickens in midland agro-ecology were much better in terms of fertility and hatchability traits than its lowland chickens in central Tigray in Ethiopia.

(ii) Growth Performance Traits

The growth performance traits reported in the present findings that indicated significant variations between the genetic stocks involved in the study has been earlier attributed to the different genetic constitutions of the chickens by Amao (2018b); Amao, (2017a,b,c); Oleforuh-Okoleh *et al.* (2017); Rotimi *et al.* (2016); Adedeji *et al.* (2015a); Padhi*etetal.*(2015); Kgwatala and Segokgo (2013) and Agu *et al.* (2012). These authors claimed that growth performance traits in chickens were differed due to the variations in the genetic background of chickens. Amao (2017a,b,c) found significant variations on the growth performance traits between the pure and crossbred chickens involving Nigerian indigenous chickens and Rhode Island Red chickens. Oleforuh-Okoleh *et al.* (2017) reported significant effects on growth traits of two Nigerian local chicken genotypes. Rotimi *et al.* (2016) also reported differed values for growth traits for Nigerian local chickens. The observation of significant influenced by Adedeji *et al.* (2015a) supported this present significant variations for growth performance traits accounted among the genetic groups of chickens used. Padhi *et al*. (2015) concluded in their research involving crossbred chickens developed using both exotic and indigenous breeds under backyard system of rearing that the crossbred chickens performed much better than their purebreds in respect to growth performance traits which indicated significant differences among the chickens evaluated. The superiority exhibited by NFRIR x NN in body weight, body length, keel length and wing length over other genetic groups of birds indicated that the naked neck had a good combining effect with NFRIR crossbred when used as dam rather than sire. This observation is expected since the sire line had been improved with fifty percent of Rhode Island Red exotic chickens and this implies that the improved NFRIR crossbred chicken combined significantly better with naked neck genes rather than normal feather, frizzled feather and Fulani ecotype chickens. This result of NFRIR x NN further suggested that naked neck birds had the ability to transmit the gene for faster growth into its offspring when using as dam while compared with its other Nigerian indigenous chickens as earlier claimed by Amao, (2017a, 2017b). Oleforuh-Okoleh *et al*. (2017) also claimed that necked neck gene was superior in term of growth traits which agreed the present findings. However, Rotimi *et al*. (2016) concluded that birds with frizzle feather genes were better in terms of growth performance than other genes of normal feather and necked neck chickens which contradicted the present findings. Findings of Oke (2011) who reported that among genotypes in their study frizzle feathered sire genotypes had better growth performance traits which is disagreed with this present results. Amao (2017a) in his study claimed that Fulani ecotype genes were superior in term of growth performance traits which contradicted the present findings.

5. CONCLUSION

Base on the results of the findings, it can be concluded that genotype of the chicken with frizzle feather and naked neck dams were superior over other genetic stocks in respects to highest fertility and hatchability, respectively while NFRIR x NN was higher for body weight, body length, keel length, shank length, wing length, thigh length and weight gain.

Recommendation

It can be recommended that dams from frizzle feather chicken can be used in breeding programme that involved eggs while naked neck dams would be better for meat production.

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