Egg Production and Growth Performance of Naked Neck and Rhode Island Red Chickens Crosses under Southern Guinea Savanna Condition of Nigeria

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Abstract

This study was focused on egg production and growth performance on naked neck and Rhode Island Red chickens crosses under Southern guinea savanna condition of Nigeria. A total of 325 day-old chickens was generated from 2x2 diallel crossing involving naked neck and Rhode Island Red chickens. The genetic groups produced were homozygous naked neck (NN x NN), Rhode Island Red (RIR x RIR), straight crossbred (RIR x NN) and reciprocal crossbred (NN x RIR) chickens. Data were collected for growth performance, egg production and reproductive traits. There was a significant (P<0.05) difference in mean body weight, average daily feed intake, weight gain and feed conversion ratio with the RIR genotype had the highest values of 1537g, 97.33g, 13.60g and 8.50 for growth performance variables more than other groups. Results also indicated that the RIR genotype had significantly (P<0.05) highest average egg weight (48.02g) while highest (HDEP %) hen day egg production and (HHEP %) hen housed egg production of values 83.33% and 81.44% were obtained for NN x RIR genotype.. The reproductive traits of Naked neck genotypes in straight combinations (RIR x NN) were significantly (P<0.05) highest than NN, RIR homozygous and NN x RIR crossbred with comparative values of 150days, 80.97% and 87.45% for earlier age of laying, fertility and hatchability respectively The study depicts the NN genotype as a fast growing indigenous chicken which may be involved in breeding for developing native foundation stock for production of egg type chicken in the humid tropics.

Keywords: *Egg production, growth performance, naked neck, RIR, crosses, southern guinea savanna*

INTRODUCTION

Crossbreeding of the indigenous stock with exotic commercial birds will take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds. A crossbreeding could lead to production of birds that will be better in growth rate, efficiency of feed conversion and reproductive traits without sacrificing adaptation to the local environment, thereby resulting in reduced cost of production (Adebambo *et al*., 2011). Khawaja *et al*. (2013) proposed that crossbreeding programmes including upgrading local chickens with suitable exotic stocks would be more appreciable. A recent study by Amao (2017) showed that the crossbred progenies of Rhode Island Red and Fulani ecotype chicken had the

better level of bodyweight, highest cost-benefit ratio with low mortality, good egg production coupled with better reproductive traits under southern guinea savanna condition of Nigeria.
The genetic potential of the indigenous chickens could be improved by crossing them with selected but still robust exotic breeds (Khawaja *et al*., 2013).

The study of egg production and its related traits such as age and body weight at sexual maturity attracted the attention of several investigators who found that there were wide variations in these traits between different breeds and/or strains of chickens (Iraqi *et al*., 2007). Genetic improvement of important economic traits would increase the production efficiency of native fowl and profitability of these birds. in order to improve on the present acute animal protein shortage in Nigeria (Wines, 2009).

Rhode Island Red, which is successfully maintained under rural as well as farming conditions in different parts of the country and have potentials of a higher economic return as layers (Javed *et al*., 2003). Several researchers have investigated how the naked neck gene is associated with high egg and meat production. The autosomal incomplete dominant naked neck (Na) gene is not only responsible for defeathering the neck region, but also restricts the feathering areas around the body by 20-30% in heterozygous (Nana) and up to 40% in the homozygous (NaNa) genotype. The Na gene and its effect on heat dissipation positively affect appetite. i.e. increased feed intake, resulting in higher body weight, egg size and liveability under high temperatures (Islam and Nishibori, 2009).The high egg and meat production genes, present in RIR, can possibly be transferred to any of Nigerian indigenous chicken such as naked neck, which already has genes for survival under harsh scavenging conditions of countryside, so as to produce a breed having higher survival and better economic returns. The aim of this present study was to determine the egg production and growth performance of naked neck and Rhode Island Red (RIR) crosses progenies under 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^{o} $5^{'}$ east of the green witch meridian and latitudes 7^{o} 5’ North eastwards from Ibadan, the capital of Oyo State. The altitude is between 300 and 600m above level. The mean annual temperature and rainfall are 27^{o}C and 1,165mm respectively. The vegetation of the area is Southern guinea savanna zone of Nigeria (Amao *et al*., 2016).

Experimental Birds and their Management

The experimental chickens that were used for the study are the local and exotic breeds. The local strain was naked neck which was sourced from villages around the study area while the exotic chicken (Rhode Island Red) was acquired from a reputable farm at 18 weeks of age. A total of 80 birds was sourced and used as parent for the experiment. This consists of 15 cocks and 25 hens each of naked neck and Rhode Island Red chickens. Each chicken were properly identified using a wing tag made from industrial galvanized aluminum. The experimental birds were strictly under the intensive management system of production and they were individually housed in a 2-tiers galvanized battery cage with a space dimension. Birds were individually housed in a cell having 0.14 x 0.14 m^2 spacing. Prior to the arrival of the experimental parent birds, the pen and cage have been properly disinfected with formalin® and morigard® as instructed by the manufacturer.

Feeds and Feeding

The cocks were fed *ad libitum* with commercial breeders mash containing 16% Crude Protein and 2600 kcal/kg Metabolizable Energy. Hens were also fed commercial layers mash containing 16% Crude Protein and 2800 kcal/kg Metabolizable Energy while clean and cool water were also supplied *ad libitum*.

Mating Technique and Procedure

Artificial insemination method was adopted for mating using the hand massage technique. The cocks were trained for semen collection by abdominal and back massage for about one minute and their vents were trimmed 3-5 days prior to semen collection. To collect semen, cocks were restrained, followed by gentle but rapid stroking of the abdomen and back region towards the tail where the testes are located. This stimulates the copulatory organ causing it to protrude. The released semen was then collected using semen collection cup. 0.1 ml of the semen collected was deposited at 2.5 cm deep on the left opening of vagina orifice of each hen. As the semen is expelled by the inseminator, pressure around the vent was released to allow the oviduct return to its normal position and draw the semen inward to the utero-vaginal junction. This was done twice in a week to replenish the sperm population in the utero-vaginal junction and sperm storage tubules in order to produce a succession of fertilized eggs between successive inseminations. This was done at the evening time around 1600 hrs to 1800 hrs to ensure that inseminated sperm gain access to the storage gland.

The mating procedure is as follows:

Naked neck (Male) × Naked neck (Female): NN_m x NN_f

Rhode Island Red (Male) × Rhode Island Red (Female): RIR_m x RIR_f

Rhode Island Red (Male) × Naked neck (Female): RIR_m x NN_f

Naked neck (Male) × Rhode Island Red (Female): NN_m x RIR_f

Egg Collection and Incubation

Eggs from artificially inseminated hens were collected and stored along genotype lines in a room with temperature ranging from 18 to 20^{o}C for five days before being transferred to the hatchery for incubation. At the hatchery, eggs were set along sire and dam lines at a temperature between 27 – 39^{o}C and a relative humidity of 55 – 56% for 18 days, thereafter, the temperature and relative humidity was increase to 29 – 40^{o}C and 70 – 75% respectively, from 19th day to hatching time. The eggs were also turn automatically through 90^o in the incubator.

Egg candling was carried out on the 18th day of incubation for the identification of fertile and clear eggs. Candling 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. After candling, fertile eggs were transferred into the hatching tray along genotypes lines for three days. After hatching, the chicks were screened for very weak, abnormal or dead in shell, and if found, they were disposed off appropriately.

Brooding, Housing Management and Feeding

Day old chicks obtained from the hatchery were wing tagged along sire and dam lines and taken to the previously disinfected brooder unit. In the brooding unit artificial heat was supplied through charcoal and electric bulb. The guard was put in place as to prevent huddling and wandering away of the chicks from the source of heat while the brooder is to provide heat for the chicks. Thermometer was placed within the brooder unit so that the temperatures were monitored. The optimum temperature for brooding were 32.2 - 35^{o}C, 29.7 - 32.2^{o}C, 26.6 - 29.7^{o}C and 26.6 – 23.2^{o}C for the first, second, third and fourth week of brooding respectively. The chicks were be brooded for 4 weeks.

The sides of the brooder house / pen were covered with either polythene or jute bags to conserve the heat and the floor were also covered with a fresh litter material. Adequate floor space was provided for the birds. At day one to eight weeks of age, the floor space was 0.07 m^2 per bird. At 9-20 weeks it was 0.15 m^2 per bird and as the birds continues to increase in size the surround or guard was correspondingly increased by drawing the guard backward until after the sixth week when it was completely removed.

During brooding stage, the chicks were fed *ad - libitum* with commercial chick mash of 18% Crude Protein and 2650 kcal/kg Metabolizable Energy from day old to eight weeks of age. The chicks were assigned to feeder at the rate of 100 birds to one tray or 1 pan of tube feeder and one drinker of 2 to 4 litre capacity. From fourth week of age, birds were fed commercial growers mash containing 16% Crude Protein and 2700 kcal/kg Metabolizable Energy. However, at 18 weeks of age, layers were fed commercial layers mash containing 16% Crude Protein and 2800 kcal/kg Metabolizable Energy and water were provided *ad- libitum*.

Data Collection

(a). Data were obtained on the following parameters when the birds were 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.

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

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.

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

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 first egg and body weight at first egg were obtained through the below procedure:

Egg weight: Eggs laid by each hen was weighed on daily basis.

Age at first egg: 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.

Body weight at first egg: This was determined by weigh the pullets with the used of an electronic kitchen scale with maximum capacity of 5kg.

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:

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

Where,

Y_{ij} = individual observation

μ = overall mean

G_i = fixed effect of i^{th} genotype (1, 2, 3, 4 i.e NN, RIR, NN x RIR, RIR x NN)

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

RESULTS

Table 1 revealed the mean values and standard errors of growth performance of naked neck, Rhode Island Red and their progenies. There are significant ($P<0.05$) differences in growth performance traits and the genotypes. Interestingly, as expected the pure RIR had the highest growth performance variables of 1537g, 97.33g, 13.69g and 8.50 for body weight, feed intake, weight gain and feed to gain ratio respectively than other group genotypes. The crossbred of RIR x NN followed the performance of pure RIR with 1419g for body weight, 90.51g for feed consumption, 13.50g for weight gain and 6.70 for feed conversion ratio than other genotype groups while the pure NN had the lowest values for body weight, feed intake, weight gain and feed conversion ratio comparing with RIR, RIR x NN and NN x RIR crossbreds.

The mean values and standard errors of egg production of naked neck, Rhode Island Red and their progenies. Egg production revealed significant ($P <0.05$) differences between the crosses. Pure cross of RIR only had highest average egg weight of 48g than other groups of genotype while NN x RIR crossbred had highest value for hen day egg production (83.33%) and hen housed egg production (81.44%) and followed closely was the pure RIR genotype for these variables. This was so because of the inherent advantages of local birds over the exotic chickens. The pure RIR mortality increases while NN x RIR crossbred reduce mortality due to hardiness.

Table 3 shows the mean values and standard errors of reproductive traits for naked neck, Rhode Island Red chickens and their progenies. Significant ($P<0.05$) difference exist between the genotypes and the measured variables for reproductive traits. Age at first egg was better for RIR x NN crossbred (150days) for earlier laying ability followed by crossbred of NN x RIR

(155days) with late laying age of 162days observed for pure NN genotype. Lighter body weights at first egg were better for pure NN and NN x RIR crossbred (1350g vs 1342g) while pure RIR genotype was the heaviest with value 1642g. RIR x NN crossbred had the highest fertility value of 85.34% followed by crossbred of NN x RIR with value of 80.97% with the least fertility (55.76%) for pure RIR. Hatchability value was better for RIR x NN and NN x RIR crossbreds (95.89% vs 87.45) with lowest observation for pure NN (71.89%).

DISCUSSION

Growth performance

The growth performance parameters in the present findings revealed a significant effect among the pure and crossbred chickens indicated that RIR genotype consumed more feed and gained maximum weight than those of NN and crossbred chickens at all ages of growing phase and this could be explained by the variation of genotype. The present results on growth performance that favoured RIR is in line with the work of Dutta *et al*. (2012) on RIR, Sonali and Fayoumi chickens. The body weight gain and feed intake of RIR chickens are higher than the NN, RIR x NN and NN x RIR chickens. The lowest body weight gain was recorded in NN chickens during growing phase. The poor feed conversion was also observed in NN chickens and better feed conversion was recorded in RIR and both crossbred chickens during growing phase. This observation were in accordance with the reports of Khawaja *et al*. (2012) and Halima *et al*. (2006) who reported growth performance of RIR chicken were better compared with other pure and crosses of chicken in their studies. The poor feed to gain in NN genotype, as observed in the present study, could be attributed to low feed intake and genetic composition of the birds and this observation were closed to the finding of Chatterjee, *et al*., (2007) and Chambers, (1990) that the difference in growth rate of chickens is due to interplay of multiple genes and this trait could be improved through intensive genetic selection. However, the potential of RIR crosses with NN breed that followed the RIR in terms of growth performance is also in agreement with the submissions given by various researchers that chickens carrying Naked neck have relatively high growth (El-Safty, 2006; Islam and Nishibori, 2009).

Egg production

The average mean of egg weight produced that favoured RIR breed is expected as the potential genetic make- up of RIR were superior than NN and the crossbreds and this results were in accordance with the findings of However, HHEP was significantly higher for NN x RIR genotype than RIR crosses and likewise for RIR x NN crossbred than pure NN and this can be attributed to lower mortality in NN genotype (Fassill *et al*., 2009) and in RIR x NN crosses. The pattern of results obtained for both HHEP and HDEP % in the current result followed the trends of findings earlier documented by Sola- Ojo and Ayorinde (2011), Wondmeneh *et al*. (2011), Rahman *et al*. (2004) who reported better HHEP% and HDEP% for crossbred chickens than purebred of chickens in the various studies. This result also similar to the findings of Shafik *et al*., (2013) for RIR, Fayoumi and crossbred of these birds where crossbred took the lead for HHEP% and HDEP%.

Reproductive traits

The present documentation on reproductive variables of naked neck, Rhode Island Red and their offspring showed that RIR x NN crossbred was observed to be significantly early maturing type layers than NN x RIR, RIR and NN under the experimental condition. This observed difference in age at first egg of four genotypes under the present study could be due to genetic and environmental differences, which is in agreement with the reports of Fassill *et al*. (2010), Lemlem and Tesfaye (2010) and Demeke (2004). The adult female body weights observed among the genotype favoured RIR pure bred since the laying hen body weight increased, egg production decreased and egg weight and feed consumption increased, because heavy birds consume more feed and lay larger eggs with large egg yolk than light hens (Tadesse *et al*., 2013). Thus, in the present study, there were significant difference recorded among NN, RIR, RIR x NN and NN x RIR laying hens on adult live body weight. However, The results of this study clearly showed that fertility and hatchability of RIR x NN chickens was significantly higher than that of NN x RIR crossbred, NN and RIR in that order. The results of fertility and hatchability obtained in this study were similar to the study of Sonaiya and Swan (2004) who reported that hatchability using broody hen is around 80% to be normal, but a range of 75 to 80% is considered to be satisfactory. In agreement to the result of this study, Abraham and Yayneshet (2010) revealed that 76 and 39% of hatchability of egg collected from indigenous and RIR, respectively in the semi-arid Tigrayi region of Northern Ethiopia.

CONCLUSION

Base on the present findings, it can be concluded that NN x RIR and RIR x NN crossbred chickens displayed an outstanding performance for growth performance variables with better gain for body weight than NN and moderate than RIR chickens with lower mortality. The results indicate that cross breeding has potential for improving economically important traits. This improvement is likely to be very important since farmers in the village will economically benefit from both the increased egg production and the heavier body weight of the chickens.

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Table 1: Mean values and standard errors of growth performance of Naked neck, Rhode Island Red chickens and their progenies

Genotype	BDW(g)	FI(g)	WG(g)	FCR
NN×NN	1250.00 ± 19.91^{d}	71.94 ± 6.02^{d}	10.35 ± 0.92^{c}	7.70 ± 0.05^{b}
RIR × RIR	1537.09 ± 15.78^{a}	97.33 ± 7.72^{a}	13.69 ± 1.72^{a}	8.50 ± 0.01^{a}
RIR × NN	1419.57 ± 10.63^{b}	90.51 ± 9.31^{b}	13.50 ± 1.04^{b}	6.70±0.09^{bc}
NN × RIR	1337.93 ± 20.90^{c}	77.33 ± 7.72^{c}	13.39 ± 1.72^{b}	5.50 ± 0.07^{c}

^{abc}Mean along the same column with different superscripts are significantly (P<0.05) different NN x NN = Naked neck, NN x RIR = Naked neck Rhode Island Red crossbred, RIR x NN = Rhode Island Red Naked neck 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: Mean values and standard errors of egg production of Naked neck, Rhode Island Red chickens and their progenies

Genotype	Average Egg Weight (g)	HDEP %	HHEP %
NN×NN	37.32 ± 0.43^{c}	33.78 ±1.72^{c}	30.35 ± 1.72^{c}
RIR × RIR	48.02 ± 0.66^{a}	58.33 ± 3.46^{b}	56.44 ± 3.88^{b}
RIR × NN	38.22 ± 0.35^{c}	45.42 ± 2.28^{bc}	43.66 ± 5.15^{bc}
NN × RIR	40.35 ± 0.03^{b}	83.33 ± 2.92^{a}	81.44 ± 1.18^{a}

^{abc}Mean along the same column with different superscripts are significantly (P<0.05) different NN x NN = Naked neck, NN x RIR = Naked neck Rhode Island Red crossbred, RIR x NN = Rhode Island Red Naked neck crossbred, RIR x RIR = Rhode Island Red, HDEP % = hen day egg production, HHEP % = hen housed egg production

Table 3: Mean values and standard errors of reproductive traits for naked neck, Rhode Island Red chickens and their progenies.

Genotype	Age at first egg (day)	Body weight at first egg (g)	Fertility %	Hatchability %
NN×NN	162.09±4.57^{a}	1350.78±45.87^{c}	66.65±0.47^{c}	78.07±8.90^{c}
RIR × RIR	161.43±3.48^{a}	1642.86±21.45^{a}	55.76±8.80^{d}	71.89±5.56^{d}
RIR × NN	150.23±3.09^{c}	1544.99±34.56^{b}	85.34±9.67^{a}	95.89±9.76^{a}
NN × RIR	155.43±3.48^{b}	1342.86±21.45^{c}	80.97±5.45^{b}	87.45±7.67^{b}

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