Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 2 (11) October 2013: 94-99

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com

ORIGINAL ARTICLE

Performance, Carcass Profile and Oxidative Stability of Broiler chickens fed Processed Baobab Seed Meal

F. E. Sola-Ojo[1], K. D. Adeyemi[1*], A. A. Toye[1], S.A. Bolu[1], T. R. Fayeye[1], A. A. Annongu[1], S. O. Garba[1] and R. O. Karim[2]
[1]Department of Animal Production, University of Ilorin, Ilorin, Nigeria
[2]Department of Home Economics and Food Science, University of Ilorin, Ilorin, Nigeria
*Corresponding author: Email: kazyadeyemi@gmail.com

ABSTRACT
The study examined the effect of substituting soybean meal with decorticated undefatted roasted baobab seed meal (DURBSM) on performance, carcass traits and meat lipid oxidation in finisher broilers. Three hundred and twenty chicks were fed starter diet for four weeks and randomly assigned to experimental finisher diets containing DURBSM at 0, 2.5, 5.0 and 7.5 % in a Completely Randomized Design. After the eighth week, thirty birds were randomly selected from each treatment and slaughtered for carcass composition and lipid oxidation. DURSBM influenced (P< 0.05) feed intake, weight gain, feed efficiency and carcass traits. Birds fed 7.5 % DURBSM had significantly higher feed intake and weight gain than other treatment groups despite similar feed efficiency. Birds fed 2.5 and 5 % DURBSM had greater (P< 0.05) lean mass in the thigh and drumstick while 7.5 % had highest lean mass in the breast. Irrespective of the treatment, lipid oxidation increased throughout the entire four-week storage showing a decrease in storage quality. However, the increase in spoilage was more intense in the control samples. Meat of birds fed 7.5 % DURBSM had the lowest (P< 0.05) TBARS values on all weeks except on the third week when no significant (P> 0.05) difference exists among the treatments. DURBSM enhanced the performance of broilers and reduced oxidative spoilage in broiler meat. Thus, DURBSM could be used up to 7.5 % to replace soybean meal in the diet of broiler finishers without compromising performance and carcass quality.
Key words: Baobab Seeds, Broiler Meat, Carcass, Lipid Oxidation

Received 23/07/2013 Accepted 06/10/2013

INTRODUCTION

There is increasing demand for poultry products globally [29]. This is due to the perceived healthiness of poultry being high in beneficial unsaturated fatty acids, it has high return over a short period, requires low capital for investment, high acceptability in many culinary traditions and increase in human population. The demand is expected to be more in developing countries due to increase in human population in the region [12]. However, the current state of poultry production in the developing regions is incapable of meeting the current protein needs of the masses let alone of meeting future demand. The major problem facing poultry industry in the developing countries is high cost of conventional feedstuffs due to undue competition for conventional feedstuffs between human and livestock making the poultry business unproductive. The foregoing scenario gives impetus to search for alternative, cheaper and less competitive feedstuff for the poultry industry. Indisputably, there exist various indigenous leguminous plants in tropical countries that could be used as poultry feed [17]. One of such plants that have potential of being inexpensive, locally available and nutritionally dense is Baobab (*Adansonia digitata*) [24]. Baobab products are highly relished due to their nutritional and medicinal values [6, 13, 15]. The European Union commission under Regulation (EC) No 258/97 of the European Parliament and of the council recently permitted Baobab fruit pulp as a novel food ingredient [26]. In addition, the Food and Drug Administration in United States of America approved Baobab pulp as food ingredient [1]. Baobab seeds have been reported to have a crude protein content of about 20-36% and energy content of 3000-4500Kcal/kg [19, 22, 25]. It also contains other nutrients such as vitamins and minerals. Of prime interest is the abundant vitamin C (ascorbic acid) content of baobab seed [5, 11]. Vitamin C content of 4.78 ± 1.02 g/kg in Baobab fruit has been reported [26]. Vitamin C is a potent antioxidant. It is well known that poultry products contains high amount of unsaturated fats, which are liable to lipid oxidation. Lipid oxidation could affect the quality attributes of the products and endanger the health of consumers of such products [18]. Although, few studies have been conducted on the effect of Baobab seed cake and pulp on poultry performance [8, 20], there is paucity of information on the effect of Baobab seed meal on performance, carcass attributes and lipid oxidation in poultry meat. Given the nutritionally dense nature of Baobab seed meal and its high vitamin C content, it is hypothesized that processed Baobab seed meal would improve performance and product quality in broilers. The objective of the study was to determine the effect of decorticated undefatted roasted Baobab seed meal on performance, carcass profile and oxidative stability of broiler meat.

MATERIALS AND METHODS

The entire experiment was conducted at the Animal pavilion and laboratory of the Department of Animal Production, Faculty of Agriculture, University of Ilorin, Ilorin Nigeria from August to November 2012.

Source and processing of Baobab Seed

Dry Baobab pods (brown and hairy) were harvested from baobab trees within University of Ilorin and its environs. The baobab pods were broken with the use of hammer. The seeds obtained were surrounded by whitish pulp. The seeds were soaked in water for 72 hours to dissolve the pulp and to reduce the level of some anti-nutritional compounds present in the seed as suggested by Sola- Ojo et al. [27]. The sundried seeds were roasted at 70 ^{0}C for 30 min and stirred continuously to ensure uniform roasting. The golden brown material, which marks the state of proper roasting was cooled, milled and sieved to remove the seed coat.

Management of Experimental birds

Three hundred and twenty day-old, mixed-sex Arbor Acre broiler chicks were obtained from Zam farms Ilemona, Kwara state, Nigeria. Birds were reared in electrically heated metabolic battery cages. Thereafter, routine management and vaccination followed. The birds were allowed ad libitum access to feed and water throughout the trial. After the 4th week, birds were randomly assigned to four treatment groups. Each treatment group was replicated four times with 20 birds per replicate.

Diet

All birds were placed on convectional broiler starter diet formulated to meet broiler starter chicken requirement [23] for the first 4 weeks. Decorticated, undefatted roasted baobab seed meal was added to the basal broiler finisher diet at 0, 2.5, 5 and 7.5 % inclusions from 5th to 8th week. The chemical analyses of the diets were carried out in accordance to the procedure outlined by Association of Official Analytical Chemists [7].

Carcass analysis

After the 8th week, 30 birds from each treatment were randomly selected, weighed and slaughtered by neck decapitation. The birds were de-feathered, washed, eviscerated and the dressing percentage was determined. The carcass was cut into different parts and weighed accordingly.

Lipid oxidation

Oxidative stability of breast muscle was determined using the Thiobarbituric acid (TBA) test following the methods of Tarlardgris et al. [28]. This was monitored for 28 days at 7-day interval while samples were kept under refrigerated (4^{0}C) storage. Thiobarbituric Acid Reactive Substance (TBARS) values were expressed as milligram malondialdehyde per kilogram (mg* $MDA^{-1}kg^{-1}$) of sample.

Statistical analysis

Performance and carcass traits data were subjected to the ANOVA model of completely randomized design. Lipid oxidation data was subjected to a 4 (levels of DURBSM) x 4 (Storage weeks) factorial analysis in a completely randomized design. Means were separated by Duncan multiple range test.

RESULTS AND DISCUSSIONS

There were significant differences ($P< 0.05$) in the intake and body weight changes of birds fed different levels of DURBSM (Table 4). Birds fed 7.5 % DURBSM had the highest weight gain that was significantly different ($P< 0.05$) from other treatments. There was no significant difference ($P> 0.05$) in the feed intake and weight gain of broilers fed 2.5 and 5% DURBSM. The control birds had the least feed intake and weight gain that differs significantly ($P< 0.05$) from other treatments. The feed to gain ratio was higher ($P< 0.05$) in control birds than other treatments. There was no significant difference ($P> 0.05$) in the feed to gain ratio of 2.5, 5.0 and 7.5 % DURBSM.

Varying levels of DURBSM influenced all performance characteristics considered in this study. The feed intake and body weight gain increased as level of DURBSM increased. This observation was in line with the findings of Bolu and Olatunde [8] who reported a proportionate increase in feed intake and weight gain when birds are fed increasing levels of Baobab fruit pulp. However, the observation in the present study contradicts the findings of Mwale et al. [20] where feed intake and body weight gain of guinea fowl keets increased when Baobab seed cake was supplemented up to 5% but declined afterwards. The authors also recorded highest mortality in birds with highest feed intake. The discrepancies between the present study and that of Mwale et al. [20] could be due to differences in the specie of poultry used, physiological stage of birds, non-treatment of Baobab seed cake to remove some antinutritional factors and difference in the form of Baobab seed that were used (meal vs cake). The authors attributed the decrease in feed intake and body weight changes to the presence of some antinutritional factors in Baobab seed cake and increase in energy density of diets containing increasing levels of Baobab seed cake. The authors' first claim corroborated the findings of Nkafamiya et al. [22] who reported the presence of some anti-nutritional factors like phytate, oxalate, tannins and saponins in Baobab seed cake. However, Nkafamiya et al. [22] opined that the levels of these anti-nutritional factors are below the toxic levels for poultry and other livestock species. Nevertheless, the processing methods (soaking and roasting) of Baobab seed employed in this study justified the positive effect of DURBSM on feed intake and weight gain in broilers. The significant differences in feed conversion ratio (FCR) observed between the control birds and Baobab treatments is a testimony of the efficacy of DURBSM to replace conventional soybean meal in broiler diets. FCR is a good indicator of how well livestock utilize feed intake for weight gain. FCR is inversely related to feed efficiency. The control birds had the highest FCR and thus lowest feed efficiency. The feed efficiency of birds fed 2.5, 5 and 7.5 % DURBSM were the same.

Carcass characteristics

Live and carcass weights differ significantly ($P< 0.05$) among varying levels of DURBSM (Table 5). However, dressing % do not differ ($P> 0.05$) among treatment groups. Birds placed on 7.5% had a significantly higher ($P< 0.05$) live and carcass weights than other treatments. There was no significant difference ($P> 0.05$) in live and carcass weights of birds fed 2.5 and 5 % DURBSM. Breast weight increases as the levels of DURBSM increases with 7.5% DURBSM having the highest weight though not significantly different ($P>0.05$) from 2.5 and 5 % DURBSM. The weight of breast lean followed the same trend. Weight of breastbone, back and abdominal fat do not differ ($P> 0.05$) among treatment groups. Wing weight do not differ ($P> 0.05$) among control, 2.5 and 5 % DURBSM but significantly lower ($P< 0.05$) than 7.5 % DURBSM. There was no significant difference ($P>0.05$) in the weight of thigh, thigh lean and drumstick among 2.5, 5 and 7.5 % DURBSM. The control birds had a significantly lower ($P< 0.05$) thigh, thigh lean and drumstick weight than other treatments. The amount of lean in drumstick was significantly higher ($P< 0.05$) in 2.5 and 5 % DURBSM than 7.5 % DURBSM and the control in that order.

DURBSM affected carcass traits in the finisher broilers. Some of these effects are direct consequences of the effect of DURBSM on performance characteristics in live birds. There was linear increase in live weight of birds as DURBSM increases. This justifies the increasing carcass weight with increasing levels of DURBSM. However, the dressing % do not differ across treatment groups. The weight of breast and wing increased as the level of DURBSM increased. The weight of breast meat (lean) and skin differs among the treatment groups. Although, 7.5 % had the highest breast weight, its breast lean is not different from 2.5 and 5% DURBSM. Consumers give much preference to lean than bone, skin and fat. The weight of the thigh and thigh lean was similar for 2.5, 5 and 7.5% DURBSM. Although, drumstick weight was similar for 2.5, 5 and 7.5 % DURBSM, 2.5 and 5 % DURBSM had higher drumstick meat than 7.5 % DURBSM and control in that order. Interestingly, the abdominal fat content was similar among treatment groups. This is an important quality indicator for consumers demanding low fat animal products. It is evident that the quantity of lean in major parts (breast, thigh and drumstick) of broiler was enhanced by DURBSM.

Lipid oxidation

Oxidation spoilage increased as storage weeks progressed regardless of the treatment. On the first week, there was no significant difference ($P> 0.05$) in the TBARS value of the control and 2.5 % Baobab but differ significantly ($P<0.05$) from 5 and 7.5 % Baobab. On the second week, the TBARS value of control samples was significantly different from other treated samples. All baobab treated samples performed equally ($P> 0.05$). No significant difference ($P> 0.05$) exists among the treatments on the third week of storage. On the fourth week, 7.5 % DURBSM differ significantly ($P< 0.05$) from other treatments.

Oxidation of unsaturated fats has been implicated in food quality deterioration [2, 3] and could have detrimental effects on human health [18]. Oxidative spoilage is omnipresent in broilers due to their high-unsaturated fats. The high propensity of unsaturated fats to undergo lipid oxidation substantiates the need for antioxidants. Kamal-Edin and Pickova [14] emphasized the need for a well-balanced unsaturated fats and antioxidant for product quality and safety to consumers. Regardless of the treatment, lipid oxidation increased as storage progressed. This observation is in line with earlier studies on lipid oxidation in broiler meat [2, 3]. DURBSM reduced oxidative spoilage as indicated by low TBARS value compared with the control. The efficacy of DURBSM as an antioxidant was concentration dependent with 7.5 % DURBSM exhibiting numerically higher antioxidant potency (lower TBARS values) on all weeks except the third week when no difference exists among the treatments. The TBARS value of 7.5 % DURBSM was not significantly different from 5 % DURBSM on the first and second week. However, it had a significantly lower TBARS value on the forth week. The appreciable antioxidant potency exhibited by DURBSM could be due to its vitamin C (ascorbic acid) content as well as phenolic and flavonoid contents [10, 15]. This observation is consistent with the findings of Lamein-Meda et al.[16] who reported that the antioxidant activity of fresh ripe Baobab fruit was about 1000mg AEAC (ascorbic equivalent antioxidant capacity)/100g. In addition, it was reported that phenolic content of Baobab fruit pulp was similar to that of *Citrus sinensis* [21] thus validating the antioxidant potency of processed Baobab seed meal.

Table 1: Composition of Broiler starter diet

Ingredients	Percentage
Maize	50
Maize bran	5
Soybean meal	30
Groundnut cake	6
Fish meal	5
Bone meal	2.5
Oyster shell	1
Vitamin Premix	0.25
Methionine	1
Lysine	0.25
Salt	1
Total	100
Calculated analysis	
Protein	23.3%

Table 2: Proximate composition of Decorticated Undefatted Roasted Baobab seed meal (DURBSM)

Proximate component	Percentage (%)
Dry matter	90.01
Moisture content	9.99
Crude protein	27.34
Ether extract	25.11
Crude fibre	5.15
Ash	10.63
Metabolizable energy (Kcal/kg)	2988

Table 3: Composition of experimental finisher diet (% DM)

Ingredient	Levels of DURBSM			
	0	2.5	5.0	7.5
Maize	55.5	55.5	55.5	55.5
Maize bran	7.0	7.0	7.0	7.0
Soybean meal	17	14.5	12	9.5
DURBSM	0	0.25	5.0	7.5
Groundnut cake	6	6	6	6
Fish meal	10	10	10	10
Bone meal	2.5	2.5	2.5	2.5
Oyster shell	1	1	1	1
Vitamin premix	0.25	0.25	0.25	0.25
Methionine	1	1	1	1
Lysine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Chemical composition				
Dry matter	90.90	90.80	91.50	91.30
Crude protein	21.70	21.09	20.66	20.24
Ether extract	6.00	6.63	7.26	7.90
Crude fibre	5.00	5.12	5.23	5.39
Ash	8.85	10.94	8.69	13.78
Metabolizable energy (Kcal/kg)	3000	2990	2980	2970

Table 4: Effect of Decorticated Undefatted Roasted Baobab seed meal on performance characteristics in finisher broilers

Parameters	Levels of DURBSM				
	0	2.5	5.0	7.5	SE
Feed intake (g/bird/week)	425.5^{bc}	450.0^{b}	450.0^{b}	512.5^{a}	1.61
Weight gain (g/bird/ week)	362.2^{c}	433.5^{b}	454.1^{b}	490.66^{a}	1.42
Feed conversion ratio	1.17^{a}	1.03^{b}	1.03^{b}	1.04^{b}	0.04

$^{a, b, c}$ means with different superscripts along the same row differs significantly (P<0.05) n=80, SE=standard error.

Table 5: Effect of dietary Decorticated Undefatted Roasted Baobab seed meal on carcass profile of broiler chickens

Parameter (g)	Levels of DURBSM			
	0	2.5	5.0	7.5
Live weight	2400±212.13	2500±70.7	2500±106.07	2700±35.35
Carcass weight	2090^{b}±106.05	2225^{a}±17.7	2200^{a}±70.7	2420^{a}±17.7
Dressing %	87.5±4.2	89.4±1.4	88.8±2.4	89.6±1.4
Breast	350.1^{b}±53.6	555.9^{ab}±34.6	617.1^{a}±52.9	627.4^{a}±1.9
Breast skin	25.8^{b}± 8.45	32.2^{ab}±1.91	56.1^{a}±4.0	33.7^{ab}±3.5
Breast bone	59.2±2.1	36.9±17.2	66.2±4.5	64.25±4.07
Breast meat	265.8^{b}±43.8	478.3^{a}±18.1	487^{a}±45.1	506.75^{a}±9.3
Neck	55.5^{b}±5.6	87.4^{a}±2.5	89.6^{a}± 3.1	70.6^{ab}±0.9
Abdominal fat	4.7±0.9	7.7±0.9	7.4±5.5	6.5±5.6
Wing	84^{b}±4.9	96.2^{b}±5.2	95.3^{b}±58.5	117.7^{a}±9.7
Back	192±17.9	190.6±5.4	260.9±2.3	249±24.1
Drumstick	83.8^{b}±7.9	124.2^{a}±14.1	110.4^{a}±17.4	114.1^{a}±4.7
Drumstick skin	3.8^{b}±1.7	8.6^{a}±2.3	9^{a}±4.9	6.5^{ab}±1.7
Drumstick bone	22.6±2	25.1±4.1	23.6±4.3	23±1.8
Drumstick meat	56.9^{b}±4.8	91.4^{a}±10.5	90.1^{a}±18.6	83.5^{ab}±2.1
Thigh	98.3^{b}±12.6	151.3^{a}±21.6	155.3^{a}±11.8	142.9^{a}±4
Thigh skin	8.1^{b}±2.8	16 .0^{a}±2.1	14.5^{a}±2.48	15.6^{a}±2.2
Thigh bone	14.7^{b}±3.4	15.4^{ab}±2.1	19.7^{a}±3.7	15.9^{ab}±1.6
Thigh meat	75.4^{b}±9.3	119.9^{a}±18.1	121.1^{a}±16.3	111.5^{a}±3.5
Shank	43.3^{a}±4.5	47.4^{a}±5.6	39^{b}±2.5	42^{ab}±6.1

$^{a, b, c}$ means having different superscripts along the same row are significantly different (P< 0.05), n=30, value= mean±standard error

Table 6: Effect of dietary Decorticated Undefatted Roasted Baobab seed meal (DURBSM) on oxidative stability of broiler meat

Storage week	TBARS (mg/MDA/kg) Levels of DURBSM			
	0	2.5	5.0	7.5
1	1.38^{a}±0.12	1.06^{a}± 0.06	0.93^{b}± 0.02	0.80^{b}±0.02
2	2.29^{a}±0.08	1.60^{b}±0.04	1.47^{b}±0.30	1.41^{b}±0.29
3	2.82±0.04	2.74±0.85	2.72±0.46	2.67±0.43
4	3.63^{a}±0.52	3.60^{a}±0.32	3.23^{a}±0.17	2.87^{ab}±0.26

$^{a, b, c}$ means having different superscripts along the same row are significantly different (P<0.05) value= mean±standard error. n=30

CONCLUSIONS

Decorticated undefatted roasted baobab seed meal (DURBSM) had positive effect on performance, carcass traits and lipid oxidation in broiler meat. In all the parameters evaluated, DURBSM treatments performed better than the control. The efficacy of DURBSM on feed intake and weigh gain was concentration dependent with 7.5 % having the highest values. However, feed efficiency was similar among 2.5, 5 and 7.5 % DURBSM. The same trend was observed on carcass traits. DURBSM reduced oxidative spoilage throughout the storage period. Thus, DURBSM is a good replacement for highly competitive soybean meal in the diet of broiler finishers coupled with its ability to reduce oxidative spoilage in broiler meat.

REFERENCES

1. Addy, R. (2009). Baobab Fruit Approved as Food Ingredient in US, Available at: http://www.nutraingredients-usa.com/content/view/print/259574. (assessed on 30/06/2013)

2. Adeyemi, K. D & Olorunsanya, A.O. (2012a). Comparative analysis of phenolic composition and antioxidant effect of seed coat extracts of four cowpea (*Vigna unguiculata*) varieties on broiler meat. Iranian J. App. Anim. Sci. 2 (4): 343-349.
3. Adeyemi, K. D & Olorunsanya, A.O. (2012b). Effect of tomato (Lycopersicon esculentum) powder on oxidative stability and sensory characteristics of broiler meat. Afr. J. Food. Agric. Nutr. Dev. 12(6): 6792-6808
4. Adeyemi, K. D; Olorunsanya, O.A. & Abe, O.T. (2013). Effect of citrus seed extracts on oxidative stability of raw and cooked chicken meat. Iranian J. App. Anim. Sci 3(1): 195-199.
5. Afolabi, O. R & Popoola, T. O. S. (2005). The effects of baobab pulp powder on the micro flora involved in tempe fermentation. Eur. Food. Res. Technol. 220(2): 187-190.
6. Ajaiyeoba, E., Ashidi, J., Abiodun, O., Okpako, L., Ogbole, O., Akinboye, D. & Falade, M. (2005). Antimalarial ethnobotany: In vitro. antiplasmodial activity of seven plants identified in the Nigerian middle belt. Pharm. Biol. 42(8): 588-591.
7. AOAC. (2005). Official methods of analysis of AOAC International, 18th edn. AOAC International, Arlington, VA
8. Bolu, S. A and Olatunde, A. A. (2009). Response of broilers to different sources of vitamin C. J. Agric. Res. Dev. 2(1): 7-13.
9. Brady, O. (2011). The characterization and bioactivity determination of *Adansonia Digitata* L.Fruit Pulp, for Commercial Product Development. Bachelor of Science, Dublin Institute of Technology, Ireland.
10. Carlsen, M. H., Halvorsen, B. L., Holte, K., Bohn, S. K., Dragland, S., Sampson L. & Sanada, C. (2010). The total antioxidant content of more than 3100 foods, beverages, spices, herbs and supplements used worldwide. Nutr. J. 9(3): 1-11.
11. Diop, A.G., Saho, M., Dornier, M., M. Cisse & Reynes, M. (2005). Le baobab Africain (Adansonia digitata L.): Principales caracteristiques et utilisations. Fruits 61: 55–69.
12. Guyomard, H., S. Manceron & Peyraud, J. (2013). Trade in feed grains, animals, and animal products: Current trends, future prospects, and main issues. Anim. Frontiers. 3(1): 14-18.
13. Inngjerdingen, K., Nergård, C. S., Diallo, D., Mounkoro, P. P & Paulsen, B. S. (2004). An ethnopharmacological survey of plants used for wound healing in dogonland, Mali, West Africa. J. Ethnopharmacol. 92(2): 233-244.
14. Kamal-Eldin, A. & J. Pickova. (2008). Balance between polyunsaturated fatty acids and antioxidants in nutrition. Lipid Technol. 20(4): 80-83.
15. Kamatou, G., I. Vermaak & Viljoen, A. (2011). An updated review of *Adansonia digitata*: A commercially important African tree. S. Afri. J. Bot. 77(4): 908-919.
16. Lamien-Meda, A., Lamien, C. E., Compaoré, M. M., Meda, R. N., Kiendrebeogo, M., Zeba, B. & Nacoulma, O. G. (2008). Polyphenol content and antioxidant activity of fourteen wild edible fruits from Burkina faso. Molecul. 13(3): 581-594.
17. Martens, S. D., Tiemann, T. T., Bindelle, J., Peters, M & Lascano, C. E. (2013). Alternative plant protein sources for pigs and chickens in the tropics–nutritional value and constraints: A review. J. Agric. Rural. Dev. Tropic. Subtropic. 113(2): 101-123.
18. Martin, C., Zhang, Y., Tonelli, C and Petroni, K. 2013. Plants, diet, and health. Annual. Rev.Plant. Biol. 64: 19-46.
19. Murray, S. S., Schoeninger, M. J., Bunn, H. T., Pickering, T.R. & Marlett, J.A. (2001). Nutritional composition of some wild plant foods and honey used by hadza foragers of Tanzania. J. Food. Compos. Anal. 14(1): 3-13.
20. Mwale, M., Mupangwa, J. F., Mapiye, C., Saina, H. & Chimvuramahwe, J. (2008). Growth performance of guinea fowl keets fed graded levels of baobab seed cake diets. Int. J. Poult. Sci. 7(5): 429-432.
21. Nhukarume, L., Chikwambi, Z., Muchuweti, M & Chipurura, B. (2010). Phenolic content and antioxidant capacities of *Parinari curatelifolia*, *Strychnos spinosa* and *Adansonia digitata*. J. Food. Biochem. 34(1): 207-221.
22. Nkafamiya, I., Osemeahon, S., Dahiru, D & Umaru, H. (2007). Studies on the chemical composition and physicochemical properties of the seeds of baobab (*Adasonia digitata*). Afr. J. Biotechnol. 6: 656-659.
23. NRC. (1994). National Research Council (U.S.) Sub-committee on Poultry Nutrition. Nutrient requirements of poultry. National Academic Press, Washington D.C.
24. NRC. (2008). Lost Crops of Africa of the National Research Council. Volume III: Fruits. The National Academies Press, Washington, DC
25. Osman, M. A. (2004). Chemical and nutrient analysis of baobab (*Adansonia digitata*) fruit and seed protein solubility. Plant. Food. Human. Nutr. 59(1): 29-33.
26. Parkouda, C., Sanou, H., Tougiani, A., Korbo, A., Nielsen, D. S., Tano-Debrah, K. & Jensen, J. S. 2012. Variability of baobab (*Adansonia digitata L.*) fruits' physical characteristics and nutrient content in the West African Sahel. Agroforest. Syst. 85(3): 455-463.
27. Sola-Ojo. F.E., Bolu, S.A.O & Usman, T.O. (2011). Performance Evaluation of Layers fed Baobab Seed Meal Based Diets. J. Appl. Agric. Res. 3: 113-122.
28. Tarladgris BG, Pearson, A.M & Dungan, L.R. (1964). Chemistry of 2- TBA test for determination of oxidative Rancidity in foods and formation of TBA malonaldehyde complex without acid heat treatment. J. Sci. Food. Agric. 15: 607-620.
29. USDA. (2012) Livestock and poultry: World markets and trade. USDA Foreign Agricultural Service, Washington, DC.

How to cite this article

F. E. Sola-Ojo, K. D. Adeyemi, A. A. Toye, S.A. Bolu, T. R. Fayeye, A. A. Annongu, S. O. Garba and R. O. Karim. Performance, Carcass Profile and Oxidative Stability of Broiler chickens fed Processed Baobab Seed Meal. Bull. Env. Pharmacol. Life Sci., Vol 2 (11) October 2013: 94-99