Journal of Animal and Veterinary Sciences
2019; 6(1): 1-7
http://www.openscienceonline.com/journal/javs

Productive Potentials of Backcrossed Nigerian Indigenous Chickens with Exotic Birds Under Southern Guinea Savanna Zone of Nigeria, I - Egg Production Performance

Amao Shola Rasheed

Department of Agricultural Education (Animal Sci. Division; Animal Breeding and Genetics Unit), School of Vocational and Technical Education, Emmanuel Alayande College of Education, Oyo, Nigeria

Email address

sholaamao@gmail.com, sholaamao@eacoed.edu.ng

To cite this article

Amao Shola Rasheed. Productive Potentials of Backcrossed Nigerian Indigenous Chickens with Exotic Birds Under Southern Guinea Savanna Zone of Nigeria, I - Egg Production Performance. *Journal of Animal and Veterinary Sciences*. Vol. 6, No. 1, 2019, pp. 1-7.

Received: January 10, 2019; **Accepted**: February 28, 2019; **Published**: April 10, 2019

Abstract

The study was designed to assess the egg production performance among the backcrossed Nigerian indigenous chickens to Rhode Island Red birds under Southern Guinea savanna zone of Nigeria. The study employed the uses of 220 birds comprises of 20 sires, 5 each of crosses involving frizzled feather Rhode Island Red crossbred (FFRIR), normal feathered Rhode Island Red crossbred (NFRIR), Fulani ecotype Rhode Island Red crossbred (FERIR) and naked neck Rhode Island Red crossbred (NNRIR) with 200 Rhode Island Red dams which were mated at ratio 1:5 to produce the backcrossed chickens of FFRIR x RIR, NFRIR x RIR, FERIR x RIR and NNRIR x RIR respectively. Data were obtained on body weight at first egg (BWFE), weight of first egg (WFE), age at sexual maturity (ASM), number of eggs at ninety days (EN90) and weight of eggs at ninety days (EW90). Significant ($P<0.05$) influenced of genotype on the egg production performance traits were obtained. FFRIR x RIR chickens was superior than its counterpart backcrossed birds for lighter body weight at first egg (1100.89 g), earlier age at sexual maturity (140.90 days) coupled with more number of eggs at ninety days (52.34 eggs) while NNRIR x RIR backcrossed chickens was better than other genetic groups in respect to weight of first egg (43.78 g) and weight of eggs at ninety days (52.89 g). The correlation coefficients between egg sets and other parameters evaluated were generally negative. The highly positive, negative and significant ($P<0.001$) correlations among the egg production performance traits of each genetic group of backcrossed chickens suggested that traits are under the same gene action (pleiotropism) which is good indicator for selection for improvements in one trait in an animal will eventually resulted in improvement of the other traits. It can be concluded that FF and NN individuals' gene were better for egg production especially in this Southern Guinea Savanna region of Nigeria.

Keywords

Backcrossed Chickens, Rhode Island Red Chicken, Nigerian Indigenous Chickens, Egg Production, Southern Guinea Savanna

1. Introduction

Indigenous chickens globally remains the poor parent in term of investment and its productivity remains low as compared to exotic strains [1]. Yet, it is agreed that the local chicken is extremely well suited to tropical environmental conditions through natural selection. The exploitation of the good adaptive characteristics of the local chicken would better be carried out through controlled crossbreeding programs with high performance exotic strains to exploit the phenomenon of heterosis and produce high yielding chickens adapted to the farming systems of tropical rural areas. Among the various aspects in poultry science, improvement in genetic constitutions by various breeding methods is an important aspect to improve feed efficiency, egg production and egg quality while genetic progress can be accomplished either by selection or crossbreeding [2]. The crossbred gives quick output for rural people without any high inputs and crossbreeding stimulates the vigor of the resulting offspring and tends to improve hatchability of eggs, viability of chicks, rate of growth and egg production, which will be suitable as dual-purpose birds for rural areas [3]. Crossbreeding between adapted local chicken and high yielding exotic strain would enable to exploit both the rusticity of the first and zootechnical performances of the second in the tropics to produce adapted and more productive genetic types [4].

Hospital [5] described backcrossing as a well-known and long established breeding scheme where a characteristic is infiltrated from a donor parent into the genomic background of a recurrent parent. The characteristic could be a trait, a gene or even an anonymous locus or chromosome segment. In successive generations, offspring are selected for the characteristic of interest and then backcrossed to the recurrent parent. This ensures that the proportion of gene from the donor parent tends to zero as generations accumulate, except for the part hosting the characteristic of interest. The objective is to reduce the latter to the smallest size necessary. If selection is applied for the desired characteristic only, then the proportion of donor genome is expected to be reduced by one-half (50%) at each generation, except on the chromosome holding the characteristic. However, very few information or research had been documented on backcrossed chickens in terms of egg production performances especially in the Southern Guinea Savanna region of Nigeria and this study aimed to assess the egg production traits of chickens progenies derived from backcrossed of Nigerian indigenous chickens to Rhode Island Red chickens.

2. Materials and Methods

2.1. Experimental Site

The study was carried out 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 [6].

2.2. Experimental Birds and Management

2.2.1. Management of Foundation Stock and 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 Nigerian indigenous 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 and were managed and assessed for egg production, fertility and hatchability, egg quality and growth performance characteristics as reported by Sagarika *et al.* [2], Amao [7], Amao [8], Amao [6].

2.2.2. Management of F_2 Reciprocal Backcross Chickens

At the end of the short term egg production period (40 weeks of age), all surviving and healthy males of F_1 reciprocal crossbred chickens were mated back to the Rhode Island Red hens to generate F_2 reciprocal backcross chickens used in this study.

2.3. 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 2800 kcal/kg Metabolizable energy. The chicks of F_1 and F_2 produced were fed with a commercial chicks mash that supplied 22% Crude Protein and 2900 kcal/kg Metabolizable Energy up to 8 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 also supplied *ad - libitum*. Medications and vaccinations were done as required by procedure described by Adedeji *et al.*[9].

2.4. 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): $NFRIR_m$ x RIR_f

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

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

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

2.5. 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° in the incubator.

2.6. 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.

2.7. 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 seven weeks. The chicks were fed with a commercial chicks mash that supplied 22% crude protein and 2900 Kcal/kg Metabolizable Energy up to 7 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* while medication and vaccination were done as at when due.

2.8. Collection of Data

Data were collected on the egg production performance, such as body weight at first egg (BWFE), weight of first egg (WFE), age at sexual maturity (ASM), egg weight at ninety days (EW90) and egg number at ninety days (EN90) were obtained through the below procedures described by Amao [3].

Weight of first egg (g): This was obtained by measuring the egg weights of individual backcrossed genotype chicken eggs as soon as it was firstly lay. All weights were obtained using an electronic weighing balance (Mettler P1020N) having a sensitivity of 0.01g.

Body weight at first egg (g): This was determined by weigh the pullets with the used of an electronic kitchen scale with maximum capacity of 20kg.

Age at sexual maturity (days): 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.

Egg Weight at 90 days (g): Eggs laid by each backcrossed hen was weighed on daily basis. The average egg weight obtained from individual backcrossed hens for each week of lay for each backcrossed genotype chicken over the short-term period for period of ninety days. All weights were obtained using an electronic weighing balance (Mettler P1020N) having a sensitivity of 0.01g.

Egg Number at 90 days: This was obtained by counting the number of egg laid by individual hens of backcrossed chickens over the period of ninety days.

2.9. Data Analysis

Data collected were analyzed for the fixed effect of genotype using One-way analysis of

Variance procedure of SAS [10] in a completely randomized design (CRD) and significant means were separated by Duncan's new multiple range test of SAS [10]. 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 [10] software. The model for the Pearson's correlation is as follows:

$$r = \frac{\Sigma X_i Y_i}{(\Sigma X^2{}_i \Sigma Y^2{}_i)\frac{1}{2}}$$

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

3. Results

Table 1 reveals that all the egg production performance traits were significantly ($P<0.05$) affected by different genotypes. The body weight at first egg of naked neck Rhode Island Red crossbred backcrossed to Rhode Island Red dam (1440.40 g) was significantly higher than other genetic groups while the light body weight at first egg was obtained for Frizzle feather Rhode Island Red backcrossed to Rhode Island Red (1100.89 g). In similar vein, weight of first egg of naked neck Rhode Island Red crossbred backcrossed to Rhode Island Red dam (43.78 g) was more than that of Normal feather Rhode Island Red backcrossed to Rhode Island Red, Fulani ecotype Rhode Island Red backcrossed to Rhode Island Red and Frizzle feather Rhode Island Red backcrossed to Rhode Island Red of values 38.10 g, 34.79 and 22.23 g respectively. Frizzle feather Rhode Island Red backcrossed to Rhode Island Red chickens laid earliest at

140.90 days than other genetic groups of chickens involved while naked neck Rhode Island Red crossbred backcrossed to Rhode Island Red dam was late to lay at 178.78 days. It is noteworthy to remark that bodyweight at first egg, weight of first egg and age at sexual maturity were decrease (P<0.05) progressively from Naked neck Rhode Island Red backcrossed to Rhode Island Red to Frizzle feather Rhode Island Red backcrossed to Rhode Island Red. However, egg number as at 90 days was more for Frizzle feather Rhode Island Red backcrossed to Rhode Island Red chickens (52.34), followed closely by both Fulani ecotype Rhode Island Red backcrossed to Rhode Island Red chickens (50.45) and naked neck Rhode Island Red backcrossed to Rhode Island Red chicken (49.56) with least value of 46.90 was recorded for normal feather Rhode Island Red backcrossed to Rhode Island Red chicken. Egg weight at 90 days was heaviest in naked neck Rhode Island Red backcrossed to Rhode Island Red chicken while the lightest egg weight at 90 days was observed in Frizzle feather Rhode Island Red backcrossed to Rhode Island Red chickens.

Table 1. *Egg production performance of backcrossed chickens as affected by different genotype.*

Genotype	BWFE (g)	WFE (g)	ASM (days)	EN90 (no)	EW90 (g)
FFRIR x RIR	1100.89±12.07[d]	22.23±1.89[d]	140.90±11.78[d]	52.34±1.32[a]	43.89±1.56[c]
FERIR x RIR	1250.45±11.88[c]	34.79±1.43[c]	148.45±20.01[c]	50.45±2.45[ab]	50.34±0.66[b]
NFRIR x RIR	1360.90±21.23[b]	38.10±2.99[b]	164.33±11.34[b]	46.90±1.78[c]	50.64±1.45[b]
NNRIR x RIR	1440.40±13.33[a]	43.78±1.88[a]	178.78±13.88[a]	49.56±1.34[ab]	52.89±1.09[a]

[abcd]Means along the same column with different superscripts are significantly (P<0.05) different

BWFE = Bodyweight at first egg (g), WFE = weight of first egg (g), ASM = Age at sexual maturity (days), EW90 = Egg weight at 90 days, EN90 = Egg number at 90 days, 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, FFRIR x RIR = Frizzle feather Rhode Island Red backcrossed to Rhode Island Red.

The pearson phenotypic correlation coefficients among egg production traits of the backcrossed chickens is as shown in Table 2. For frizzled feather Rhode Island Red backcrossed to Rhode Island Red (FFRIR x RIR) chickens, very highly positive and significant (P<0.001) correlations was found between bodyweight at first egg (BWFE) and weight of first egg (WFE) (0.94) while a highly positive and significant (P<0.01) was observed between WFE and Age at sexual maturity (ASM) (0.11). A very highly negative and significant relationship was found between BWFE and egg number at 90 days (EN90) (-0.93) while highly and negative significant (P<0.01) was obtained between WFE and EN90 (-0.68) and negative significant (P<0.05) correlation was record for ASM against EN90 (-0.66). The correlation magnitudes of FFRIR x RIR chickens was between -0.93 to 0.94. However, highly negative and significant (P<0.01) was recorded for EN90 against WFE (-0.82) and ASM (-0.57) for Fulani ecotype Rhode Island Red backcrossed to Rhode Island Red (FERIR x RIR) chickens. Highly positive and significant (P<0.01) relationship was observed between BWFE and WFE (0.73) while the highly negative and significant (P<0.01) correlation was recorded between BWFE and EN90 (-0.69) was obtained for normal feather Rhode Island Red backcrossed to Rhode Island Red (NFRIR x RIR) chickens. Meanwhile, for naked neck Rhode Island Red backcrossed to Rhode Island Red (NNRIR x RIR) chickens, only the relationship between ASM and WFE (0.88) was highly positive and significant (P<0.01) correlated.

Table 2. *Pearson phenotypic correlation coefficients among egg production traits of the backcrossed chickens.*

Genotype		BWFE	WFE	ASM	EN90	EW90
FFRIR x RIR	BWFE	1				
	WFE	0.94***	1			
	ASM	0.24	0.11**	1		
	EN90	-0.93***	-0.68**	-0.66*	1	
	EW90	0.45	0.89	0.45	0.23	1
FERIR x RIR	BWFE	1				
	WFE	0.38	1			
	ASM	0.01	0.01	1		
	EN90	0.34	-0.82**	-0.57**	1	
	EW90	0.44	0.22	0.42	0.22	1
NFRIR x RIR	BWFE	1				
	WFE	-0.69**	1			
	ASM	0.15	0.07	1		
	EN90	0.73**	-0.31	0.11	1	
	EW90	0.34	0.67	0.41	0.40	1
NNRIR x RIR	BWFE	1				
	WFE	-0.23	1			
	ASM	-0.04	0.88**	1		

Genotype		BWFE	WFE	ASM	EN90	EW90
	EN90	0.03	-0.16	0.31	1	
	EW90	0.06	0.35	0.34	0.31	1

***P<0.001 =Very highly significant, **P<0.01 = Highly significant, *P<0.05 = Significant

BWFE = Bodyweight at first egg (g), WFE = weight of first egg (g), ASM = Age at sexual maturity (days),, EW90 = Egg weight at 90 days, EN90 = Egg number at 90 days, 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, FFRIR x RIR = Frizzle feather Rhode Island Red backcrossed to Rhode Island Red.

4. Discussion

The significant genotype differences obtained in the egg production components such as body weight at first egg, weight of first egg, age at sexual maturity, egg number at 90 days and egg weight at 90 days among the backcrossed chicken progenies indicated that these characters were highly influenced by genetic factors and this study is similar with the earlier findings of Amao [7], Adedeji *et al.*[11], Munisi *et al.* [12], Moula *et al.* [13]. These authors claimed that variations in the egg production were linked to different background of the chickens involved. The variations in the values of body weight at first egg, weight of first egg, age at sexual maturity, egg number at 90 days and egg weight at 90 days in all the backcrossed chickens progenies can also be associated to different genetic background of the chickens [14 -15]. The lighter in body weight at first egg exhibited by Frizzle feather Rhode Island Red backcrossed to Rhode Island Red chickens over its backcrossed chickens counterpart suggests that they have a better bodyweight at first egg that favoured egg production. This reports was supported by the finding of Munisi *et al.*[12] that backcrossed chicken were better in egg production than their F_1 crosses and the lighter the body weight of laying chickens the better the egg production. The better earliest laying ability displayed by Frizzle feather Rhode Island Red backcrossed to Rhode Island Red chickens over other backcrossed genetic groups showed that the improved indigenous breed through backcrossing have a good combining effect with RIR (exotic) when used as male line rather than a female line. This early laying attribute of frizzled feather over other genetic backcrossed groups has been earlier documented by Amao [3] that frizzled feather birds had genetic potential of laying earlier than its other Nigerian local chickens. The attribute of coming earlier of frizzled feather genes over other Nigerian indigenous chickens were found by Nwachukwu and Ogbu [16], Abou El- Ghar [17] showing that backcrossed of local chicken to exotic birds was better at sexual maturity than their other indigenous birds. Farruk *et al.[*18], Moula *et al.[*13], Khawaja *et al.[*19] also reported highly significant effects among different genotypes (pure, crosses and backcrosses) in age at sexual maturity in chickens.

The potential of heaviest weight of egg at first lay displayed by Fulani ecotype Rhode Island Red backcrossed to Rhode Island Red chickens might be linked to its the better genetic constitutions of naked neck chicken and this was in accordance to the findings of Amao [7] that inherent gene in naked neck birds for egg production traits were superior than other Nigerian local chickens. The significant effects on the egg weight at first laid in this present study disagreed with the reports of Amin [15], Nwachukwu and Ogbu [16], who revealed non- significant influenced in the weight of first eggs for backcrossed chickens and backcrossed of white Nicholas turkey respectively. Meanwhile, the laying capacity at 90 days that favoured Frizzle feather Rhode Island Red backcrossed to Rhode Island Red chickens was as expected because of its ability to lay earliest coupled with light body weight that are better for egg production. This observation is consistency with the findings of Munisi *et al.* [12] Nwachukwu and Ogbu [16], Abou El-Ghar [20] who reported that backcrossed chicken generally surpassed the F_1 chicken in most of egg production variables considered.

Generally, effects of frizzled feather and naked neck genes on performance characteristics are known to be more pronounced under sub-optimal environmental conditions such as under thermal stress [16, 21]. The frizzle (FFRIR x RIR) and naked neck (NNRIR x RIR) individuals in the backcrossed groups outperformed their normal feathered and Fulani ecotype counterparts in respect to bodyweight at first egg, age at sexual maturity, egg number at 90 days, weight at first egg and weight of eggs at 90 days. Interestingly, the pattern of variations displayed among the backcrossed birds in respect to as body weight at first egg, weight of first egg, age at sexual maturity, egg number at 90 days and egg weight at 90 days might be associated to the variations in the maternal and paternal performance of the dams and sires used. Abou El-Ghar [20] found differences in the egg production parameters in the two backcrossed (backcrossed with Gimmizah parents and backcrossed with Bandarah parent) and suggested that the differences might be attributed with different dams used in their study and their documentation was comparable with the current study that proved that dams.

The correlation procedure describes the interrelationships that exist among traits of interest and the estimates of correlation coefficients are therefore very useful in animal breeding as a tool of predicting potential response to or progress made from selection [22]. Correlations permit prediction of direction and magnitude of change in the dependent trait as a correlated response to direct selection of the principal trait [23]. Thus, correlations are of great interest to the breeder. The extent and direction of correlated selection response are determined by the genetic correlation or covariance between the concerned traits. The pattern of phenotypic correlation among the egg production performance of each genetic group of backcrossed chickens suggested that traits are under the same gene action (pleiotropism) and good indicator for selection for improvements in one trait in an animal will eventually resulted in improvement of the other traits correlated in direct selection. The present results on the phenotypic correlations for egg production performance traits among the backcrossed chickens was in line with the findings of Osei-Amponsah *et al. [*24] in Ghana who documented similar range of values for local Ghanaian chickens in respect to phenotypic correlation of egg production traits. Faruque *et al. [*25] found positive and significant correlation among non-descript, desi and naked neck chickens in Bangladesh and this conformed to the current findings on phenotypic correlations of egg production traits. The results of this study also affirmed those of several reports stating negative correlations phenotypic magnitudes between body weight at first egg and egg number, and between egg weight and egg number or egg production [26-28].

5. Conclusion

This study indicated that the FFRIR x RIR chickens was better for its lighter body weight which favoured egg production, earlier potential of laying ability and more eggs at 90 days than its other counterparts backcrossed chickens and NNRIR x RIR backcrossed individuals was also superior in respect to its attributes of more heavier weights of eggs both at weight of first egg and egg weight at 90 days. However, the relationships between the body weight at first egg, weight of first egg, age at sexual maturity, number of eggs laid for 90 days and egg weight at 90 days revealed a pleiotropism action and this is a good indicator for selection for improvements in one trait in an animal.

References

[1] Mafeni, J. M., Horst, P., Verhulst, A. and Pone, K. D. (2005). Production performance and exploitation of heterosis in Cameroon indigenous and German Dahlem Red chickens and their crossbreds. *Bull. Anim. Health Prod. Afr.* 53: 266-272.

[2] Sagarika, B., Bhagirathi, P., Chitta, R. P., Nrusingha, B., Niranjan, P. and Jessy, B. (2017). Performance of back cross progeny from hansli male and coloured broiler female chicken. *International Journal of Current Microbiology and Applied Sciences,* 6 (7): 2739-2744.

[3] Amao, S. R. (2017a). Productive potentials of Nigerian indigenous chickens versus Rhode Island Red chicken reared southern guinea savanna environment of Nigeria. *International Journal of Agricultural and Environmental Sciences,* 2 (5): 49-55.

[4] Keambou, T. C., Mboumba, S., Touko, B. A. H., Bembide, C., Mezui, T. M., Tedongmo, A. M. Y. and Manjeli, Y. (2015). Growth performances, carcass and egg characteristics of the local chicken and its first generation reciprocal crossbreds with an exotic strain in Cameroon. *Adv. Anim. Vet. Sci.*, 3 (10): 507-513.

[5] Hospital, F. (2005). Selection in backcross programme. *Philosophical Transaction of the Royal Society London, B, Biological Sciences,* 360 (1459): 1503-1511.

[6] Amao, S. R. (2018). Early growth characteristics of chicken progenies derived from different chickens sires on fulani ecotype dams in southern guinea savanna environment of Nigeria. *7th ASAN-NIAS Joint Annual Meeting, Ilorin,* 9th -13 Sept, 2018. Pp 174-178.

[7] Amao, S. R. (2017b). Effect of crossing fulani ecotype with Rhode Island Red chickens on growth performance and reproductive traits in southern guinea savanna region of Nigeria. *Journal of Animal and Veterinary Sciences*, 4 (2): 14-18.

[8] Amao, S. R. (2017c). Egg production and growth performance of naked neck and Rhode Island Red chickens under Southern Guinea Savanna condition of Nigeria. *International Journal of Agriculture and Earth Science*, 3 (2): 1-10.

[9] Adedeji, T. A., Amao, S. R., Popoola, A. D. and Ogundipe, R. I. (2015). Fertility, hatchability and eggs quality traits of Nigerian locally adapted chickens in the derived savanna environment of Nigeria. *International Journal of Biology, Agriculture and Health Sciences,* 5 (17): 36-42.

[10] SAS (2009). Statistical Analysis System (SAS) Users guide, version 9.6 SAS Institute, Cary NC, USA.

[11] Adedeji, T. A., Amao, S. R., Mathew, O. C., Fasoyin, O. A. and Olugbemiga, K. S. (2016). Comparative study of semen characteristics, egg fertility and hatchability of naked neck, Fulani ecotype, isa brown and their F_1 crossbreds. 41st Annual Conference of the Nigerian Society for Animal Production held at Federal University of Agriculture, Abeokuta. March, 20th –24th, 2016. 41: 133-137.

[12] Munisi, W. G., Katule, A. M. and Mbaga, S. H. (2016). Comparisons of egg production and quality traits of parental and crosses of broiler and black Australorp chickens in Tanzania. *Livestock Research for Rural Development*, 28 (6). http://www.irrd.org/irrd28/6/muni28111.htm

[13] Moula, N., Diaw, M. T., Salhi, A., Famir, F., Antoine-Moussiaux, N. and Leroy, P. (2013). Egg production performance of the local Kabyle hen and its crossbreeds with ISA-Brown strain in Semi-Intensive conditions. *International Journal of Poultry Science,* 12 (3): 148-152.

[14] Rayan, G. N., El-Faham, A. I., Ibrahim, S. A. and Hattaba, N. A. (2015). Comparative study of egg quality, hatching performance and carcass traits for Rhode Island Red, Bahij and Matrouh chicken strains. *Egytian Poultry Science Journal,* 35 (3): 817-831.

[15] Amin, E. M. (2014). Effect of repeated backcrossing for two generations between the local black baladi and white Nicholas turkeys on egg production and hatch traits 1- egg production traits. *Egyptian Poultry Science Journal*, 34 (1): 187-211.

[16] Nwachukwu, E. N. and Ogbu, C. C. (2015). Effect of feathering genes and mating pattern on short term egg production and egg quality traits of upgraded native chickens. *Global Journal of Animal Breeding and Genetics,* 3 (2): 110-116.

[17] Abou El-Ghar, R. Sh. (2014). Estimation of genetic and phenotypic parameters in 3rd generation and backcrosses of some local strains of chicken. *Egyptian Poultry Science Journal*, 34 (II): 521-535.

[18] Farrukh, S., Babar, H. A., Saleem, Z. and Bilal, K. (2014). Comparative productive performance of indigenous naked neck and naked neck crossbred layer chickens. *Pakistan J. Agric. Res.*, 7 (4): 340-344.

[19] Khawaja, T., Khan, S. H., Mukhtar, N., Parveen, A. and Fareed, G. (2013). Production performance, egg quality and biochemical parameters of three way crossbred chickens with reciprocal F_1 crossbred chickens in sub-tropical environment. *Italian Journal of Animal Science,* 12: 127-132.

[20] Abou El-Ghar, R. Sh. (2013). Genetic analyses of generation means for a cross between two local breeds of chickens: 4- a model for hatchability prediction as a function of some egg quality traits. *Global Journal of Science Frontier Research Agriculture and Veterinary*, 13 (7): 1-5.

[21] Mahrous, M., Galal, A., Fathi, M. M. and Zein El-Dein, A. (2008). Impact of naked neck (Na) and frizzle (F) genes on growth performance and immunocompetence in chickens. *International Journal of Poultry Science*. 7 (1): 45-54.

[22] Obike, O. M., Nwachukwu, E. N. and Onwuchekwa, J. U. (2016). Phenotypic correlation of body weight and linear body traits in heavy, medium and low body weight lines of sigmond strains of Japanes quails in humid rain forest zone of Nigeria. *Nigerian Journal of Animal Production,* 43 (1): 1-9.

[23] Laxmi, P., Jaya, S., Prasad, V. L. K.., Murthy, A. R. and Eswara, R. (2002). Correlations among various egg quality traits in White Leghorns. *J. Ind. Vet.,* 79: 810-813.

[24] Osei-Amponsah, R., Kayang, B. B. and Naazie, A. (2013). Phenotypic and genetic parameters for production traits of local chickens in Ghana. *Animal Genetic Resources*, page 1 of 6. © Food and Agriculture Organization of the United Nations.

[25] Faruque, S., Siddiquee, N. U., Afroz, M. A. and Islam, M. S. (2010). Phenotypic characterization of native chicken reared under intensive management system. *J. Bangladesh Agril. Univ*. 8 (1): 79–82.

[26] Francesch, A., Estany, J., Alfonso, L., and Iglesias, M. (1997). Genetic parameters for egg number, egg weight, egg shell colour in three Catalan poultry breeds. *Poult. Sci.*, 76: 1627-1631.

[27] Jeyarubau, M. G. and Gibon, J. P. (1996). Estimation of additive genetic variance in commercial layer poultry and simulated populations under under selection. *Theor. Applied Genet*. 92: 483-491.

[28] Besbes, B., Ducrooq, V., Foulley, J. C., Protais, M., Tavernier, M., Tixier-Boichard, M. and Beaumount, C. (1992). Estimation of genetic parameters of egg production traits of laying hens by restricted maximum likelihood applied to multiple traits reduced animal model. *Genet. Selection Evolution*, 24: 539-552.