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PRODUCTIVE POTENTIALS OF BACKCROSSED NIGERIAN INDIGENOUS CHICKENS WITH EXOTIC BIRDS UNDER SOUTHERN GUINEA SAVANNA ZONE OF NIGERIA. II - FERTILITY AND HATCHABILITY

Amao Shola Rasheed*¹

¹*Department of Agricultural Education (Animal Sci. Division, Animal Breeding and Genetics Unit), School of Secondary Education (Vocational and Technical Programmes), Emmanuel Alayande College of Education, P.M.B.1010, Oyo, Oyo State, Nigeria.

ABSTRACT

The productive potential of backcrossed Nigerian indigenous chickens with exotic birds under Southern Guinea savanna zone of Nigeria especially for fertility and hatchability was evaluated using eight hundred and fifty (850) eggs from crosses involving frizzled feather Rhode Island Red crossbred backcrossed to Rhode Island Red dam (FFRIR x RIR) (200), normal feathered Rhode Island Red crossbred backcrossed to Rhode Island Red dam (NFRIR x RIR) (225), Fulani ecotype Rhode Island Red crossbred backcrossed to Rhode Island Red dam (FERIR x RIR) (210) and naked neck Rhode Island Red crossbred backcrossed to Rhode Island Red dam (NNRIR x RIR) (215). Data were obtained on number of eggs set, number of fertile eggs, infertile eggs, number of fertile eggs hatched, fertile eggs not hatched, chicks dead in shell and analyzed by SAS (2009)¹ using analysis of variance (ANOVA). Significant ($p < 0.05$) effect of genotype on the eggs set, number of fertile eggs, infertile eggs, number of fertile eggs hatched, fertile eggs not hatched, chicks dead in shell were observed. NFRIR x RIR birds had more of eggs set (68.85) coupled with lowest infertile eggs (18.55) while NNRIR x RIR chickens had the superior mean number of fertile eggs hatched (35.35), percentage fertile eggs (89.29), number of fertile eggs hatched (33.27) and least number of chicks dead in shell (14.65). The correlation coefficients between egg sets and other parameters evaluated were generally negative. The correlation magnitudes for FFRIR x RIR chickens was between -0.57 to 0.77 while that of NFRIR x RIR chickens ranges between -0.43 to 0.75, FERIR x RIR birds varied from -0.37 to 0.60 and NNRIR x RIR chickens was between -0.36 to 0.69. The use of NNRIR x RIR backcrossed chicken should be encouraged for better percentage of fertility, hatchability and lesser chicks dead in shell.

KEYWORDS

Backcrossed chickens, Rhode Island Red chicken, Nigerian Indigenous chickens, Fertility, hatchability and Southern guinea savanna.

Author for Correspondence:

Amao Shola Rasheed.
Department of Agricultural Education,
Emmanuel Alayande College of Education,
P.M.B.1010, Oyo, Oyo State, Nigeria.
Email: sholaamao@gmail.com

INTRODUCTION¹

Reproduction characteristics indicated as most paramount importance for livestock and poultry both in evolutionary and economic perspectives (Kulkarni and Zhang, 2015)². Fertility and hatchability are major traits of reproductive performance for egg-layer type of chickens and fertility measured the

capacity of poultry to initiate its reproduction process (Wright *et al*, 2012)³ while hatchability of fertile eggs is a major component of reproductive fitness (King'ori, 2011)⁴. Fertility and hatchability are also reported by Wondmeneh *et al*, (2006) as two major parameters that highly influence the demand for day-old chicks since fertility refers to the percentage of incubated eggs that become fertile while hatchability is the percentage of fertile eggs that hatch. Agaviezor *et al*, (2018)⁵ reported that the productive value of animals is determined by its ability to meet production demand and the production potential of domestic fowl is controlled by several parameters including those related to its reproductive potential (fertility and hatchability of eggs). Abou El-Ghar (2014)⁶ claimed that poultry breeders worldwide usually target at conserving and increasing the productive efficiency of native chickens genetically for economic traits and high fertility and hatchability of eggs of breeder stock and survivability of the chicks is necessary to produce large numbers of birds.

Several reports has suggested that Nigerian indigenous chickens are superior in adaptation, resistant to low management, feed shortages and tolerate to diseases, even as their genetic potential is poor (Amao 2017a⁷, Ndofor-Foleng *et al*, 2015⁸, Adedeji *et al*, 2006)⁹ but due to poor in genetic make-up of these indigenous birds, improvement of their genetic constitutions are through selection and cross breeding (Amao, 2018¹⁰, Amao, 2017b¹¹, Adebambo *et al*, 2009)¹². In Nigeria, reproductive performance evaluation among crossed, local and exotic chickens were conducted from different research around the country (Alabi *et al*, 2017¹³, Adedeji *et al*, 2015¹⁴ and Adeleke *et al*, 2012)¹⁵ and the overall output of the crossed breed was superior than either of the native or exotic parents under the different production systems. The products of the crossbreds are also well resistant to harsh tropical condition and produced a comparable amount of egg and meat (Amao, 2018¹⁰, Addis and Molede, 2014)¹⁶.

Backcrossing is a crossing of a hybrid with one of its parents or an individual genetically similar to its parent, in order to achieve offspring with a genetic

identity which is closer to that of the parent. It is used in horticulture, animal breeding and in production of gene knockout organisms. Backcrossing may be deliberately employed in animals to transfer a desirable trait in an animal of inferior genetic background to an animal of preferable genetic background (Schweitzer *et al*, 2002)¹⁷. However, very few information or research had been documented on backcrossed chickens in respect to fertility and hatchability especially in the Southern Guinea Savanna region of Nigeria and this study aimed to assess the fertility and hatchability of chickens progenies derived from backcrossed of Nigerian indigenous chickens to Rhode Island Red chickens.

MATERIAL AND METHODS

Experimental site

The study was conducted at the Animal Breeding and Genetics 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 Greenwich 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, 2017a)⁷.

Experimental Birds and Management Foundation stock and management of F1 crossbred chickens

The foundation stock of the chickens used for the study were adult males of normal feather, Fulani ecotype, naked neck and frizzle feather local chickens which were selected from a population of local chickens maintained at the Animal Breeding and Genetics Unit of Teaching and Research Farm, Emmanuel Alayande College of Education, Oyo, Oyo state, and females of Rhode Island Red breeder parent stock procured from a reputable farm in Ibadan. These birds were mated to generate F1 reciprocal crossbred populations. These birds were managed and assessed for egg production, fertility and hatchability, egg quality and growth performance characteristics as reported by Amao,

(2017a)⁷, Amao, (2017b)¹¹, Amao, (2017c)¹⁸ and Amao, (2018)¹⁰.

Assessment and management of F2 reciprocal backcross chickens

At the end of the short term egg production period (40 weeks of age), all surviving and healthy males of F1 reciprocal crossbred chickens were mated back to the Rhode Island Red hens to generate F2 reciprocal backcross chickens used in this study.

Experimental Feeds and Feeding

The birds were fed *ad-libitum* with commercial breeder mash containing 17.5 % crude protein and 2700 kcal/kg Metabolizable energy while the hens were also fed commercial layers mash containing 16 % crude protein and 2800kcal/kg Metabolizable energy. The chicks of F1 and F2 produced were fed with a commercial chicks mash that supplied 22 % crude protein and 2900kcal/kg Metabolizable Energy up to 8 weeks of age. Thereafter, they were fed with commercial grower's ration that supplied 16 % crude protein and 2800Kcal/kg Metabolizable Energy. Clean and cool water was also supplied *ad - libitum*. Medications and vaccinations were done as required by procedure described by Adedeji *et al*, (2015)¹⁴.

Experimental Mating

Artificial Insemination (AI) was adopted in mating the hens. The massage technique was used to collect semen from the cocks (normal feather, Fulani ecotype, naked neck and frizzle feather). The semen collected was inseminated immediately into a doughnut shape in the left vent of the hens. This was done once a week in the evening. For each hen 0.1ml of undiluted semen was used for insemination each time.

The mating procedure adopted is as follows:

Normal Feather Rhode Island Red crossbred (Male) × Rhode Island Red (Female): NFRIR_m × RIR_f

Fulani Ecotype Rhode Island Red crossbred (Male) × Rhode Island Red (Female): FERIR_m × RIR_f

Naked-Neck Rhode Island Red crossbred (Male) × Rhode Island Red (Female): NNRIR_m × RIR_f

Frizzle Feather Rhode Island Red crossbred (Male) × Rhode Island Red (Female): FFRIR_m × RIR_f

Method of Egg Collection and Incubation

Eggs produced from artificial inseminated 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 reputable hatchery in Ibadan 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°C in the incubator.

Candling Process

Candling procedures was carried out on the 18th day of incubation for the determination 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.

Data Collection

Data were collected on the following traits when the backcrossed chickens were ten weeks into laying: number of egg set per backcrossed genotype, number and percentage of fertile eggs, number and percentage of infertile eggs, number of eggs hatched and hatchability percentage, number of dead in shell and percentage using the below formula:

Number of fertile eggs =

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

Percentage fertility =

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

The eggs hatched and hatchability was estimated as

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

Percentage hatchability =

Percentage of dead in shell was calculated as:

$$\frac{\text{Number of dead in shell} \times 100}{\text{Number of fertile eggs}}$$

Analysis of Data

Data obtained were analyzed for the fixed effect of genotype using One-way analysis of Variance procedure of SAS (2009)¹ in a completely randomized design (CRD) and significant means were separated by Duncan's new multiple range test of SAS (2009)¹. The model was as follows:

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

Where,

Y_{ij} = individual observation

μ = population mean

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

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

Phenotypic correlations among the egg production performance traits for each of the genotypes were determined with Pearson's correlation coefficients (r) using SAS (2009)¹ software. The model for the Pearson's correlation is as follows:

$$r = \frac{\sum X_i Y_i}{(\sum X_i^2 \sum Y_i^2)^{1/2}}$$

Where,

r = Pearson product moment correlation coefficient

X_i = first random variable of the i^{th} egg production performance trait

Y_i = second random variable of i^{th} egg production performance trait

RESULTS AND DISCUSSION

Table No.1 indicated the hatchability and fertility traits of backcrossed chickens as affected by different genotypes. The results showed a significant ($P < 0.05$) effect of genotype on the eggs set, number of fertile eggs, percentage of fertile eggs, number of infertile eggs, percentage of infertile eggs, number of hatched eggs, percentage of hatched eggs, chicks dead in shell and percentage of chicks dead in shell. NFRIR x RIR chicken had the highest number of eggs set (68.85) than NNRIR x RIR (65.25), FERIR x RIR (62.45) and FFRIR x RIR (60.35). Number of fertile eggs were more for both NFRIR x RIR (35.47) and NNRIR x RIR (35.35) as compared to FERIR x RIR (30.47) and FFRIR x RIR (23.48)

backcrossed chickens. The percentage of fertile eggs was more for NNRIR x RIR (89.29 %) backcrossed chickens followed by FERIR x RIR backcrossed (79.23 %) with least value of 75.35 % recorded for FFRIR x RIR backcrossed eggs. For infertile eggs, FFRIR x RIR backcrossed chicken had the highest mean number of infertile eggs (23.47) followed by FERIR x RIR (23.22) and the lowest value of 18.35 was obtained in NFRIR x RIR backcrossed birds. The percentage infertile eggs were highest for FFRIR x RIR (24.65 %) followed by FERIR x RIR (20.77 %) with the least value (10.71 %) observed for NNRIR x RIR birds. NNRIR x RIR backcrossed chickens had the highest hatchable eggs (33.47) followed by both NFRIR x RIR (30.25) and FERIR x RIR (30.43) while the lowest value of 28.90 was recorded for FFRIR x RIR birds. NNRIR x RIR backcrossed chickens had more of percentage of hatched eggs (85.35 %) followed by NFRIR x RIR (80.48 %) and least value was obtained for FFRIR x RIR (68.35 %). Chicks dead in shell was highest for FERIR x RIR birds (2.89) followed by both NNRIR x RIR (1.65) and FFRIR x RIR (1.88) with the lowest value of 0.34 recorded for NFRIR x RIR backcrossed birds. The percentage chicks dead in shell was more in FFRIR x RIR chickens (31.65) as compared to FERIR x RIR, NFRIR x RIR and NNRIR x RIR backcrossed birds of values 29.45, 19.52 and 14.65 respectively.

The phenotypic correlation coefficient of eggs set, fertile eggs, infertile eggs, hatched eggs and chicks dead-in-shell parameters for all the backcrossed genotype chickens is as shown in Tables No.2 and 3. The correlation coefficients between egg sets and other parameters evaluated were generally negative for FFRIR x RIR, NFRIR x RIR, FERIR x RIR and NNRIR x RIR chickens respectively. The correlation magnitudes for FFRIR x RIR chickens was between -0.57 to 0.77 while that of NFRIR x RIR chickens ranges between -0.43 to 0.75, FERIR x RIR birds varied from -0.37 to 0.60 and NNRIR x RIR chickens was between -0.36 to 0.69.

Fertility and hatchability are interrelated heritable traits and they vary among breeds, variants and individuals within breeds and variants (Adedeji *et al*, 2015)¹⁴. The results of this study show that

difference in genetic constitutions of chickens has a significant effect on fertility and hatchability parameters evaluated. The findings of this study is thus in line with the fact that fertility and hatchability performance of eggs depends on genetic factors (Qureshi and Krishna, 2015¹⁹, Allanah *et al*, 2014²⁰, Abou El-Ghar, 2013²¹, Jha *et al*, 2013²² and Islam *et al*, 2002)²³. The differences in the backcrossed birds in respects to fertility and hatchability components presently corroborated the findings of Abou El-Ghar (2013)²¹ that variations existed among backcrossed chickens in respect to fertility and hatchability components due to different dams involved. The values and pattern of fertility and hatchability components reported for backcrossed birds with Gimmizah parents and backcrossed birds with Bandarah parents by Abou El-Ghar (2011)²⁴ in Egypt were comparable with the findings in the current study. Abou El-Ghar *et al*, (2010)²⁵ reported that variations in terms of fertility and hatchability traits were found among backcrossed birds with different sources of dam parents. Abou El-Ghar (2013²¹ and 2011)²⁴ concluded in his different studies involving backcrossed birds with Gimmizah parents (BC1), backcrossed birds with Bandarah parents (BC2) and repeated backcrossed birds (F3 generation) that variations existed among BC1, BC2 and F3 generation birds in respect of fertility and hatchability components.

The superiority in number of egg set displayed by NFRIR x RIR backcrossed chickens over other genetic groups showed that they have a better laying potentials than others genetic stocks. This result on number of egg set agrees with the works of Youssao *et al*, (2011)²⁶ and Sola - Ojo and Ayorinde (2011)²⁷ who reported that smooth or normal feathered Nigerian local chickens gene were of ability to lay more eggs than their counterparts frizzled and naked necked chickens. Moreki *et al*, (2014)²⁸ also reported that normal feather gene of local birds in Tswana had more egg laying potential than its counterpart naked neck chickens. Adeleke *et al*, (2012)¹⁵ found more eggs laid for normal feathered chickens compared to naked neck chickens. Meanwhile, the surpassed potential showed by backcrossed of NNRIR to RIR

dams for more fertile eggs, fertility percentage, hatchability and lesser chicks dead- in- shell over the other backcrossed chickens indicated that improved local birds of NN birds has a good combining effects with RIR when used as sires. This observation supported by the findings of Lamiaa (2014) in Egypt that naked neck gene had more of fertile eggs, hatch able eggs coupled with lowest dead in shell which was compactable to this current study. However, Ashart *et al*, (2003)²⁹ reported non- significant influenced in the fertility between Lyallpur silver black and Rhode Island Red interaction while between the hatches, significant effects were observed. Amira *et al*, (2013)³⁰ in Egypt found no significant differences between the genetic groups of their chickens used in their study for fertility and hatchability performance.

Correlation coefficients in report of Ige (2013)³¹ vindicated the strength of a linear relationship between traits and give valuable information about the involved traits for breeding purposes and improvement of breeding stock. A negative correlation between egg sets and other evaluated parameters for fertility and hatchability performance in backcrossed chickens was in accordance with the reports of Larivieve *et al*, (2009)³², Larivière and Leroy (2007)³³, Beaumont *et al*, (1997)³⁴ and Chaudhang *et al*, (1987)³⁵. These authors reported negative correlation values for most of the parameters measured in respect to fertility and hatchability performance of different chickens. However, Adedeji *et al*, (2015)¹⁴ and Bobbo *et al*, (2013)³⁶ findings disagreed with this present study on phenotypic correlation coefficient on fertility and hatchability traits. These authors found positive relationships between most of their variables measured for fertility and hatchability traits.

Table No.1: Hatchability and fertility traits of backcrossed chickens as affected by different genotypes
Backcrossed Chickens

S.No	Traits	NFRIR x RIR	FERIR x RIR	NNRIR x RIR	FFRIR x RIR
1	Eggs set	68.85 ^a	62.45 ^c	65.25 ^b	60.35 ^d
2	Fertile eggs	35.47 ^a	30.47 ^b	35.35 ^a	23.48 ^c
3	% fertile eggs	78.42 ^c	79.23 ^b	89.29 ^a	75.35 ^d
4	Infertile eggs	18.35 ^d	23.22 ^b	20.48 ^c	23.47 ^a
5	% Infertile eggs	21.58 ^b	20.77 ^b	10.71 ^c	24.65 ^a
6	Hatched eggs	30.25 ^b	30.43 ^b	33.47 ^a	28.90 ^c
7	% hatched eggs	80.48 ^b	70.55 ^c	85.35 ^a	68.35 ^d
8	Chicks dead in shell	0.34 ^c	2.89 ^a	1.65 ^b	1.88 ^b
9	% Chicks dead in shell	19.52 ^c	29.45 ^b	14.65 ^d	31.65 ^a

^{abcd}Means along the same row with different superscripts are significantly (P<0.05) different

NFRIR x RIR = Normal feather Rhode Island Red backcrossed to Rhode Island Red, FERIR x RIR = Fulani ecotype Rhode Island Red backcrossed to Rhode Island Red, NNRIR x RIR = Naked neck Rhode Island Red backcrossed to Rhode Island Red, Frizzle feather Rhode Island Red backcrossed to Rhode Island Red

Table No.2: Phenotypic correlation coefficients of fertility and hatchability traits of FFRIR x RIR and NFRIR x RIR backcrossed chickens

S.No		Egg set	Fertile eggs	Infertile eggs	Hatchable eggs	Chicks dead-in-shell
1	Egg set	1	0.62	0.77	-0.02	-0.57
2	Fertile eggs	0.43	1	0.78	-0.10	-0.56
3	Infertile eggs	-0.13	0.18	1	-0.32	-0.61
4	Hatchable eggs	-0.07	0.40	0.75	1	0.42
5	Chicks dead- in -shell	-0.26	0.26	-0.36	-0.43	1

Upper diagonal = FFRIR x RIR backcrossed chickens

Lower diagonal = NFRIR x RIR backcrossed chickens

Table No.3: Phenotypic correlation coefficients of fertility and hatchability traits of FERIR x RIR and NNRIR x RIR backcrossed chickens

S.No		Egg set	Fertile eggs	Infertile eggs	Hatchable eggs	Chicks dead-in-shell
1	Egg set	1	-0.16	0.53	0.83	0.32
2	Fertile eggs	0.45	1	-0.06	-0.37	-0.04
3	Infertile eggs	0.69	-0.04	1	0.60	0.92
4	Hatchable eggs	-0.13	0.34	-0.30	1	0.28
5	Chicks dead- in -shell	-0.06	-0.70	-0.02	-0.36	1

Upper diagonal = FERIR x RIR backcrossed chickens

Lower diagonal = NNRIR x RIR backcrossed chickens

CONCLUSION

Genetic and non-genetic factors influenced hatchability and fertility in FFRIR x RIR, NFRIR x RIR, FERIR x RIR and NNRIR x RIR backcrossed chickens. A significant effect of genotype on fertility and hatchability parameters was observed. The use of NNRIR x RIR backcrossed chicken should be

encouraged for better percentage of fertility, hatchability and lesser chicks dead in shell. However, understanding the genetic constitutes of chickens and how they affect chickens reproductive or productive traits will help to develop practicable selection and breeding programmes and to regulate hen productive performance at a profitable level.

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CONFLICT OF INTEREST

I declare that I have no conflict of interest.

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