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Effect of Chicken Genotype on Growth Performance of Pure and Crossbred Progenies in the Development of a Broiler Line

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Abstract – **This experiment was conducted to assess the effect of chicken genotype on the growth performance, feed intake and feed conversion efficiency of the progenies resulting from purebred (Giriraja (Gr) X Giriraja (Gr)), straight (Gr male X Alpha female), reciprocal (Alpha male X Gr female) and Alpha male X White Leghorn (WL) female crosses. Data obtained on body weight, body length, breast girth, keel length, feed intake and feed conversion efficiency in a Completely Randomized Design were analysed using one-way analysis of variance for the fixed effect of chicken genotype. Generally, all growth traits, feed intake and feed conversion efficiency were significantly affected (P < 0.05) by chicken genotype. Body parameters, feed intake and feed conversion efficiency increased as birds advanced in age. Progenies resulting from mating of Giriraja X Giriraja chickens had the highest body weight, breast girth and feed conversion efficiency. However, the reciprocal crosses of Alpha X Gr resulted in significant (P < 0.05) improvement of body length, keel length and feed intake. In conclusion therefore, the genetic superiority exhibited by the crosses of Alpha x Gr when compared with other crossbreds could be exploited to speed up the growth performance of indigenous chicken towards having Nigerian indigenous broiler line.**

Keywords – **Body parameters, Chicken, Crossbred, Feed intake, Purebred.**

I. INTRODUCTION

The total poultry population in Nigeria is estimated at 104, 257, 960 [1], out of which the indigenous chicken constitute 75 to 80% of the total population [2]. They are generally characterized by poor growth, small body size, small egg size as well as slow growth rate. These qualities are however not desirable in an economic situation. Moreover, these indigenous strains have not been thoroughly worked upon to explore their adaptive genetic potentials. National or regional breeding programme based on gene pools of indigenous strains is also lacking. However, with the preponderance of indigenous chicken population in Nigeria, adequate developmental breeding plans will no doubt improve indigenous poultry production, enhance foreign exchange earnings [3] and limits genotype-environment interaction [4] affecting exotic chicken in Nigeria. One of the major problems of the poultry industry in Nigeria is the lack of breeds of chicken that are adapted to the traditional small-scale production system prevalent in the area. There is the need to expand the narrow genetic base of the poultry industry in Nigeria to include the indigenous species as contributors of rare genes. Crossbreeding indigenous chickens with exotic breeds will go a long way in improving the performance of the indigenous chickens without necessarily losing their adaptive features as their desirable genes are conserved [5]. There is therefore the need for breeding policies that will involve the production of improved local chicken through cross-breeding with the exotic breed. This research therefore seek to study the growth performance of purebred and crossbred involving straight and reciprocal crossing of both improved indigenous and exotics with a view to develop a broiler line that will be able to cope with available local feed resources in Nigeria environment.

II. MATERIALS AND METHODS

Description of study area

The research was carried out at the Poultry Breeding Unit of the Teaching and Research Farm of the University of Agriculture, Abeokuta, Nigeria. The area is located on $7^0 10^1$N and $3^0 2^1$E in Odeda Local Government Area of Ogun State, Nigeria. This area lies in the South western part of Nigeria and has a prevailing tropical climate with a mean annual rainfall of about 1037mm. The mean ambient temperature ranges from 28^0C in December to 36^0C in February with a yearly average relative humidity of 82%. The vegetation represents an interphase between the tropical rainforest and the derived savannah.

Experimental birds and their management

The experimental birds comprised of the exotic Giriraja (Gr) male and females developed in India, Improved Nigerian Indigenous (Alpha) male and females and the exotic White Leghorn (WL) females reared at the Poultry Breeding Unit of the Federal University of Agriculture, Abeokuta, Nigeria. The breeding cocks and hens were housed separately in two-tier battery cages. The birds were individually wing.-tagged along sire and dam lines for identification purposes. The birds were fed *ad libitum* on compounded diet supplying 16% crude protein, 10.9KJ/g metabolizable energy, 3.2% calcium and 0.45% (available) phosphorus. The chickens were also provided with water *ad libitum*.

The description of the experimenter birds is as shown below:

Giriraja - 100% hybrid dual- purpose exotic chicken from India

Alpha (α) breed - chicken containing 37.5% local and 62.5% exotic genes

White Leghorn - 100% hybrid layers (egg)

Mating pattern

Semen was collected from each sire by the massage technique as described by [6] and subsequently, each dam was artificially inseminated. The mating pattern adopted is as shown below

Giriraja (Gr) male x Giriraja (Gr) female --- pure breed crossing

Giriraja (Gr) male x ALPHA female ----- straight crossing

ALPHA male x Giriraja (Gr) female ------- reciprocal crossing

ALPHA male x White Leghorn (WL) female -------straight crossing

Egg collection, incubation and management of the chicks

Eggs were collected twice from the inseminated females and pedigreed along sire and dam lines. The eggs were allowed to accumulate for five days in a cool room having 50% relative humidity. Afterwards, all accumulated were taken to the hatchery for incubation. Proper cleaning, disinfection and fumigation of the incubator were done before setting of eggs along the genotype lines. The eggs were subsequently turned automatically through 90^0 in the incubator with adequate temperature. All chicks that resulted from each mating were properly identified, wing tagged and vaccinated against Marek's disease before been transferred to previously disinfected pen in the brooding unit. The chicks were fed *ad libitum* on commercially prepared broiler starter that supplied 23% crude protein for a period of four weeks and finisher diet containing 20% crude protein for the remaining eight weeks. Clean water was supplied *ad libitum* throughout the experimental period.

Data collection

The wing tagged chicks were weighed with an electronic kitchen scale (model EK5350) having maximum calibration of 5kg/11lb. Growth traits and feed intake of each bird were obtained on the first week and subsequently at four weeks interval till 12 weeks (i.e. day old, 4, 8, 12). The growth traits measured were the body weight, breast girth, keel length and body length. The feed intake was measured by the subtraction of feed left unconsumed from feed initially supplied (gram) and this was later used to calculate the feed conversion efficiency for each genotype. Feed conversion efficiency was calculated for each week thus:

Rate of gain/feed intake. The growth traits under study were measured thus;

Body weight (BW):- This was measured with the use of an electronic kitchen scale with maximum with maximum capacity of 5kg/11lb.

Breast girth (BG):- This was taken as the circumference of the breast around the deepest region of the breast. A tape rule calibrated in centimeters was used to take the measurement (cm)

Keel length (KL):- This was taken as the length of the sternum. A tape rule was used to take the measurement (cm)

Body length (BDL):- It was measured as the distance between the base of the neck and the cloaca. A tape rule was used to take the measurement (cm).

Data analysis

The preliminary analyses revealed that sex of the progenies had significant effects ($P < 0.05$) on all the growth traits, feed intake and feed efficiency; therefore, the raw data was subsequently adjusted for sex effect. This was done by adding the mean differences between male and female chicken in each of the growth traits under consideration to the means obtained for female birds. The data were reanalyzed for sex effect and when no significant differences were recorded, subsequently, the adjusted data were then analysed using a one-way analysis of variance for the fixed effect of genotype using the procedure of [7]. The model is as shown below:

$Y_{ij} = U + G_i + e_{ij}$

where:

Y_{ij} = parameters interest

U = overall mean when equal sub-class frequencies exist

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

e_{ij} = random residual error normally distributed with zero mean and variance, δe^2

III. Results and Discussion

The least square means of body weight and linear body measurements as affected by chicken genotype at different weeks are presented in Table 1. Chicken genotype significantly affected ($P < 0.05$) bodyweight, body length, breast girth and keel length at day old, 4 weeks, 8 weeks and 12 weeks. At day-old, Gr x Gr crosses had the highest bodyweight (51gm) and breast girth (7.76cm) while Gr x ALPHA crossbreds were the best in body length (5.89cm) and keel length (3.68cm). Similarly, bodyweight and breast girth at 4 weeks old were highest in the resulting Gr x Gr purebreds, however, WL x ALPHA and ALPHA X Gr crossbreds had more of body length and keel length. The values obtained for body length, breast girth and keel length in the crosses involving Gr x Gr and Gr x ALPHA at 8 weeks were not significantly different ($P > 0.05$) except bodyweight which was significantly higher in the Gr x Gr purebreds. However, the ranking changed at 12 weeks, purebreds recorded significant highest values of bodyweight (1273gm) and breast girth (21.62cm) while ALPHA x Gr crossbreds had the highest body length (29.87cm) and keel length (2.90cm). Consistently, values of bodyweight and other body parameters increased with the age of the birds in all the genotypes.

Components of growth, such as bodyweight and morphometric measurements, are important factors to both poultry breeders and meat processors [8]). Morphometric traits are the quantitative analyses of the structure, shape and size of an organism. The results of the present study revealed increased body weight and other linear body measurements of birds as age advanced. This is expected because age is a major determinant of growth and physiological development and this is consistent with the reports of [9] and [10].

The significant genotype differences in body weight among the chickens showed that this trait is highly influenced by genetic factors and this agrees with the reports of [11], [12], [13] and [10]. The variation in the values of linear body measurement (keel length, breast girth and body length) in all the crosses can also be attributed to different genetic background [14].

The superiority in body weight and breast girth exhibited by Gr x Gr purebreds exotic birds over their crossbred counterpart suggests that they have a better growth potential than the others. This result contrasted the findings of [15], [16], [17] and [10]. In Egypt, [18] found that crossbreds obtained from crossing between local breeds (Silver Montazah and Dandarawi) had positive and high magnitude of heterosis for body weight at different ages. [17] found that crossbreds obtained from crossing between Sinai (S) and White Leghorn had positive and high heterotic percentage at all ages, except at 2 and 3 months of age [15] reported that strain cross pullets were lighter than purebreds at 20 weeks of age while [16] reported that crossbreds were superior than purebreds in body weight at 20 and 40 weeks of age. [10] concluded in their research involving Nigerian local chicken and White Leghorn that crossbred of Naked neck x White Leghorn performed better than their purebreds counterpart in terms of bodyweight and other body measurements. The performance of Gr x Gr purebreds as witnessed in this study may be due to the fact that this breed (Giriraja) had undergone series of improvement and selection for higher body weight and growth rate. The fact that the performances of the crosses that involved the improved indigenous breed with the Giriraja were lower than that of the pure exotic breed (Giriraja) was expected [19]. The explained that the Nigerian indigenous chickens have gone through more of natural selection for survival in tropical climate rather than artificial selection for productivity.

The superiority exhibited by ALPHA X GR in body length and keel length over the other genotypes showed that the improved indigenous breed has a good combining effect with the Giriraja (exotic) when used as a male line rather than a female line. The result of this investigation is expected since the male line here is an improved indigenous cross which has 50% indigenous blood. The results also indicated that the improved indigenous breed of chicken combined significantly well with the exotic strain to achieve an improved body parameters as the paternal line rather than maternal line. Also, it further proves that Giriraja exotic strain is able to transmit the gene for faster growth into its progenies ([20], [21]).

The lower values of body parameters recorded by the crosses of ALPHA X WL could be attributed to the fact that two breed have been classified as light breeds.

Table 1: Least square means of bodyweight and linear body measurements as affected by chicken genotype at different weeks

		WEEKS			
GENOTYPE	**OBS**	**Day-old**	**4 weeks**	**8 weeks**	**12 weeks**
			BODYWEIGHT (gm)		
GR(M) X GR(F)	32	51.00±2.64^{a}	245±17.39^{a}	784±31.31^{a}	1273±51.50^{a}
GR(M) X ALPHA(F)	13	51.00±3.55^{a}	62±11.86^{b}	617±11.15^{b}	1008±32.60^{b}
ALPHA(M) X GR(F)	10	45.00±1.99^{b}	256±26.87^{a}	609±44.62^{b}	1017±40.87^{b}
ALPHA(M) X WL(F)	101	45.00± 0.71^{b}	206±7.74^{ab}	555±15.14^{b}	956±19.80^{c}
			BODYLENGHT (cm)		
GR(M) X GR(F)	32	5.05±0.22^{b}	11.39±0.47^{b}	19.48±0.37^{a}	25.87±0.65^{b}
GR(M) X ALPHA(F)	13	5.89±0.16^{a}	11.00±0.26^{c}	17.54±0.35^{b}	23.69±0.28^{c}
ALPHA(M) X GR(F)	10	3.06±0.35^{c}	11.78±0.46^{b}	19.40±0.83^{a}	29.87±0.64^{a}
ALPHA(M) X WL(F)	101	5.64±0.11^{ab}	12.08±0.20^{a}	18.06±0.26^{ab}	23.60±0.30^{c}
			BREAST GIRTH (cm)		
Gr (M) X Gr (F)	32	7.76±0.16^{a}	9.91±0.23^{a}	16.17±0.37^{ab}	22.72±0.78^{a}
Gr (M) X ALPHA (F)	13	7.05±0.24^{b}	9.62±0.23^{ab}	17.15±0.41^{a}	21.62±0.33^{b}
ALPHA (M) X Gr (F)	10	6.17±0.17^{c}	9.49±0.44^{b}	14.65±0.54^{c}	21.50±0.76^{b}
ALPHA(M) X WL (F)	101	6.87±0.07^{b}	9.88±0.13^{a}	14.88±0.23^{c}	19.47±0.29^{b}
			KEEL LENGHT (cm)		
Gr (M) X Gr (F)	32	3.13±0.18^{b}	6.59±0.21^{c}	13.44±0.54^{ab}	19.18±0.89^{b}
Gr (M) X ALPHA (F)	13	3.68±0.15^{a}	7.70±0.36^{ab}	14.77±0.26^{a}	21.62±0.41^{a}
ALPHA (M) X Gr (F)	10	3.10±0.24^{b}	8.01±0.63^{a}	13.80±0.66^{a}	21.90±0.71^{a}
ALPHA(M) X WL(F)	101	2.27±0.10^{c}	6.83±0.15^{bc}	12.13±0.23^{b}	16.87±0.35^{c}

$^{a, b, c}$ means occupying same row having different superscripts are significantly different ($P < 0.05$

Table 2 revealed the least square means of feed intake and feed conversion efficiency as affected by chicken genotype at different weeks. Significant differences ($P < 0.05$) obtained showed that ALPHA x Gr crossbreds consumed more feed consistently from 4 weeks (0.50gm) to 12 week (0.61gm). However, ALPHA x WL crossbreds had the lowest feed intake throughout the duration of the study. Consistently, Gr x Gr purebreds had the highest

feed conversion efficiency which was significantly different ($P < 0.05$) from other genotypes from day old to 12 weeks. The lowest efficiency was obtained in the ALPHA x GR crossbreds generally in all the weeks. However, crosses of Gr x ALPHA were the second most efficient birds at 12 weeks (96).

The quantity of feed in grams eaten by different strains differed between strains [22] and it showed that feed intake by the birds in this study is genetically influenced. The highest feed intake observed in ALPHA X Gr crossbreds could be attributed to their active physical activity, which might have required additional feed consumption to meet the maintenance requirement as reported by [23]. The values of feed intake reported for local Kei, Kei x Fayoumi and Kei x RIR chickens form day old to 8 weeks of age by [24] in watershed areas of Ethiopia were comparable with the findings in the current study and at similar age.

The better efficiency in feed utilization (higher FER) of Gr-crosses might be due to their improved body weight gain performance along with low feed intake. [25] reported better efficiency in feed utilization of RIR breeds as compared with Lyallpu Silver Black and Fayoumi breeds. The present results also agreed with observations of [26] that genotype significantly affected feed efficiency and feed conversion ratio.

Table 2: Least square means of feed intake and feed conversion efficiency as affected by chicken genotype at different weeks

Genotype	obs	Day old	4 weeks	8 weeks	12 weeks
			Feed intake (gm)		
Gr (M) X Gr (F)	32	0.32 ± 0.04^{c}	0.45 ± 0.06^{b}	0.50 ± 0.04^{b}	0.55 ± -0.06^{c}
Gr (M) X ALPHA (F)	13	0.35 ± 0.02^{a}	0.49 ± 0.03^{a}	0.54 ± 0.01^{a}	0.57 ± 0.03^{b}
ALPHA (M) X Gr (F)	10	0.34 ± 0.01^{b}	0.50 ± 0.02^{a}	0.55 ± 0.09^{a}	0.61 ± 0.06^{a}
APLHA(M) X WL (F)	101	0.30 ± 0.01^{c}	0.38 ± 0.07^{c}	0.45 ± 0.02^{c}	0.50 ± 0.01^{d}
			Feed conversion efficiency		
Gr (M) X Gr (F)	32	40 ± 0.01^{a}	58 ± 0.01^{a}	83±0.02a	99 ± 0.02^{a}
Gr (M) X ALPHA (F)	13	35 ± 0.02^{b}	38 ± 0.01^{b}	60 ± 0.01^{bc}	96 ± 0.00^{b}
ALPHA (M) X Gr (F)	10	30 ± 0.01^{c}	35 ± 0.01^{c}	59 ± 0.01^{c}	90 ± 0.00^{d}
ALPHA(M) X WL(F)	101	30 ± 0.01^{c}	39 ± 0.01^{b}	68 ± 0.01^{b}	93 ± 0.00^{c}

[a, b, c] means occupying same row having different superscripts are significantly different ($P < 0.05$)

IV. Conclusion

The greater effect of chicken genotype on body weight and linear body measurements coupled with better performances from the progenies involving Giriraja crosses, Nigeria local chicken though unimproved can still be exploited for greater genetic improvement. Therefore, introduction of exotic strains (Giriraja) into our indigenous chicken population will bring a rapid and desirable improvement of our indigenous species.

References

[1] RIMs, Nigerian Livestock Resources Vol. II National Synthesis and Resource Inventory Management Limited, 1992, Pp. 472.

[2] G.G. Trait, 'Problems facing the Poultry Industry in Nigeria'. Proc. 1st continuing Education Seminar for veterinary officers, Ibadan, Nigeria, 1980, 285pp.

[3] S.N. Ibe, 'Incorporating adaptability genes in poultry breeding Program in Nigeria'. Proc. XIX World's congress on genetic applied to livestock Production. Edinburgh, Scotland, 1990

[4] O. Akinokun, 'An evaluation of exotic and indigenous chicken as Genetic Materials for development of rural poultry in Africa'. In: Proceedings of An International Workshop on Poultry Development In Africa held at the. Obafemi Awolowo University, Ile-ife, Nigeria, 1990, 13-16 Nov. 1989 pp 36-61.

[5] F.O. Ajayi, 'Nigerian indigenous chicken: A valuable genetic resource for meat and egg production', 2010, *Asian Journal of Poultry Science, 4: 164-172*.

[6] P.E. Lake, 'Artificial insemination in poultry'. In: Malie, J.P. (eds). The Semen of animals and A..l. Commonwealth Agric. Burean, Bucks, England, 1962, Pp 331-335.

[7] Statistical Analysis System. SAS stat.Version 9. SAS Institute Inc. Gary NC 27513, U.S.A, 2003

[8] F.O. Adeniyi, F.O. and K.L. Ayorinde, 'Prediction of body weight of broilers at different ages from some linear body measurements', 1990, *Nig .J. Anim. Prod.*, 17:42-47.

[9] H. Pingel, K.H. Schneider, and M. Birla, Factors affecting meat quality in broilers', 1990, *Anim Breed. Abst.* 59 (1). 1991.

[10] T.A. Adedeji, O.A. Adebambo, S.O. Peter, L.O. Ojedapo and A.O. Ige, 'Growth performance of crossbred and purebred resulting from different sire strain in humid tropical environment', 2006, *Journal of Animal and Veterinary Advances*, 5(8): 674-678.

[11] C.O.N. Ikeobi and S.O. Peters, 'Strain differences in the genetic parameter estimates for growth trait in meat type chicken', 1996, *Nigerian. Journal Animal Prod. 23:103 – 106.*

[12] S.N. Ibe, and U.F. Nwosu, 'Influence of naked neck and frizzle genes on early growth of chickens. Book of Proceedings. 26th Annual NSAP Conference 21 – 25 March, Ilorin Nigeria, 1999, Pg 292-295.

[13] S.O. Peters, 'Genetic variation in the reproductive performance of Indigenous chicken and the growth rates of its pure and half-bred progeny'. M.Agric. Thesis. Dept. of Animal Breeding and Genetics. Federal University of Agriculture Abeokuta, Nigeria, 2000, Pp 120.

[14] B.S. Malik, S. Didar and R.P. Singh, 'Evaluation of production performance of two strains of White Leghorn and their crosses'. Proceedings of IPSACON, 2005.

[15] N. Singh, and R.P. Singh, 'Heritability estimates of performance traits in purebred and crossbred egg type chicken', 2005, *Indian Journal of Poultry Science, 40: 52-55.*

[16] S.M. Saadey, A. Galal, H.I. Zaky and A. Zein El-Dein, 'Diallel crossing analysis for body weights and egg production traits of two native Egyptian and two exotic chicken breeds', 2008, *International Journal of Poultry Science, 7: 64–71.*

[17] S.N. Ibe, 'Improving productive adaptability of the Nigeria Local Chicken'. In: Proceedings of the silver Anniversary conference of the Nigerian Society for the Animal Production held at Gateway. Hotel, Abeokuta, Nigeria 21-26 March, 1998. 46-465.

[18] S.N. Ibe, 'Growth Performance of normal, frizzle and naked Chicken in a tropical Environment', 1993, *Nig. J. Anim. Prod.* 20:25-31.

[19] A.C. Ebangi, and S.N. Ibe, 'Heritability and genetic correlations between some growth traits in. Nigerian local chicken', 1994, *Nig. J. Anim. Prod.* 21: 19-24.

[20] A. Melesse, 'Physiology of Animal Adaptations in Stressful Environments'. Teaching Book, Hawassa University, Hawassa, Ethiopia, 2008, 391 pp.

[21] A. Misba and M. Aberra 'Evaluating the growth performance of local kei chickens and their f-crosses with Rhode Island red and fayoumi breeds in watershed areas of Guraghe administrative zone, Southern Ethiopia', 2013 *Tropical and Subtropical Agroecosystems, 16 (2013): 39 – 50*

[22] N. Akhtar, S. Mahmood, M. Hassan, F. Yasmeen, 'Comparative study of production potential and egg characteristics of Lyallpur Silver Black, Fayoumi and Rhode Island Red breeds of poultry',2007, *Pakistan Veterinary Journal. 27(4): 184-188.*

[23] B.O. Agaviezor, 'Genetic evaluation of laying performance of pure exotic and indigenous crossbred pullets'. M. Agric. Dissertation. Dept. of Animal Breeding and Genetics. Federal University of Agriculture, Abeokuta, Nigeria, 2005, Pp 76.