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Effect of Genotype and Sex on Growth Performance of Improved Nigerian Indigenous and Three Exotic Chickens

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Abstract

This study was conducted to evaluate the effects of genotype and sex on the growth performance of an improved Nigerian Indigenous Chicken (FUNAAB Alpha) and three exotic chicken genotypes. A total number of 480 birds were used for the trial. The four chicken genotypes were FUNAAB Alpha, ISA Brown, Nera Black and Amberlink White. Each genotype contained 60 males and 60 females, replicated 3 times. Data collected were subjected to a two-way analysis of variance (ANOVA) in a 4 × 2 factorial arrangement. Results showed that the growth performance across genotypes and sexes was significant (P<0.05). The initial weight was significantly (P<0.05) higher (35.09g) in Isa Brown and lower (27.28g) in FUNAAB Alpha. However, the final weight, weight gain and total feed intake were highest (2130.17g, 2102.89g and 9473.66g) in FUNAAB Alpha and lowest (1648.17g, 1616.23g and 8496.91g) in Amberlink White. The final weight, weight gain and total feed intake per bird were higher in male than female. The final weight was highest (2463.33g) in males of FUNAAB Alpha and lowest (1533.00g) in females of Amberlink White. The feed conversion ratio was best in FUNAAB Alpha (4.61), likewise in male (4.78) than the female (5.44) across chicken genotypes. The highest (P<0.05) mortality was recorded in FUNAAB Alpha (2.50%), while there was no mortality in Amberlink White. In conclusion, both sexes of FUNAAB Alpha, being a dual-purpose strain, performed better in most of the growth traits than other genotypes.

Introduction

The most widely consumed poultry species worldwide is chicken (Dessie *et al*., 2011). In Africa and Asia, native chicken makes up roughly 80% of the national flocks (Gwaza *et al*., 2016). Reports on native ecotype chicken in the tropics revealed that, when managed by small farmers, their potential for egg production and growth are low. However, the level of outputs dramatically rose with better housing, health care, and feeding circumstances (Dessie *et al*., 2011). In addition, native chickens are generally more disease-resistant and could sustain a greater level of performance under poor nutrition and high environmental temperatures compared to commercial strains under village systems, despite their low growth rate and egg production (Karima and Fathy, 2005; Gwaza *et al*., 2016). Compared to their exotic counterparts, native chicken produces fewer eggs and less meat. As a result, commercial strains are replacing the native chickens in many developing nations. According to Abdelqader *et al*. (2007), the method to boost productivity in village systems failed to produce long-lasting improvements in several nations. Given the better management system alone, however, there was a noticeable improvement in the performance of local poultry (Gwaza *et al*., 2016). The performance indicators considered for improvement were hatchability, survivability, flock size, number of clutches, egg weight, and egg mass (Abdelqader *et al*., 2007). According to Magothe (2012), crossbreeding with synthetic breeds, including the Black Australorp,

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White Leghorns, Light Sussex, and Rhode Island Red, improved performance significantly. According to Sola-Ojo and Ayorinde (2011), a crossbred of an exotic egg-type chicken and the Fulani ecotype of Nigeria performed better than the original Fulani ecotype. The growth performance of crossbred chicken developed from Nigerian native chicken and exotic broiler breeders outperformed the pure native chicken (Adeleke *et al*., 2011). However, most research focused more on exotic breeds than the improved indigenous chicken, which substantially supplies the protein needs of the rural populace, especially in Nigeria. Therefore, this study aimed to validate the potential of newly developed improved Nigerian Indigenous chicken to the existing commercial stocks

Materials and Methods

The study was carried out at the Teaching and Research Farm, College of Agricultural Sciences, Olabisi Onabanjo University, Ayetoro Campus, Ogun State, Nigeria. The campus is located in a deciduous/ derived savannah zone of Nigeria at latitude 7^0 15´ N and Longitude 3^0 3´ E. The climate is sub-humid tropical with an annual rainfall of 1,909.3mm. The rainy season is between early April and late October. The rainfall pattern is bimodal, with peaks in June and September. The maximum temperature varies between 29^0C during the peak of the wet season and 34^0C at the onset of the dry season, and the mean annual relative humidity is 81.0% (Onakomaiya *et al*., 1992).

Management of birds and experimental design

A total number of 480 day-old chicks were used for the experiments, which lasted fifteen months (July 2019 - October 2020). They comprised 120 birds each from four (4) genetic groups, namely improved Nigerian indigenous chicken, FUNAAB Alpha (FA), Isa Brown (IB), Nera Black (NB) and Amberlink White (AW). The four (4) genetic groups represented Treatments 1, 2, 3 and 4. Each genetic group was replicated three (3) times with 40 birds in each treatment, consisting of 20 males and 20 females per replicate. Data collected were subjected to analysis of variance (ANOVA) in a completely randomized block design experiment using a 4 x 2 factorial arrangement.

The chicks were brooded on a replicate basis. The birds were housed in battery cage cells measuring 2 x 2m. Feed and water were provided in feeders and drinking troughs, respectively. The housing is an open-sided, well-ventilated pen with natural lighting and without thermal insulation or cooling systems. The pullets were later transferred to battery cage at 14 weeks for laying. There were four (4) birds in a cell, measuring 51 x 36.5 x 16cm. Chicks, pullets and cockerels were fed commercial chicks, growers and layers' mash (Table 1) at different stages. The birds were fed *ad libitum* and had unrestricted access to water supply. The daily left-over feed was accumulated and weighed every week. The weight gain was determined by weighing birds in each replicate at the beginning of the experiment and subsequently every week. The weight of the birds was obtained using a 20 kg capacity weighing scale. Daily mortality (%), cumulative mortality (%), and feed conversion ratio (FCR) were computed every week. The calculated analysis of proprietary feed used during the experiment is presented in Table 1.

Table 1: Calculated analysis of experimental diets

Nutrient composition (%)	Chicks Mash	Growers Mash	Layers Mash
Crude protein	19.00	16.00	16.50
Crude fibre	5.00	6.00	6.00
Ether extract	2.50	3.00	6.00
Calcium	1.00	1.00	3.60
Phosphorus	0.45	0.45	0.45
Metabolisable energy (Kcal/kg)	2800.00	2600.00	2650.00

Source: Animal Care Feed®

The performance characteristics of the birds were determined as follows:

$$\text{Daily feed intake per bird} = \frac{\text{Daily feed served(g)} - \text{leftover feed (g)}}{\text{No of birds}}$$

$$\text{Cumulative feed intake per bird} = \frac{\text{Total feed served in (g)} - \text{left over feed (g)}}{\text{No of birds present on that day}}$$

$$\text{Daily mortality (\%)} = \frac{\text{Number of dead birds}}{\text{No of chicks present}} \times \frac{100}{1}$$

$$\text{Cumulative mortality (\%)} = \frac{\text{Total number of dead birds}}{\text{Total number of chicks received}} \times \frac{100}{1}$$

$$\text{Feed conversion ratio } \frac{\text{Total feed consumed (g)}}{\text{Feed weight gain in birds (g)}}$$

Results

Genotype and sex effects on growth traits of improved Nigerian indigenous and three exotic chickens

Table 2 shows the growth traits of improved Nigerian indigenous and three exotic chickens. Genotypes and sex had significant (P<0.05) effects on initial body weight, final weight, weight gain and total feed intake. The initial weight was highest (35.09g) in Isa Brown (IB) and lowest (27.28g) in FUNAAB Alpha (FA). Initial weights per bird were 32.82g and 30.96g for males and females, respectively. The values of final weight (g), weight gain (g) and total feed intake (g) per bird were highest (2130.17, 2102.89 and 9473.66) in FUNAAB Alpha and lowest (1648.17, 1616.23 and 8496.91) in Amberlink White. The final weight, weight gain and total feed intake per bird were higher in males than the females. FUNAAB Alpha exhibited a better feed conversion ratio (4.61) than the exotic chickens, while the FCR was significantly better (P<0.05) in males (4.78) than in females (5.44). The highest mortality was observed in FUNAAB Alpha (2.50%), while no mortality was recorded in Amberlink White.

Interactive effects of genotype and sex on growth traits of improved Nigerian indigenous and three exotic chickens

The interactive effect of genotype and sex on growth traits of improved Nigerian indigenous chicken is presented in Table 3. Performance characteristics (initial weight, final weight, weight gain, feed intake, FCR and mortality) across genotypes and sexes were significantly (P<0.05) different. The initial weight varied from 27.20g in FUNAAB Alpha males to 37.25g in Isa Brown males. The final weight (g) and weight gain (g) were highest in males of FUNAAB Alpha (2463.33 and 2436.13) and lowest in females of Amberlink White (1533.00 and 1503.41). The feed intake ranged from 8501.29g in Amberlink White females to 9767.89g in FUNAAB Alpha males. The values of FCR obtained in males of FUNAAB Alpha were lower (4.01) and higher (5.66) in females of Amberlink White. There was higher mortality (3.33%) in females of FUNAAB Alpha, while no mortality was recorded in both sexes of Amberlink White.

Discussion

In this study, the significant differences observed in initial body weight and the superior mean values recorded for Isa Brown indicated that the post-hatch weight of chicks depends on the size of the eggs that hatched the chicks. This result agreed with Bamidele *et al.* (2020), who observed differences in initial weight among various improved tropically adapted chicken breeds. Benyi *et al.* (2015) affirmed that the significant effects of genotype on initial body weight could mean that genetic variations exist between the genotypes in these traits. The superior initial weight recorded for the male compared with the female agrees with several authors (Olawumi and Fagbuaro, 2011; Thutwa *et al.*, 2012; Benyi *et al.*., 2015) who reported that male chicks had higher initial weight than the females. Zerehdaran *et al.* (2004) opined that the significant differences between males and females in a trait cannot be due to a single factor. Other factors, such as greater competition for feed, aggression in males, social dominance, and variations in nutritional requirements, play important roles. The significant differences in genotype and sex interactive effects on initial body weight and the superior mean values obtained in Isa Brown males at the beginning of this experiment suggest that these traits are controlled simultaneously by genotype and sex

Table 2: Effects of genotype and sex on growth traits of improved Nigerian indigenous chicken and three exotic chickens

Parameters (g/bird)	Genotype						Sex			
	FA	IB	NB	AW	SEM (±)	P-value	Male	Female	SEM (±)	P-value
Initial weight	27.28^{c}	35.09^{a}	33.26^{b}	31.94^{b}	0.49	0.003	32.82^{a}	30.96^{b}	0.34	0.002
Final weight	2130.17^{a}	1792.00^{b}	1818.33^{b}	1648.17^{c}	22.25	0.000	2048.33^{a}	1646.00^{b}	15.73	0.000
Weight gain	2102.89^{a}	1756.91^{b}	1785.08^{b}	1616.23^{c}	22.22	0.000	2015.52^{a}	1615.04^{b}	15.71	0.000
Total feed intake	9473.66^{a}	8953.14^{c}	9162.22^{b}	8946.91^{c}	50.04	0.000	9511.69^{a}	8756.27^{b}	35.38	0.000
FCR	4.61^{c}	5.12^{b}	5.17^{b}	5.55^{c}	0.07	0.000	4.78^{b}	5.44^{a}	0.05	0.000
Mortality (%)	2.50^{a}	0.83^{b}	2.00^{a}	0.00^{c}	0.30	0.000	1.00^{b}	1.67^{a}	0.21	0.041

^{abc} = means on the same row with different superscripts are significantly different ($p<0.05$)

FA= FUNAAB Alpha, IB= Isa Brown, NB= Nera Black, AW= Amberlink White, SEM= Standard Error of Mean; FCR= Feed Conversion Ratio

Table 3: Interactive effect of genotype and sex on growth traits of improved Nigerian indigenous chicken with three exotic chickens

	Genotype (Male)				Genotype (Female)					
Parameters (g/bird)	FA	IB	NB	AW	FA	IB	NB	AW	SEM (±)	P-value
Initial weight	27.20^{d}	37.25^{a}	32.53^{b}	34.28^{b}	27.35^{d}	32.93^{b}	33.98^{b}	29.59^{c}	0.69	0.003
Final weight	2463.33^{a}	1963.33^{b}	2003.33^{b}	1763.33^{c}	1797.00^{c}	1620.67^{de}	1633.33^{d}	1533.00^{e}	31.47	0.017
Weight gain)	2436.13^{a}	1926.08^{b}	1970.80^{b}	1729.05^{c}	1769.65^{c}	1587.73^{d}	1599.35^{d}	1503.41^{d}	31.43	0.018
Feed intake)	9767.89^{a}	9371.74^{bc}	9514.61^{b}	9392.53^{bc}	9179.43^{c}	8534.54^{e}	8809.83^{d}	8501.29^{e}	70.77	0.033
FCR	4.01^{d}	4.86^{c}	4.83^{c}	5.43^{ab}	5.20^{b}	5.38^{ab}	5.51^{ab}	5.66^{a}	0.10	0.008
Mortality (%)	1.67^{bc}	0.33^{d}	2.00^{ab}	0.00^{d}	3.33^{a}	1.33^{bcd}	2.00^{ab}	0.00^{d}	0.43	0.011

^{abcd} = means on the same row with different superscripts are significantly different ($p<0.05$)

FA= FUNAAB Alpha, IB= Isa Brown, NB= Nera Black, AW= Amberlink White, SEM= Standard Error of Mean, FCR= Feed conversion ratio

The highest mean values of final body weight and weight gain obtained in FUNAAB Alpha male may be attributed to the amount of feed consumed. This aligned with the findings of Karima and Fathy (2005) and Musa *et al.* (2006), who reported significant breed effects in body weight among various indigenous and exotic chicken breeds, respectively. Also, the higher average performance of male chickens compared to their female counterparts agrees with Musa *et al.* (2006), who recorded higher live weight in male chickens than in females. This notable difference may be attributed to sexual dimorphism, which is initiated by the rapid growth and muscle-building activity of male hormones (Adebambo *et al.*, 2010). This finding is also in agreement with Adeleke (2005), Fayeye *et al.* (2006), Adedeji *et al.* (2008), Ilori *et al.* (2010) and Ilori *et al.* (2017), who posited that sexual dimorphism favored males of all genotypes to body weight and conformational traits.

The effects of genotype and sex on FCR showed that FUNAAB Alpha male had the lowest FCR, hence, the birds in this treatment group were the fastest growing and the most efficient in converting feed to live body weight. The superior performance exhibited by FUNAAB Alpha males in terms of FCR is not unconnected to increased secretion of enzymes such as amylase, trypsin, chymotrypsin and lipase (Wang *et al.*, 2016), which aided better feed conversion of the birds.

Although Amberlink White female birds had the poorest FCR, it is worthy of note that both sexes of this genotype had no mortality throughout this study. As expected, heavy breeds relative to light breeds are more susceptible to higher mortality rates due to heat stress. Also, a high incidence of mortality has been reported to be connected to weakened immunity due to an elevation in temperature-induced stress and the inability of animals to efficiently regulate their internal body temperature (Mashaly *et al.*, 2004; Mumma *et al.*, 2006; Perreira *et al.*, 2010). The higher rate of mortality in female birds compared to the males in this study suggests that mortality may be sex dependent. This could be traceable to the ability of male birds to withstand rigor and stress more than the females (Olawumi and Dudusola, 2010).

The significant genotype/sex interactive effects on initial body weight, final weight, body weight gain, feed intake, feed conversion ratio, and mortality rate during the entire experimental period could be an indication that these traits are controlled by genotypic effect and influenced by sex.

Conclusion

Genotype and sex significantly affected the growth performance of the chickens while FUNAAB Alpha had the overall best growth performance except for initial weight and percentage mortality, being as a dual-purpose strain compared to the other chicken genotypes, which are essentially layer-type. Therefore, FUNAAB Alpha of both sexes is suitable for meat production because of its higher meat yield and meat/bone ratio.

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