COMPARATIVE STUDY OF THE GROWTH PERFORMANCE AND FEED UTILIZATION PARAMETERS OF LOCAL AND EXOTIC CHICKS IN AN INTENSIVE REARING SYSTEM

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ABSTRACT

A comparative study of local and exotic chicks' growth performance and feed utilization under an intensive rearing system was undertaken. A total of 32 chicks comprising 16 birds each of local and exotic breeds were studied. All birds were raised from day-old to eight weeks of age under identical housing, feeding, and management procedures during which growth and feed utilization parameters were measured. At the end of the study, the exotic breed had a significantly higher (p<0.05) mean weight than the local breed (Exotic 241.60 ± 51.33, Local 36.14 ± 9.08). Local breed had a significantly lower (p<0.05) mean feed intake (FI) (Local 168.65 ± 29.94, Exotic 665.00 ± 112.82) over the same period. The mean feed efficiency ratio (FER) of the exotic breed was significantly higher (p<0.05) than that of the local breed (Exotic 0.38 ± 0.05, local 0.20 ± 0.03). Furthermore, there was a significant difference (p<0.05) in the mean specific growth rate (SGR) and the mean feed conversion ratio (FCR) of the two breeds when compared weekly, the feed conversion ratio (FCR) of the exotic breed was significantly lower (p<0.05) than that of the local breed throughout the experimental period. In conclusion, the exotic chickens had better growth rates than local chickens, as observed in their linear body measurements. The local chickens consume less feed when compared to exotic counterparts reared under the same conditions despite a significant improvement in the growth and feed utilization of local chickens.

Keywords: Local chicken, Exotic chicken, Growth parameters, Feed utilization, Feed efficiency ratio, Feed conversion ratio

INTRODUCTION

Local chickens, also known as native chickens, scavenging chickens, indigenous chickens, or village chickens (Padhi, 2016), are chicken breeds that have been domesticated and evolved within specific regions due to factors such as genetic drift, mutation, and adaptation. They are pools of heterogeneous chickens that differ in adult body size, weight, and plumage (Sola-Ojo *et al*., 2013).

In Nigeria, livestock production including chicken rearing is a good source of protein, industrial raw materials, employment, and income (Higenyi *et al*., 2014; Tasie *et al*., 2020). Chicken rearing thrives in every part of the world including Nigeria and outnumbers all forms of livestock production (Rischkowsky and Pilling, 2007; Govoni *et al*., 2021). Recent reports by Unaeze and Akinola (2016) and Gonzalez Ariza *et al.* (2021) indicated that the total chicken population in Nigeria was 150 and 120 million respectively of which 60 and 80% were local chicken respectively. This showed a decline in the population of local chicken which generally was attributed to their poor meat and egg output has necessitated the importation and rearing of exotic breeds for food security (Guèye, 2000; Wong *et al.,* 2017).

Indigenous chickens are self-reliant and hardy which makes them capable of withstanding the locally harsh climatic conditions, minimal managerial care, and inadequate nutrition (Apuno *et al.,* 2011; Padhi, 2016; Bekele *et al*., 2021). They are reared on the free-range system and feed largely on weeds, insects, and waste foods; these have reduced their productivity (Alders *et al*., 2001).

The egg and meat productivity of Nigerian local chickens is poor (Orajaka, 2005) when compared to exotic chickens, they are very well adapted to their environment (Alders *et al*., 2001), and resistant to diseases and the climatic conditions in their immediate environment unlike their exotic counterparts (Laenoi *et al*., 2015; Manyelo *et al*., 2020). So, exotic chickens possess no clear-cut superiority in the combination of productivity, adaptability, and resistance to local diseases which are desirable to earn maximum profit in poultry farming. Attempts to improve local chickens as a source of meat and eggs by the Nigerian government have not yielded the desired result because research has been focused mostly on genetic improvement without adequate consideration of the nutritional and managerial improvements of local chicken (NAERLS, 2000; Adedeji *et al*., 2006).

Generally, chicken performance is affected by exogenous and endogenous intrinsic factors (Ogbu *et al,* 2015). The exogenous factors include ambient temperature, nutrition (including FI (FI)), parasites and disease, light, and relative humidity, while the endogenous factors include, the physiology and the genetic makeup of fowls (Miles *et al*., 2004; Ferket and Gernat, 2006; Ilori *et al*., 2010; Ogbu, 2010; Piyaratne *et al.,* 2012; Sola-Ojo *et al.,* 2013; Flanders and Gillespie, 2016). Since local chickens are promising source of protein, employment, and poverty reduction but do not perform well under scavenging conditions, this study investigated the real meat production potential of pure breed of local chicken found in Nsukka, Enugu State, Nigeria, and exotic chicken if reared in an intensive system of farming; since very little in terms of nutritional improvement and managerial care has been done to improve the productivity of local chicken while maintaining their good qualities like hardiness and hatchability values.

MATERIALS AND METHODS

Site of Experiment: The experiment was carried out at the Animal Breeding Unit of the Department of Zoology and Environmental Biology, University of Nigeria, Nsukka. Nsukka located in the Enugu State of Nigeria is situated at a longitude of 7°12.5'E and latitude of 6°45°N, with a semi-humid equatorial tropical climate generally known for its well-defined rainy season (April – October) and dry season (November - March). It has a temperature range of 27.7°C in August to 32.7°C January (Momoh *et al*., 2010).

Experimental Design: The experiment was carried out in a completely randomized design (CRD) of two treatments, replicated four times, with each replicate having four birds. Sixteen chickens of each exotic and local breed purchased from farmers in Nsukka and Heritage Veterinary Clinic, Nsukka respectively were used. The chickens were kept in a pen partitioned into two main different cages, each cage for the different breeds. The floor of the pens was covered with sawdust to absorb moisture. The poultry house was properly sanitized. All medication and vaccination schedules such as Newcastle Disease (Lasota) and Gomborro Vaccine were strictly adhered to, and good hygienic condition was maintained throughout the feeding trial. Other management practices carried out include; daily washing of drinkers, administration of antihelmintics, and weekly packing of litter. The chickens were fed with commercially prepared feed (Top feed) throughout the experiment and water *ab libitum*. The rations were fed in the following order; 0 – 4 weeks, chick starter mash (22.50 crude protein, 3110 Kcal/kg metabolizable energy) and 4 – 8 weeks chick finisher mash (18.50 crude protein, 3250 Kcal/kg metabolizable energy).

The chicks were brooded on a deep litter using 200W electric bulbs for four weeks. This was done to provide light and heat during this period. The birds were transferred to the rearing house on deep litter in the 5th week. During this period adequate and strict sanitation was observed. The first method of application of feed was by ground floor to allow maximum feeding. In this method, a measured quantity of feed was introduced using a cardboard paper spread on the litter floor. After three days, small aluminium feeders and conical drinkers were used. The quantity of feed given to the birds each time was measured and then the quantity left over at the end of each week was also measured, to enable weekly feed consumption determination.

Data Collection: Body weight (BW) data were collected on day one by weighing each of the chicks and thereafter, BWs were taken per replicate of birds weekly for the duration of the experiment, and mean BW was calculated. FI and feed efficiency ratio (FER) were also determined weekly. The mean FI (MFI) per bird, per week was determined using this formula: Mean FI (g) = total amount of feed served/week – total amount left over/week ÷ total number of birds housed/week. The weight gain (WG), and the specific growth rate (SGR) were calculated as follows: WG (g) = $W_2 – W_1/T_2 - T_1$, where W_1 = initial weight (g), W_2 = final weight (g), $T_2 - T_1$ = time interval (days). SGR (g/s) = $InW_2 – InW_1/T_2 - T_1$, where InW_1 = Natural logarithm of initial weight, InW_2 = Natural logarithm of final weight, and $T_2 - T_1$ = time interval (days). Furthermore, mean FER and feed conversion ratio (FCR) were calculated using Uzodigwe (2012).

Linear Body Measurement

Body length (cm): This was obtained by using a measuring tailors' tape in centimetres as the length of the body from the comb to the base of the tail.

Shank length (cm): This was determined by measuring the distance in centimetres from the hock joint to the tarsometatarsus digits using a measuring tailors' tape.

Thigh length (cm): This was determined by measuring the distance in centimetres between the hock and Pelin joints using a measuring tailors' tape.

Breast length (cm): This was obtained by measuring the largest breast expansion just below the wattle in centimetres using a measuring tailors' tape.

Wing length (cm): This was done by measuring the length of the wing from the scapula joints to the last digit of the wing in centimetres using a measuring tailors' tape.

Statistical Analysis: The data were analysed using SPSS version 20.0. One-way ANOVA and Student T-test were used to compare the mean growth parameters of exotic and local chickens. Results were expressed as mean ± standard deviation (SD). The level of significance was set at $p<0.05$.

RESULTS AND DISCUSSION

The result of the weekly distribution of growth parameters and linear body measurement of local and exotic fowls are shown in Tables 1 and 2 respectively. When compared weekly, the weight, WG, FI, SGR, and FER of the exotic fowl were significantly higher ($p<0.05$) than the local breed, but the local fowl had a significantly higher ($p<0.05$) FCR than the exotic fowl (Table 1). However, comparing the overall mean of the growth parameters shows that the exotic fowl had significantly higher ($p<0.05$) weight, WG, FI, and FER than that of the local breed but there was no significant difference ($p<0.05$) in the overall mean of the SGR and FCR. Also, the linear body measurement revealed that for all the measured parameters (body length, shank length, thigh length, breast length, and wing length), the exotic fowl had significantly higher ($p<0.05$) values than the local fowl (Table 2).

Table 1: Weekly distribution of the growth parameters of local and exotic chickens

Duration	Weight		Weight gain (%)		FI	
	LC	EC	LC	EC	LC	EC
Week 1	31.76 ± 2.39^{a}	107.32 ± 1.30^{a*}	419.00 ± 204.00^{a}	6646.00 ± 203.00^{a*}	55.89 ± 0.61^{a}	157.55 ± 2.02^{a*}
Week 2	44.48 ± 4.27^{b}	202.52 ± 13.73^{b*}	1270.00 ± 606.00^{a}	9520.00 ± 1503.00^{a*}	69.62 ± 5.78^{b}	337.27 ± 12.81^{b*}
Week 3	68.94 ± 0.23^{c}	426.93 ± 2.00^{c*}	2447.00 ± 471.00^{b}	22441.00 ± 1572.00^{b*}	154.26 ± 5.58^{d}	439.29 ± 11.70^{c*}
Week 4	99.84 ± 8.63^{d}	733.75 ± 22.98^{d*}	3089.00 ± 906.00^{b}	30708.00 ± 2534.00^{bc*}	134.11 ± 6.23^{c}	745.74 ± 33.85^{d*}
Week 5	155.94 ± 4.86^{e}	1088.75 ± 121.98^{e*}	5610.00 ± 377.00^{d}	35500.00 ± 9899.00^{c*}	151.27 ± 2.44^{d}	720.32 ± 2.03^{d*}
Week 6	186.91 ± 1.72^{f}	1408.48 ± 25.51^{f*}	3097.00 ± 314.00^{b}	30800.00 ± 8202.00^{bc*}	250.29 ± 13.44^{e}	967.07 ± 4.75^{e*}
Week 7	271.88 ± 4.42^{g}	1868.13 ± 7.95^{g*}	8493.00 ± 614.00^{e}	47438.00 ± 3624.00^{d*}	265.51 ± 5.34^{f}	943.00 ± 38.78^{e*}
Week 8	316.70 ± 6.99^{h}	1970.00 ± 42.43^{h*}	4482.00 ± 257.00^{c}	10225.00 ± 3500.00^{a*}	268.27 ± 1.44^{f}	1009.78 ± 18.99^{f*}
Overall mean	147.06 ± 105.68	973.89 ± 256.49*	36.14 ± 25.69	241.60 ± 145.19*	168.65 ± 84.68	665.00 ± 319.11*
Duration	**SGR (%)**		**FCR**		**FER (%)**	
	LC	**EC**	**LC**	**EC**	**LC**	**EC**
Week 1	2.00 ± 0.90^{a}	13.80 ± 0.43^{f*}	15.08 ± 7.20^{b*}	2.37 ± 0.04^{a}	8.00 ± 4.00^{a}	42.00 ± 1.00^{cd*}
Week 2	4.79 ± 2.45^{b}	9.06 ± 1.14^{d*}	6.22 ± 2.81^{a*}	3.60 ± 0.70^{a}	18.00 ± 8.00^{bc}	28.00 ± 3.00^{b*}
Week 3	6.29 ± 1.43^{b}	10.67 ± 1.04^{e*}	6.40 ± 1.00^{a*}	1.96 ± 0.19^{a}	16.00 ± 2.00^{abc}	51.00 ± 5.00^{d*}
Week 4	5.26 ± 1.33^{b}	7.73 ± 0.51^{d*}	4.57 ± 1.54^{a*}	2.43 ± 0.09^{a}	23.00 ± 8.00^{c}	41.00 ± 2.00^{cd*}
Week 5	6.40 ± 0.78^{b}	5.60 ± 1.16^{c}	2.70 ± 0.22^{a}	2.11 ± 0.58^{a}	37.00 ± 4.00^{d}	49.00 ± 14.00^{d*}
Week 6	2.57 ± 0.35^{a}	3.57 ± 1.15^{b}	8.10 ± 0.39^{a*}	3.26 ± 0.88^{a}	12.00 ± 1.00^{ab}	32.00 ± 9.00^{bc*}
Week 7	5.35 ± 0.36^{b*}	4.19 ± 0.39^{bc}	3.14 ± 0.28^{a*}	2.00 ± 0.23^{a}	32.00 ± 3.00^{d}	52.00 ± 3.00^{d*}
Week 8	2.18 ± 0.08^{a*}	0.76 ± 0.25^{a}	6.00 ± 0.38^{a}	10.46 ± 3.39^{b*}	17.00 ± 1.00^{bc*}	10.00 ± 3.00^{a}
Overall mean	4.36 ± 1.83	6.92 ± 4.23*	6.53 ± 3.89*	3.52 ± 2.87	0.20 ± 0.10	0.38 ± 0.14

*LC: Local Chicken; EC: Exotic chicken; FCR: Feed Conversion Ratio; FER: Feed Efficiency Ratio; SGR: Specific Growth Rate; $^{a-h}$ Mean values with different letter superscripts in the same column are statistically significantly different ($p<0.05$); *value on the same row for each parameter with regards to the breeds with an asterisk are significantly different ($p<0.05$) using t-test pairwise comparison. All values are expressed as mean ± deviation (SD)*

Table 2: Weekly distribution of the linear body measurements of local and exotic chickens

Duration	Shank length (cm)		Thigh length (cm)		Breast length (cm)	
	LC	EC	LC	EC	LC	EC
Week 1	1.85 ± 0.19^{a}	2.51 ± 0.04^{a*}	5.20 ± 0.23^{a}	6.93 ± 0.06^{a*}	6.66 ± 0.31^{a}	8.33 ± 0.26^{a*}
Week 2	2.01 ± 0.01^{b}	2.99 ± 0.35^{a*}	6.47 ± 0.14^{b}	9.61 ± 0.80^{b*}	7.09 ± 0.09^{a}	11.93 ± 1.12^{b*}
Week 3	2.91 ± 0.02^{c}	4.34 ± 0.75^{b*}	8.14 ± 0.21^{c}	9.61 ± 0.37^{b*}	10.19 ± 0.18^{b}	14.11 ± 0.33^{c*}
Week 4	2.79 ± 0.00^{c}	4.84 ± 0.31^{b*}	10.59 ± 1.05^{d}	18.79 ± 0.06^{c*}	11.05 ± 0.72^{b}	13.61 ± 2.28^{c*}
Week 5	3.74 ± 0.01^{d}	5.71 ± 0.17^{c*}	13.20 ± 0.90^{e}	22.83 ± 1.12^{d*}	14.71 ± 1.05^{c}	21.16 ± 0.30^{d*}
Week 6	4.26 ± 0.06^{e}	6.37 ± 0.03^{d*}	18.32 ± 0.16^{f}	26.38 ± 0.02^{e*}	17.57 ± 1.97^{d}	26.76 ± 0.35^{e*}
Week 7	4.52 ± 0.14^{f}	7.33 ± 0.11^{e*}	25.25 ± 0.39^{g}	30.59 ± 0.25^{f*}	22.48 ± 1.97^{e}	31.27 ± 0.18^{f*}
Week 8	5.23 ± 0.07^{g}	8.32 ± 0.07^{f*}	31.39 ± 1.39^{h}	38.92 ± 0.28^{g*}	25.19 ± 0.3^{gf}	39.04 ± 0.42^{g*}
Duration	**Body length (cm)**		**Wing length (cm)**			
	LC	EC	LC	EC		
Week 1	7.84 ± 0.05^{a}	17.19 ± 0.34^{a*}	5.95 ± 0.19^{a}	13.91 ± 0.32^{c*}		
Week 2	15.68 ± 0.17^{b}	24.12 ± 0.02^{b*}	7.33 ± 0.06^{b}	10.52 ± 0.15^{a*}		
Week 3	18.17 ± 0.33^{c}	29.63 ± 0.62^{c*}	9.16 ± 0.13^{c}	12.83 ± 0.03^{b*}		
Week 4	19.52 ± 0.49^{d}	32.39 ± 0.72^{d*}	10.88 ± 0.34^{d}	16.61 ± 0.81^{d*}		
Week 5	25.68 ± 0.07^{e}	42.75 ± 0.21^{e*}	12.21 ± 0.04^{e}	19.88 ± 0.89^{e*}		
Week 6	34.12 ± 0.75^{f}	52.75 ± 1.06^{f*}	13.69 ± 0.61^{f}	26.08 ± 0.30^{f*}		
Week 7	43.84 ± 0.54^{g}	60.96 ± 0.62^{g*}	17.53 ± 0.61^{g}	31.95 ± 0.25^{g*}		
Week 8	55.53 ± 0.64^{h}	74.24 ± 0.35^{h*}	20.18 ± 0.52^{h}	35.23 ± 0.04^{h*}		

*LC: Local fowl; EC: Exotic Fowl; Mean values with numerals as superscripts in the same row are statistically significant (P<0.05); $^{a-h}$ Mean values with different letter superscripts in the same column are statistically significantly different (p<0.05); *value on the same row for each parameter with regards to the breeds with an asterisk are significantly different (p<0.05) using t-test pairwise comparison. All values are expressed as mean ± deviation (SD)*

Growth parameters are essential in assessing the performance of livestock. Chickens are reared mainly for meat, egg, and feather production (Govoni *et al.*, 2021). In this study, the performance of exotic and local chickens in terms of growth rate largely depended on the combination of the genetic makeup and the nutritional factors. The local and exotic chickens had an increased growth rate during the early stages of their life (from week one to week five) which gradually decreased with age. This is in line with the established growth pattern of animals (Govoni *et al.*, 2021). Also, the linear body measurements of exotic chickens were significantly higher (p<0.05) than the local chickens. Hence as chickens grow, they increase in size (hypertrophy) and cell number (hyperplasia) (Jo *et al.*, 2009).

Furthermore, there was a significant difference (p<0.05) in the BW of the local and exotic breeds from a day old to week eight. The BW of the exotic breed was three times higher than that of the local breed in week one and more than four times higher than that of the local breed as the age increased. The weight of the day-old local chicken (27.58 ± 344 g) was similar to that of Momoh *et al.* (2010) who obtained 28.6 ± 0.07 g for the weight of reciprocal cross-breed local chicken at day old. However, the value 40.88 ± 0.73 g was obtained for the exotic counterpart and was similar to the weight (43.30 ± 1.49 g) obtained by Uzodigwe (2012). Also, the values (1150 ± 3.91 g) and (248 ± 2.54 g) obtained for exotic and local breeds at eight weeks by Uzodigwe (2012) are different from the values (1970 ± 42.43) and (316.70 ± 6.99) obtained in this study respectively.

The overall mean FI of exotic chicken was significantly different (p<0.05) from that of local chicken. At week four, the exotic chicken consumed more than five times (745.74 ± 33.85 g) the feed consumed by local chicken (134.11 ± 6.23 g) and gained weight of 307.08 ± 25.34 g and 30.89 ± 9.06 g respectively. This implies that the feed utilization rates were about 40% and 23% for exotic and local breeds respectively but at week eight, feed utilization rates for exotic and local breeds were 16.17 and 10.16% respectively. This means that as the chickens' age increases the rate of FI increases while the feed utilization rate decreases. The higher BW of exotic chickens than local chickens, subjected to similar management conditions, confirmed the effects of genetic traits between breeds on growth (Bedru, 2021). A high WG was recorded at weeks five and seven for both breeds with week seven recording the highest. The week seven WG was preceded by a sharp decrease in the WG at week six. In animal growth and developmental period, the synthesis of growth material such as proteins needed for structural development, which will also lead to in the weight of the animal, usually slows down the immediate growth rate, because the focus is shifted from just cell division to structural development (Miettinen *et al.*, 2019; Huțu *et al.*, 2020).

The SGR is the rate of increase of biomass of a cell population per unit of biomass concentration (Bhatia, 2015; Crane *et al.*, 2020). It measures the rate of growth of a particular organ in the body. The weekly SGR of exotic chicken was significantly higher (p<0.05) than that of local chicken throughout the experimental period. A similar result was also obtained by Uzodigwe (2012) and Bedru (2021). However, the SGR decreases in exotic chickens as the chicken's age increases unlike in the local chickens as the highest SGR occurred in weeks three and five and the lowest at weeks one, six, and eight.

Also, from the result obtained the overall mean FER of both breeds was significantly different (p>0.05). This implies that the ratio of WG to feed consumed in both breeds was significantly different (p>0.05) when considered as a whole. Furthermore, the weekly FCR of local chicken was significantly higher (p<0.05) than that of exotic chicken signifying a low meat output (Bai *et al.*, 2022). A similar result was obtained by Bedru (2021) in his study on the performance of Ethiopian local chicken and exotic counterparts.

Conclusion: In conclusion, the result of this study showed that the exotic breed of *Gallus domesticus* had better FI, linear body measurements, BW, body WG, SGR, and FER when compared with their local counterpart. Hence, the high performance of exotic chickens is not only attributed to the managerial care given to them in the intensive rearing system but also, it is largely influenced by their genetic makeup. Even though there is improved performance of local chickens when reared under an intensive system, the local breed's high mean FCR is an indication that local chickens utilize less feed for productivity and, therefore, might not be profitable to be reared under a fully intensive system of raising birds because of the high cost of rearing that without correspondent yield. Considering the difference in the performance of local and exotic chickens reared under the same conditions, this study recommends that systematic efforts should be made towards improving the growth status of local chickens by embarking on a planned cross-breeding and selection program with the proper nutrition-matched stipulated to ensure maximum output of such developed local chickens.

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