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Genetic Variability in Growth Performance of Three Meat-type Chickens (Abor Acre, Ross 308 and FUNAAB Alpha Broiler Line) based on different Flock Compositions

Sanda, A. J.*[1], Sanda, M. O.[3], Iyanda, A. I.[2], Oluwadare, O. P.[1], Adebayo A, A.[1], Simeon, T. D.[1] and Dada, B. D.[1]

[1]*Department of Animal Breeding and Genetics, Federal University of Agriculture, P. M. B. 2240, Abeokuta, Nigeria*
[2]*Department of Animal Production and Health, Federal University of Agriculture, P. M. B. 2240, Abeokuta, Nigeria*
[3]*Department of Microbiology and Biotechnology, Abiola Ajimobi Technical University, P. M. B. 5015, GPO, Dugbe Ibadan, Oyo State, Nigeria*

Corresponding author: *sandaaj@funaab.edu.ng +234 8038487865*
Target audience: *Poultry breeders, poultry farmers, commercial broiler producers*

Abstract

A total of 450 chicks comprising 150 each of Arbor Acre, Ross 308 and FUNAAB Alpha broiler line chickens were used for this study on flock composition. The birds were sexed at 3 weeks and randomly distributed into three different flocks which includes mono-sex of female only (50), male only (50) and mixed-sex (50) for the three genotypes. These birds were managed intensively for 8 weeks and their productive performance were compared. Data collected was analysed using the Generalized Linear Model of SAS 2002. Significant means were separated using least significant difference (LSD). Arbor Acre and Ross 308 broiler chickens were significantly superior to FUNAAB Alpha broiler line chickens for body weight and linear body measurements at all weeks except for shank length were the reverse was the case at week 6. Male birds in male flock composition only and mixed pens were consistently better ($p<0.05$) than the other flock compositions for both body weight and body circumference at weeks 4, 6 and 8 while for thigh and wing lengths similar performance was recorded at only week 8. Genotype by flock composition on parameters revealed that among the 12 interactive groups, flocks consisting of Arbor Acre and Ross 308 broiler male chickens in both mixed and male only flocks were superior in body weight and most of the linear body measurements from week 2 to 8. It is recommended that broiler chickens should be raised separately as mono-sex as against mixed rearing from fourth week of age to slaughter.

Keywords: Chicken; strains; growth traits; flock-compositions; mono-sex; mixed-sex

Description of Problem

Poultry production is an important agricultural activity for most rural communities in Africa. It provides rural house hold with scarce animal protein in the form of meat and eggs as well as reliable source of petty cash (1). Nigeria is blessed with many poultry species which live and reproduced for several years (2). Poultry production is a significant part of

the livestock Industry in Nigeria contributing to food security and economic development. Chickens largely dominate the flock of Poultry composition (3). Poultry meat and eggs offer considerable potential for meeting human needs for dietary animal supply (4). Broiler birds are specifically bred for rapid growth to attain mature body size within 7–10 weeks depending on the strain, sex and management (5). Most of the hatcheries sell unsexed broiler chicks. However, male broiler is mostly preferred because it grows faster and has higher live weight (6; 7).

Growth of any trait is an occurrence of genetic potentials of the individual and environment interaction (8). To determine the growth performance of these chickens. It may be evaluated with body components such as live weight and linear body measurements such as body circumference, thigh length, wing length and shank length (9). Many factors such as genotype (10), diets content, sex, design of pen and stocking density (11) have been reported to affect the growth performance, meat quality and carcass yields of broiler chickens. It has also been reported that in sex separate growing, the male chickens showed better performance in terms of more production (12). The growth performance of broiler chickens is influenced by various factors, including flock composition. Flock composition refers to the number and ratio of male and female birds in a group, as well as other factors such as group size and broiler density. It also relate to the arrangement and combination of birds within a group. Understanding the impact of different flock compositions on the growth performance of broiler chickens is crucial for optimizing the efficiency, productivity and profitability of poultry production (13).

Broiler farming is one of the promising and sustainable businesses in agricultural sector but one of the great economic problems of the broiler production is that all broilers are not the same weight at the market age. This is because most broilers are being raised as straight run or mixed sex population. As a result of difference in their sex, male and female broiler differ from each other in many aspects. Under similar management condition, the males grow faster, converts feed more efficiently, achieve marketable weight earlier than their female counterpart. The consumer interest in chicken meat-type production increased due to many benefits issued from several essential and meaningful properties; it is affordable, a safe and healthy protein source, suitable for processing, and without any religious constraints (14). However, impact of flock composition on the Growth performance of Arbor Acre, Ross 308 broiler chickens, FUNAAB Alpha broiler line and Noiler chickens raised in different flock composition remain unexplored. This study is aimed at evaluating the comparative growth performance of these meat-type chickens raised in different flock Composition for 8 weeks.

The demand for chicken meat has been steadily increasing and is expected to reach 131,607.3 thousand tonnes in the year 2026 (15). Inability of broilers of the same age to attain uniform weight at the market age has been identified as one of the great economic problems of the broiler production. Simply because broilers are

being raised as straight run or mixed sex population. Quite a number of researches have reported disparity in growth rate of male and female broilers, linking this to sexual dimorphism in favour of male birds. Despite the rigorous research and experimentation over the years, only a handful of investigation has been done towards the comparative growth performance of meat-type chickens raised in different flock compositions. Hence, this research is designed to compare the growth performance of three meat-type chickens (Arbor Acre, Ross 308 and FUNNAB Alpha broiler line chickens) raised in different flock compositions of mono sex and mixed sex

Materials and Methods

Experimental site

This research was conducted at the Poultry Unit of Sustainable Livelihood Support and Development Centre (SLIDEN AFRICA), Alabata Road, opposite Federal University of Agriculture, Abeokuta (FUNAAB), Agbede, Abeokuta, Ogun State, Nigeria. The farm site lies in the rain forest zone of South Western part of Nigeria, located within Latitude 7.2311°N; Longitude 3.4564°E and Altitude 187.5 meters above sea level in a prevailing tropical climate with an annual rainfall of 142.49 millimetres (5.61 inches) of precipitation and annual mean temperature and relative humidity of 29.53°C and 82%, respectively (16).

Cleaning of the pen

Prior to brooding of the chicks, the pen was washed thoroughly with detergent and disinfectants and allowed to rest for a week to air out the smell of disinfectant. The pen surroundings was also cleared and drainage system around the pen was cleaned by removing stagnant water to prevent harbouring of pathogens, pest and predators.

Source of experimental birds

A total of 450 day old chicks was sourced from three reputable hatcheries in Ibadan, Oyo State and Abeokuta, Ogun State. One hundred and fifty day old chicks each of Arbor Acre and Ross 308 broiler chickens were purchased from hatcheries in Ibadan while One hundred and fifty day old chicks of FUNAAB Alpha broiler line were purchased from the Programme for Emerging Agricultural Research Leaders (PEARL) hatchery at FUNAAB. The birds were managed intensively under a deep litter system with a two way analysis of variance (Randomized Complete Block Design) as the experimental design.

Brooding of the chicks

The brooding pen was prepared and disinfected prior to the arrival of the chicks. Wood shavings were spread up to 3 cm high on the floor of the pen as bedding material. A source of light was provided to ensure the birds stay active at all times and particularly when eating. Heat was provided using 200 watt bulb and coal pot as an alternative source of heat when there is power shortage to keep the temperature at 33-35°C. Black nylon was used at the open side of the pen to maintain the brooding house temperature and humidity at 33-35°C and 82%, respectively. The brooding lasted for two weeks.

Management of birds

The birds were managed intensively using

deep litter system. Commercial feed and clean water were provided to bird's *ad libitum*. The birds were subjected to the same management system from one-day-old to 8 weeks of age. Water containing anti-stress (vitamin supplement and glucose) was served on the first day of arrival to replenish the energy lost during transportation. On the second day through fifth day, antibiotics were administered to help the chicks acclimatise to their new environment. Vaccination and medication programme remained the same for the three genotypes throughout the experimental period.

Flock composition

The birds were labelled with tag numbers at random for easy identification at week 2. A random selection of one hundred (100) birds from each genotype of 150 unsexed birds was done and further categorized based on sex. The birds were divided into three different flocks (50 birds apiece) such that there were mono sex (male and female broiler chickens separately) and mixed sex of both male and female. Distinction between male and female bird was made possible through their secondary sexual characteristics such as combs, wattles, and tail feather length. Males typically exhibit more prominent and bright combs and wattles, while females have longer tail feathers compared to their male counterparts. These sex-separated groups were reared in distinct pens from week 2 to week 8, enabling a comparative analysis of growth performance based on genotype and flock composition.

Feeds and feeding

The birds were fed *ad libitum* with a commercial starter feed containing 22 % crude protein and 2 900 kcal/kg metabolizable energy (ME) from one-day-old to 4 weeks of age, and also with commercial finisher feed containing 18% crude protein and 3050 kcal/kg ME from 5 to 8 weeks of age. Clean drinking water was provided *ad libitum* to the birds on daily basis.

Biosecurity measures

Measures were put in place to ensure proper sanitation of the pens and prevent the incubation and build-up of foreign pathogens in and around the pen house. At the entrance of the poultry pen, a foot dip and a pair of rubber slippers was placed at the entrance in order to prevent virulent pathogenic microbes. In addition, visitors were restricted from entering into the brooding pen to prevent disease outbreak. Furthermore, the litter was changed when necessary to ensure good hygiene and prevent wet litter which could lead to bacterial build-up within the pens. This was done regularly to ensure proper hygiene and to prevent bad odour.

Data Collection

The body weight and linear measurements were measured for each bird early in the morning before feeding once every week (7days interval) for the duration of the experiment (17).

Body weight was taken in grams (g) from 2nd week to 8th week using digital weighing scale with 0.1 sensitivity.

The linear body measurements were taken in centimetre (cm) using a tailor's tape rule.

1. Body circumference (BC): The

circumference between the breasts around the deepest region of the breast.

2. Shank length (SL): This was taken from the beginning of hock joint to the last ring before the tarsal or meta-tarsal digit.
3. Thigh length (TL): The distance between the hock joint and the pelvic joint.
4. Wing length (WL): Distance between the tip of the phalanges and the coracoids-humerus

Statistical analysis

Data collected from the experiment was subjected to two way Analysis of Variance (ANOVA) using the Generalised Linear Model of Statistical Analysis Software (18). Significant differences among means were separated using least significant difference. The model used is as shown below.

$Y_{ijk} = \mu + G_i + F_j + (GF)_{ij} + \varepsilon_{ijk}$

Where:

Y_{ijk} = Observed value of dependent variable

μ = Population mean

G_i = Fixed effect of genotype (Arbor Acre, FUNAAB Alpha broiler line, Ross 308)

F_j = Fixed effect of flock composition (female only, male only, mixed sex)

$(GF)_{ij}$ = Interaction between genotype and flock composition.

ε_{ijk} = Random error

Results

Significant ($p < 0.05$) differences were observed among the three strains of broiler chickens at weeks 2, 4, 6 and 8 in body weight, body circumference, thigh length and wing length. While shank length was significantly ($p < 0.05$) different at week 6 only. Table 1 represents this results.

Arbor Acre and Ross 308 broiler chickens were consistently superior ($p < 0.05$) to FUNAAB Alpha broiler line chickens in body weight and body circumference in all the weeks studied. While for thigh length, Ross 308 recorded the best length, which was closely followed by Arbor Acre and lastly FUNAAB Alpha broiler line for all the weeks considered.

Wing length witnessed superiority ($p < 0.05$) of Arbor Acre over Ross 308 and FUNAAB Alpha broiler line chickens in that order for weeks 2, 4, 6 and 8 while FUNAAB Alpha broiler line chickens recorded the best ($p < 0.05$) shank length over both Arbor Acre and Ross 308 broiler chickens at week 6.

It is worthy of note that Arbor Acre and Ross 308 broiler chickens had statistically similar weights which were progressively superior ($p < 0.05$) to the FUNAAB Alpha broiler line with an average of 300 g at week 2, 700 g at week 4, 1000 g at week 6 and 1500 g at week 8.

Flock composition significantly ($p < 0.05$) influenced the body weight and some linear body measurements especially at week 8. This result is presented in table 2.

Significant ($p < 0.05$) differences were observed in body weight and body circumference at weeks 4, 6 and 8. Male only and males in mixed flocks were superior to their female counterparts at week 4 while at week 6, male only flock had the best body weight, followed by males in mixed, female only and lastly females in mixed flock. At week 8, similar body weights were seen for male only, males in mixed and female only, which were superior to the female in mixed flock. Similarly for body circumference at week

Table 1: Effect of genotype on body weight and linear body measurements of the three strains of broiler chickens at weeks 2, 4, 6 and 8

AGE (Weeks)	GENOTYPES	BW (g)	BC (cm)	TL (cm)	SL (cm)	WL (cm)
2	Arbor Acre	543.32±4.95^{ab}	26.33±0.14^{a}	10.80±0.08^{b}	5.47±0.05	12.90±0.09^{a}
	FUNAAB Alpha Broiler line	217.09±5.15^{b}	18.90±0.11^{b}	7.30±0.08^{c}	4.81±0.05	9.27±0.08^{b}
	Ross 308	577.93±5.34^{a}	26.01±0.12^{a}	12.78±0.08^{a}	5.32±0.05	10.92±0.08^{c}
4	Arbor Acre	1519.70±15.19^{ab}	41.56±0.21^{a}	16.24±0.11^{b}	7.25±0.08	18.36±0.11^{a}
	FUNAAB Alpha Broiler line	836.59±20.05^{b}	30.12±0.27^{b}	14.98±0.14^{c}	7.96±0.09	16.16±0.13^{b}
	Ross 308	1547.24±20.16^{a}	41.09±0.28^{a}	18.53±0.14^{a}	7.56±0.09	15.98±0.14^{b}
6	Arbor Acre	2780.17±35.27^{a}	53.24±0.30^{a}	21.11±0.17^{b}	8.36±0.07^{b}	22.91±0.14^{a}
	FUNAAB Alpha Broiler line	1760.74±42.70^{b}	38.33±0.37^{b}	18.81±0.16^{c}	9.52±0.07^{a}	20.16±0.17^{b}
	Ross 308	2784.94±43.87^{a}	52.52±0.38^{b}	22.42±0.16^{a}	8.59±0.07^{b}	20.56±0.17^{b}
8	Arbor Acre	3799.8±30.49^{a}	58.92±0.31^{a}	24.23±0.21^{b}	9.90±0.14	26.02±0.16^{a}
	FUNAAB Alpha Broiler line	2185.57±42.40^{b}	41.15±0.33^{b}	20.37±0.15^{c}	10.95±0.08	21.90±0.17^{c}
	Ross 308	3782.93±42.60^{a}	59.97±0.33^{a}	25.70±0.16^{a}	9.79±0.08	23.93±0.17^{b}

4, male only, males in mixed and female only were superior ($p < 0.05$) to the female in mixed flock, while at weeks 6 and 8, male only and males in mixed flocks both recorded better ($p < 0.05$) body circumference than their female counterparts.

Shank length was not significantly ($p > 0.05$) affected by flock composition in all the weeks considered, while thigh and wing lengths showed significant ($p < 0.05$) differences at week 8. For thigh length, Male only and males in mixed flocks were superior to their female counterparts while for wing length significant differences were observed in this order; Male only, males in mixed, female in mixed and female only flock compositions.

Effect of interaction between genotype and flock composition on body weight and linear body measurements of the three strains of broiler chickens at weeks 2 and 4

Table 2 : Effect of flock composition on body weight and linear body measurements of the three strains of broiler chickens at weeks 2, 4, 6 and 8

AGE (Weeks)	Flock Composition	BW(g)	BC(cm)	TL(cm)	SL(cm)	WL(cm)
2	Female only	429.83±8.07	23.86±0.19	10.31±0.13	5.19±0.08	10.95±0.13
	Male only	469.31±8.07	24.10±0.21	10.36±0.13	5.32±0.08	11.18±0.15
	Female mixed	440.19±10.84	23.19±0.24	10.20±0.16	4.99±0.12	10.89±0.22
	Male mixed	457.11±9.60	23.83±0.21	10.28±0.15	5.28±0.10	11.03±0.19
4	Female only	1215.50±24.78^{b}	37.26±0.34^{a} ^{b}	16.80±0.19	7.42±0.13	16.98±0.19
	Male only	1380.72±32.92^{a}	38.60±0.45^{a}	17.01±0.22	7.74±0.14	17.07±0.22
	Female mixed	1253.43±42.92^{b}	36.86±0.49 ^{b}	16.12±0.29	7.47±0.18	16.46±0.29
	Male mixed	1358.35±38.39^{a}	37.64±0.53^{a} ^{b}	16.41±0.26	7.74±0.17	16.89±0.31
6	Female only	2313.65±52.10^{c}	46.71±0.49 ^{b}	20.62±0.26	8.54±0.11	20.65±0.22
	Male only	2644.24±70.73^{a}	49.70±0.61^{a}	21.37±0.29	9.30±0.12	21.59±0.23
	Female mixed	2276.83±87.92^{d}	46.81±0.76 ^{b}	20.26±0.32	8.44±0.15	21.02±0.34
	Male mixed	2532.70±73.66^{b}	48.71±0.69^{a} ^{b}	20.86±0.30	8.99±0.14	21.58±0.30
8	Female only	3312.17±50.70^{a}	51.20±0.53 ^{b}	22.35±0.37 ^{b}	9.84±0.16	22.76±0.26 ^{d}
	Male only	3462.18±53.25^{a}	55.23±0.54^{a}	24.28±0.25 ^{a}	10.48±0.15	25.01±0.28 ^{a}
	Female mixed	2952.38±69.57^{b}	51.55±0.60 ^{b}	22.89±0.36 ^{b}	9.99±0.23	23.62±0.35 ^{c}
	Male mixed	3477.83±71.69^{a}	55.38±0.64^{a}	24.11±0.45 ^{a}	10.52±0.32	24.40±0.34 ^{b}

$^{a, b, c,d}$ Means on the same column for each parameter with different superscripts are significantly different ($p<0.05$)

Interactive effect of genotype and flock composition is presented in table 3. Significant ($p< 0.05$) differences were observed in traits studied with the exception of shank length ($p>0.05$). For body weight, superiority ($p< 0.05$) was displayed among the 12 interactive groups. At week 2, Ross 308 males in male only and mixed flocks together with Arbor Acre female in mixed flock recorded the best bogy weights, followed by Arbor Acre female and male only, Arbor Acre males in mixed and Ross 308 Females in Female only and mixed flocks. Arbor Acre and Ross 308 interactive groups outweigh the FUNNAAB Alpha interactive groups.

Similar pattern of superiority ($p< 0.05$) was experienced at week 4. Arbor Acre males in male only and mixed flock, Arbor Acre females in mixed flock, Ross 308

Table 3: Effect of interaction between genotype and flock composition on body weight and linear body measurements of the three strains of broiler chickens at weeks 2 and 4

AGE (Weeks)	Genotypes	Flock Composition	BW (g)	BC (cm)	TL (cm)	SL (cm)	WL (cm)
2	Arbor Acre	Female Only	519.65±8.07^{b}	26.32±0.23^{a}	10.89±0.13^{b}	5.40±0.08	12.76±0.15^{ab}
		Male Only	558.91±8.07^{b}	25.91±8.07^{b}	10.72±0.13^{b}	5.54±0.08	12.75±0.15^{ab}
		Female Mixed	584.06±11.77^{ab}	24.94±0.19^{bc}	10.94±0.19^{b}	5.34±0.11	12.93±0.22^{ab}
		Male Mixed	546.67±11.09^{b}	26.32±0.23^{a}	10.63±0.18^{b}	5.61±0.10	13.03±0.21^{c}
	Ross 308	Female Only	549.12±8.72^{b}	26.01±0.19^{a}	12.74±0.13^{a}	5.22±0.08	10.91±0.13^{b}
		Male Only	604.35±8.72^{a}	26.31±0.19^{a}	12.91±0.13^{a}	5.29±0.08	11.11±0.13^{b}
		Female Mixed	544.88±12.33^{b}	25.21±0.27^{b}	12.47±0.19^{a}	5.19±0.12	10.68±0.19^{b}
		Male Mixed	613.35±12.33^{a}	26.50±0.27^{a}	12.98±0.19^{a}	5.56±0.12	10.96±0.19^{b}
	FUNAAB ALPHA	Female Only	220.71±11.09^{c}	19.25±0.25^{c}	7.05±0.17^{c}	4.97±0.11	9.20±0.17^{c}
		Male Only	244.68±9.60^{c}	19.46±0.21^{c}	7.45±0.15^{c}	5.15±0.09	9.70±0.15^{c}
		Female Mixed	191.64±10.84^{d}	18.22±0.24^{d}	7.20±0.16^{c}	4.45±0.10	9.08±0.17^{c}
		Male Mixed	211.32±9.60^{c}	18.68±0.21^{d}	7.25±0.15^{c}	4.67±0.09	9.11±0.15^{c}
4	Arbor Acre	Female Only	1441.82±24.78^{b}	41.70±0.34^{ab}	16.29±0.19^{c}	7.41±0.13	18.70±0.19^{a}
		Male Only	1572.50±24.78^{ab}	41.87±0.34^{a}	16.29±0.19^{c}	7.41±0.13	18.70±0.19^{a}
		Female	1520.36±36.	41.34±0.4	16.31±0.2	7.18±0.	17.89±0.3

males in male only and mixed flocks were significantly ($p< 0.05$) better than Arbor Acre female only and Ross 308 females in mixed flock. Ross 308 female only and the FUNAAB Alpha interactive groups were the least in hierarchy.

Apart from shank length that was not significantly ($p> 0.05$) different among the interactive groups, other linear body measurements (body circumference, thigh length and wing length) were significantly ($p< 0.05$) different. The superiority did not follow a particular pattern but Arbor Acre and Ross 308 males in male only and mixed flocks were mostly dominant both at weeks 2 and 4.

Effect of interaction between genotype and flock composition on body weight and

linear body measurements of the three strains of broiler chickens at weeks 6 and 8

Results of interaction between genotype and flock composition at weeks 6 and 8 is presented in table 4. Significant ($p< 0.05$) differences were observed in all traits studied except shank length. At week 6, for body weight, Arbor Acre males in male only flock and Ross 308 males in both mixed and mono sex flocks were significantly ($p< 0.05$) superiority to Arbor Acre males in mixed flock, whose weights were also better ($p< 0.05$) than that of Arbor Acre females in both mixed and mono sex flock and Ross 308 females in mixed flock. Of the 12 interactive groups, the aforementioned performed better than the others. At week 8, the order of superiority was slightly similar, with Ross 308 males in mixed flocks being the superior ($p< 0.05$), closely followed by Arbor Acre males in both mixed and mono sex flocks and Ross 308 males in mono sex flocks. Followed by Arbor Acre females in mono sex flock. The least ($p< 0.05$) among the interactive group at week 8 was FUNAAB Alpha female in mixed flock.

For the linear body measurements, a replica performance of body weight was observed for body circumference at both weeks 6 and 8, while for thigh length at week 6, Ross 308 females in both mixed and mono sex and males in mixed flock were significantly ($p< 0.05$) to their other counterparts. Arbor Acre males in both mixed and mono sex flock, together with Ross 308 females in mixed sex flock were also superior to Arbor Acre females in both mixed and mono sex flocks and other interactive groups. At week 8, similar body

Table 4 : Effect of interaction between genotype and flock composition on body weight and

AGE (Weeks)	Genotypes	Flock Composition	BW (g)	BC (cm)	TL (cm)	SL (cm)	WL (cm)
6	Arbor Acre	Female Only	2663.06±52.10^{c}	52.24±0.49^{bc}	20.85±0.27^{c}	8.22±0.11	21.87±0.22^{bc}
		Male Only	2947.06±55.44^{ab}	54.24±0.52^{a}	21.63±0.29^{b}	8.83±0.11	23.30±0.23^{a}
		Female Mixed	2637.30±75.93^{c}	52.13±0.71^{bc}	20.93±0.41^{c}	8.09±0.15	23.00 ±0.31^{a}
		Male Mixed	2872.18±73.66^{b}	53.82±0.69^{ab}	21.00±0.38^{b}	8.29±0.15	23.47±0.30^{a}
	Ross 308	Female Only	2499.15±71.79^{d}	49.27±0.62^{c}	22.22±0.26^{a}	8.04±0.12	20.22±0.28^{bc}
		Male Only	2942.09±70.73^{ab}	54.37±0.61^{a}	23.38±0.26^{a}	8.99±0.12	20.51±0.27^{bc}
		Female Mixed	2665.65±93.02^{c}	51.82±0.87^{b}	21.65±0.36^{b}	8.26±0.17	20.47±0.39^{bc}
		Male Mixed	3032.88±93.04^{a}	54.63±0.90^{a}	22.44±0.38^{a}	9.06±0.17	21.03±0.40^{b}
	FUNAAB Alpha	Female Only	1778.76±89.99^{f}	38.64±0.78^{g}	18.79±0.33^{g}	9.38±0.15	19.86±0.35^{c}
		Male Only	2043.58±80.88^{e}	40.50±0.70^{d}	19.12±0.29^{g}	10.09±0.14	20.96±0.31^{bc}
		Female Mixed	1527.59±87.92^{h}	36.50±0.76^{g}	18.20±0.32^{e}	8.98±0.15	19.59±0.34^{c}
		Male Mixed	1693.04±82.48^{g}	37.68±0.72^{f}	19.14±0.30^{g}	9.64±0.14	20.24±0.32^{bc}
8	Arbor Acre	Female Only	3780.66±50.70^{c}	56.25±0.53^{cd}	22.78±0.35^{c}	9.8±0.23	24.52±0.26^{b}
		Male Only	3961.88±53.25^{b}	60.69±0.60^{b}	25.01±0.37^{ab}	9.8±0.24	26.95±0.27^{a}
		Female Mixed	3506.71±71.69^{d}	57.25±0.75^{c}	24.03±0.49^{b}	10.00±0.32	26.13±0.37^{a}
		Male Mixed	3950.47±65.78^{b}	61.47±0.71^{b}	25.02±0.45^{ab}	9.93±0.30	26.50±0.34^{a}
	Ross 308	Female Only	3380.47±69.57^{dc}	56.26±0.54^{cd}	23.79±0.24^{b}	9.21±0.13	22.28±0.28^{d}
		Male Only	3921.24±69.57^{b}	61.43±0.54^{b}	26.67±0.25^{a}	9.94±0.13	24.87±0.28^{b}
		Female Mixed	3485.29±98.38^{dc}	58.35±0.76^{c}	25.65±0.36^{ab}	9.62±0.18	24.00±0.50^{b}
		Male Mixed	4344.71±98.38^{a}	63.82±0.76^{a}	26.68±0.36^{a}	10.41±0.18	24.56±0.40^{b}
	FUNAAB Alpha	Female Only	2235.38±88.52^{f}	41.10±0.69^{e}	20.48±0.32^{dc}	10.53±0.16	21.50±0.36^{d}
		Male Only	2503.44±81.13^{e}	43.58±0.63^{d}	21.10±0.30^{d}	11.70±0.15	23.22±0.33^{c}
		Female Mixed	1865.14±86.48^{g}	39.05±0.67^{f}	19.30±0.31^{f}	10.35±0.16	20.75±0.35^{ef}
		Male Mixed	2138.33±82.80^{f}	40.85±0.64^{e}	20.63±0.30^{dc}	11.24±0.15	22.15±0.33^{d}

linear body measurements of the three strains of broiler chickens at weeks 6 and 8

^{a,b,c,d,e,f,g,h} Means on the same column for each parameter with different superscripts are significantly different ($p<0.05$)

BW = Body Weight, BC = Body Circumference, TL = Thigh Length, SL = Shank Length and WL = Wing Length

weights were observed in Arbor Acre males in both mixed and mono sex, Ross 308 males in both mixed and mono sex and females in mixed flocks which were greater ($p< 0.05$) than Arbor Acre females in mixed flock and Ross 308 females in female only flock. Arbor Acre females in female only flock followed this group and better than other interactive groups. Wing length displayed a different pattern of superiority among the 12 interactive groups. Arbor Acre males in both mixed and mono sex and females in mixed flocks topped this group at week 6 and 8. Arbor Acre females in female only flock and Ross 308 males and females in both mixed and mono sex flock were next in rank and were superior ($p< 0.05$) to their other counterparts in the interactive group both at weeks 6 and 8.

Discussion

Growth is the process through which farm animals expand in size or weight over time until they reach maturity (19). Genotype and Flock composition played a vital role in enhancing growth performances of Abor Acre, FUNAAB Alpha and Ross 308 broiler chickens understudied in this research. Live weight and body measurements are important parameters in assessing growth performance of broiler chickens. This study suggests that minimizing social stressors, such as competition for feed and space, positively influences overall flock performance. Differences observed between female and male broilers under the separated and mixed-sex groups indicated that sex had significant effect on growth, which is in agreement with those previously reported by (20); (21); (22) and (23). This study reaffirms the notion that a harmonious social environment promotes better growth outcomes. The absence of females in male only pens likely reduced hierarchical conflicts and territorial behaviours, fostering an optimal growth environment.

Growth performance of broilers at different ages have been reported by many authors (24); (25) and (26). In this study, body weight and linear body measurements considered for the three strains showed male groups were higher than separate female and mixed sex groups at 2, 4, 6 and 8 weeks of age. This indicates that rearing of broilers separately might be beneficial than the conventional rearing of broilers as mixed sex from 4 to 8 weeks of age. The variation observed in body weight and linear body measurements for the three strains can be attributed to differences in the flock composition. This agrees with earlier reports of (27) and (26) who noted that sex separate rearing had a positive effect on live weight of female broilers. A replica of this result is seen in this study with female birds in mono sex having significantly better weights than those in mixed flock composition at week 6 and 8. The male's body weight and linear body measurements were relatively heavier and higher than the other sex groups. This could be attributed to faster growth rate of the males due to testosterone hormone.

A comparison between mono and mixed sex performance in this study reviewed better productive performance in favour of male / female reared as mono sex as compared to their counterparts raised in mixed sex flocks. It is suggested that the presence of male chickens in mixed sex

group enacted territorial effect from their fourth week after the hormonal changes (28), sex competition (29) and sexual dimorphism (30) which however becomes visible at the age of 35 days. The result of this study clearly showed the benefits of sex separation of the chicks in terms of performance and bird uniformity at processing age, this is also supported by the report of (31).

Report by (32) state that the effect of sex on the weight of the birds is usually observed in broilers and that the difference tends to increase with advancing age. Considerably higher body weight of male broiler chickens compared to females have been reported by several authors (12, 26 and 33) which were in support of the findings of this study. The superiority of the males in flock composition of males in mono and mixed flocks compared to their female counterparts for body weight and body circumference at weeks 4, 6 and 8, while shank and wing lengths at only week 8 agrees with (34) who reported that male broilers grow faster and record heavier body weights than the females under various flock compositions.

According to (35), sexual size dimorphism in most avian species favours male birds. Such dimorphism could have resulted from differential sexual and natural selection pressures experienced by both sexes (36), or from adaptive selection pressures which is a reflection of the evolution of males and females towards fitness optima divergence. Taking into cognisance the sex composition (mono / mixed sex) of the flock also creates a conducive environment for optimal growth. The findings of this research is corroborated by the report of (37) which state that the productivity of Arbor Acre and Ross 308 chickens raised in different flock compositions was significantly influenced by feed intake and environmental factors. By understanding the interplay between feed intake, environmental factors and flock composition, the poultry industry can optimize production practices, improve bird welfare and enhance overall sustainability.

Conclusions and Applications

1. Arbor Acre and Ross 308 broiler chickens were significantly superior to FUNAAB Alpha broiler line chickens for body weight and linear body measurements at all weeks considered except for shank length were the traverse was the case at week 6 which happens to be the only significant week.
2. Birds in male only and mixed pens were consistently better than the other flock composition for both body weight and body circumference at weeks 4, 6 and 8, while for thigh and wing lengths similar performance was recorded at only week 8.
3. The genotype by flock composition interaction on body weight and linear body measurements revealed that among the 12 interactive groups, flocks consisting of Arbor Acre and Ross 308 broiler male chickens in both mixed and male only flocks were superior in Body weight and most of the linear body measurement from week 2 to 8.

4. Sexual dimorphism favoured male birds of all strains in terms of body weight and linear body measurements. Understanding growth performance is crucial for optimizing poultry production systems. The findings of this study can serve as a foundation for future research aimed at improving growth, feed efficiency, and overall bird health.

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