Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 9 ~ Issue 6 (2022) pp: 01-05
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Growth and Laying Performance of Improved Nigerian Indigenous Chickens in South-East Nigeria

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ABSTRACT
This research was carried out to assess the growth and laying performance of improved Nigerian indigenous chickens in South-South Nigeria using Shika Brown, Funnab Alpha and the Nigerian local chicken. The traits monitored were the body weight, egg weight, shell thickness, Haugh unit, egg shape index, body length, shank length and breast girth. Multiple linear regression analysis was carried out to determine the predictability of the dependent variable on the predictors. The results revealed that Shika Brown had consistent significant higher mean values (P<0.05) of body weight. Mean value of (33.0)g was recorded for Funnab Alpha ecotype at day old, (25.09)g was recorded Local chicken while Shika Brown had the mean value of 29.49g. In week 12 of the study, non-significant (P>0.05) mean difference was observed in the body length of the Funnab Alpha chicken and the Shika Brown chicken. Similarly, Funnab Alpha had highest significant (P<0.05) mean values (21.03cm) of breast girth parameter across the weeks of study. Consistent increase in the egg size of the Shika Brown ecotype was observed which was significantly higher (P<0.05) than the values obtained for the Funnab Alpha and the Local chicken ecotype respectively except in week 14 where non-significant (P>0.05) mean value was observed between the Shika Brown and the Funnab Alpha. Non significant (P>0.05) mean difference was observed in the mean shell thickness of the Funnab Alpha and the Local chicken ecotype. In weeks 4 and 8, Funnab Alpha had highest mean value which was significantly different (P<0.05). In weeks 8, 10 and 14, Funnab Alpha ecotype had highest mean values (P<0.05), while local ecotype had highest means of Haugh unit (P<0.05) only in week 4. Result obtained in the three ecotypes was highly significant (P<0.01) with high coefficient of determination for Funnab Alpha (0.918± 202.2248) and the Shika Brown (0.880± 187.7151), and a lower coefficient for the local chicken (0.357±637.4092). The results of this study are useful information needed to assess the genetic gain made so far with the improvement programme of the Nigerian native chicken.
Keywords: *Shika Brown, Funnab Alpha, Local chicken, Ecotype performance, Egg quality, Regression.*

***R**eceived 28 May, 2022; **R**evised 05 June, 2022; **A**ccepted 07 June, 2022 © The author(s) 2022.*
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I. INTRODUCTION

The need for protein consumption by man cannot be over stressed. This necessitates the need for continuous research on the chicken ecotype's performance. Chickens serve as affordable sources of meat and egg on account of their feed efficiency, short life cycle, fast growth rate, and quick return on investment (Oluyemi and Roberts, 2007). Poultry production has its own peculiarities that make them special to the national food security (Daikwo *et al.,* 2011). The changes in demand for consumption of higher-value and quality foods such as meat, eggs, and milk have led to large increase in the total demand for animal products in many developing countries (Okoro *et al.,* 2017). The traditional sub-sector of poultry production consists of local or native chickens which have not been classified into breeds, although there are many ecotypes (Daikwo *et al.,* 2011). These chickens contribute substantially to the annual egg and meat production (up to 90%) for family consumption and for sale (Fayeye *et al.,* 2005). The dominant chicken production system is an extensive /traditional type of production using a majority of local chicken ecotypes, managed mainly on scavenging, with seasonal supplementation of home grown grains and household leftovers (Moges *et al.,* 2010). The role of the native chicken could be seen in terms of its contribution to the income and protein consumption of the rural dwellers where native chicken are predominantly reared (Sonaiya, 2007). Consumers preference for indigenous chicken meat is attributed to the characteristics leanness, flavour and presumed organic product (King'ori *et al.,*

2010). Farmers prefer adapted productive chickens for economic empowerment of the women, for value addition, improved nutrition and health (Adebambo, 2015). Growth rate is an important tool in assessing the growth performance and potential productivity of the animal livestock. Growth increases with age in laying birds with consistency in egg weight (Ojedapo *et al.,* 2008). Body weight at the onset of egg production is a major factor influencing hen productivity (Perez-Bonilla *et al.,* 2012). Selection of chickens for body size and egg production has led to the production of large-sized eggs with desirable egg shell characteristics (Shafey, 2002). Egg weight is the most important egg quality trait in both table and hatching eggs as the nutrient content of eggs and weight of day old chicks depend on it (Khan *et al.,* 2004). Hence the aim of this study was to determine the performance of three chicken ecotypes in Nigeria namely the Funnab Alpha chickens, the Shika Brown and the local chickens and to establish the predictability of the dependent variables on the predictors.

II. MATERIALS AND METHODS

A total of two hundred and seventy birds were used for this experiment which consisted of three different ecotypes namely: the Funnab Alpha, the Shika Brown and the Local chickens. Funnab Alpha and Shika Brown are genetically improved Nigeria indigenous chickens. The birds were procured at day old, brooded and reared into laying. Each of the ecotypes was replicated into three compartments which comprised of ninety birds per ecotype. The experiment was conducted between (May 2016 and March 2017) at the FUTO Teaching and Research Farms, Owerri, Imo State Nigeria. The general chicken handling and management were carried out according to Oluyemi and Roberts (2007). Feed and water were provided *ad libitum* from chick stage to layer stage throughout the experiment. The birds were raised on a deep litter and fed commercially mixed diets. The nutrient composition is as reported by Okafor *et al.* (2019).

All the parameters measured including the Body weight, Body length, Shank length and Breast girth, Wing length, Breast length and width were taken from day old and stopped at 20th week of age in order to avoid variations in the body weight as a result of egg production. Egg size, Egg shape index, Shell thickness, Haugh unit and Age at first egg were taken during the egg production. Digital scale was used in weighing the eggs and the birds respectively. Measuring tape was used in taken the measurements of the body length, shank length, breast girth, wing length, breast girth and width. Micrometer screw guage was used in reading the thickness of the shell.

Egg shape index was taken as: $\frac{\text{Maximum egg width}}{\text{Maximum egg length}}$

While the Haugh Unit (Hu): 100 log $\left[H - \sqrt{\frac{G(30w^{0.37-100} + 1.9}{100}}\right]$

Age at first egg (AFE) was taken as the age of the first egg drop.

Statistical Analysis

The experimental design was Completely Randomized, while the Genotype was the only factor of interest. Data were subjected to One Way Analysis of Variance using the General Linear Model Procedure (GLM) of SAS, 2004. Mean separation for significant effects were done using Duncan's New Multiple Range Test (Duncan, 1955), while Correlation was done using the Pearson's Moment Correlation (SAS, 2004). Regression equations were determined for each ecotype and Coefficients of determination (R^2) were used to compare the accuracy of prediction.

III. RESULTS AND DISCUSSION

The effect of ecotype on the body weight parameter showed consistently significant higher mean values (*P<0.05*) in the Funaab Alpha chickens than in the Shika Brown and Local chickens respectively from day old (week 0) to the 20th week of age (Table 1). The Shika Brown also had consistent significant higher mean values (*P<0.05*) of body weight parameter than the local Chicken across the weeks of study. The Local chicken showed the least mean values of body weight throughout the experiment. Mean value of (33.0)g was recorded for Funnab Alpha ecotype at day old, (25.09)g was recorded Local chicken while Shika Brown had the mean value of 29.49g. On the 4th week of age, mean values of 331.56g, 139.95g and 210.49g were recorded for the Funnab Alpha, Shika Brown and Local chicken respectively. On 8th week, Funnab Alpha had high mean values of 864.33g more than the other two ecotypes. Mean values of 1163.83g, 1640.80g and 1981.57g were recorded for the Funnab Alpha ecotype on weeks 12, 16 and 20 respectively. Local chicken had mean values of 823.90g, 990.10g and 1281.0g for weeks 12, 16 and 20 respectively, while Shika Brown had the mean values of 929.27g, 1208.0g and 1540.97g for weeeks 12, 16 and 20 respectively. Coefficient of variation values of 0.7017, 1.256

and 0.7294 were calculated for the Funnab Alpha ecotype chicken, the local ecotype chicken and the Shika Brown ecotype chicken respectively.

The same trend was simultaneously observed in the body length and in the shank length measurements, where the Funnab Alpha chicken showed highest significant (*P<0.05*) values than the Shika Brown and the Local chicken from week 0 to week 20. The Shika Brown in turn had higher significant (*P<0.05*) values than the Local chicken which had the least values across the table (Table 2). In week 12 of the study, non-significant (*P>0.05*) mean difference was observed in the body length of the Funnab Alpha chicken and the Shika Brown chicken. Total mean values of 20.38cm, 17.75cm and 19.43cm were observed in the body length measurement for the Funnab Alpha, Local ecotype and Shika Brown chickens respectively, while coefficients of variation of 0.3522, 0.3682 and 0.3695 were also calculated for the Funnab Alpha, the local ecotypes and the Shika Brown ecotypes respectively. In the shank length measurement, total mean values of 8.92cm, 7.35cm and 8.07cm were recorded for the Funnab Alpha, Local ecotype and Shika Brown chickens in that order, with coefficients of variation of 0.4317, 0.5506 and 0.5295 respectively. Similarly, Funnab Alpha had highest significant (*P<0.05*) mean values (21.03cm) of breast girth parameter across the weeks of study. This followed by the Shika Brown ecotype which had higher (*P<0.05*) means values (19.43cm) than the Local chicken ecotype with the least values of breast girth measurement (17.35cm). Coefficients of variation were found to be 0.3735, 0.6807 and 0.3754 for the Funnab Alpha, Local chicken and the Shika Brown ecotypes respectively.

Table 1: Growth performance of improved Nigerian indigenous chickens in South-South Nigeria

		Age (Weeks)								
Parameters	**Ecotype**	**0**	**4**	**8**	**12**	**16**	**20**	**Mean**	**SEM**	**CV**
Bodyweight (g)	Funnab	33.00^{a}	331.56^{a}	864.33^{a}	1163.83^{a}	1640.80^{a}	1981.57^{a}	1002.49^{a}	28.03	0.7017
	Alpha	25.09^{c}	139.95^{c}	515.60^{c}	823.90^{c}	990.10^{c}	1281.00^{c}	629.27^{c}	31.49	1.256
	Local Chicken	29.49^{b}	210.49^{b}	518.17^{b}	929.27^{b}	1208.00^{b}	1540.97^{b}	739.25^{b}	21.48	0.7294
	Shika Brown									
Body Length(cm)	Funnab	6.19^{a}	14.83^{a}	20.22^{a}	24.65^{a}	27.25^{a}	29.13^{a}	20.38^{a}	0.29	0.3522
	Alpha	5.55^{c}	10.77^{c}	18.03^{c}	22.25^{b}	24.45^{c}	25.43^{c}	17.75^{c}	0.26	0.3682
	Local Chicken	6.10^{b}	13.30^{b}	19.25^{b}	24.83^{a}	26.05^{b}	27.02^{b}	19.43^{b}	0.29	0.3695
	Shika Brown									
Shank Length(cm)	Funnab	2.63^{a}	5.41^{a}	8.03^{a}	11.37^{a}	12.77^{a}	13.33^{a}	8.92^{a}	0.15	0.4317
	Alpha	2.39^{c}	4.83^{c}	6.92^{c}	8.35^{c}	10.68^{c}	10.93^{c}	7.35^{c}	0.16	0.5506
	Local Chicken	2.46^{b}	5.23^{b}	7.15^{b}	9.44^{b}	11.98^{b}	12.20^{b}	8.07^{b}	0.17	0.5295
	Shika Brown									
Breast Girth(cm)	Funnab	6.22^{a}	14.57^{a}	21.85^{a}	24.93^{a}	28.27^{a}	30.33^{a}	21.03^{a}	0.31	0.3735
	Alpha	5.48^{c}	8.33^{c}	17.03^{c}	21.18^{c}	24.08^{c}	27.97^{c}	17.35^{c}	0.47	0.6807
	Local Chicken	6.08^{b}	12.73^{b}	19.07^{b}	26.13^{b}	26.13^{b}	28.85^{b}	19.43^{b}	0.29	0.2754
	Shika Brown									

Mean values within columns with the same superscript are significantly different (P< 0.05)

Consistent increase in the egg size of the Shika Brown ecotype was observed which was significantly higher (*P<0.05*) than the values obtained for the Funnab Alpha and the Local chicken ecotype respectively (Table 2) except in week 14 where non-significant (*P>0.05*) mean value was observed between the Shika Brown and the Funnab Alpha. Shika Brown had mean egg weights of 44.8g, 44.6g, 47.8g, 48.2g, 51.2g, 51.80g and 43.50g in the 14th weeks of egg collection (weeks 2, 4, 6, 8, 10,12 and 14), with a total mean egg weight of 47.4g. On the other hand, Local chicken had mean egg weights of 26.4g, 29.8g, 36.6g, 36g, 39.2g, 39.2g and 39.4g, with a total mean of 35.23g. Funnab Alpha had mean values of 41g, 39g, 37.4g, 41.8g, 45.8g, 45.2g and 44.2g, with a total mean egg weight of 42.06g across the table. Coefficients of variation for the egg weight were found to be 0.073, 0.16 and 0.12 for the Shika Brown, Local chicken and Funnab Alpha chicken respectively. Non significant (*P>0.05*) mean difference was observed in the mean shell thickness of the Funnab Alpha and the Local chicken ecotype. In weeks 4 and 8, Funnab Alpha had highest mean value which was significantly different (*P<0.05*). Local chicken ecotype only recorded highest (P<0.05) mean value only in week 14, while Shika Brown had highest (*P<0.05*) mean values of shell thickness in weeks 6, 10 and 12. In week 2, non-significant (*P>0.05*) mean difference was observed between the Funnab Alpha and the Shika Brown. 0.15, 0.14 and 0.15 were the coefficients of variation for the Funnab Alpha, the Local chicken and the Shika Brown ecotypes respectively. Shell thickness determines the strength of the egg shell which minimizes breakage and cracking during handling and transportation and also preserves the embryo until hatching.

Local chicken ecotype had highest mean value of the Haugh unit which was not significantly different (*P>0.05*) from the mean Haugh unit of the Funnab Alpha. Shika Brown had the least mean values of the Haugh unit which was significantly different (*P<0.05*) from the mean values of the other two ecotypes. In weeks 8, 10 and 14, Funnab Alpha ecotype had highest mean values (*P<0.05*), while local ecotype had highest means of Haugh unit (*P<0.05*) only in week 4. Shika Brown ecotype recorded highest mean values in weeks 2, 6, and 12 which differs from the mean values of the other two ecotypes (P<0.05). Coefficients of variation of 0.19, 0.14 and 0.18 were recorded for the Funnab Alpha, the Local chicken and the Shika Brown in that order. Haugh unit was found to be highest in small, medium and large eggs in that order and this confirmed the reports of Shi *et al*. (2009). Significant highest (*P<0.05*) mean values was obtained in the egg shape index between the Funnab Alpha and the other two ecotypes, while non-significant difference (*P>0.05*) was obtained between the mean values of the Local ecotype chickens and the Shika Brown. Funnab Alpha had highest mean values of shape index at weeks 2, 6, 10 and 14, which was significantly different *(P<0.05*) from the mean values obtained in the other two ecotype. At week 4, non significant (*P>0.05*) mean value was found in the Funnab Alpha and the Shika Brown. Local Chicken had highest significant (*P<0.05*) mean value only in week 12, while Shika Brown had highest significant mean value (*P<0.05*) only in week 8. 0.00042, 0.00065 and 0.00038 were found to be the values of coefficient of variation for the Funnab Alpha, Local chicken and the Shika Brown chickens respectively.

Table 2:Laying performance of improved Nigerian indigenous chickens in South-South Nigeria

		Age (Weeks)									
Parameters	**Ecotype**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**Mean**	**SEM**	**CV**
Egg size (g)	Funnab Alpha	41.00^{b}	39.00^{b}	37.40^{b}	41.80^{b}	45.80^{b}	45.20^{b}	44.20^{a}	42.06^{b}	0.60	0.12
	Local	26.40^{c}	29.80^{c}	36.60^{c}	36.00^{c}	39.20^{c}	39.20^{c}	39.40^{c}	35.23^{c}	0.67	0.16
	Chicken	44.80^{a}	44.60^{a}	47.80^{a}	48.20^{a}	51.20^{a}	51.80^{a}	43.50^{a}	47.4^{a}	0.41	0.073
	Shika Brown										
Shell thickness (mm)	Funnab Alpha	0.41^{a}	0.44^{a}	0.36^{b}	0.39^{a}	0.35^{b}	0.31^{c}	0.29^{b}	0.36^{b}	0.01	0.15
	Local	0.34^{b}	0.38^{b}	0.38^{b}	0.35^{c}	0.34^{c}	0.37^{b}	0.39^{a}	0.36^{b}	0.01	0.14
	Chicken	0.41^{a}	0.38^{b}	0.40^{a}	0.36^{b}	0.36^{a}	0.39^{a}	0.27^{b}	0.37^{a}	0.01	0.15
	Shika Brown										
Haugh Unit (%)	Funnab Alpha	56.02^{b}	58.25^{b}	50.40^{c}	67.85^{a}	67.77^{a}	60.78^{c}	64.37^{a}	60.78^{a}	1.34	0.19
	Local	53.79^{c}	59.76^{a}	59.60^{b}	62.31^{b}	65.41^{b}	63.82^{b}	62.10^{c}	60.97^{a}	1.00	0.14
	Chicken	56.69^{a}	56.55^{c}	61.42^{a}	59.09^{c}	56.33^{c}	64.16^{a}	64.49^{a}	59.82^{b}	1.26	0.18
	Shika Brown										
Shape Index	Funnab Alpha	79.01^{a}	77.24^{a}	78.79^{a}	75.43^{b}	77.48^{a}	74.34^{b}	78.35^{a}	77.24^{a}	0.00	0.00042
	Local	76.97^{b}	72.90^{b}	76.91^{b}	73.55^{c}	74.62^{b}	75.66^{a}	67.26^{c}	73.98^{b}	0.01	0.00065
	Chicken	71.71^{c}	77.10^{a}	75.78^{c}	76.72^{a}	74.43^{c}	73.15^{c}	70.36^{b}	74.18^{b}	0.00	0.00038
	Shika Brown										

Mean values within columns with the same superscript are significantly different (P< 0.05)

Table 3 shows the Multiple Linear Regression of the Body weight (dependent variables) on Linear morphometry (predictors) in the three chicken ecotypes. Multiple linear regression analysis of the body weight (dependent variable) on linear morphometry in the three chicken ecotypes was highly significant (*P<0.01*) with high coefficients of determination for Funnab Alpha (0.918± 202.2248) and the ShikaBrown (0.880± 187.7151), and a low coefficient of determination for the Local ecotype (0.357±637.4092).

The regression model accounted for 92% of the total variability in Funnab Alpha, 88% in ShikaBrown and 36% in the Local chicken respectively. The multiple correlation indicated that the three chicken ecotypes vary together about 96% of the time in Funnab Alpha, 94% in Shika Brown and 60% in local Chicken.

Table 3: Multiple Linear Regression of the Body weight (dependent variables) on Linear morphometry (predictors) in the three chicken ecotypes (Regression coefficient ± SEM).

Predictors	**Funnab Alpha**	**Shika Brown**	**Local chicken**
Constant	–583.048± 32.658	–590.204± 25.059	–589.829± 97.298
Body length	–13.532± 5.286	–11.128± 5.200	46.822± 22.352
Shank length	186.750±10.483	17.469±3.005	7.462±9.505
Thigh length	–21.294± 10.859	27.841±7.901	43.133±32.457
Wing length	–49.259± 6.686	13.756±5.619	24.658±23.137
Breast length	22.163± 4.790	–1.576± 5.521	–31.263± 24.191
Breast girth	28.864±3.636	41.996±3.890	0.073±2.711
Breast width	17.891±4.578	5.300± 1.580	1.016±3.735
R^2	0.918±202.2248	0.880± 187.7151	0.357 ± 637.4092

R	0.958 ± 202.2248	0.938 ± 187.7151	0.597 ± 637.4092

*** Highly significant difference (P<0.01)*

Funnab Alpha = - 583.048 – 13.532BL + 186.750SL – 21.294TL – 49.259WL + 22.163BRL + 28.864BRG + 17.891 + 0.918 BRW (SEM ± 202.2248)**

ShikaBrown = –590.204 – 11.128BL + 17.469SL + 27.841TL + 13.756 WL – 1.576 BRL + 41.996BRG + 5.300 BRW (SEM ± 187.7151)**

Local Chicken: –589.829 + 46.822 BL + 7.462SL + 43.133 TL + 24.658 WL – 31.263BRL + 0.073BRG + 1.016 BRW (SEM ± 637.4092)**

IV. CONCLUSION

This study showed significant heterosis or genetic gains in both growth and laying performance of the Nigerian local chicken as significant ($p<0.05$) differences were observed. In conclusion, the result obtained in this study showed the productivity of the two improved Nigerian indigenous breeds as well as the local ecotype in South-South Nigeria. The results of this study are useful information needed to assess the genetic gain made so far with the improvement programme of the Nigerian native chicken.

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