

Comparative Evaluation of Growth Performance and Feed Utilization of Improved Nigerian Indigenous Broiler and Different Crossbreds

O.J.Ogunpaimo^{1}, H.T.Ojoawo², O.R.Ogunpaimo³, M.Y.Wheto⁴, A.O.Adebambo⁴ and O.A.Adebambo⁴.*

^{1}Directorate of University Farms, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.*

²Centre of Excellence in Agricultural Development and Sustainable Environment, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.

³Department of Agricultural Economics and Farm Management, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.

⁴Department of Animal Breeding and Genetics, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.

*Corresponding Author's Email: ogunpaimoolaiwola@gmail.com

Article timeline

Submitted: 04-06-2021, Revised: 25-07-2021, Accepted: 03-08-2021, Published: 12-02-2022

Tanzania Veterinary Journal Vol. 36 (2) 2021 <https://dx.doi.org/10.4314/tvj.v36i2.2>

Copyright and permission information available at the Journal webpages shown below

Manuscript submission, annual subscriptions and other information: <https://tvj.sua.ac.tz>
Single article purchases: <https://www.ajol.info/index.php/tvj/index>

Comparative Evaluation of Growth Performance and Feed Utilization of Improved Nigerian Indigenous Broiler and Different Crossbreds

O.J.Ogunpaimo^{1}, H.T.Ojoawo², O.R.Ogunpaimo³, M.Y.Wheto⁴, A.O.Adebambo⁴ and O.A.Adebambo⁴.*

^{1*}*Directorate of University Farms, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.*

²*Centre of Excellence in Agricultural Development and Sustainable Environment, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.*

³*Department of Agricultural Economics and Farm Management, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.*

⁴*Department of Animal Breeding and Genetics, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.*

*Corresponding Author's Email: ogunpaimoolaiwola@gmail.com

SUMMARY

The study was carried out as part of efforts to improve the performance of the Nigerian indigenous chicken and improve potentials of indigenous broiler strains to provide higher quality of meat at a reduced cost. The study compared the growth and feeding traits of three different chicken crossbreds with the generated lines of Improved Nigerian indigenous broiler (FUNAAB-Alpha) using the Arbor Acre broiler as the experimental control. Males of three broiler breeds types (Kuroiler, Sasso and Arbo Acre) were mated with a total of 120 improved Nigerian indigenous pullets (FUNAAB-Alpha) to generate 360 crossbred broilers. 120 each of Arbor Acre and FUNAAB-Alpha improved line were also reared in a separate pen for comparison. Growth performance, feed intake, body weight gain and feed conversion efficiency of all the chicken breeds were recorded for 8 weeks and compared. Two way analysis of variance (ANOVA) was used for the analysis with consideration of the effect of breeds, sex and its interaction. The results revealed a significant ($P < 0.05$) influence of the breeds on the traits across all ages. FUNAAB-Alpha broiler consumed the least quantity of feed/bird/day followed by the Sasso-FUNAAB-Alpha crossbred throughout the period of the experiment. However, Sasso-FUNAAB-Alpha chicken had the highest mean value for body weight and other linear body parameters among the crossbreds. Despite of the improvements achieved in FUNAAB-Alpha crosses, there is a need for further analysis and research in order to achieve the maximum potential of the improved broiler strain.

Keywords: *Arbor Acre, Broiler, Feed, FUNAAB-Alpha, Sasso*

INTRODUCTION

Crossbreeding is the mating of two different breeds to acquire an offspring that will inherit desired traits from the two parent breeds. The main purpose of crossbreeding is to produce superior crosses by combining different characteristics of different breeds in the cross to make it more valuable (Willham and Pollack, 1985; Hanafi and Iraqi, 2001). For example, there are efforts to improve various potentials of broiler strains mainly to provide higher quality meat at a reduced cost (Kemp and Kenny, 2003). More so that hybrid vigour has become a tool for animal breeders to produce progeny that exhibit more desirable phenotypes than those of their parental populations (Williams *et al.*, 2002). Despite the fast growth of commercial chicken production during the 1990s, breeding programs in the developing countries are still low in the developed countries due to non-accessibility to technological advantages and lower economics of scale (Hoffmann, 2005). There have been several efforts by the poultry breeders across Nigeria to improve the performance of the Nigerian indigenous chicken which (Nwosu and Asuquo, 1985; Ogunpaimo *et al.*, 2020) described as slow-growing, poor feed converters. The desired features of these local chickens were attributed to their exposure to long term natural selection for

fitness in harsh tropical diseases prevalent in their environment. However, the good adaptive traits without improvement in the body size have affected their acceptability within the commercial poultry industry and this forms the ultimate reason while the Nigerian indigenous chicken was genetically improved and named the FUNAAB-Alpha chicken breed. The FUNAAB-Alpha chickens are of two types; the meat and the dual-purpose line. Both lines are made up of the Normal feathered, naked neck and the frizzle feathered genotypes. The breed was developed by the Federal University of Agriculture, Abeokuta, Nigeria and was approved for distribution as an improved adapted dual-purpose chicken breed by the Federal Government of Nigeria (Ogunpaimo *et al.*, 2020). The chicken is an improved version of the Nigerian indigenous chicken and it was developed by scientists in the Department of Animal Breeding and Genetics, Federal University of Agriculture Abeokuta, Nigeria (Udoh, 2014) and efforts for further improvements to enhance their performance are ongoing. Consequently, this study was carried out to compare the growth and feeding traits of three different chicken crossbreds with the generated lines of Improved Nigerian indigenous broiler (FUNAAB-Alpha broiler) using the Arbor Acre broiler as the experimental control

MATERIALS AND METHODS

All the animals used for this study were handled according to the laid down rules and regulations of the Animal welfare and ethics committee of the Federal University of Agriculture, Abeokuta, Nigeria.

The study was carried out at the Poultry Breeding Unit of the Federal University of Agriculture, Alabata, and Abeokuta, Nigeria. Alabata in Odeda local government area of Ogun State, Nigeria. The 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°C in December to 36°C in February with a yearly average of 34°C. Relative humidity ranges

from 60% in January to 94% in August with a yearly average of about 82%. The vegetation represents an inter-phase between the tropical rainforest and the derived Savannah (Google Earth, 2018).

36 males, that is; 12 each of the chicken breed (Sasso, Kuroiler and FUNAAB-Alpha) were mated with one hundred and twenty FUNAAB-Alpha (Supporting Figure 1) dual-purpose pullets to generate three hundred and sixty crossbreds which were selected and grouped into three different replicates, alongside, one hundred and twenty each of Arbor Acre and FUNAAB-Alpha broiler chicks, reared at the same time at separate pens to compare their feed intake and other performance traits (Supporting

Table 1). The FUNAAB-Alpha chicks were sourced from the University's PEARL (Programme for Emerging Agricultural Research Leaders) farm, while the Arbor Acre chicks were purchased from Obasanjo's farm, the Sasso and Kuroiler chicks were sourced from the African Chicken Genetic Gain (ACGG). All the chicks from the respective groups were properly identified with numbering tags and were vaccinated against Marek and Newcastle diseases at day old before they were transferred to a previously disinfected deep litter pen with adequate floor space. The birds were raised on a deep litter system and fed *ad-libitum* using a commercial feed (Top feed from Premier Feed Industry Limited, Nigeria) for a period of 8 weeks at different phases of growth differentiated into starter phase with 3000 kcal ME/kg of feed fed for 0-4 weeks and finisher phase of 5 – 8 weeks with 3200 kcal ME/kg of feed, the birds were allowed to have access to fresh, clean water throughout the period of the experiment.

Data on the following growth traits were obtained on weekly basis from day old till 8 weeks of age. Body weight (g) was measured using a sensitive weighing balance of 5kg capacity and manufactured by Jiangsu Suzhou. Shank length (cm) was measured as the distance between the end of the thigh and the tarsus. Breast girth (cm) was measured as the circumference around the deepest region of the breast using a measuring tape. Feed intake was estimated using the formula:

$$\text{Daily feed intake (g)} = \frac{\text{Feed given (g)} - \text{Feed refused}}{\text{Number of birds per replicate}}$$

RESULTS

The effect of genotype on body weight (gram) and other linear body traits (cm) of different chicken breeds at different ages is presented in Table (1). The results showed that genotype significantly ($P < 0.05$) influenced the growth traits across all ages. At week 2, the highest average mean of 450.28 ± 30.48 g for body weight was observed in Arbor Acre chicken followed by

After every two weeks bodyweight gain (g) was estimated using the formula

$$\text{Weight Gain (g)/bird} = \frac{\text{Recent weight gain}}{\text{Previous weight gain}}$$

Whereas feed conversion ratio (FCR) was estimated as the ratio of daily weight gain to daily feed intake within each measurement period using the formula:

$$\text{Feed Conversion Ratio (g)} = \frac{\text{Daily feed intake}}{\text{Daily weight gain}}$$

The growth data obtained were analyzed using the General Linear Model (SAS, 2002) version 9.0. The model is as specified below:

$$Y_{ijk} = \mu + G_i + S_j + (GS)_{ij} + \sum_{ijk}$$

Where:

- Y_{ijk} = Individual observation
- μ = Overall mean for the trait of interest
- G_i = Fixed effect of the i^{th} genotype ($i = 1 - 3$)
- S_j = Fixed effect of the j^{th} sex ($j = 1 - 2$)
- $(GS)_{ij}$ = Interaction effect between the i^{th} genotype and j^{th} sex
- \sum_{ijk} = Random error associated with each record

Means were separated using Duncan's Multiple Range Test (Gomez and Gomez 1984).

423.33 ± 9.80 g recorded for Sasso crossbred.

The FUNAAB-Alpha broiler, Kuroiler crossbred and Arbor Acre crossbred showed mean body weight of 347.38 ± 11.65 g, 303.37 ± 11.99 g and 369.43 ± 13 g respectively. An increase in the body weight was consistent for the chicken breeds across all the ages, except for the Kuroiler crossbred, all the other chicken breeds

already weighed more than 1000g at 6 weeks of age. At week 8, Arbor Acre chicken averaged 1926.48 ± 10.78 g which was slightly higher than the 1882.43 ± 13.64 g observed for the Sasso crossbred chicken and, the FUNAAB-Alpha broiler with 1647.40 ± 11.99 g which is higher than the 1508.92 ± 11.80 g observed in the Kuroiler crossbred.

At week 2, the breast girth for the FUNAAB-Alpha broiler was 6.33 ± 0.29 cm and it was higher than that of the Arbor Acre crossbred 5.98 ± 0.44 cm and Kuroiler crossbred 4.87 ± 0.31 cm chickens. The values were consistent until week 8 when the value of 18.71 ± 0.09 cm was recorded for the Arbor Acre crossbred which is slightly higher than 17.57 ± 0.21 cm obtained for FUNAAB-Alpha broiler. The Sasso crossbred showed the highest mean value of 21.00 ± 0.32 cm and this supersedes the mean of 20.78 ± 0.32 cm observed in the Arbor Acre breed.

The shank length of 4.10 ± 0.06 cm was observed in the Arbor Acre broiler at week 2 followed by 3.68 ± 0.10 cm obtained by the FUNAAB-Alpha broiler at the same week. The lowest value of 2.75 ± 0.14 cm was shown by the Kuroiler crossbred. In the same view, the FUNAAB-Alpha, Sasso crossbred and Arbor Acre broilers showed similar mean values of 6.90 ± 0.18 cm, 6.51 ± 0.39 cm and 6.65 ± 0.13 cm at 8 weeks of age. In summary, it was noted that the Arbor Acre, an exotic broiler breed showed the

The interactive effect between genotype and sex on the body weight (g), shank length (cm) and breast girth (cm) of different chicken breeds from week 2 to 8 are presented in Table (3). It was observed that genotype and sex interactions, significantly ($P < 0.05$) affected body weight (g) and the other two linear measurements across the ages.

Moreover, the male chicken had higher body weight across the ages, it was revealing to note that none of the male birds, including the FUNAAB-Alpha broiler that is more of indigenous origin, also weighed less than 1000g at 6 weeks. Similarly, a close margin

highest values for the body traits except for the differences such as 21.00 ± 0.32 cm observed in the breast girth of Sasso crossbred as against the mean of 20.78 ± 0.32 cm obtained for the Arbor Acre breed. Also, the values of 5.23 ± 0.22 cm and 6.26 ± 0.15 cm that were observed at weeks 4 and 6 for the FUNAAB-Alpha broiler are higher than the means of 5.11 ± 0.04 cm and 6.03 ± 0.09 cm recorded for Arbor Acre breed.

The results indicated that sex had a significant ($P < 0.05$) influence on the body parameters across all ages (Table 2).

For Arbor Acre broiler, the female chicken had the value of 5.10 ± 0.25 cm compared to the mean of 4.90 ± 0.66 cm of their male counterpart for shank length at week 4. The means observed at weeks 2 and 8 are statistically the same for both sexes and a clear difference in the mean was observed at week 6 for this particular trait. From weeks 2 to 8 of the experiment, the male chicken displayed a higher mean value for the FUNAAB-Alpha broiler and their crossbreds. However, the same statistical means of 5.35 ± 0.25 cm and 5.09 ± 0.25 cm were recorded for the shank length of male and female lines of FUNAAB-Alpha broiler at week 4. Also, a rapid increase in the breast girth of Arbor Acre and crossbred broilers was observed between weeks 4 and 6.

was observed in the mean values of Arbor Acre breed 994.17 ± 12.48 g and the crossbred broilers 900.02 ± 19.46 g at 4 weeks of age. Notwithstanding, it was only the male of Arbor Acre broiler that displayed an average body weight of 2000g at 8 weeks.

The breast girth for both sexes of Arbor Acre broiler showed the same statistical means at weeks 2 and 4 and the mean values of the male Arbor Acre chicken was more than the female counterpart at weeks 6 and 8 of the experiment. In the same view, the male line of the crossbred and FUNAAB-Alpha broilers had higher mean values for breast girth compared to the female strain

from week 2 to 8 of the study. The same occurrence in the shank length of the broiler lines was observed in this experiment; however, the mean values for both sexes of FUNAAB-Alpha broiler were not statistically different at weeks 4 and 6. This

The effect of genotype on the feed intake (g), body weight gain (g) and feed conversion ratio of different chicken breeds at different ages is presented in Table (4). It was observed that genotype significantly ($P < 0.05$) affected the traits from week 2 to 8 of the study.

Throughout the study, Kuroiler crossbred consumed the highest quantity of feed and this was followed by the Arbor Acre crossbred. However, FUNAAB-Alpha broiler had the lowest mean values for feed intake and this was followed by the Arbor Acre and Sasso crossbreds. In other words, the Kuroiler and Arbor Acre crossbreds are less efficient in the quantity consumed.

The Arbor Acre breed had the highest mean body weight gain followed by the Sasso crossbred while, at every week, the Kuroiler crossbred, displayed the lowest mean body weight gained throughout the study. The weight gain of the Arbor Acre crossbred

DISCUSSION

The progenies produced from the matings that involved sires of the exotic breeds with the dams of FUNAAB-Alpha genotypes are herein referred to as crossbreds and their respective average mean performance were recorded every 2 weeks.

In practical breeding, crossbreeding is a major feature of modern broiler breeding programme (Sakthevel *et al.*, 2000) and breeding for meat-type poultry is the attainment of market weight at an earlier age. In the early 90s, production of a 1.3kg broiler required 13 to 14 weeks with a feed conversion of about 5.5 but with continuous improvement, nowadays this weight can be attained between 4 to 5 weeks of age with a feed conversion of 1.5 (Nir, 2000). In this study, all the chicken breeds including the FUNAAB Alpha broiler that is an improved indigenous broiler have attained an average

result also showed that the mean value for shank length of male FUNAAB-Alpha broiler $7.90 \pm 0.76\text{cm}$ at 8 weeks is higher than the male line of Arbor Acre breed $7.65 \pm 0.22\text{cm}$ at the same age.

$500.77 \pm 15.55\text{g}$ was above the average means recorded for the Sasso crossbred $480.66 \pm 20.51\text{g}$ at week 4. For instance, it was noted that only Arbor Acre broiler showed an increase in the body weight gain between week 2 and 4, the other broiler breeds experienced a reduction in the body weight gain at this period and this reduction was however compensated for between week 4 and 6.

At week 2, the Kuroiler crossbred had the highest mean value of 3.80 ± 0.19 for feed conversion ratio and the least value of 2.82 ± 0.02 was obtained for Arbor Acre crossbred broilers. The mean values did not follow any particular pattern but results showed that Kuroiler crossbred had the highest mean value at week 4 (4.32 ± 0.32) while FUNAAB-Alpha and Arbor Acre showed the highest mean feed conversion ratio at week 6 with conversion ratio of 4.38 ± 0.11 and 2.94 ± 0.03 respectively.

of 1.2kg at 6 weeks with a feed conversion ratio of 2.0.

Furthermore, findings of this study is consistent with previous report by Campbell *et al.*, (2006) that larger and heavier breeds of meat type chicken are more appropriate for meat production as demonstrated in the performance of crossbreds generated from the Sasso and Arbor Acre breeds.

The results of crossbred performance reveals that genotype influenced the body parameters and among the chicken breeds. This observation is consistent the findings of Peters (2000) who reported that chick genotype, which arose from crossbreeding of strains of chickens, significantly affected body parameters and crossbreds had higher values in all the body parameters studied followed by crossbreds of the indigenous

chickens and lastly the pure indigenous genotype.

However, the outcome of this study did not completely agree with this statement as shown by the values of the body parameters of Kuroiler/FUNAAB-Alpha crossbreds which were of higher value. In addition, this study showed that the males had higher body weight and other body parameters compared to their female counterpart. This is partly attributed to sexual dimorphism which is a natural phenomenon in all growing animals by the manifestation of visible differences between the male and the female species. Even though the male chicken showed higher mean values during the period of this study, it is pertinent to note that some exceptions were discovered

at some weeks particularly for the shank length of the birds at the 4th and 6th weeks of age. Nevertheless, this deviations does not negate the findings in this study that indicate body weight gain, feed intake and other body parameters in broiler chickens are genotype and sex-dependent similar to previous reports including report by Razuki *et al.*, (2011). In addition, the higher weight other body parameters attained by Arbor Acre chicken and Sasso crossbreds at 8 weeks observed in this study and Akanni (2007) implies that sires of the two breeds were able to pass their traits onto their crossbred progenies and can be used for further improvement of FUNAAB-Alpha broiler

ACKNOWLEDGMENT

The authors would like to acknowledge the assistance provided by Professor Emeritus (Mrs) Olufunmilayo Adebambo towards the conduct and actualization of this research work.

CONFLICT OF INTEREST

Authors do not have any conflict of interest

REFERENCES

- Akanni, KT. Genetic evaluation of egg production traits of exotic, indigenous and crossbred pullets. A dissertation submitted to the Department of Animal Breeding and Genetics, Federal University of Agriculture, Abeokuta. Pp 133, 2007.
- Campbell, KL, Garforth, C, Heffernan, C, Morton, J, Paterson, R, Ryner, C, Upton, M. Small Stock in Development, CDROM. DFID Livestock Production Programme, Natural Resources International Ltd, Aylesford, Kent, UK, ISBN: 0 – 9546452 – 8 – 6, 2006.
- Gomez, AK, Gomez, AA. Statistical Procedure for Agricultural Research. 2nd Ed. John Wiley and Sons Inc., New York, U.S.A. Pp68, 1984.
- Hanafi, MS, Iraqi, MM. Evaluation of purebreds, heterosis, combining abilities, maternal and sex-linked effects for some productive and reproductive traits in chickens. *Second International Conference on Anim. Prod. Health in Semi-Arid Areas*, 4-6 September, Organized by Faculty of Environmental Agricultural Sciences, Suez Canal Univ. El Arish-North Sinai, Egypt, pp: 545-555, 2001.
- Hoffmann, I. Research and investment in poultry genetic resources-challenges and options for sustainable use. *World's Poult. Sci.*, 61:57-69, 2005.
- Kemp, C, Kenny, M. Feeding the modern broiler for more meat. *Int. Hatchery practice* 17: 11 – 13, 2003.

- Nir, I. How artificial selection for increased growth and feed intake has altered meat-type poultry. Abstract of *Proceeding of the 21st World's Poultry Congress*, held at Montreal, Canada from August 20-24, 2000.
- Nwosu, CC, Asuquo, BO. Heritability and correlation estimates of body weight in the local chicken. *Proceedings of the 9th Annual Conference of Nigerian Society for Animal Production*, March 25 – 29, 1984, University of Nigeria, Nsukka, Pp. 49 – 56, 1985.
- Ogunpaimo, OJ, Wheto, M, Ojoawo, HT, Adebambo, AO, Adebambo, OA, Durosaro, SO. Use of growth models to predict body weight of FUNAAB-Alpha chicken, its crossbreds and two other exotic chickens at an early stage of growth. *FUDMA Journal of Science, Nigeria* 4(1) 686 – 694, 2020.
- Peter, SO. Genetic variation in the reproductive performance of indigenous chickens progeny. M. Sc. Dissertation. Dept. of Animal Breeding and Genetics, University of Agriculture, Abeokuta, Pp 120, 2000.
- Razuki, WM, Mukhlis, SA, Jasim FS. H, Hamad, RF. Productive performance of four commercial boiler genotypes reared under High Ambient temperatures. *Intentional Journal of Poultry Science*, 10(2): 87 – 92, 2011.
- Sakthevel, L, Smigh, RV, Nath, M, Dev Roy, AK, Singh, B, Singh, UB, Singh, D, Singh, BP. Combined ability analysis of body weight in Broiler with indigenous crossbred chickens, *Proceedings of the 21st World Poultry Congress, Montreal, Canada*. August 20th-24th, 2000
- Udoh, JE. Genomic evaluation of growth performance of the indigenous broiler genotypes. Ph. D thesis, Department of Animal Breeding and Genetics, College of Animal Science and Livestock Production. Federal University of Agriculture, Alabata, Abeokuta, Ogun State. Nigeria. Pp 10-11, 2014.
- Willham, RL, Pollack, E. Theory of heterosis. *J. Dairy Sci.*, 68: 2411-2417.
- Williams, SM, Price, SE and Siegel, PB. 2002. Heterosis of growth and reproductive traits in fowl. *Poultry Sci.* Volume 81, Issue 8, Pp 1109 – 1112, 1985.
- Yunusa, AJ, Adeoti, TM. Multivariate Analysis for body weight and some linear body measurements of Nigerian Indigenous Chickens. *Slovak Journal of Animal Sci.* 47:142 148, 2014.

Table 1. Effect of genotype on the body weight (gram) and other linear body traits (cm) of different chicken breeds at different ages

Genotype	Body weight (gram)			
	Week 2	week 4	week 6	week 8
Arbor Acre	450.28 ± 30.48 ^a	978.03 ± 36.33 ^a	1450.64 ± 37.30 ^a	1926.48 ± 10.78 ^a
FUNAAB-Alpha broiler	347.38 ± 11.65 ^{cd}	705.59 ± 11.88 ^d	1050.15 ± 15.83 ^c	1547.40 ± 11.99 ^d
Arbor Acre crossbred	369.43 ± 13.26 ^c	879.16 ± 20.32 ^c	1284.62 ± 20.69 ^{bc}	1752.39 ± 16.48 ^c
Kuroiler crossbred	303.37 ± 11.99 ^d	689.41 ± 11.46 ^e	980.48 ± 14.19 ^d	1308.92 ± 11.80 ^e
Sasso crossbred	423.33 ± 9.80 ^b	900.04 ± 10.54 ^b	1300.69 ± 13.79 ^b	1882.43 ± 13.64 ^b
		Breast girth (cm)		
Arbor Acre	9.88 ± 0.12 ^a	14.98 ± 0.17 ^a	18.76 ± 0.19 ^a	20.78 ± 0.32 ^{ab}
FUNAAB-Alpha broiler	6.33 ± 0.29 ^c	11.36 ± 0.42 ^c	14.73 ± 0.61 ^{bc}	17.57 ± 0.21 ^c
Arbor Acre crossbred	5.98 ± 0.44 ^d	9.21 ± 0.78 ^{cd}	14.05 ± 0.53 ^{bc}	18.71 ± 0.09 ^b
Kuroiler crossbred	4.87 ± 0.31 ^e	8.54 ± 0.34 ^d	11.18 ± 0.38 ^d	15.96 ± 0.15 ^d
Sasso crossbred	8.87 ± 0.83 ^b	13.59 ± 0.37 ^b	17.73 ± 0.41 ^b	21.00 ± 0.32 ^a
		Shank length		
Arbor Acre	4.10 ± 0.06 ^a	5.11 ± 0.04 ^b	6.03 ± 0.09 ^{ab}	6.65 ± 0.13 ^b
FUNAAB-Alpha broiler	3.68 ± 0.10 ^b	5.23 ± 0.22 ^a	6.26 ± 0.15 ^a	6.90 ± 0.18 ^a
Arbor Acre crossbred	3.00 ± 0.13 ^c	3.78 ± 0.18 ^{bc}	5.30 ± 0.24 ^{bc}	5.86 ± 0.16 ^c
Kuroiler crossbred	2.75 ± 0.14 ^d	3.04 ± 0.14 ^d	4.48 ± 0.20 ^c	5.18 ± 0.06 ^d
Sasso crossbred	3.50 ± 0.26 ^{bc}	4.52 ± 0.15 ^c	5.72 ± 0.19 ^b	6.51 ± 0.39 ^{ab}

Means with different superscript a, b, c, d on the same column are significantly ($P < 0.05$) different.
 \pm indicates the mean values plus or minus the standard error

Table 2. Effect of sex on the body weight (gram) and other linear body traits (cm) of different chicken breeds at different

Week			2	4	6	8
Body parameters	Breed	Sex				
Bodyweight (gram)	Arbor Acre	Male	455.75 ± 22.35 ^a	990.17 ± 23.48 ^a	1486.00±26.27 ^a	2106.17 ± 20.24 ^a
		Female	403.10 ± 12.08 ^b	734.50 ± 17.45 ^b	1209.63 ± 18.42 ^b	1850.36 ± 15.48 ^b
Shank length (cm)		Male	4.70 ± 0.28 ^a	4.90 ± 0.66 ^{ab}	6.56 ± 0.17 ^a	7.08 ± 0.76 ^a
		Female	4.10 ± 0.03 ^a	5.10 ± 0.25 ^a	5.80 ± 0.19 ^a	7.03 ± 0.35 ^b
Breast girth (cm)		Male	10.50 ± 0.75 ^a	14.98 ± 0.48 ^a	18.86 ± 0.08 ^a	20.46 ± 0.11 ^a
		Female	9.00 ± 0.20 ^b	11.36 ± 0.28 ^b	14.83 ± 0.45 ^b	18.82 ± 0.55 ^b
Bodyweight (gram)	Crossbred broiler	Male	430.12 ± 12.30 ^a	910.35 ± 13.70 ^a	1310.29±12.27 ^a	1835.50 ± 25.28 ^a
		Female	380.18 ± 10.60 ^b	650.00 ± 12.60 ^b	1170.35±17.60 ^b	1350.70 ± 13.45 ^b
Shank length (cm)		Male	3.75 ± 0.08 ^a	4.35 ± 0.25 ^a	5.85 ± 0.09 ^a	6.00 ± 0.02 ^a
		Female	2.85 ± 0.06 ^b	3.87 ± 0.25 ^b	4.67 ± 0.09 ^b	5.09 ± 0.02 ^b
Breast girth (cm)		Male	9.93 ± 0.75 ^a	12.90 ± 0.48 ^a	17.80 ± 0.08 ^a	19.46 ± 0.11 ^a
		Female	6.00 ± 0.24 ^b	11.36 ± 0.07 ^b	14.82 ± 0.05 ^b	16.88 ± 0.26 ^b
Bodyweight (gram)	FUNAAB-Alpha broiler	Male	386.12 ± 12.30 ^a	708.35 ± 13.70 ^a	1285.29 ± 12.27 ^a	1650.50 ± 25.28 ^a
		Female	300.18 ± 10.60 ^b	650.00 ± 12.60 ^b	900.35 ± 17.60 ^b	1280.70 ± 13.45 ^b
Shank length (cm)		Male	4.02 ± 0.08 ^a	5.35 ± 0.25 ^a	6.08 ± 0.09 ^a	7.48 ± 0.02 ^a
		Female	3.65 ± 0.06 ^b	5.09 ± 0.25 ^a	4.85 ± 0.09 ^b	6.12 ± 0.02 ^b
Breast girth (cm)		Male	7.13 ± 0.75 ^a	12.60 ± 0.48 ^a	15.08 ± 0.08 ^a	17.80 ± 0.11 ^a
		Female	6.45 ± 0.24 ^b	10.30 ± 0.07 ^b	11.02 ± 0.05 ^b	13.62 ± 0.26 ^b

Means with different superscript a, b, c, d on the same column are significantly (P < 0.05) different.

Table 3. Interaction between genotype and sex on the body weight (gram) and other linear body traits (cm) of different chicken breeds at different ages

Genotype	Sex	Body Traits	Week				
			2	4	6	8	
Arbor Acre	Male	Body weight	465.02 ± 19.46 ^a	994.17 ± 12.48 ^a	1470.05 ± 21.48 ^a	2080.65 ± 18.76 ^a	
	Female		380.47 ± 19.46 ^b	784.02 ± 19.46 ^b	1205.02 ± 19.46 ^b	1750.02 ± 19.46 ^b	
Crossbred broilers	Male		425.02 ± 19.46 ^a	900.02 ± 19.46 ^a	1350.02 ± 19.46 ^a	1800.02 ± 19.46 ^a	
	Female		378.40 ± 21.46 ^b	600.13 ± 24.18 ^b	1050.35 ± 15.55 ^b	1220.37 ± 16.66 ^b	
FUNAAB-Alpha broiler	Male		350.02 ± 15.03 ^a	710.14 ± 10.08 ^a	1280.40 ± 10.07 ^a	1680.70 ± 5.76 ^a	
	Female		283.10 ± 11.23 ^b	690.47 ± 0.12 ^b	838.27 ± 10.15 ^b	1176.51 ± 15.08 ^b	
Arbor Acre	Male		Breast girth	10.10 ± 0.55 ^a	14.50 ± 0.17 ^a	18.60 ± 0.39 ^a	19.35 ± 0.30 ^a
	Female			10.23 ± 0.22 ^a	14.40 ± 0.13 ^a	16.13 ± 0.29 ^b	17.24 ± 0.77 ^b
Crossbred broilers	Male	8.85 ± 0.29 ^a		12.19 ± 0.16 ^a	16.69 ± 0.13 ^a	18.21 ± 0.33 ^a	
	Female	7.34 ± 0.25 ^a		10.32 ± 0.14 ^b	13.70 ± 0.12 ^b	16.19 ± 0.11 ^b	
FUNAAB-Alpha broiler	Male	6.53 ± 0.62 ^a		7.68 ± 0.13 ^a	11.03 ± 0.42 ^a	14.80 ± 0.38 ^a	
	Female	5.84 ± 0.23 ^b		6.56 ± 0.11 ^b	10.09 ± 0.45 ^b	11.70 ± 0.39 ^b	
Arbor Acre	Male	Shank length		4.53 ± 0.46 ^a	4.83 ± 0.26 ^b	6.41 ± 21.46 ^a	7.65 ± 0.22 ^a
	Female			3.92 ± 0.15 ^b	5.32 ± 0.55 ^a	5.79 ± 0.55 ^b	6.93 ± 0.45 ^b
Crossbred broilers	Male		3.66 ± 0.55 ^a	4.11 ± 0.15 ^a	5.80 ± 0.75 ^a	6.11 ± 0.55 ^a	
	Female		2.40 ± 0.55 ^b	3.31 ± 0.55 ^b	4.68 ± 0.27 ^b	5.25 ± 0.55 ^b	
FUNAAB-Alpha broiler	Male		4.15 ± 0.66 ^a	5.92 ± 0.34 ^a	6.52 ± 0.28 ^a	7.90 ± 0.76 ^a	
	Female		3.48 ± 0.44 ^b	5.89 ± 0.26 ^a	6.29 ± 0.54 ^a	6.48 ± 0.43 ^b	

Mean with different superscript a, b, c, d on the same column are significantly ($P < 0.05$) different.

Table 4. Effect of genotype on feed intake (gram), body weight gain (gram) and feed conversion ratio of different chicken breeds at different ages

Weeks		2	4	6	8
Genotype	Feeding traits				
Arbor Acre	Feed Intake (gram)	42.01 ± 0.78 ^{bc}	122.24 ± 0.33 ^{bc}	154.09 ± 0.56 ^b	145.22 ± 0.56 ^b
FUNAAB-Alpha broiler		36.42 ± 0.93 ^d	104.53 ± 0.34 ^d	112.11±0.35 ^e	125.83 ± 0.37 ^d
Arbor Acre crossbred		49.14 ± 0.36 ^b	127.11 ± 0.10 ^b	135.73±0.98 ^c	145.00 ± 0.36 ^b
Kuroiler crossbred		51.26 ± 1.76 ^a	141.80 ± 0.42 ^a	157.84±0.40 ^a	152.63 ± 0.44 ^a
Sasso crossbred		40.86 ± 0.19 ^c	113.84 ± 0.42 ^c	125.26±0.44 ^d	143.10 ± 0.17 ^{bc}
Arbor Acre	Body weight gain (gram)	400.17 ± 6.35 ^a	520.00 ± 28.49 ^a	660.08 ± 17.44 ^a	600.73 ± 15.55 ^a
FUNAAB-Alpha broiler		295.04 ± 3.89 ^d	346.87 ± 14.26 ^e	240.08 ± 11.29 ^d	398.24 ± 17.27 ^d
Arbor Acre crossbred		306.07 ± 7.93 ^c	500.77 ± 15.55 ^b	370.89 ± 14.22 ^c	420.23 ± 17.66 ^c
Kuroiler crossbred		261.48 ± 8.87 ^e	370.18 ± 8.74 ^d	180.63 ± 10.28 ^e	350.16 ± 18.24 ^e
Sasso crossbred		358.08 ± 5.55 ^b	480.66 ± 20.51 ^c	450.28 ± 12.32 ^b	490.49 ± 10.69 ^b
Arbor Acre	FCR	2.82 ± 0.02 ^e	2.12 ± 0.16 ^e	2.94 ± 0.03 ^e	1.86 ± 0.15 ^e
FUNAAB-Alpha broiler		3.28 ± 0.03 ^c	4.20 ± 0.14 ^b	4.38 ± 0.11 ^a	4.00 ± 0.40 ^a
Arbor Acre crossbred		3.64 ± 0.04 ^b	3.80 ± 0.22 ^c	3.19 ± 0.07 ^d	2.90 ± 0.05 ^d
Kuroiler crossbred		3.80 ± 0.19 ^a	4.32 ± 0.32 ^a	4.04 ± 0.06 ^b	3.72 ± 0.03 ^c
Sasso crossbred		3.00 ± 0.02 ^d	3.70 ± 0.18 ^d	3.92 ± 0.14 ^c	3.76 ± 0.13 ^b

FCR – Feed conversion ratio; Mean with different superscript a, b, c, d on the same column are significantly (P < 0.05) different.



Supporting Figure 1. Types of typical FUNAAB-Alpha Broilers. A: Naked neck type, B: Frizzle feathered type, C: Normal feathered type

Supporting Table 1. The mating designs and control groups (2&3):

1 st group	Sire (n)	Dam	Crossbreds Broiler (n)
a	Arbor Acre (12)	FUNAAB-Alpha pullet	Arbor Acre-FUNAAB-Alpha (120)
b	Kuroiler (12)	FUNAAB-Alpha pullet	Kuroiler-FUNAAB-Alpha (120)
c	Sasso (12)	FUNAAB-Alpha pullet	Sasso-FUNAAB-Alpha (120)
Total	36	120	360
			Control (n)
2 nd group	FUNAAB-Alpha Broiler		120
3 rd group	Arbor Acre		120