DOI: https://dx.doi.org/10.4314/gjpas.v24i1.2

GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL. 24, 2018: 11-16
COPYRIGHT© BACHUDO SCIENCE CO. LTD PRINTED IN NIGERIA ISSN 1118-0579
www.globaljournalseries.com, Email: info@globaljournalseries.com

GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF THE BLACK AND PEARL GUINEA FOWL (*NUMIDA MELEAGRIS*) AND THEIR CROSSES

VICTORIA N. EBEGBULEM AND BASSEY O. ASUQUO

(Received 21 July 2017; Revision Accepted 2 November 2017)

ABSTRACT

This study was carried out to estimate and evaluate the growth performance and carcass yield of the black and pearl guinea fowl and their crosses. The following three mating groups were established: Pearl male X Pearl female (PXP), Black male X Black female (BXB) and Black male X Pearl female (BXP), from which a total of 317 guinea fowl keets were obtained in six hatches and used for the study. There were 100 PXP, 118 BXB and 99 BXP keets. Growth parameters estimated were body weight, body weight gain, feed intake and feed conversion ratio. Carcass traits studied include live weight at point of slaughter, slaughter weight, dressed weight and dressing percentage. Carcass traits were taken at 14 weeks of age. All the growth performance traits studied did not differ significantly ($P > 0.05$) across the genotype groups, except body weight at 10, 12 and 14 weeks of age. Birds of the PXP pure line were significantly higher ($P < 0.05$) at 10-14 weeks old than the other two genotype in this respect. The average bi-weekly body weight gains (g/bird) were 149.34, 126.78 and 124.24g and average daily body weight gains were 9.33, 9.06 and 8.87g for birds in the PXP, BXP and BXB genotypes respectively. The average daily feed intake were 47.92, 47.15 and 47.18g for the PXP, BXB and BXP genotypes respectively while average feed conversion ratios were 5.14, 5.22 and 5.32 for the PXP, BXP and BXB genotypes respectively. Significant differences were not observed among the genotype groups in all the carcass traits. The dressing percentages were 75.83, 75.17 and 74.50 for the BXB, PXP and BXP genotypes respectively. It was concluded that the genotype groups did not differ significantly in their growth performance and carcass traits due to a probable genetic relatedness among the ancestors.

KEYWORDS: Weight gain, Feed Conversion Ratio, Slaughter weight, Dressing Percentage

INTRODUCTION

The guinea fowl is next to the domestic chicken in terms of number and supply of protein in Nigeria (Ayorinde 2004). A large population of guinea fowl in Nigeria is found in the northern guinea savanna zone, while the forest-dwelling crested guinea fowl (*Guttera edouardi edouardi*) also exist within the southern region (Obike *et al.*, 2011). The population of semi-domesticated guinea fowl in Nigeria is put at over 50 million and is widely distributed in the savanna areas of the country (Ikani and Dafwang, 2004). Guinea fowls are reared traditionally under the extensive system just like the local chicken; they are left to scavenge around farmsteads, open fields and compounds for scraps, worms, insects, seeds, leaves, fruits *etc.* As a result of this system of management, their productivity is low. Guinea fowls in Nigeria are recognizable by their plumage color variations. The common varieties include: pearl, white, lavender and black.

The animal protein consumption in Nigeria falls below the FAO recommended quantity of 35 g per caput per day (FAO, 1999). This shortfall in animal protein intake is more severe in the rural areas of Nigeria due to the high cost of animal products. Next to the local chicken, guinea fowl meat and eggs provide good sources of cheap protein to the rural populaces (Obike *et al.,* 2011; Naandam and Issah, 2012) which serve to cushion the effects of poultry products shortages. Despite the abundant number of guinea fowls in Nigeria and its numerous benefits, the production of guinea fowl is still at a rudimentary level. According to Ocheja *et al*. (2011) full scale domestication of the guinea fowl has not been attempted in Nigeria because seemingly, little attention has been given to its commercial production as the prevailing situation is small flocks maintained in free range.

The investigation of the growth performance as well as the carcass yield of the guinea fowl will provide baseline information on the genetic improvement of this wonderful species of poultry.

MATERIALS AND METHODS

The study was executed at the poultry unit of the Teaching and Research Farm of Animal Science Department, University of Calabar, Nigeria. Calabar is located at 4^{O} 9` latitude North and 8$^{O}$ 3` longitude East with an average altitude of 42 meters. The annual rainfall range from 3000-3500 mm and the average daily

Victoria N. Ebegbulem, Department of Animal Science, University of Calabar, Calabar, CRS, Nigeria.
Bassey O. Asuquo, Department of Animal Science, University of Calabar, Calabar, CRS, Nigeria.

temperature is 25^{O} C, while the wind speed/direction is 8.1km/hr west Google Earth (2012).

A base population of 115 adult guinea fowls at point of lay, consisting of 15 pearl males, 56 pearl females, 14 black males and 30 black females was acquired for the study. The parent population was randomly divided into three different mating groups (Pearl male X Pearl female, Black male X Black female, and Black male X Pearl female). The Pearl X Pearl group (36 females and 9 males) was replicated into three with 15 birds per replicate. The Black X Black and Black X Pearl groups (24 females and 6 males respectively) replicated into two each.

The mating ratio was 1:4 in the mating scheme of:

a. Pearl male X pearl female (P X P) Homozygous pearl thorough bred line.
b. Black male X black female (B X B) Homozygous black thorough bred line.
c. Black male X pearl female (B X P) Heterozygous crossbred line.

The parent birds were maintained on deep litter floor in breeding pens and fed *adlibitum* formulated breeders ration containing 20.41% crude protein with 2804Kcal/Kg metabolizable energy.

Egg collection and management of experimental birds:

After mating, eggs were collected from the breeding pens and identified with coloured marker according to the mating groups. The eggs were held in egg trays and stored in well aerated room (under room temperature) for a maximum of eight days before incubation. The eggs were set in seven batches, one week apart, in an artificial incubator with 37.5 ^{0} C temperature and 60 percent relative humidity. Hatched keets were identified with permanent marker ink under the belly according to their mating group, weighed and commonly brooded for four weeks under continuous illumination in a brooder house. Thereafter, they were raised on deep litter (according to their genotype group) under natural daylight until the end of the study. The keets were fed *ad libitum* on a commercial starter diet (Vital Super Starter) containing 23percent Crude Protein and 3000Kcal/Kg ME from 0 – 6 weeks of age and a finisher diet (Vital Finisher) with 19 percent Crude Protein and 2900 Kcal/Kg ME from 7-14 weeks of old. At all times the birds were given clean drinking water, proper hygiene applied and necessary medications administered.

Estimation of growth performance traits of the progeny:

Hatched keets were weighed, pedigreed and identified with differently colored marker ink according to their genotype groups. They were reared commonly during the brooding period (0 – 4 weeks), but separated into their genotype groups from 4 – 14 weeks old. They were raised on deep litter using standard management procedures. A total of 317 keets obtained in six hatches were used for the growth studies. There were 100 P X P, 118 B X B and 99 B X P keets altogether.

Growth traits measured include:

- Body weight – at 0, 2, 4, 6, 8, 10, 12 and 14 weeks
- Body weight gain – at 2, 4, 6, 8, 10, 12 and 14 weeks
- Daily weight gain at 2, 4, 6, 8, 10, 12 and 14 weeks
- Daily feed intake at 2, 4, 6, 8, 10, 12 and 14 weeks
- Bi-weekly feed intake
- Feed conversion ratio : feed intake/ weight gain at 2, 4, 6, 8, 10, 12 and 14 weeks

Estimation of carcass characteristics:

At the end of 14 weeks, three birds were picked from each genotype group, from the six hatches. They were starved overnight and slaughtered. The birds picked were those whose live weight were closest to the average body weight of group. The jugular veins of the birds were cut and they were bled, feathers softened by dipping in hot water for about 2 minutes and defeathered by hand picking. Dressed weight was taken after the removal of the shanks, head and viscera. Carcass traits measured include:

- Live weight – at point of slaughter
- Slaughter weight – after bleeding
- Dressed weight
- Dressing percentage- dressed weight/ live weight X 100

Statistical Analysis

Data generated was subjected to Analysis of Variance in a Randomized Complete Block Design using SAS (2010) computer application programme. Means with significant difference were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

Growth performance of the three genotypes of guinea fowl:

Results of the growth performance of the three genotypes of guinea fowl are presented in Table1. All the growth performance traits studied did not differ significantly ($P > 0.05$) across the genotype groups, except body weight at 10, 12 and 14 weeks of age. Birds of the PXP genotype exhibited the highest numerical body weight from 2- 14 weeks of age, though they had the least day old body weight (24.88g). They were however significantly different ($P < 0.05$) at 10-14 weeks old from the other two genotype groups. The PXP genotype similarly manifested a higher body weight gain from weeks 2-14 of age, except at the 8th week. The average bi-weekly body weight gains (g/bird) were 149.34, 126.78 and 124.24g and average daily body weight gains were 8.17, 7.56 and 7.78g for birds in the PXP, BXP and BXB genotypes respectively. The average total feed intake (were 670.87, 660.14 and 661.91g, while the average daily feed intake were 47.92, 47.15 and 47.18g for the PXP, BXB and BXP genotypes respectively. The average feed conversion ratios were 5.14, 5.22 and 5.32 for the PXP, BXP and BXB genotypes respectively. The highest values were recorded in the 14th week of age, while the lowest values were in the 2nd week of age.

Table 1: Mean growth performance of three genotypes of guinea fowl

Weeks	Parameter	Genotypes			SEM
		P × P	B × B	B×P	
Wk2	Body weight (g)	100.79	97.62	99.91	2.40
	Body weight gain (g/bird)	75.96	71.92	73.22	2.35
	2-weekly feed intake (g/bird)	203.17	203.17	203.17	3.44
	Feed Conversion Ratio (FCR)	2.67	2.82	2.77	0.09
	Daily weight gain (g/day)	5.43	5.14	5.23	0.17
	Daily feed intake (g/day)	14.51	14.51	14.51	0.25
Wk4	Body weight (g)	176.29	167.32	173.60	2.66
	Body weight gain (g/bird)	75.44	69.70	73.69	4.96
	2-weekly feed intake (g/bird)	317.00	317.00	317.00	8.59
	Feed Conversion Ratio (FCR)	4.20	4.55	4.30	0.35
	Daily weight gain (g/day)	5.39	4.98	5.26	0.35
	Daily feed intake (g/day)	22.64	22.64	22.64	0.61
Wk6	Body weight (g)	287.23	274.79	273.01	4.48
	Body weight gain (g/bird)	110.94	107.47	99.41	7.71
	2-weekly feed intake (g/bird)	482.23	459.20	468.93	20.37
	Feed Conversion Ratio (FCR)	4.35	4.27	4.72.	0.50
	Daily weight gain (g/day)	7.92	7.68	7.10	0.55
	Daily feed intake (g/day)	34.45	32.80	33.49	1.46
Wk8	Body weight (g)	464.91	458.99	454.05	3.14
	Body weight gain (g/bird)	177.68	184.20	181.13	14.21
	2-weekly feed intake (g/bird)	704.78	665.36	663.67	27.48
	Feed Conversion Ratio (FCR)	3.97	3.54	3.94	0.40
	Daily weight gain (g/day)	4.62	3.92	4.00	1.01
	Daily feed intake (g/day)	50.34	47.53	47.40	1.96
Wk10	Body weight (g)	637.98^{a}	605.24^{ab}	619.84^{b}	10.76
	Body weight gain (g/bird)	173.07^{a}	146.25^{b}	165.71^{a}	16.94
	2-weekly feed intake (g/bird)	818.81	793.53	815.24	20.78
	Feed Conversion Ratio (FCR)	4.73	5.43	5.41	0.40
	Daily weight gain (g/day)	12.36	10.45	11.84	1.21
	Daily feed intake (g/day)	58.49	56.68	58.23	1.48
Wk12	Body weight (g)	822.47^{a}	750.74^{b}	768.28^{b}	10.51
	Body weight gain (g/bird)	184.49	145.51	148.44	11.37
	2-weekly feed intake (g/bird)	1028.48	990.53	994.22	33.33
	Feed Conversion Ratio (FCR)	5.57	6.82	5.32	0.73
	Daily weight gain (g/day)	13.18	10.39	10.60	0.81
	Daily feed intake (g/day)	73.46	70.75	71.02	2.38
Wk 14	Body weight gain (g/bird)	247.80(**939.02)**	144.61(**895.36)**	145.86(**914.14)**	9.28
	2-weekly feed intake (g/bird)	1141.64	1192.18	1171.17	21.23
	Feed Conversion Ratio (FCR)	9.78	8.24	8.03	0.61
	Daily weight gain (g/day)	8.33	10.33	10.42	0.75
	Daily feed intake (g/day)	81.55	85.16	83.66	1.52
Mean	2-weekly body weight gain(g/b)	149.34	124.24	126.78	8.01
	Feed intake(g/b)	670.87	660.14	661.91	30.56
	Feed Conversion Ratio (FCR)	5.14	5.32	5.22	0.25
	Daily weight gain (g/day)	8.18	7.78	7.56	0.38
	Daily feed intake (g/day)	47.92	47.15	47.28	2.18

Means with different superscripts across the rows differed significantly at P>0.05; SEM= Standard error of the mean; g = grammes; b = bird; FCR = feed conversion ratio * Figures in bracket at wk 14 = Body weight

Carcass characteristics of genotypes of guinea fowls:

Table 2 shows the results of the carcass characteristics of the three genotypes of guinea fowl. Significant differences were not observed among the genotype groups in all the carcass traits. The live weights were 975, 950 and 916g for the PXP, BXP and BXB genotypes respectively. The PXP genotype

showed a numerical superiority in slaughter weight (886.67g), followed by the BXP group (856g) and lastly the BXB group (826g). The dressed weights were 736.67, 708.33 and 700.00g in the PXP, BXP and BXB genotypes respectively. The dressing percentages were 75.83, 75.17 and 74.50 in the BXB, PXP and BXP genotypes respectively.

Table 2: Mean carcass characteristics of three genotypes of guinea fowl

Parameter	Genotypes			SEM
	P × P	B × B	B × P	
Live weight (g)*	975.00	916.67	950.00	16.91
Slaughter weight (g)	886.67	826.67	856.67	17.34
Dressed weight (g)	736.67	700.00	708.33	11.11
Dressing percent (%)	75.17	75.83	74.50	0.52

Means across the rows did not differ significantly at P>0.05; SEM= Standard error of the mean
*At point of slaughter

DISCUSSION

Growth performance of guinea fowl genotypes:

Body weight of guinea fowl genotypes:

The non-significant differences obtained among the genotype groups from 0-14 weeks of age indicate that observed numerical differences were generally due to environmental factors than genetic. This observation could also be an indication of genetic relatedness among the groups. As expected, body weight increased with age in the present study as the birds were in the growing stage. This observation is consistent with the opinion Nobo *et al.* (2012) who reported body weight range of 31-32g in guinea fowl keets at 0 week of age. These values were slightly higher than 24.88, 25.72 and 26.70g recorded at day old in the present study for PXP, BXB and BXP genotypes respectively. Nsoso *et al.* (2008) reported lower BWT range (22.0- 25.0g) in keets at five days of age. The body weight values of 100.79, 176.29, 287.23 and 464.91, recorded for the PXP genotype in the present study, at 2, 4, 6 and 8 weeks of age respectively, were close to the values (100, 181.15, 375.25 and 392.59g) reported by Oke *et al.* (2012) in pearl guinea fowl at 3, 5, 7 and 9 weeks of age respectively.

Nobo *et al.* (2012) reported ranges of 66-82, 116-125, 354- 399, 445-479, 667-709, 952-1043 and 1065-1129g at 2, 4, 6, 8, 10 12 and 13 weeks of age. Nsoso *et al.* (2008) like- wise, reported higher figures (346-394g) at 6 weeks of age. These reports by the authors were at variance with the results of the present study. Under intensive and semi-intensive systems of management, Saina (2005) reported values (807 and 591g respectively) for birds at 12 weeks of age. These were within the range of the results of the present study at 12 weeks of age. Guinea fowls have been reported to tend to be slow growing birds (Nsoso *et al.*, 2008). According to Ayorinde (2004), "low body weight is a characteristic feature of guinea fowls". CABI (1987) opined that low body weight and trim body structure were evolutionary adoptions of the guinea fowl, appropriate for speedy flying and running fast, which aid its survival in the wild. The author asserted that the guinea fowl had been selected against heavy weight or fleshiness naturally.

Body weight gain of guinea fowl genotypes:

The mean daily weight gain values recorded in the present study (8.87, 9.06 and 9.33g) were higher than the figures (6.18, 6.35, 6.55 and 6.52g) reported by Adjetey (2010) who fed varying concentrations of dietary crude protein to pearl guinea fowls, and Odukwe (2009)(6.05g) in guinea fowls. Saina (2005) on the other hand, reported average daily weight gain of 8g in guinea fowls kept under intensive system of management, which is similar to the results of the present study. The author however, obtained higher average daily weight gain of 12.3g for guinea fowls raised under the semi-extensive system of management. Nobo *et al.* (2012) reported average daily weight gain of 12.8-13.8g in guinea fowls raised under intensive system of management.

The import of the non-significant differences in body weight gain among the three genotype groups of guinea fowl is a probable genetic similarity among the groups.

Feed intake of genotypes of guinea fowl:

The feed intake of the birds increased expectedly with age, in corroboration of the assertion of Nobo *et al.* (2012) that guinea fowls increase their feed intake in response to their requirement for protein and energy need necessary for growing and advancement. The average daily feed intake observed in this research was slightly below a range (51.10-53.69g) reported by Adjetey (2010) in guinea fowls up to 27 weeks of age. Nobo *et al.* (2012) however, recorded slightly lower average daily feed intake of the range 41.13- 42.24g for guinea fowls at 0-13 weeks of age. Seabo *et al.* (2011) who fed a commercial grower diet to guinea fowls from 6-12 weeks of age, reported feed intake of 60.20 - 62.70g per bird. From the fore going, it is plausible comment that feed intake is subject to the birds age, nutrient digestibility of the feed, as well as, the energy needs of the birds.

Feed conversion ratio (FCR) of guinea fowl genotypes:

The FCR of the birds was high among the genotype groups, with the peak being recorded at 14 weeks of age. The average FCR recorded in this study

(5.14, 5.32 and 5.22) were within the range (5.2-6.83) reported by Nsoso *et al.* (2008). Nobo *et al.* (2012) reported FCR range of 3.83 to 4.09 in guinea fowls fed differing planes of phane meal diets. On the other hand, Seabo *et al*. (2011) had FCR range of 6.37 to 6.71. Mwale *et al.* (2008) opined that age has an inverse relationship with FCR in the guinea fowl which they explained to be as a result of higher quantities of feed required for growth. Furthermore, the wild behavior of guinea fowls contributed to the poor FCR in the birds.

Carcass characteristics of the guinea fowl genotypes:

The live weight at point of slaughter recorded in the present study (950.0, 916.67 and 975.0g) were lower than 1103-1156g reported by Nobo *et al.* (2012) in guinea fowls at 13 weeks of age, as well as 1210-1470g reported by Seabo *et al.* (2011) in 12 weeks old guinea fowls. Similarly, Mareko *et al.* (2006) reported a live weight of guinea fowls at 14 weeks of age, ranging from 1005-1155g. The low heterosis recorded in the present study could be attributed to low genetic variability of the birds.

Carcass dressed weight of guinea fowls in the present study (700.00-736.67g) were similar to the range of 655 to 786g reported by Nobo *et al* (2012) for 13 weeks old guinea fowls. Adjetey (2010) however reported higher carcass dressed weight ranges of 1015-1056g 14 weeks of age. The dressing percentage recorded in the present study (74.50, 75.17 and 75.83 percent) were slightly higher than 70.30 percent reported by Ogah (2011), but similar to the reports of Nobo *et al.* (2012) in 13 week old guinea fowls (60.47-75.82 percent). Dressing percentages obtained in this research work were however less than 94.40 and 93.59 percent given by Mareko *et al.* (2006) in 14 week old guinea fowls. Carcass dressing percentage has been suggested to be influenced by the stage of maturity of the birds, breed, degree of finish and the contents of the gut of the birds (Mareko *et al.,* 2006). These factors could be explained as the reason for the differences between the results of the present research and others. Dressing percentages of various species of farm animals were given by Wariss (2000) as: 50 percent (sheep), 53 percent (cattle), 75 percent (pigs), and 72 percent (broiler chicken).

CONCLUSION

The non-significant differences obtained among the genotype groups in most of the growth traits and in all the carcass traits indicate the genetic relatedness among the black and pearl guinea fowl.

REFERENCE

Adjetey, A. N. A., 2010. Protein requirements for growing and laying indigenous guinea fowls (Numida meleagris) in the humid tropical zone of Ghana. Master of Science Thesis, Department of Animal Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Ahaotu, E. O., Umoh, G., Onweagba, A. E., Chukwu, A. O. and Iwuanyanwu, U. P., 2013. Guinea fowl keets performance under improved and extensive conditions in Anthony Patience Farms, Atta-Ikeduru, Imo State, Nigeria. Int J Agri & Biosc. 2(2):82 -86.

Ayorinde, K. L., 2004. The Spice of Life. Inaugural lecture, University of Ilorin, Ilorin, Nigeria,.

CAB International., 1987. The Technical Agricultural and Rural Co-operation Manual of Poultry Production in the Tropics. Cambrian News Ltd. Aberystwyth, United Kingdom, 111-114.

Duncan, E. B., 1955. Duncan's Multiple Range Test. Biometrics, 11:1

Food and Agriculture Organization., 1999. Statistical database. Food and Agricultural Organization of United Nations, Rome, Italy; www.fao.org.

Google Earth., 2012. GeoNames Geographical database, courtesy of Google Earth. Travelling luck for Calabar, Cross River State, Nigeria. Time zone, latitude, longitude, elevation and map/satellite image, retrieved November 13, 2013, 9.05 am.

Ikani, E. I. and Dafwang, I. I., 2004. The Production of Guinea fowl in Nigeria. Extension Bulletin No. 207. Poultry Series No. 8. National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria, Nigeria ,1-28.

Mareko, M. D. H., N`soso, S. J. and Thibeng, K., 2006. Preliminary carcass and meat characteristics of guinea fowl (Numida meleagris) raised on concrete and earth floors in Botswana. J Food Tech, 4(4):313-317.

Mwale, M. E., Mupangwa, J. F. and Mapiye, C., 2008. Growth performance of guinea fowl keets fed graded levels of baobab seed cake diets. Int. J Poult. Sc, 7: 429-432.

Naandam, J. and Issah, G. B., 2012. Hatchability of guinea fowl eggs and performance of keets under the traditional extensive system in Tolon-Kumbungu district of Ghana. Online J. Anim. & Feed Res, 2(3):253-257.

Nobo, G., Moreki, J. C and Nsoso, S. J., 2012. Feed intake, body weight, average daily gain, feed conversion ratio and carcass characteristics of helmeted guinea fowl fed varying levels of phane meal (Imbresia belina) as replacement of fishmeal under intensive system. International Journal of Poultry Science,11 (6):378-384.

Nsoso, S. J., Mareko, M. H. D., Manyanda, S. and Legodimo, P. P., 2008. The effect of housing type on body parameters, feed intake and feed conversion ratio of guinea fowl (Numida

meleagris) keets and chemical composition of their meat during growth and development in Botswana. Research Journal of Animal Sciences, 2(2): 36-40.

Obike, O. M., Oke, U. K. and Azu, K. E., 2011. Comparison of egg quality traits of Pearl and Black varieties of guinea fowl in a Rain- Forest Zone of Nigeria. Proc. of 36th Conf. Nig. Soc. Anim. Prod., 13-16 March, 2011, University of Abuja, Nigeria.19-21.

Ocheja, J. O., Okpanachi, U., Okpe, A. A. and Lalabe, C. B., 2011. Management problems of guinea fowl production in Nigeria. Proc. 36th Conf. of Nig. Soc. Anim. Prod.12-16th March, University of Abuja, Nigeria.296-298.

Odukwe, C. N., 2009. Growth performance of guinea fowl raised in a humid tropical environment. Unpublished Doctoral Thesis, Department of Non-ruminant Animal Production, Micheal Okpara University of Agriculture Umudike.

Ogah, D. M., 2011. In-vivo prediction of live weight and carcass traits using body measurements in indigenous guinea fowl. Biotech. Anim. Husb., 27 (4):1827-1836.

Oke, U. K., Ariwodo, C. A., Herbert, U., Ukachukwu, S. N., Ukwueni, A. I., Akinmutimi, A. H., Ezeigbo, I. I. and Chukwu, D. O., 2012. Impact of egg size on the fertility, hatchability and early growth traits of two varieties of guinea fowl in a humid tropical environment. Journal of Animal Science Advances, 2, Suppl. 3(2) :299 – 305.

Saina, H., 2005. Guinea fowl Production under small holder farmer management in Guruve District, Zimbabwe. Master of Philosophy Thesis, Department of Animal Science, University of Zimbabwe, Harare.

SAS., 2010. Statistical Analysis Institutes User's Guide. SAS Institute inc. Cary N.C.,.

Seabo, D., Moreki, J. C., Bagwasi, N. and Nthoiwa, G. P., 2011. Performance of guinea fowl (Numida meleagris) fed varying protein levels. Online J Anim. & Feed Res., 1:255-258.

Wariss, P. D., 2000. Meat Science: An Introductory Text. Britol, United Kingdom, CABI Publishers.