Growth Performance of Guinea Fowl Fed Diets Containing Yellow Maize, Millet and White Sorghum as Energy Sources and Raised under Intensive System.

Article *in* Pakistan Journal of Nutrition · January 2013

S J Nsoso
Botswana Univesity of Agriculture and Natural Resouces

Othusitse Ricky Madibela
Botswana University of Agriculture and Natural Resources

John Cassius Moreki
Botswana College of Agriculture

Pakistan Journal of Nutrition 12 (4): 306-312, 2013
ISSN 1680-5194

Growth Performance of Guinea Fowl Fed Diets Containing Yellow Maize, Millet and White Sorghum as Energy Sources and Raised under Intensive System

Samuel Uaperendua Tjetjoo, John Cassius Moreki,
Shalaulani James Nsoso and Othusitse Ricky Madibela
Department of Animal Science and Production, Botswana College of Agriculture,
Private Bag, 0027, Gaborone, Botswana

Abstract: This study investigated growth performance of guinea fowl fed diets containing 3 cereal grains as energy sources in comparison to commercial broiler diets. Birds were raised under intensive system from 3 to 16 weeks of age. A completely randomized design was used where 160 keets were randomly assigned to 4 dietary treatments. Each treatment had 40 birds with 4 replicates of 10 birds each. Data were analyzed using General Linear Model Procedure of Statistical Analysis Software (version 9.0). The results showed that dietary treatment did not (P>0.05) influence body length, body circumference, wing stretch, shank length and neck length of guinea fowl. From 3 to 16 weeks of age feed intake was significantly (P<0.0001) lower for control diet (13714.79±209.65 g) than maize (16085±209.65 g), millet (1609.63±209.65 g) and sorghum (15872±209.65 g) diets. Furthermore, FCR was significantly (P<0.0001) lower on control diet (11.33±0.37) than maize (13.91±0.37), millet (14.90±0.37) and sorghum (13.72±0.37) diets. Average weekly body weight gain was significantly (P<0.05) lower for birds on millet diet (82.98±2.18 g) than birds on control (93.14±2.18 g), maize (89.25±2.18 g) and sorghum (89.03±2.18 g) diets. These results suggest that cereal grains can be used in guinea fowl diets without affecting performance.

Key words: Dietary treatment, growth parameters, guinea fowl, intensive system, keets

INTRODUCTION

The production of guinea fowl as an alternative poultry enterprise is gaining ground throughout the world, especially in developing countries which have shown increasing demand for this particular meat (Nahashon *et al*., 2006; Yildirim, 2012). The gamey flavour of guinea fowl meat may be the factor influencing its preference and demand. Guinea fowl adapt to different environmental conditions and as such, they are ubiquitous (Kokosyzyski, 2011). As a result of the increasing interest in guinea fowl farming and gradual domestication of the bird, feeding management and breeding strategies are required that will bring about improvement in its performance (Ogah, 2011). However, according to Nahashon *et al*. (2006) and Elhashmi *et al*. (2011), turning guinea fowl production into a profitable enterprise requires understanding of their growth characteristics and patterns as these allow the design of optimum management practices and hence improved profitability.

The success of poultry meat production has been strongly related to improvements in growth rates and carcass yield (Musa *et al*., 2006). Indigenous guinea fowl varieties have lower body weights (Mundra *et al*., 1993) than improved strains. Furthermore, Ayorinde and Ayeni (1983) reported that a guinea fowl tends to grow slowly weighing less than 1 kg at 8 weeks of age compared to a broiler chicken which reaches 1.5 to 2 kg in 6-8 weeks. Nahashon *et al*. (2005) reported carcass yields of about 70% at 8 weeks of age. Similarly, Teye *et al*. (2006) obtained a carcass yield of 66.9 and 69.7% for male and female Cobb broilers at 8 weeks of age, respectively. Hughes and Jones (1980) reported carcass yield (dressing percentage) of male and female guinea fowl broilers at 12 weeks of age to be 76.8 and 76.9%, respectively.

Guinea fowl farming is in its infancy in Botswana (Tebesi *et al*., 2012); hence information on their nutrition is limited. According to Nahashon *et al*. (2006), the profitability of guinea fowl is hampered by poor nutrition due in part to lack of management and feeding guidelines. Currently, formulated guinea fowl diets are not available in Botswana resulting in guinea fowl fed commercial diets for chickens. Therefore, a study was conducted to evaluate growth performance of guinea fowl under intensive management system fed diets containing millet, white sorghum and yellow maize as energy sources in comparison to commercial broiler diets (control).

MATERIALS AND METHODS

Experimental site: The study was carried out at Botswana College of Agriculture (BCA) Guinea Fowl Rearing Unit, Sebele Content farm from February to

Corresponding Author: John Cassius Moreki, Department of Animal Science and Production, Botswana College of Agriculture, Private Bag, 0027, Gaborone, Botswana

June 2012. The BCA is 24°33' S, 24°54' E and is located at an altitude of 994 m above sea level with an average annual rainfall of 538 mm and mean daily temperature of 30°C (Emongor, 2007).

Experimental design: A completely randomized design was used where 160 keets were randomly allocated to 4 dietary treatments: control (commercial broiler diet), maize, millet and sorghum. Each dietary treatment had 40 birds with four replicates of 10 birds each.

Management of keets: A total of 160 keets were hatched at BCA hatchery unit and raised in a closed house which provided both warmth and adequate ventilation. At 4 weeks of age, the keets were transferred to 16 growing pens where they were randomly assigned to 4 dietary treatment groups. The 4 treatments comprised control diet and experimental diets consisting of yellow maize, white sorghum and millet as energy sources. Birds were raised on earth floor pens with perches. A drinker and a feeder were placed in each pen. Feed and water were provided *ad libitum* to all treatments.

Experimental diets: Dietary treatments comprised control diet and experimental diets consisting of yellow maize, white sorghum and millet as energy sources. Diets for each feeding phase were isocaloric and isonitrogenous. Cereal grains were bought from Botswana Agricultural Marketing Board and commercial broiler diets and feed premixes from feed distributors and feed manufacturers. Experimental diets were mixed at the Department of Agricultural Research and were formulated according to Botswana Standard for Guinea fowl (BOS 234:2006). Experimental diets contained 24% CP and 12.13 MJ/Kg ME starter diet which was fed from 0 to 6 weeks of age; a grower diet (20% CP and 12.13 MJ/Kg ME) from 7 to 12 weeks of age and a finisher diet (15% CP and 11.30 MJ/Kg ME) fed from 13 to 16 weeks of age. The commercial broiler diet contained 20% CP and 12.0 MJ/Kg ME starter diet and was fed from 0 to 6 weeks of age; a grower diet (18% CP and 12.2 MJ/Kg ME) from 7 to 12 weeks of age and a finisher diet (16% CP and 12.6 MJ/Kg ME) was fed from 13 to 16 weeks of age. In this study, 16 weeks was regarded as market age of guinea fowl.

Data collection: Data collection started at 3 weeks of age. Feed Intake (FI) was determined as the difference between the amount of feed offered and refusals (Tufarelli *et al*., 2011) in each replicate. Pen body weights were recorded on weekly basis. Body Weight (BW) and FI were measured in the morning before watering and feeding. Body Weight Gain (BWG) was determined as the difference between BW of the present week from that of the previous week over 7 days (Oke *et al*., 2012). Morphological parameters of growth such as body length, body circumference, shank length, neck length and wing stretch length were measured weekly (Nsoso *et al*., 2006) using a measuring tape. On average, 14 birds per treatment were randomly selected, measured and weighed from 3 to 16 weeks of age. Feed conversion ratio (FCR) was calculated by dividing the average weekly FI with the average weekly BWG for each replicate (Tufarelli *et al*., 2011). Mortality was recorded throughout the experimental period.

Statistical analyses: Data on FI, average weekly BWG and FCR were analyzed using General Linear Model (GLM) procedure of SAS (version 9.0, 2002-2008) (SAS Institute, 2002) to determine the effect of dietary treatments on growth parameters of guinea fowl. The results reported are least square means separated using Least Significant Difference (LSD). The following statistical model was used:

$$Y_{ijk} = \mu+T_i+\$_{ji}+E_{ijk}$$

where, Y_{ijk} = Observed variables (FI, FCR, BWG, BW, body length, body circumference, wing stretch, shank length, neck length):

μ = Overall mean
ı = Treatment effects (Diets: control, maize, millet, sorghum)
$\$_{ji}$ = Replicate effects
E_{ijk} = Error which is randomly distributed

RESULTS

Table 1 presents a cumulative FI, FCR and BWG of guinea fowl in 13 weeks of production. Dietary treatment had a significant effect on FI, FCR and BWG. Guinea fowl fed control diet showed a significantly (P<0.001) lower overall (0-91 days) FI and FCR compared with maize, millet and sorghum diets. A significant (P<0.05) effect of the dietary treatment on BWG was observed on guinea fowl fed millet diet.

Body weight: The effects of dietary treatment on guinea fowl BW is shown in Table 2. Generally, treatments had no significant (P>0.05) influence on BW.

Body length: Table 3 shows the effect of dietary treatment on guinea fowl body length. Generally, there was no significant (P>0.05) effect of treatments on body length.

Body circumference: Table 4 shows the effect of dietary treatment on guinea fowl body circumference. Dietary treatment did not cause a significant (P>0.05) difference on guinea fowl body circumference.

Wing stretch: Generally, wing stretch of guinea fowl was not significantly (P>0.05) affected by dietary treatment (Table 5).

Table 1: Cumulative feed intake, feed conversion and body weight gain per guinea fowl fed commercial broiler diets and experimental diets from 3 to 16 weeks under intensive management system

	Treatments (experimental diets)					
Parameters	Control	Maize	Millet	Sorghum	CV	SL
FI (g)	13714.79±209.65^{a}	16085±209.65^{b}	16019.63±209.65^{b}	15872.52±209.65^{b}	2.72	***
FCR	11.33±0.37^{a}	13.91±0.37^{b}	14.90±0.37^{b}	13.72±0.37^{b}	5.50	***
BWG (g)	93.14±2.18^{b}	89.25±2.18^{ab}	82.98±2.18^{a}	89.03±2.18^{ab}	4.93	*

^{a,b} Row means with different superscripts are significantly different. FI: Feed intake; FCR: Feed conversion ratio;
BWG: Body weight gain; SL: Significance level. Significant *(P<0.05), Significant ***(P<0.001)

Table 2: Means and standard errors of guinea fowl body weights (g) fed commercial broiler diets and experimental diets from 3 to 16 weeks of age under intensive management system

	Treatments (experimental diets)					
Weeks	Control	Maize	Millet	Sorghum	CV	SL
3	198.13±2.03	198.13±2.03	198.75±2.03	196.25±2.03	2.58	NS
4	211.27±6.37	207.51±6.37	217.43±6.37	224.43±6.37	13.53	NS
5	310.81±7.70	308.17±7.70	322.51±7.70	317.03±7.70	13.14	NS
6	434.28±9.21^{ab}	396.97±9.21^{a}	425.89±9.21^{ab}	441.40±9.21^{b}	10.72	*
7	530.57±15.42	490.02±15.42	491.81±15.42	496.06±15.42	11.30	NS
8	665.21±15.52	629.73±15.52	624.93±15.52	634.90±15.52	10.83	NS
9	785.81±17.78	737.87±17.78	757.19±17.78	763.05±17.78	9.32	NS
10	894.70±16.99	856.21±16.99	844.16±16.99	899.11±16.99	8.57	NS
11	1028.41±14.2^{c}	979.68±14.27^{b}	1019.36±14.2^{c}	1004.84±14.2^{b}	6.93	*
12	1049.49±14.2	999.95±14.22	1057.69±14.2	1013.24±14.2	7.45	NS
13	1217.49±22.8^{b}	1137.93±22.8^{ab}	1074.91±22.8^{a}	1140.30±22.8^{ab}	8.36	**
14	1274.49±30.9	1219.93±30.9	1180.91±30.9	1227.30±30.9	7.37	NS
15	1353.26±30.04	1299.00±30.04	1241.82±30.04	1288.16±30.04	6.95	NS
16	1408.98±28.62^{b}	1358.43±28.62^{ab}	1277.43±28.62^{a}	1353.65±28.62^{ab}	7.44	*

^{a,b,c} Row means with different superscripts are significantly different. SL: Significance level. Significant* (P<0.05),
Significant** (P<0.01), Non-significant (NS-P>0.05)

Table 3: Means and standard errors of growth of guinea fowl body lengths (cm) fed commercial broiler diets and experimental diets from 3 to 16 weeks of age under intensive management system

	Treatments (experimental diets)					
Weeks	Control	Maize	Millet	Sorghum	CV	SL
3	15.40±0.39	15.10±0.39	14.89±0.39	15.66±0.39	9.06	NS
4	19.38±0.30	19.07±0.30	19.27±0.30	19.81±0.30	9.08	NS
5	23.61±0.55	22.89±0.55	23.81±0.55	24.01±0.55	6.36	NS
6	27.96±0.43	26.44±0.43	27.43±0.43	27.83±0.43	5.64	NS
7	30.68±0.59	29.13±0.59	29.28±0.59	29.21±0.59	5.51	NS
8	33.59±0.70	31.93±0.70	31.88±0.70	32.71±0.70	6.63	NS
9	36.16±0.45	35.01±0.45	34.64±0.45	34.66±0.45	5.12	NS
10	35.89±0.56	36.67±0.56	34.39±0.56	35.51±0.56	4.68	NS
11	39.90±0.78	38.83±0.78	38.86±0.78	38.57±0.78	4.68	NS
12	41.59±0.63^{b}	37.47±0.63^{a}	41.07±0.63^{b}	38.32±0.63^{a}	5.86	***
13	39.97±0.66^{b}	39.36±0.66^{ab}	37.28±0.66^{a}	38.91±0.66^{ab}	5.89	**
14	42.23±0.47	41.71±0.47	40.88±0.47	41.52±0.47	4.48	NS
15	43.14±0.70	41.85±0.70	40.78±0.70	41.30±0.70	5.47	NS
16	3.43±1.66	41.71±1.66	41.13±1.66	39.78±1.66	9.76	NS

^{a,b}Row means with different superscripts are significantly different. SL: Significance level.
Significant level **(P<0.01), Significant ***(P<0.001), Non-significant (NS-P>0.05)

Shank length: Table 6 shows the effect of dietary treatments on guinea fowl shank length. Generally, shank length of was not significantly (P>0.05) influenced by dietary treatment.

Neck length: Neck length of guinea fowl was not significantly (P>0.05) affected by dietary treatment (Table 7).

DISCUSSION

This study was conducted to investigate growth performance of guinea fowl fed diets containing millet, white sorghum and yellow maize as energy sources in comparison to commercial broiler diets. Guinea fowl fed control diet had significantly (P<0.001) lower overall (0-91 days) FI and FCR than other dietary treatments which themselves did not differ significantly. This result is in

Table 4: Means and standard errors of guinea fowl body circumferences (cm) fed commercial broiler diets and experimental diets from 3 to 16 weeks of age under intensive management system

		Treatments (experimental diets)				
Weeks	Control	Maize	Millet	Sorghum	CV	SL
3	15.93±0.38	15.61±0.38	16.57±0.38	16.57±0.38	6.99	NS
4	20.11±0.33	19.79±0.33	19.69±0.33	20.27±0.33	5.38	NS
5	23.22±0.39	22.71±0.39	23.14±0.39	23.04±0.39	5.38	NS
6	26.49±0.41	25.20±0.41	25.98±0.41	26.33±0.41	4.68	NS
7	28.06±0.43	27.45±0.43	27.09±0.43	27.16±0.43	4.38	NS
8	31.19±0.47	30.46±0.47	30.28±0.47	29.91±0.47	4.47	NS
9	32.49±0.66	31.03±0.66	30.76±0.66	32.51±0.66	7.55	NS
10	33.86±0.37	33.64±0.37	33.55±0.37	33.48±0.37	4.60	NS
11	35.32±0.54	33.68±0.54	34.08±0.54	33.35±0.54	6.81	NS
12	36.12±0.34	35.78±0.34	35.18±0.34	35.40±0.34	4.52	NS
13	37.36±0.52	36.80±0.52	36.35±0.52	37.28±0.52	4.21	NS
14	38.36±0.53	38.07±0.53	37.52±0.53	38.72±0.53	5.01	NS
15	38.71±0.75	38.43±0.75	38.78±0.75	38.09±0.75	4.92	NS
16	3.13±0.87	37.08±0.87	36.38±0.87	35.83±0.87	6.57	NS

SL: Significant level, Non-significant (NS-P>0.05)

Table 5: Means and standard errors of guinea fowl wing stretches (cm) fed commercial broiler diets and experimental diets from 3 to 16 weeks of age under intensive management system

		Treatments (experimental diets)				
Weeks	Control	Maize	Millet	Sorghum	CV	SL
3	14.36±0.40	14.87±0.40	15.67±0.40	15.22±0.40	7.91	NS
4	17.06±0.26[a]	17.86±0.26[ab]	19.29±0.26[c]	18.16±0.26[b]	6.28	***
5	19.73±0.36	20.76±0.36	20.44±0.36	19.88±0.36	3.91	NS
6	21.83±0.39	21.35±0.39	21.92±0.39	22.08±0.39	5.49	NS
7	22.98±0.32[ab]	23.56±0.32[b]	21.91±0.32[a]	22.28±0.32[a]	5.06	*
8	25.80±0.51	26.48±0.51	25.73±0.51	25.90±0.51	6.19	NS
9	23.89±0.35	24.83±0.35	24.27±0.35	24.04±0.35	4.51	NS
10	28.70±0.61	29.18±0.61	27.91±0.61	27.86±0.61	7.35	NS
11	24.83±0.69	25.23±0.69	25.01±0.69	24.61±0.69	5.90	NS
12	27.95±0.74	28.09±0.74	28.32±0.74	29.49±0.74	6.14	NS
13	28.66±0.44	29.60±0.44	28.64±0.44	29.28±0.44	3.90	NS
14	28.43±0.49	29.47±0.49	28.54±0.49	28.38±0.49	4.51	NS
15	29.77±0.74	30.13±0.74	28.28±0.74	29.88±0.74	6.63	NS
16	26.68±0.53[b]	27.05±0.53[b]	24.93±0.53[a]	25.97±0.53[ab]	5.78	*

[a,b,c] Row means with different superscripts are significantly different,
SL: Significant level *(P<0.05), ***(P<0.001), Non-significant (NS-P>0.05)

Table 6: Means and standard errors of guinea fowl shank lengths (cm) fed commercial broiler diets and experimental diets from 3 to 16 weeks of age under intensive management system

		Treatments (experimental diets)				
Weeks	Control	Maize	Millet	Sorghum	CV	SL
3	5.88±0.11	6.06±0.11	5.64±0.11	6.10±0.11	7.07	NS
4	6.89±0.11	7.04±0.11	7.13±0.11	6.99±0.11	8.24	NS
5	8.13±0.18	8.26±0.18	8.44±0.18	8.28±0.18	7.16	NS
6	9.68±0.13	9.38±0.13	9.43±0.13	9.41±0.13	4.64	NS
7	10.59±0.20	10.01±0.20	10.08±0.20	10.06±0.20	5.28	NS
8	11.36±0.15	11.04±0.15	11.41±0.15	11.19±0.15	6.37	NS
9	12.26±0.13	12.18±0.13	12.18±0.13	12.18±0.13	3.80	NS
10	12.48±0.12	12.22±0.12	12.14±0.12	12.48±0.12	4.35	NS
11	13.31±0.14	13.01±0.14	13.16±0.14	13.16±0.14	3.75	NS
12	13.48±0.99	13.53±0.99	13.78±0.99	15.59±0.99	26.38	NS
13	13.76±0.14[b]	13.26±0.14[ab]	13.28±0.14[ab]	13.13±0.14[a]	3.79	*
14	13.83±0.13[b]	13.39±0.13[ab]	13.30±0.13[a]	13.80±0.13[ab]	4.24	*
15	13.94±0.17	13.86±0.17	13.65±0.17	13.87±0.17	4.54	NS
16	14.60±0.19	14.35±0.19	13.51±0.19	14.44±0.19	5.44	NS

[a,b] Row means with different superscripts are significantly different. SL: Significant level *(P<0.05), Non-significant (NS-P>0.05)

Table 7: Means and standard errors of guinea fowl neck lengths (cm) fed commercial broiler diets and experimental diet from 3 to 16 weeks of age under intensive management system

		Treatments (experimental diets)				
Weeks	Control	Maize	Millet	Sorghum	CV	SL
3	4.15±0.25	4.40±0.25	4.38±0.25	4.11±0.25	12.63	NS
4	5.13±0.13	4.83±0.13	5.09±0.13	5.35±0.13	5.10	NS
5	5.83±0.23	6.12±0.23	6.19±0.23	6.45±0.23	8.78	NS
6	6.45±0.15	6.43±0.15	6.55±0.15	6.49±0.15	5.38	NS
7	7.13±0.15	6.90±0.15	6.88±0.15	6.91±0.15	6.29	NS
8	7.88±0.07	7.73±0.07	7.90±0.07	8.13±0.07	4.80	NS
9	8.51±0.05	8.56±0.07	8.44±0.05	8.51±0.05	2.43	NS
10	8.51±0.18	8.86±0.18	9.21±0.18	9.06±0.18	4.46	NS
11	9.67±0.07	9.46±0.07	9.67±0.07	9.51±0.07	2.97	NS
12	9.95±0.07	9.88±0.07	10.01±0.07	9.97±0.07	2.10	NS
13	11.53±0.28	11.16±0.28	11.43±0.28	11.22±0.28	5.12	NS
14	11.65±0.25	11.42±0.25	11.66±0.25	11.63±0.25	4.20	NS
15	12.73±0.15	12.53±0.15	12.69±0.15	12.70±0.15	4.29	NS
16	12.39±0.10	12.52±0.10	12.31±0.10	12.26±0.10	2.44	NS

SL: Significant level, Non-significant (NS-P>0.05)

agreement with Nahashon *et al*. (2005) and Seabo *et al*. (2011) who reported increased FI in guinea fowl fed increased dietary CP levels. Nahashon *et al*. (2011) reported higher FCR values (20.63 and 18.13 in guinea fowl reared at 15.6 birds/m² and 18 birds/m², respectively) at 16 weeks of age. The stocking density of 10 birds/m^2 was used in the current study. According to Ikani and Dafwang (2005), guinea fowl have high FCR because of their tendency to waste feed by scooping and picking of the feed which was also observed in this study.

In general, dietary treatment had no influence on BW at the same stage of growth. This observation is consistent with previous findings by Nsoso *et al*. (2003, 2006) who fed guinea fowl keets commercial broiler diets and reported no significant difference in live weights at the same stage of growth and development. At 12 weeks of age, BW of guinea fowl was lower than that reported by Seabo *et al*. (2011) during the same period. The difference in BW between the two studies could be due to variation in sources of protein used in the dietary treatments. For instance, the present study, used soybean meal as a protein source while sunflower was used in the study by Seabo *et al*. (2011). Araujo *et al*. (2011) contended that despite its high fibre content (14%) and deficient lysine (0.5%) compared to soybean meal, sunflower cake is relatively rich in sulphur amino acids (methionine and cystine). Sulphur amino acids play an important role in poultry nutrition because they are essential for optimum muscle accretion (Vieira *et al*., 2004). At 16 weeks of age BW in the present study was consistent with Nsoso *et al*. (2003) in Botswana in the wild and domesticated indigenous guinea fowl. However, Ogah (2011) in Nigeria reported a lower BW during the same period in indigenous guinea fowl.

Guinea fowl fed millet diet had significantly lower BWG (P<0.05) compared to other dietary treatments which did not differ significantly from each other. The lower BWG in guinea fowl fed millet diet can be attributed to the presence of tannins in millet that hinders the utilization of feeds by monogastric animals, especially poultry. Tannins depress growth rate and feed utilization by forming complexes with proteins and carbohydrates or inhibiting digestive enzymes (Medugu *et al*., 2012).

Generally, there was no significant difference in body length of guinea fowl at the same age. From 5 to 12 weeks of age body length increases for all the dietary treatments was lower than 22.79 cm reported by Nsoso *et al*. (2006) in guinea fowl raised on concrete floor during the same period. The present study also raised birds on concrete floor finish. The differences in results between the two studies could be attributable to differences in dietary treatments. The present study fed control (commercial broiler diets) and formulated guinea fowl diets containing maize, millet and sorghum as energy sources, whereas commercial broiler starter and grower diets were fed by Nsoso *et al*. (2006). In this study, body length was higher than 22.17±0.13 cm obtained in Nigeria by Ogah (2011) in indigenous guinea fowl from 3 to 16 weeks of age. Guinea fowl breeds and environmental factors might have contributed to variations in the results in these studies.

Body circumference generally increased with age of guinea fowl in all dietary treatments. Kasperska *et al*. (2011) contended that the increase in body circumference may be indicative of the normal growth and good development of internal organs. In the present study, body circumference at 13 weeks of age for all the dietary treatments was inconsistent with Kasperska *et al*. (2011) who reported lower body circumference of 27.2 and 26.2 cm for male and female guinea fowl, respectively. The variation in results for the two studies might be due to differences in breeds, environmental conditions and dietary treatments. The present study used pearl and lavender strains while Kasperska *et al*. (2011) used the grey pearl. In addition, the study was conducted in Sebele, Botswana which has an average annual rainfall of 538 mm and mean daily temperature of 30° (Emongor, 2007). Bydgosccz in Poland has an average annual rainfall of 500-550 mm and average annual temperature of 7.5 to 8.0°C (Slowinska *et al*., 2010).

Generally, wing stretch of guinea fowl was not significantly affected by dietary treatment at the same age of growth. In this study, wing stretch values obtained from 5 to 12 weeks were lower than those reported by Nsoso *et al*. (2006) during the same period. However, the present study, recorded higher wing stretch values at 16 weeks of age than Fajemilehin (2010) in Nigeria for the Pearl, Ash and Black guinea fowl types. Similarly, a lower value of 19.38±0.08 cm was reported by Ogah (2011) during the same period. According to Nsoso *et al*. (2006), wings are late maturing traits and are a physiological advantage to guinea fowl as they are flighty and revert easily to feral conditions.

In general, shank length of guinea fowl was not affected by dietary treatment. According to Nsoso *et al*. (2006) and Fajemilehin (2010), shank length constitutes the length of the leg and is an early maturing trait that is needed to support the whole body frame. From 5 to 12 weeks of age, shank length in this study was lower than 8.91 and 8.38 cm obtained by Nsoso *et al*. (2006) during the same period. The difference in results could be due to variation in stocking densities for the two studies. In the first study guinea fowl were reared at 10 birds/m^2, whereas in the second study they were reared at 4 birds/m^2. According to Estevez (2007), high stocking density in poultry results in reduced BW, FI and FCR and this affects growth. Again, high stocking density leads to poor air quality at bird level due to inadequate air exchange and increased ammonia (Feddes *et al*., 2002). Furthermore, high stocking density results in reduced access to feed and water, thus contributing to poor growth rate. In this study, at 13 weeks of age guinea fowl shank length for control, maize, millet and sorghum diets was higher than 6.4 cm obtained by Kasperska *et al*. (2011) in guinea fowl fed commercial turkey diet. The shank length at 16 weeks of age in the present study was also higher than Fajemilehin (2010) in Nigeria in three varieties of helmeted guinea fowl (Pearl: 7.14±0.07 cm; Ash: 7.04±0.05 cm and Black: 7.01±0.10 cm) at 16 weeks of age. The differences in shank length values might be due to environmental and breeds factors for the two studies. The current study commenced during the wet season in February while that of Fajemilehin (2010) in Nigeria started during the dry season in September. Obidi *et al*. (2008) stated that seasonal factors exert significant influence on domestic birds. The authors pointed out that direct climatic factors acting on the birds include high ambient temperature and relative humidity resulting in severe heat stress. These factors will affect bird's performance by reducing BW, FI and FCR. Furthermore, mineral metabolism and deposition in bones are affected by heat stress in poultry (Abioja *et al*., 2012).

Neck length of guinea fowl was not significantly affected by dietary treatment. From 5 to 12 weeks of age neck length increase for the dietary treatments was lower than 6.45 cm reported by Nsoso *et al*. (2006) during the same period. Neck length is an early maturing trait that enables birds to have good view of their surroundings in order to detect danger or see predators in advance (Nsoso *et al*., 2006).

Conclusion: In conclusion, generally, dietary treatment did not have significant effect on morphological parameters of growth in guinea fowl during the same stage of growth and development. These results suggest that maize, sorghum or millet diets can be used in guinea fowl diets without affecting growth performance.

ACKNOWLEDGEMENT

We would like to thank Desmond Tutu Education Trust for financial support. Our profound gratitude goes to Messrs S. Mogwase, K. Podi, K. Kelemogile and Mrs. S.C. Chiripasi for assistance during slaughter and measuring of growth parameters. Also, Dr. B. Sebolai, Mr. J. Makore and Ms. G. Nobo are gratuitously thanked for help with statistical analysis and interpretation. Our special gratitude is also extended to Ms. S. Dirienge for help with bird management.

REFERENCES

Abioja, M.O., K.B. Ogundimu, T.E. Akibo, K.E. Odukoya, O.O. Ajiboye, J.A. Abiona, T.J. Williams, E.O. Oke EO and O.A. Osinowo, 2012. Growth, mineral deposition and physiological responses of broiler chickens offered honey in drinking water during hot dry season. Intl. J. Zool., 6 pages, doi: 2012; 10.1155 / 2012 / 403502.

Araújo, L.F., C.S. Araújo, N.B. Petroli, A.C. Laurentiz, R. Albuquerque and M.A.T. Neto, 2011. Sunflower meal for broilers of 22 to 42 days of age. Rev Brasil de Zoot, 40: 2142-2146.

Ayorinde, K.L. and J.S.O. Ayeni, 1983. Comparison of the performance of different varieties of indigenous guinea fowl (*Numida meleagris*) and imported stock (*Numida meleagris*) in Nigeria. KLRI Annual Report, pp: 170-182.

Elhashmi, Y.H., A. El Amin and F.A. Omer, 2012. Growth and development of muscles, bones and fat of guinea fowl (*Numida meleagris galeata*). Online J. Anim. Feed Res., 1: 6-9.

Emongor, V., 2007. Gibberellic Acid (GA3) Influence on vegetative growth, nodulation and yield of cowpea (*Vigna unguiculata* (L.) Walp J. Agro., 6: 509-517.

Estevez, I., 2007. Density allowance for broilers: Where to set limits? Poult. Sci., 86: 1265-1272.

Fajemilehin, S.O.K., 2010. Morphostructural characteristics of three varieties of grey breasted helmented guinea fowl in Nigeria. Int. J. Morph., 28: 557-562.

Feddes, J.J.R., E.J. Emmanuel and M.J. Zuidhoft, 2002. Broiler performance, body weight variance, feed and water intake and carcass quality at different stocking densities. Poult. Sci., 81: 774-779.

Hughes, B.L. and J.E. Jones, 1980. Diet regimes for growing guineas as meat birds. Poult. Sci., 59: 582-584.

Ikani, E.I. and I.I. Dafwang, 2005. The Production of Guinea Fowl in Nigeria. National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Nigeria. http://www.naerls.gov.ng/extmat/bulletins/Duck.pdf (accessed 8 November 2011).

Kasperska, D., H. Korytkowska and D. Kokoszyñski, 2011. Effect of age and sex on body weight and body dimensions of pearl grey guinea fowl (*Numida meleagris L*.). Acta Sci. Pol. Zootech., 10: 39-44.

Kokoszyñski, D., Z. Bernacki, H. Korytkowska, A. Wilkanowska and K. Piotrowska, 2011. Effect of age and sex on slaughter value of guinea fowl (*Numida meleagris*). J. Cent. Euro. Agri., 12: 255-266.

Medugu, C.I., B. Saleh, J.U. Igwebuike and R.L. Ndirmbita, 2012. Strategies to improve the utilization of tannin-rich feed materials by poultry. Int. J. Poult. Sci., 11: 417-423.

Mundra, B.L., K.L. Raheja and H. Singh, 1993. Genetic and phenotypic parameter estimates for growth and conformation traits in guinea fowl. Indian J. Anim. Sci., 63: 445-450.

Musa, H.H., G.H. Chen, J.H. Cheng, B.C. Li and D.M. Mekki, 2006. Study on carcass characteristics of chicken breeds raised under the intensive condition. Int. J. Poult. Sci., 5: 530-533.

Nahashon, S.N., N. Adefope, A. Amenyenu and D. Wright, 2005. Effect of dietary Metabolizable energy and crude protein concentrations on growth performance and carcass characteristics of French guinea broilers. Poult Sci., 84: 337-344.

Nahashon, S.N., S.E. Aggrey, N.A., Adefope, A. Amenyunu and D. Wright, 2006. Growth characteristics of Pearl Gray Guinea fowl as predicted by the Richards, Gompertz and Logistic Models. Poult Sci., 85: 359-363.

Nahashon, S.N., N. Adefope and D. Wright, 2011. Effect of floor density on growth performance of Pearl Grey guinea fowl replacement pullets. Poult. Sci., 90: 1371-1378.

Nsoso, S.J., G.M. Seabo, J. Kgosiemang, S.G. Molatlhegi, M. Mokobela, R.G. Chabo and O.M. Mine, 2003. Performance of progeny of wild and domesticated Guinea fowl (*Numida meleagris*) in Southern Botswana. S. Afr. J. Anim. Sci., 4: http://www.sasas.co.za/sites/sasas.co.za/files/nsosoc.pdf (accessed 26 November 2011).

Nsoso, S.J., M.H.D. Mareko and C. Molelekwa, 2006. Comparison of growth and morphological parameters of guinea fowl (*Numida meleagris*) raised on concrete and earth floor finishes in Botswana. Livest. Res. Rural Dev., 18: http://www.lrrd.org/irrd18/12/nsos18178.htm (accessed 26 November 2011)

Obidi, J.A., B.I. Onyeanusi, P.I. Rekwot, J.O. Ayo and T. Dzenda, 2008. Seasonal variations in seminal characteristics of Shika brown breeder cocks. Int. J. Poult. Sci., 7: 1219-1223.

Ogah, D.M., 2011. *In vivo* prediction of live weight and carcass traits using body measurements in indigenous guinea fowl. Biotechnol. Anim. Husbandry, 27: 1827-1836.

Oke, U.K., O.M. Onyiro, I.A. Ukweni and S.P. Ukpong, 2012. Crossbreeding effect on growth traits at 8 weeks of age in Pearl and Lavender guinea fowl and their reciprocal crosses in a Humid Tropical environment. J. Anim. Sci. Adv., 2: 236-243.

SAS Institute Inc., 2002. SAS user's guide: Statistics. SAS Institute Inc., Cary, NC.

Seabo, D., J.C. Moreki, N. Bagwasi and G.P. Nthoiwa, 2011. Performance of guinea fowl (*Numida meleagris*) fed varying protein levels. Online J. Anim. Feed Res., 6: 255-258.

Slowinska, S., M. Slowinski and M. Lamentowicz, 2010. Relationship between local climate and hydrology in Sphagnum Mire: Implications for palaeo hydrological studies and ecosystem management. Pol. J. Environ. Stud., 19: 779-787.

Teye, G.A., L. Munkaila and D.K. Dei, 2006. Carcass characteristics of male and female broiler chicken. Ghana Agric. J. Food Sci., 5: 363-368.

Tebesi, T., O.R. Madibela and J.C. Moreki, 2012. Effect of storage time on internal and external characteristics of guinea fowl (*Numida meleagris*) eggs. J. Anim. Sci. Adv., 2: 534-542.

Tufarelli, V., R.U. Khan and V. Laudadio, 2011. Feed intake in guinea fowl, layer hen and pheasant as influenced by particle size of pelleted diets. Int. J. Poult. Sci., 10: 238-240.

Vieira, S.L., A. Lemme, D.B. Goldenberg and I. Brugalli, 2004. Response of growing broilers diets with increased sulphur amino acids to lysine ratios at two dietary protein levels. Poult. Sci., 83: 1307-1313.

Yildirim, A., 2012. Nutrition of guinea fowl breeders: A review. J. Anim. Sci. Adv., 2: 188-193.