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Effect of Crossing Fulani Ecotype with Rhode Island Red Chickens On Growth Performance, Egg And Reproductive Traits Under Southern Guinea Savanna Region Of Nigeria

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Abstract

The study evaluated the crossing potential of Fulani ecotype (FE) with Rhode Island Red (RIR) chickens and their progenies on productive performance. The two chicken breeds used were the Fulani Ecotype (FE) and Rhode Island Red (RIR) as dams and sires line. Pure, straight and reciprocal crosses mating designed were adopted to produced progenies of FE x FE, RIR x RIR, RIR x FE, FE x RIR genotypes. RIR genotype were significantly ($P < 0.05$) differed for body weight (1650g), feed intake (90.66g), average daily gain (10.22g) and feed to gain ratio (8.87) than other genotypes but followed closely was FE x RIR crossbred for variables measured on growth performance. Egg production performance of the pure and crossbred were compared with each other and RIR x FE crossbred were better in respect to values of 47g, 60,78% and 58.88% for egg weight, HDEP% and HHEP% respectively. FE x RIR crossbred better for age at sexual maturity (151days) while RIR x FE genotype were favoured for body weight at sexual maturity (1841g), fertility (76.15%) and hatchability (98.25%) than other groups of genotype. It can be concluded that combining effect of FE x RIR or RIR x FE crossbred were better than pure FE and lesser than pure RIR chickens while outstanding crosses was the straight mating (RIR x FE).

Keywords: *Crossing, Fulani ecotype, RIR, reproductive traits, southern guinea savanna*

Introduction

Indigenous chickens in the tropics had been identified for their poor producer of egg and meat (Tadelle *et al.*, 2003; Adedeji *et al.*, 2006a) but even with their low productivity, they are well adapted to the tropics, resistant to poor management, feed shortages and tolerate some of the most common diseases and parasites (Adedeji *et al.*, 2006b). On the other hand, improved exotic chickens produce higher number of eggs and more meat than the indigenous chicken breeds, but tropical climate is a great challenge. They are not adapted to adverse environmental conditions, such as high temperature, disease and shortage of feed (Adedeji *et al.*, 2008; Islam and Nishibori, 2009). Meanwhile, the genetic diversity merit of indigenous and exotic chicken breeds could be utilized by cross breeding schemes. Crossbreeding is one of the tools for exploiting genetic variation. The main purpose of crossing in chicken is to produce superior crosses (hybrid vigor), to improve fitness and fertility traits and to combine different characteristics in which the crossed breeds were valuable (Hanafi and Iraq, 2001). The goal will then be to get a new breed or hybrid that is resistant to harsh tropical conditions and at the same time produces a reasonable amount of egg and meat (Iraqi *et al.*, 2005; Mekki *et al.*, 2005; Fassill *et al.*, 2010).

Studies in Nigeria indicated that the egg production at smallholder level could be doubled in the existing production system through intervention of crossbreeding in a semi-scavenging poultry model (Egahi *et al.*, 2010). Moreover, in an evaluation of the egg production performance of crossbreeds between local and exotic birds, conducted by different research and development organizations in Nigeria, it was showed that the overall performance of the crosses was better than either of the native or exotic parents under the prevailing production condition (Sola-Ojo and Ayorinde, 2011).

Moreover, crossing between chicken strains improved the production traits such as body weight at sexual maturity, egg number, egg weight and egg mass compared with those

for pure strains (Amin, 2008). Recent reports from Shafik *et al.* (2013) revealed the potential of crossing RIR with fayoumi chickens while Ige (2013) also reported the possible impact of Fulani ecotype chickens using in breeding schemes in the tropical environment. These attributes of the mentioned chickens can therefore be utilized in this environment. The aim of study was to evaluate the effect of crossing effect of Fulani ecotype and Rhode Island Red (RIR) chickens on growth performance (body weights, feed intake, average daily gain and feed to gain ratio), egg production traits (average egg weight, HHEP and HDEP) and reproductive traits (age at sexual maturity, body weight at sexual maturity, fertility and hatchability percentage) especially in the southern guinea savanna condition of Nigeria.

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°5' east of the green witch meridian and latitudes 7°5' North eastwards from Ibadan, the capital of Oyo State. The altitude is between 300 and 600 meter above sea level. The mean annual temperature and rainfall are 27°C and 1,165mm respectively. The vegetation of the area is Southern guinea savanna zone of Nigeria (Amao *et al.*, 2016).

Experimental Birds and Management

Total of forty-eight (48) cocks and seventy- two (72) hens belonging to two different strains were used for the experiment. The two strains were the Fulani ecotype (hens: 36; cocks: 24) and Rhode Island Red (hens: 36; cocks: 24) chickens. The indigenous chickens used as parents stock were purchased from some villages around the study site while the Rhode Island Red chickens were procured from a reputable farm. All hens were purchased at age range of 16 - 18weeks, while the cocks were purchased at age range of 15 - 17weeks old. The birds were individually wing tagged for identification purpose. The cocks were trained for semen collection by applying slight pressure at the back towards the tail forty times daily before sperm production. Feathers around the sire's vent were shaved at two weeks interval and semen collection started at 22 weeks of age.

Experimental Feeds and Feeding

The birds were fed *ad-libitum* with commercial breeder mash containing 17.5% crude protein and 2700kcal Metabolizable energy. Clean water was also supplied *ad- libitum.* Medications and vaccinations were done as required by procedure described by Oladunjoye *et al.* (2006).

Experimental Mating

Artificial Insemination (AI) was adopted in mating the hens. The massage technique was used to collect semen from the cocks of Fulani ecotype and 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 week in the evening. For each hen 0.1ml of undiluted semen was used for insemination each time.

The mating procedure is as follows:

Fulani Ecotype (Male) × Fulani Ecotype (Female): FE_m x FE_f = Pure
Rhode Island Red (Male) × Rhode Island Red (Female): RIR_m x RIR_f = Pure
Rhode Island Red (Male) × Fulani Ecotype (Female): RIR_m x FE_f = Straight
Fulani Ecotype (Male) × Rhode Island Red (Female): FE_m x RIR_f = Reciprocal

Method of Egg Collection and Incubation

Eggs from artificial insemination hens were collected pedigreed along genotype lines and stored in a cool room at 18°C to 20°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^{o} 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 unfertile 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 genotypes 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 four weeks period. The chicks were fed with a commercial chicks mash that supplied 22% crude protein and 2900 Kcal/kg Metabolizable Energy up to 6 weeks of age. Thereafter, they were fed with commercial grower's ration that supplied 16% crude protein and 2800 Kcal/kg Metabolizable Energy. Clean water was supplied *ad-libitum.* Medication and vaccination were done as at when due and as described by Oladunjoye *et al.* (2006).

Data Collection

(a). Data were obtained on the following parameters when the birds were twelve weeks into 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%, hatchability%, hen day egg production percentage and hen housed production using the formula below:

$$\% \text{ fertility} = \frac{\text{Number of fertile eggs}}{\text{Number of egg set}} \times \frac{100}{1}$$

The eggs hatched and hatchability was calculated thus:

$$\% \text{ hatchability} = \frac{\text{Number of chicks hatched}}{\text{Number of fertile eggs}} \times \frac{100}{1}$$

$$\text{HDEP } \% = \frac{\text{Number of eggs produced}}{\text{Number of hen alive}} \times \frac{100}{1}$$

$$\text{HHEP } \% = \frac{\text{Number of eggs produced}}{\text{Number of hens housed}} \times \frac{100}{1}$$

(b). Growth performance: body weights, feed intake, average daily gain and feed to gain ratio were monitored on each genotype from day old to 36 weeks of age. These were obtained through the below procedures:

Body weight (g): This will be measured with the use of an electronic kitchen scale with maximum capacity of 20kg or 2000g

Feed Intake: The feed left over were subtracted from feed given and the value divided by total number of birds daily.

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

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

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

(c). Reproductive traits: age at maturity and body weight at sexual maturity were obtained through the below procedure:

Egg weight: Eggs laid by each hen was weighed on daily basis. The average egg weight obtained from individual hens for each week of lay for each line over the short-term period was used in

the data analysis. All weights were obtained using an electronic weighing balance (Mettler P1020N) having a sensitivity of 0.01g

Body weight at sexual maturity: This was determined by weigh the pullets with the used of an electronic kitchen scale with maximum capacity of 20kg.

Age at sexual maturity: This was determined by counting days or weeks from hatch to the day the first egg is laid provided a second egg was laid within ten days following the first.

Data Analysis

All data was subjected to one-way analysis of variance in a completely randomized design using the procedure of general linear model of SAS (2003) and significant means were separated with the same procedure of SAS (2003). The below model was adopted:

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

Where,

Y_{ij} = individual observation

μ = overall mean

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

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

Results

The mean values of body weight, feed intake, average daily weight and feed to gain ratio is presented in table 1. Growth performance was significantly ($P < 0.05$) affected by the genotype. RIR had the highest body weight (1650g), feed intake (90.66g), feed conversion ratio (8.87) coupled with least weight gain (10.22g) followed closely was reciprocal crossbred of FE x RIR with values 1405g, 88.19g, 15.44g and 8.55 for body weight, feed intake, average daily weight and feed to gain ratio respectively while the FE birds had the least values for all the parameters measured.

Table 1: Mean values and standard errors of body weights, feed intake, average weight gain and feed to gain ratio of Fulani Ecotype, Rhode Island Red chickens and their crosses.

Genotype	BDW(g)	FI(g)	WG(g)	FCR
FE × FE	1129.00 ± 17.09^{d}	89.25 ± 8.04^{a}	10.44 ±1.02^{c}	8.55 ± 0.27^{a}
FE × RIR	1405.18 ± 35.96^{b}	88.19 ± 7.73^{ab}	15.44 ± 1.27^{a}	5.71 ± 0.02^{b}
RIR × FE	1337.93 ± 17.90^{c}	77.33 ± 7.72^{b}	13.69 ± 1.72^{b}	5.50 ± 0.07^{b}
RIR × RIR	1650.90 ± 19.60^{a}	90.66 ± 6.67^{a}	10.22 ± 1.05^{c}	8.87 ± 0.03^{a}

^{abc}*Mean along the same column with different superscripts are significantly (P<0.05) different*
FE x FE = Fulani ecotype, FE x RIR = Fulani ecotype Rhode Island Red crossbred, RIR x FE = Rhode Island Red Fulani ecotype crossbred, RIR x RIR = Rhode Island Red. BDW (g) =Body weight, FI (g) = Feed intake, WG (g) = Average weight gain, FCR = feed to gain ratio.

Table 2 showed mean values and standard errors of average egg weights, hen day egg production and hen housed egg production of Fulani Ecotype, Rhode Island Red chickens and their crosses. There were significant (P<0.05) difference between the genotype and the variables measured. RIR genotype and RIR x FE crossbred had the highest average egg weight of values 48 g and 47 g respectively while the observations for both HDEP and HHEP were better in RIR x FE crossbred (60.78 % and 58.88 %) compared to other genotypes.

Table 2: Mean values and standard errors of average egg weights, hen day egg production% and hen housed egg production of Fulani Ecotype, Rhode Island Red chickens and their crosses

Genotype	Average Egg Weight (g)	HDEP %	HHEP %
FE×FE	35.75 ± 0.76^{c}	52.97 ± 4.45^{c}	50.34 ± 2.33^{c}
FE × RIR	43.22 ± 0.73^{b}	53.90 ± 3.56^{c}	51.22 ± 1.99^{c}
RIR × FE	47.35 ± 0.22^{a}	60.78 ± 4.78^{a}	58.88 ± 4.55^{a}
RIR × RIR	48.02 ± 0.66^{a}	58.33 ± 3.46^{b}	56.44 ± 3.88^{b}

^{abc}Mean along the same column with different superscripts are significantly (P<0.05) different

FE x FE = Fulani ecotype, FE x RIR = Fulani ecotype Rhode Island Red crossbred, RIR x FE = Rhode Island Red Fulani ecotype crossbred, RIR x RIR = Rhode Island Red. HDEP % = hen day egg production, HHEP % = hen housed egg production

Table 3 indicates the mean values and standard errors of age and body weight at sexual maturity, fertility % and hatchability of Fulani ecotype, Rhode Island Red chickens and their crosses. Significant (P < 0.05) effect observed between the genotype and the measured variables. FE x RIR crossbred matured earlier (151days) than other genotypes with ranges of 161-167days. FE and RIE x FE crossbred had the highest body weight at sexual maturity with the leat value of 1342g for RIR genotype. FE x RIR crossbred had the highest fertility and hatchability percentage (83.48% and 98.25%) followed by RIR x FE crossbred with least observations of RIR genotype.

Discussion

The current documentation on the growth performance and reproductive characteristic of Fulani Ecotype and RIR breed that favoured RIR genotype and followed closely with the potential of RIR x FE were earlier observed by Shafik *et al.* (2013) on Fayoumi and RIR, Khawaja *et al.* (2012) on Fayoumi and RIR, Adedeji *et al.* (2008) on pure and crossbred chickens in tropical environment of Nigeria and Miah *et al.* (2002) on pure and crossbred chickens in Bangladesh.

Table 3: Mean values and standard errors of age and body weight at sexual maturity, fertility % and hatchability of Fulani ecotype, Rhode Island Red chickens and their crosses.

Genotype	Age at sexual maturity (day)	Body weight at sexual maturity(g)	Fertility %	Hatchability %
FE×FE	162.09±4.57^{c}	1850.25±16.89^{a}	66.65±0.47^{b}	99.07±8.90^{a}
FE × RIR	151.32±3.78^{d}	1690.45±19.80^{b}	83.48±6.09^{a}	80.35±9.78^{b}
RIR × FE	167.80±3.09^{a}	1841.35±12.89^{a}	76.15±9.69^{ab}	98.25±2.25^{a}
RIR × RIR	161.43±3.48^{c}	1342.86±21.45^{c}	50.00±8.80^{c}	71.89±5.56^{c}

^{abc}Mean along the same column with different superscripts are significantly (P<0.05) different FE x FE = Fulani ecotype, FE x RIR = Fulani ecotype Rhode Island Red crossbred, RIR x FE = Rhode Island Red Fulani ecotype crossbred, RIR x RIR = Rhode Island Red.

These authors obtained results on improvement of crossing effects of RIR and other breeds of layer birds compared with pure breed of RIR. However, the present observations on body weight, average daily gain, feed intake and feed to gain ratio that favoured RIR genotype and made a great improvement on RIR x FE crossbred were in accordance with the reported findings of Khawaja *et al*. (2013) on Fayoumi, Rhode Island Red and their reciprocal crossbred chickens, Dilip *et al.* (2013) on evaluation of dahlem red and desi crosses chicken and Mekki *et al.* (2005) on growth performance of indigenous x exotic crosses of chickens. These authors concluded that crossing effects of RIR with Fayoumi, Dahlem and desi crosses improved the potential of growth performance of the progenies arising from these crosses. These results contradicted observations made on local birds that showed higher average daily weight gain than the exotic chickens (Iraq *et al*., 2002 and Tadelle *et al*., 2003).

Meanwhile, the present reports on average egg weight, hen day egg production and hen housed production percentages that revealed better performance for RIR x FE crossbred apart from pure RIR had also indicated an improvement on the part of crossing effect. Thus, these observations were in agreement with the works of Fassill *et al.* (2010) and Shafik *et al.* (2013) on Fayoumi and RIR crossing. However, HDEP and HHEP percentages were significantly highest for RIR x FE crossbred than FE x RIR crosses and likewise for RIR than FE. This was agreed with the findings of Addis and Malede (2014). The present results on age at sexual maturity, body weight at sexual maturity, fertility and hatchability percentages across the genotype indicated that FE x RIR crossbred was better in days of coming to laying and this was in line with related studies that age at first egg was reduced by a few days in crosses of Fayoumi and RIR chickens (Zaman *et al*., 2004; Islam and Nishibori, 2009) while body weight at sexual maturity, fertility and hatchability percentages were heaviest and highest for RIR x FE crossbred than other genotypes. These results were in harmony with the findings of Dilip *et al.* (2013) that the crosses between local and exotic birds showed significantly higher body weight, early sexual maturity and higher egg weight than local Desi birds under same system of management. These results disagreed with the reports of Miazi *et al*. (2012) and Shafik *et al*. (2013) that there were non-significant differences between pure and crossbred in fertility and hatchability percentages.

Conclusion

Indigenous chickens have good adaptive performances to hot and humid tropics but poor in reproductive and productive performance while exotic breeds take the advantages of better reproductive and productive performance characteristics to indigenous chickens but tropical conditions are the great challenged for the exotic birds. Thus, this helped to develop cross breeding scheme. The resulting progenies from crosses of RIR and Fulani ecotype (RIR x FE and FE x RIR crossbred) performed better in terms of growth, egg and reproductive

characteristic than the pure FE and lesser than RIR breed but outstanding crosses was the straight mating (RIR x FE).

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