UNDER PEER REVIEW

Original Research Article

GROWTH RESPONSE, MEAT YIELD AND CARCASS CHARACTERISTICS OF BROILERS FED BENISEED (*Sesamum indicum)* AND DRUMSTICK (*Moringa oleifera)* LEAVES AS SOURCES OF LYSINE

Abstract

One hundred and thirty five day old chicks of Abor acre breed of birds with average weight of 40.00g were used to evaluate growth response, meat yield and carcass characteristics of broilers fed beniseed and drumstick leaves as sources of lysine. The birds were randomly allotted to three treatment groups with forty five birds per treatment. Each treatment had three replicates with fifteen birds per replicate. The treatments were designated as T_1, T_2 and T_3. T_1 had 0.2 % lysine, T_2 had 6 % beniseed and T_3 had 15 % drumstick leaves. The amount of 6 % beniseed and 15 % drumstick leaves included were calculated to supply 0.2 % lysine which was the control. The result of the experiment at the end of the seventy days feeding trial were not significantly (P>0.05) different in body weight, body weight gain and feed conversion ratio. The crude fibre digestibility was significantly (P<0.05) different. The average live weight of the birds, breast, back and wing were significantly (P<0.05) different. It was concluded that 6 % beniseed and 15 % drumstick leaves can substitute 0.20 % industrial lysine in broilers diets without any deleterious effect and with optimum broilers performance.

Key words: Broilers carcass, beniseed, drumstick leaves, lysine.

Introduction

Poultry is one of the most popular industry/enterprise and also a source of animal protein to the ever growing Nigerian population, thus, making significant contribution to human nutrition and economic development (Idowu *et al.*, 2005). The industry contributes more than 75 % of the total livestock production in Nigeria (Alabi and Osipo, 2004). Feeding has a great effect on poultry growth, production and meat quality. The evaluation of growth and carcass characteristics of hybrid broilers carrying fizzle and normal feathering genes is desirable since this will provide base-like information for the improvement and development of highly producing indigenous chicken stocks. Apart from the preference of the consumer for heavily looking birds, the live weights of the birds determine to some extent the component of the body parts. Aina (1990) reported that other body parts increase with increasing body weight. The fizzle chicken is known to be a heavy bird (Omlet, 2006) that converts feed efficiently (Lin *et al.*, 2006). The effect of diet on the yield of broilers carcass and cut-up parts is expected to be positively significant though some body parts are less sensitive than others. Wesley (1980) reported that the cut-up pieces of yield are significant decrease in eviscerated yield, giblet yield, wing yield as well as boneless breast meat yield when birds are given restricted feeding. He also reported a substantial decrease in live weight and lower feed conversion efficiency in diet with 90 % NRC recommended diet. The yield of poultry meat depends on the culture of the processor. In European and American dressing culture, carcass and giblets, head and shank are considered edible and the yield is about

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70 %. In Nigeria, where carcass, giblets, head and shank are considered edible yield as it is often 78 S%. When the cleared out-gut is added to the edible yield as often is the case, the yield is 80.4% (Aduku and Iji, 1990). Yield is also designated dressing percent which is the yield weight divided by live weight of the bird

There are approximately twenty-eight commonly known amino acids that are combined in various ways to create 150 or more other intermediates inside the body as well as the more than 40,000 proteins known so far to science (Gong *et al.*, 2005). The essential amino acids are those that the body cannot synthesize in sufficient quantities to satisfy the nutritional requirements for good health and that they must be included in the diet. The nine essential amino acids are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine; their best sources are meat, fish, fowl, eggs and dairy products. In addition,cysteine (cystine) and tyrosine, sometimes classified as non essential amino acids, are now considered semi-essential because if the diets contain them (meat, milk, fish, poultry and legumes are good sources), the body can use them in place of two essential amino acids methionine and phenylalanine, respectively to make protein. The nonessential amino acids are alanine, arginine, asparagine, aspartic acid, glutamic acid, glutamine, glycine, proline, serine and taurine. (Gong *et al.*, 2005). The NRC (1994) recommended that broilers receive 1.1 and 1.0 % lysine of diets at starter and grower periods respectively. Aduku (2004) recommended 1.25 and 1.1 % lysine and 0.86 and 0.75 methionine for starter and finisher diets. Some research have shown that, is higher for male than for the female during starter and grower period (Han and Baker, 1994). D'mello (1999) reported that lysine requirement was higher for improved feed consumption and feed conversion than is required for weight gain. The effect of lysine on the body weight and feed conversion showed consistently that NRC (1994) recommendation are low and do not meet the needs of modern broiler, when diets are adapted to commercial feeding regime. Increasing dietary lysine level 1.25 % of NRC (1994) requirement resulted in high breast yield at 42 days of age in broilers but the difference was not statistically significant (P>0.05). Performance of broilers is affected by lysine HCl from 1-42 days of age. It is a well known fact that lysine is considered as an important factor which affects the performance and carcass characteristics of growing chicks, so dietary requirement of protein is usually a requirement for lysine contained in the protein (Baker and Itan, 1994). Amino acids requirements of broilers have been widely studied and interactions with crude protein level (Sterling *et al*., 2002). The importance of utilizing correct amount of balanced dietary protein and amino acid for poultry is of high priority issue (Nasir *et al.,* 2011). The authors attributed this to two issues. The first being the most expensive cost of protein and amino acids in feeds per unit weight and the second as the environmental concerns about nitrogen losses in poultry wastes. Lysine requirements of broiler chicks during different growth phases has been well established (Han and Baker, 1994; Knowles and Southern, 1998; Mack *et al*., 1999; Baker, 2003; Corzo *et al*., 2003). Most of these studies are conducted under the "standard" conditions i.e. feeding high nutrient-density basal diets (3,200 kcal per kg ME; 20-23 % CP) to chickens kept under thermo-neutral conditions. But actual raising and feeding conditions can be much different from these "standard" conditions, which would

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affect lysine requirement (Usama *et al.*, 2007). The authors recorded in their results that feed intake, body weight gain and feed efficiency were significantly (P<0.05) depressed by the un supplemented basal diets. Supplementation of increments of lysine to the basal diets improved feed intake, body weight gain and feed conversion ratio. Furthermore, chickens are mostly reared in open sided houses and are exposed to chronic heat stress during the summer season.

It is important that nutritional regimes meet the broiler birds' needs for maintenance and growth so that breast meat accretion is optimized. Lysine is one of the most limiting amino acids in practical corn-soybean meal and sorghum-soybean meal diets for broilers. The level of dietary Lysine needed in the grower/finisher period to optimize breast meat yield may be higher than that needed for optimallive performance traits [Moran *et al.*, 1990; Kidd *et al.*, 1997 and kidd *et al* 1998. Sibbald and Wolynetz (1986) demonstrated that the amount of Lysine required to maximize protein accretion **i**n 10-day-old male chicks was higher than that needed to maximize BW gain. Similarly, Holsheimer and Ruesink (1993) found that breast meat was increased in 49-day-old male broilers fed diets containing increased Lysine levels from 1-14 days of age. However, the broilers were not affected by dietary Lysine from 15 to 49 days of age (Kidd *et al*., 1998). There is controversy **as** to the level of Lysine required in a starting chick diet. Because the level of Lysine in a starter diet may affect breast meat yield in finish weight of broilers. This situation has created the need to look for cheap, locally available and less competitive source of protein rich in lysine, an essential amino acid required for the normal and proper utilisation of feed by broiler chicken. An essential amino acid such as lysine needs to be supplemented in the animal diet in order to ensure the adequate absorption of calcium, production of antibodies, hormones and enzymes as its deficiency could lead to tiredness, inability to concentrate, irritability, bloodshot eyes, retarded growth, hair loss, anemia and reproductive problems. Industrial lysine is one ingredient of high cost in poultry diet today. Hence, the imperative need to substitute it for cheap, available and less competitive sources.

The use of leguminous multipurpose trees and shrubs has been suggested to be a viable alternative source of lysine, methionine, vitamins and minerals for poultry feeding (Church, 1991). Plant source of amino acids such as beniseed, contains 24.2 % protein, 49 % oil and good source of methionine (0.75 %) but poor in lysine (0.37 %) (Aduku, 2004). Moringa (drumstick) leaves are also rich in vitamins and minerals. Leaves (100 g) contain 440 mg Ca, 70 mg P, 7 mg Fe, 110 mg Cu, 5.1 mg I, 11,300 IU pro-vitamin A, 120 mg vitamin B, 0.8 mg nicotinic acid, 220 mg ascorbic acid, and 7.4 mg tocopherol per 100 g. Beniseed (*Sesamum indicum*) and drumstick leaves (*Moringa oleifera)* are good sources of lysine and methionine. They are natural compared to the industrial lysine and methionine (Makker and Baker, 1997) which are scarce and expensive in developing countries. Beniseed is an herbaceous plant growing up to 15 m high, it has purple, pink or white flower and fruits are cotton capsule which contain several seeds from 2-5 mm long. It contains protein rich in lysine, methionine, leucine and arginine. The seed contains 0.35 % lysine and 0.75 % methionine (Aduku, 2005). Beniseed is a rich source of protein, carbohydrate, minerals and vitamins, also rich in essential amino acids like lysine,

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methionine, arginine and tryptophan. It contains 24.2 % crude protein, 4971 kcal/kg metabolism energy, 1.02 % calcium, 0.76 % phosphorus, 0.75 % methionine, 0.37 % lysine, 1.59 % arginine and 0.11 % tryptophan respectively (Aduku, 2005). Beniseed is a rich source of edible oil with its oil content generally varying from 46-52 %. The seeds can be processed by frying with a mixture of sugar to give sweet taste; its oil is used in southern India for cooking. Recent research has shown that Beniseed protein has certain advantages over other oil seed protein in processed foods, which increases its potential market (Johnson *et al.,* 1997; McDonald *et al.,* 1998). Beniseed after extraction contains about 44 % crude protein (Peace corps, 1990; Manputu and Bhur, 1991). The oil contains 50-60 % oil and fibre content of 2.7-6.7 % (Beckstoom-stenberg and Duke 1994).

Drumstick (*Moringa oleifera*) belongs to the genus moringaceae with 13 species. It is native ti subhimalayan region in India and is now naturalized in many countries in Africa, Arabia, South East Asia, Caribean Island and South America (Ramachandra *et al.*, 1980). Drumstick is a fast growing leguminous tree which can 12m height at maturity, yielding up to 120 tonnes Dm/ha/yr when planted very densely for use as forage (Makkar and Becker, 1997). Drumstick goes by many names, in Philippines where the leaves of the Moringa are cooked and fed to babies; it is called mother's best friend and malunggay. Other names include benzolive tree (Haiti), Hoseradish tree (Florida) and Nebeday (Senegal). Drumstick leaves are usually small in diameter and retain its greenish colour when properly processed by drying. The drumstick leaves are highly nutritious containing significant quantities of lysine, methionine, vitamins A, B and C, calcium, iron, phosphorus and protein. Drumstick leaves are outstanding as a source of vitamin A and when raw in vitamin C. The composition of amino acids in its leaf protein is well balanced. Laboratory analysis has shown that the protein concentrate in its leaf is about 27 % and 29 %, methionine of 0.35 % and lysine of 1.32 % respectively with a negligible amount of tannins (1-23 g/kg) in all fraction of the drumstick plant (Makker and Becker, 1997). The high protein content must be balanced with other energy foods. Care must be taken to avoid excessive protein intake. Too much protein in pig diet may increase muscle development at the expense of fat production. In cattle, too much protein can be fatal (from alteration of the nitrogen cycle). Extensive trails using Moringa leaves as cattle feed, (beef and dairy cow), swine feed and poultry feed, with Moringa leaves constituting 40 %-50 % of feed. Milk yield for dairy cow and daily weight gain for beef cattle increases by 30 %. Birth weight averaging 22kg for Local jersey cattle, increased by 3-5 kg (Martin, 2000). Nutrient value for Moringa can be increased for poultry and swine through the addition of an enzyme (phytase) to break down the phytate, leading to increased absorption of phosphorus found in Moringa. The enzymes should be mixed with the leaves without heating, at 1kg of enzyme to 3,333 kg of broiler chicken diet and

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1 kg to 5,555 kg of layers diet (Martin, 2000). These could be richly used by the birds. The aim and objective of this study was to determine the growth performance, meat yield and carcass characteristics of broilers fed on beniseed and drumstick leaves as sources of lysine.

Materials and method

Experimental design: A total of 135 day old broiler chicks of Abor acre breed were used in the research. The birds were purchased from Tuns farms Osogbo. The birds were managed under a deep litre system with three (3) treatment groups and three replicates per treatment. 15 chicks were randomly allotted to each replicate in a complete randomised design arrangement.

Management: Series of medication including vaccination was given to the birds in the course of the experiment. Feed and water were supplied to the birds' *ad-libitum* throughout the seventy days of the experiment.

Source of ingredient and processing: the beniseed, maize and palm oil used were purchased from Central Market Minna. Other feed ingredients such as fish meal, groundnut cake, rice offal, bone meal, limestone, industrial lysine, methionine, broilers premix and salt were purchased from Dominion feed mill Minna. The beniseed was of the early planting grown in part of Niger state, the beniseed was subjected to roasting to remove the anti nutritional factors. Roasted seeds samples were collected and subjected to chemical analysis according to A.O.A.C (1990) before inclusion into the experimental diets. The drumstick leaves used was purchased from Central Market, Mariga, Niger state. The drumstick tree was planted, harvested and sundried by the local farmers. The dried drumstick leaves were grinded to powder and was subjected to chemical analysis according to A.O.A.C (1990) before it was mixed with other feed ingredient.

Experimental diet: Three experimental diets were formulated. Diet T_1 served as the control and contained 0 % Beniseed and drumstick leaves, T_2 contained 6 % Beniseed and T_3 contained 15 % Drumstick leaves respectively as shown in Table 1.

Chemical analysis: The chemical analysis of the diets and faecal samples were determined according to A.O.A.C (1990) methods.

Data collection: Data collected for ascertaining the performance of the birds includes; *initial body weight* which was collected by taking the weight of the day old birds at arrival from the farm using a weighing scale, *final body weight* was collected at the last day of the experiment using the same weighing scale. Body weight gain was calculated by subtracting the initial body weight from the final body weight. Feed intake was calculated by subtracting the amount of feed refused from the amount of feed offered the birds. Feed conversion ratio was calculated by dividing the feed intake by the body

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weight gain. The *digestibility trial* was conducted by selecting two birds from each replicate of the treatments which were weighed and transferred into the metabolism cages. The birds continued to receive their diets for five days of the adjustment period. the faecal droppings from each replicate separately collected daily were weighed and oven dried at 80°c until a constant weight was obtained. After drying, the droppings from each treatment were bulked together and sub-samples for proximate analysis were taken and the final body weights of the birds were also recorded.

The meat yield and carcass characteristics were determined at the end of the experiment by selecting randomly, one bird from each replicate. The selected birds were starved of feed and water over night. Before slaughtering, the individual weight of the birds was recorded. Thereafter, the birds were slaughtered by cutting the jugular vein around the neck. The birds were immediately scalded in warm water and the feathers were manually removed. Thereafter, the fully dressed weights of the carcasses were taken and recorded. The carcasses were then separated into breast, back, upper back, thigh, shank, neck, arm, wing, drumstick, head and the internal organs (viscera). The parts were individually weighed and the weights were expressed as percentage of the live weight of the carcass. In addition, the length of the intestine of each carcass was taken and recorded. The dressing percentage and percentage weight of body in relation to the live weights of the birds were calculated.

Statistical analysis: Data obtained from the experiment were subjected to one way analysis of variance (ANOVA) using (SAS, 1998). Treatment means were separated using Duncan Multiple Range Test (DMRT) (Duncan. 1985)

Table 1**. Composition of diets fed to broilers**

	Starter phase			Finisher phase		
Ingredients	T1	T2	T3	T1	T2	T3
Maize	50.65	47.62	43.43	51.73	48.52	44.94
Groundnut cake	36.50	33.73	28.92	28.42	25.83	20.41
Fish meal	3.00	3.00	3.00	2.00	2.00	2.00
Drumstick leaves	0.00	0.00	15.00	0.00	0.00	15.00
Beniseed	0.00	6.00	0.00	0.00	6.00	0.00
Rice offal	3.00	3.00	3.00	12.00	12.00	12.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00	1.00
Lysine	0.20	0.00	0.00	0.20	0.00	0.00
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Broiler premix	0.25	0.25	0.25	0.25	0.25	0.25
Palm oil	3.00	3.00	3.00	2.00	2.00	2.00
Salt	0.20	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100	100
Calculated						
Protein	23.00	23.00	23.00	20.00	20.00	20.00
Energy/Kcal/Kg	3,033.31	3,157.50	3,037.75	2,874.00	2,996.57	2,878.43

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Supplied per Kg: 800 IU vitamin A; 1200 IU vitamin D3; 13mg vitamin E; 2mg vitamin K; 3mg riboflavin; 10mg cobalamin; 1.5mg folic acid; 0.25mg biotin; 125mg antioxidant (satoquin); 25mg Fe; 80mg Mn; 50mg Zn; 2mg Cu, 0.2mg Co; and 0.1mg Se.
$T_1$0 % Beniseed: drumstick leaves,T_2 6 % Beniseed,T_3:15 %Drumstick leaves.

Results and discussion

The result of performance of broilers fed beniseed and drumstick leaves as sources of lysine at the starter and finisher phases are shown in Table 2 and Table 3 revealed no significant (P>0.05) differences in final body weight, body weight gain, feed intake and feed conversion ratio and is in line with the study of Payne (1989) who reported that adequate energy, protein and supplementation of feed with essential amino acid and vitamin enhanced feed utilization in the body.

Table 2 **Performance of broilers fed beniseed and drumstick leaves as sources of lysine at the starter phase**

PARAMETER	T_1	T_2	T_3	SEM
Initial body weight (g)	40	40	40	0.00NS
Final body weight (g)	690.00	620.00	583.33	25.79NS
Body weight gain (g)	23.21	20.71	19.40	0.92NS
Feed intake (g)	57.86	58.93	56.86	0.88NS
FCR	2.50	2.85	3.00	0.12NS

Means in the same row were not significantly (P> 0.05) different.

Table 3 **Performance of broilers fed beniseed and drumstick leaves as sources of lysine at the finisher phase**

PARAMETER	T_1	T_2	T_3	SEM
Initial body weight	690.00	620.00	583.33	25.79NS
Final body weight	1883.30	1693.30	1675.00	54.53NS
Body weight gain	21.31	19.17	19.49	0.66NS
Feed intake	96.15	96.00	91.86	5.25NS
FCR	4.54	5.05	4.66	0.26NS

Mean in the same row were not significantly (P> 0.05) different.

Table 4 showed the results of the nutrient digestibility of broilers fed beniseed and drumstick leaves as sources of lysine. The results were not significantly (P> 0.05) different in the nutrient digestibility of dry matter, crude protein, ash, ether extract and nitrogen free extract. However, the results of crude fibre was significantly (P<0.05) different. This might be as a result of the 15 % drumstick leaves replacement of industrial lysine in the diets, giving a higher crude fibre content compared to beniseed and industrial lysine, and this agrees with the study of Atteh and Ologbenla (1993) who reported that nutrient digestibility of protein, crude fibre and dry matter enhances body weight.

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Table 4: **Nutrient digestibility of broilers fed beniseed and drum stick leaves as sources of lysine**

Parameter (%)	T1	T2	T3	SEM	LS
Dry matter	95.02	95.73	94.21	0.72	NS
Crude protein	96.91	97.63	95.91	0.49	NS
Crude fibre	94.50[ab]	93.04[b]	97.96[a]	0.86	*
Ash	97.28	97.40	95.60	0.50	NS
Ether extract	98.08	96.72	97.31	0.37	NS
Nitogen free extract	91.66	94.77	91.90	1.14	NS

ab: Means with different superscript in the same row are significantly different (P<0.05)

The result of carcass characteristics of the cut-up parts of broilers fed beniseed and drumstick leaves as sources of lysine shown in Table 5 revealed that only the average live weight, breasts, backs, and wings differed significantly (P<0.05) between treatment groups. This is however in line with the report of Wesley (1980) which reported that the than the industrial lysine. Cut-up pieces of meat yield are significantly affected by the diet. The significant (P<0.05) increase of breast T_3 might be as a result of high quality content of drumstick in lysine compared to beniseed and the industrial lysine. Holsheimer and Ruesink (1993) as cited by Kidd *et al*. (1998) observed that breast meat yields of broilers increased **as** dietary Lysine increased in the diet. Although the lysine content of this experiment were at the same level it could be established that drumstick is superior. Secondly the result showed that plant lysine could produce better breast meat

Table 5: **Carcass characteristics of cut-up parts visceral organs of broilers fed beniseed and drumstick leaves as sources of lysine**

Parameter	Ti	T2	T3	SEM	LS
Live wt (g)	2066.70[a]	2050.00[a]	1750.00[b]	57.40	*
Dressed wt (%)	89.49	90.28	89.43	0.73	NS
Breast (%)	16.51[c]	17.85[b]	19.35[a]	O.44	*
Back (%)	11.12[ab]	11.54[a]	10.11[b]	1.27	*
Thigh (%)	12.94	12.01	11.33	0.36	NS
Shank (%)	4.69	3.56	4.81	0.12	NS
Neck (%)	6.09	6.16	5.81	0.12	NS
Wing (%)	7.19[b]	7.66[b]	8.06[a]	0.94	*
Drumstick (%)	9.80	9.33	10.09	0.19	NS
Head (%)	2.61	2.32	2.65	0.83	NS
Intestinal wt	4.95	4.79	5.00	0.14	NS
Kidney	0,07	0.11	0,11	0.01	NS
Lungs	0.49	0.46	0.45	0.04	NS
Liver	1.91	1.96	1.93	0.06	NS
Spleen	0.73	0.74	0.71	0.07	NS
Gizzard	3.40	3.41	3.13	0.20	NS
Heart	0.56	0.52	0.56	0.03	NS
Abdominal fat	0.73	2.19	0.58	0.42	NS

abc: Means with different superscript in the same row are significantly different (P<0.05)

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Conclusion

It was concluded that 6% beniseed and 15% drumstick leaves can substitute 0.20 % industrial lysine in broilers diets without any deleterious effect.

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Refernces

A.O. A. C. 1990. Association of analytical Chemists. Official Methods of Analysis, 15th edition. Arlington, Virginia, U.S.A pp 807-809

Aduku A. O and Iji, P. A 1990. The effect of offal on yield and demand for dressed live broilers. Tropical Science in press.

Aduku, A. O. 2004. Animal nutrition in the tropics: Feeds and feeding, pasture management, monogastric and ruminant nutrition. Davon computers and ventures Samaru, Zaria, Pp 95 – 102.

Aduku, A. O. 2005. Tropical Feeding stuff. Analysis Table. Department of Animal Science Faculty of Agriculture. Ahmadu Bello University, Saniaru, Zaria, Nigeria.

Aina, A. B. J 1990. Replacement of maize with cassava peel in finisher ration for cockerel: The effect on cut-up pieces of eviscerated carcass. Nigeria Journal of Animal Production 11: 12 – 22.

Alabi R.A and Osipo, A. A. 2004. Contributory role of animal production in national development. Proceeding of 9th (ASAN) conference 13th-16th Sept. 2004. Ebonyi state University Abakaliki Nigeria Page 117-180.

Atteh, J.O. and Ologbenla, F.O. 1993. Replacement of fish with maggots in broiler diets. Effect on performance and nutrient. Nigeria journal of Animal production 20:44-49.

Baker, D. H (2003) Partitioning of nutrients for growth and other metabolic functions; efficiency and priority consider ration. Poultry science 70: 1797 – 1805.

Baker, D. H and Itan . Y (1994) Ideal Amino acid profile for broiler chicks during the first three weeks post. Poultry science 73: 1441- 1447.

Beckstoom-stenberg, S.M and Duke, J.A (1994). The phytochemical database. http://genome.cornell.edu/cgibin/webace

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Church, D.C. 1991. Livestock feed and feeding 3rd edition. Prentice Hall, Eagle Wood Cliff, New Jersey, pp 546

Corzo, A., E. T. Moran and D. Hoehler. 2003. Lysine needs of summer-reared male broilers form six to eight weeks of age. Poult. Sci. 82:1602-1607.

D'mello, J.P.F (1999) Amino acid in farm animal Nutrion 2nd Edition. Formally of the Scottish Agricultural College, Edinburgh, U.K., pp 544

Duncan, D.B. 1985. Multiple ranges and multiple F: tests. *Biometric* 11: 1 – 42

Gong, L. M., C. H. Lai, S. Y. Qiao, Defa Li, Y. X. Ma and Y. L. Lin. 2005. Growth performance, carcas cheracteristics, nutrient digestibility, and serum biochemical parameters of broilers fed low protien diets supplemented with various ratios of threonine to lysine. Asian-Aust. J. Anim. Sci. 18(8):1164-1170.

Han, Y.M and baker, D.H 1994. Lysine requirement of male and female broiler chicks during the period of three to six weeks post hatching. Poultry Science 73: 1739-1745.

Holsheimer, J.P. and EW. Ruesink, 1993. Effect on performance, carcass composition, yield, and financial return of dietary energy and lysine levels in starter and finisher diets fed to broilers. Poultry Sci. 72: 806-815.

Idowu, A.O., O.M.O., Bambose, A.M., jegede, A.U., Sule, R and Enubetina, D. 2005. Effect of replacing of cassava peel with cassava root on performance and egg quality characteristic of laying hens, Animal conference animal science association of Nigeria (ASAN) Sept 12th-15th, 2005. 135-139.

Johnson, L.A, Suleiman, T.M and Lucas, E.W. 1997 Sesame protein. A review and prospect, American journal Organisation. Chemistry Society. 56(30) 463-468.

Kidd, M.T., BJ. Kerr, and N.B. Anthony. 1997. Dietary interactions between lysine and threonine in broilers. Poultry Sci. 76:608-614.

Kidd, M. T., B. J Kerr, K. M Halpin, G. W. Mcward and C. L Quarles. 1998. Lysine levels in starter and grower finisher diets affect broiler performance and carcass traits. Journal appl. Poultry Res. 7: 351 – 358.

Knowles, T. A. and L. L. Southern. 1998. The lysine requirement and ratio of total sulfur containing amino acids to lysine for chicks fed adequate or inadequate lysine. Poult. Sci. 77: 564 - 569.

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Lin, H. C., Jiao, H. C., Buyse, J and Decupyere, E. 2006. Strategies for preventing heat stress in poultry. World poultry Science 62 (1) 71 - 89

Maker, H.P.S., Becker, K. 1997. Nutrients and antiquality factors in different morphological parts of the *Moringa oleifera* tree. *Journal of Agricultural Science.* Cambridge 128: 311-322

Manputu, M and Buhr, R. J. 1991 effect of substituting sesame meal for soybean meal on layers performance. Journal of Poultry Science. 70:70.

Mack, S., D. Bercovici, G. De Groote, B. Leclercq, M. Pack, J. B. Schutte and Van Cauwenberghe. 1999. Ideal amino acid profile and dietary lysine specifications for broiler chickens from 20 to 40 days of age. Br. Poult. Sci. 40:257-265.

Martin, L. P. 2000. The moringa Tree. Echo Technical note. www.echonet.org

McDonald, p., Edward, R. A., Green Heigh, J. F. D. 1989. Animal Nutrition, 4th Edition, Longman, London.

Moran, E T., Jr. and S. F. Bilgili, 1990. Processing losses, carcass quality, and meat yield of broiler chickens as influenced by dietary lysine. Poultry Sci. 69702709.

Nasir J., Kheiri F., Solati A., A Hajibabaci and Senemari M. 2011. The efficiency of energy and protein of broiler chickens fed on diets with different lysine concentrations. Journal of Animal and Veterinary advances 10 (18): 2394 – 2397.

Nigerian Research Council 1994. Nutrient Requirements of poultry 9th revised edition. National Academy of Pres, Washington D. C.

Omlet. 2006. Omlet United States of America breed information chicken frizzle. http://www.omlet/us/breed.

Payne, W. S. A. 1990. An Introduction to Animal Husbandry in the Tropics. 4th Edition. Longman group Ltd. Pp 684-721SAS, Statistical Analysis Institute (2000).

Peace Corps, 1990. New crop production Hand Book, Information collection and exchange, Yermanos, D. M (Eds). Washington D. C. 20526, U. S. A.

Ramachandra, C., Pefer, K. V and Gopalakrishan, P. K 1980. Drumstick (*Moringa oleifera*): A multipurpose Indian Vegetable. Economy, Botany, 34 (3), 276 – 283.

SAS. 1998. Statistical Analysis System Institute, Users guide. SAS Institute Inc.Carry N. C.Cary, USA, pp 943.

UNDER PEER REVIEW

Sibbald, 1.R and M.S. Wolynetz, 1986. Effects of dietary lysine and feed intake on energy utilization and tissue synthesis by broiler chicks. Poultry Sci. 6598-105.

Sterling K. G, G. M Pesti and R. I Bakalli 2002. The response of broiler chickens to dietary lysine and crude protein with different amino acid profiles. Poult. Sci. 81: 26 – 36.

Usama A. M., Ashraf, A., mumtaz and Jiang, Z. 2007. Lysine requirement of broiler chickens fed low density diets under tropical conditions. Asian – Ust. J. Animal. Sci. Vol. 20; (6) 939 – 943.

Wesley, R.D, Adams, R.L and Stadelman, W.J. 1980. Effects of Amino acid Restrictions and Age on weights and meat yield of turkeys. *Poultry Science* 60: 1422-1428