Nutrient Assessment of Some Tropical Leaf Meals

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***Abstract*— *Nutrient availability of five tropical leaves were carried out, the tropical leaves were harvested fresh and the leaves were dried under room temperature (air-dry) until a moisture content of less than 11.00% was obtained in all the leaves. The air-dried leaves were milled and analyzed for their; proximate composition, mineral composition, anti-nutritional composition, fibre fractions, amino-acid concentration and biophysical properties. The results revealed that the crude protein content ranged between 30.77% in amaranthus and 44.09% in fluted pumpkin, fat content ranged between 6.11% in fluted pumpkin and 9.13% in moringa, ash content ranged between 9.28% in cotton seed leaf and 19.29% in amaranthus, crude fibre ranged between 8.10% in squash-gourd and 15.32% in fluted pumpkin and CHO ranged between 14.85% in squarch-gourd and 30.57% in cotto seed leaf. The macro and micro minerals analysis and essential and non-essential amino acid analysis revealed that all the parameters analysed for were reasonably high, the anti-nutritional factors of the leaves were very low, the fibre fractions were within range and the biophysical characteristic were normal.This study shows that the leaves were rich in nutrients that are good for poultry production.*

Keywords*— *Nutrient, assessment, Tropical and Leaf Meal.

I. INTRODUCTION

Despite the advances made in poultry nutrition in the last few decades, a lot of nutritional problems still remain unresolved (Igbasan and Olugosi, 2013). One of the most critical areas is amino acid nutrition. Vegetable-based feeds are a rich source of nutrients i.e. essential plant amino acids, vitamins and minerals. Furthermore, it has been established that green vegetable leaves are the cheapest and most abundant source of proteins because of their ability to synthesize amino acids from a wide range of available primary materials such as water, carbon dioxide and atmospheric nitrogen (Agbede and Aletor, 2004 and Fasuyi, 2006). Natural resources are available for the synthesis and polymerization of amino acids into less mobile forms and stored as such in plant leaves. However, the build-up of the amino acids in plant leaves is also accomplished with other anti-nutritional factors that render them less nutritious for consumptive purpose in man and animal. Such factors limiting the nutritive value of leaf protein are the high fibre content and other anti-nutrients (Aletor and Adeogun, 1995).

One of the major problems encountered in the tropics by poultry farmers who wish to formulate their own rations is the high prices of the feed ingredients, and lack of data on the average nutrient contents of the many local foodstuffs in the ration. Therefore, there is great renewed interest in developing natural alternatives to supplement and maintain animal performance and wellbeing, leaves from some tropical plants such as Moringa (*Moringaoleifera*), Fluted pumpkin (*Telfairiaoccidentalis*), Squash-Gourd Melon Pumpkin (*Cucurbita maxima*), cotton seed (*Gossypiumherbaceum*) and African spinach (*Amaranthuscruentus L*), contains appreciable methionine, that could be harnessed for methionine supplementation in chicken diets. The objective of the study is to evaluate the nutritive values of the aforementioned leaves in arbor acre breed of broiler chicken.

II. MATERIALS AND METHODS

2.1 Sources and processing of tropical leaf meals

The tropical vegetables were purchased fresh in the Sasha market in Akure, Ondo State Nigeria. The stalks of the vegetables were removed and the leaves were dried under room temperature (air-dry) for seven days to acquire 11.00% moisture content and to prevent volatilization of the nutrients and milled using the laboratory hammer mill. The milled samples were stored in a cool environment before they were used for chemical and biochemical analyses and digestibility test.

2.2 Determination of the chemical composition of the leaf meals

Proximate analysis of the leaf samples; the percentage of moisture, ash, ether extract, crude fibre, and crude protein content of the leaves were carried out by the methods of AOAC (2006).The gross energy of the samples were determined against thermocouple grade benzoic acid a

Gallenkamp Adiabatic bomb calorimeter (Model CBB-330-01041). The caloric values of the samples were further estimated in Kcal/kg through the use of Atwater conversion factors (4.00, 9.00 and 4.00 for protein, fat and carbohydrate respectively) to multiply the percentage of crude protein, fat and carbohydrate in the sample. The proportion of the energy as contributed by protein, fat and carbohydrate and the Utilizable Energy due to Protein (UEDP) were calculated as described by Oloruntola (2015). The fat content was determined by the method of (AOAC, 2006). Determination of amino acid profiles of the samples was done according to the procedure of Beniter (1989).The Na and K contents were determined by flame photometry (Jewnway Ltd, Dunwow, Essex, UK) and P by Vanadomolybdate method (AOAC, 2006). The Ca, Mg, Fe, Zn, Fe, Mn and Cu were determined after wet digestion with a nitric, sulphuric and hydrochloric acid, using atomic absorption spectro-photometer (Buck Scientific, 2000 A. USA).The fibre fractions (Neutral-Detergent Fibre (NDF), Acid-Detergent Fibre (ADF) andAcid-Detergent Lignin) were determined according to Van Soest and Robertson (1985) procedures. The biophysical characteristics: bulk density and water holding capacity were determined by the methods of Makinde and Sonaiya (2007) and modified by Omede (2010), the specific gravity was determined as a ratio of the bulk density of known mass of each sample to density of water. Oxalate was estimated quantitatively according to the procedure of Day and Underwood (1986). Saponin was determined using the method similar to that of Hudson and El-Difrawl (1981), phytate was determined in accordance with the procedure of Ruales and Nair (1993). Tannic acid was determined in accordance with the procedure of AOAC (1995). Alkaloid determination was done using (Griffiths, 2000), flavonoidwas determined according to the method of Harborne (1973). Phenol was determined using the method of Shubhangi*et al* 2017, trypsin was determined using the method described bySmith *et al*. (1980) and terpenoids was determined using the method described by (Akinmoladun*et al* 2007). All parameter determined were performed in triplicates.

III. RESULTS

3.1 Proximate composition of the tropical leaf meals

The proximate composition of the tropical leaf meals is presented in Table 2. The statistical analysis revealed that there were significant (P≤0.05) differences among the tropical leaf meals for the parameters analysed. The moisture content values obtained ranged from 7.37 to 10.61%. The highest value was recorded for squash-gourd leaf meal and the lowest value for moringa leaf meal. The crude protein content values that were recorded varied from 30.77% to 44.09%. Amaranthus leaf meal had the highest value while moringa leaf meal had the least value. The fat content values recorded were between 6.11 and 9.13%. Moringa and fluted pumpkin leaf meals had the highest and lowest values respectively. Fluted pumpkin leaf meal had the least ash content value (9.94%), while amaranthus leaf meal had the highest ash content value (19.29%). Squash-gourd leaf meal had the lowest crude fibre and carbohydrate contents; 8.10% and 14.85% respectively. Fluted pumpkin leaf meal had the highest value of crude fibre (15.32%), while cotton seed leaf meal had the highest value of carbohydrate (30.57%). The range of values obtained for calculated energy content was between 2,973.63 and 3,983.94kcal/kg with amaranthus leaf and moringa leaf meals having the highest and lowest values respectively.

3.2 Mineral composition of the tropical leaf meals

The results of the mineral composition of the tropical leaf meals are shown in Table 3. Moringa leaf meal had the highest value recorded for calcium. The values obtained for phosphorus varied between 0.59 and 0.78ppm. The highest and lowest values were recorded in fluted pumpkin and squash-gourd leaf meals respectively. The values obtained for magnesium ranged from 9.44 to 12.04ppm. Amaranthus leaf meal had the highest value, while fluted pumpkin leaf meal had the lowest value. Moringa leaf meal had the highest value recorded for sodium (6.90ppm) while squash-gourd had the lowest value (2.0ppm).

3.3 Amino acid profile of the tropical leaf meals

The results of the amino acid profile of the tropical leaf meals are presented in Table 4, the values of histidine were significantly (P≤0.05) different with moringa leaf meal having the highest value (2.52g/100g) and amaranthus leaf meal with least value (1.80g/100g). Isoleucine values recorded were also significantly (P≤0.05) differentwith squach-gold leaf meal having the highest value (4.63g/100g) and moringa leaf meal having least value (1.80g/100g).The values of the leucine contents recorded were significantly (P≤0.05) different, the values ranged from 7.26g/100g in amaranthus leaf meal to 8.74g/100gin cotton seed leaf meal. The values of the lysine contents recorded were significantly (P≤0.05) different, the values ranged from 3.24g/100g in amaranthus leaf meal to 5.12g/100g in cotton seed leaf meal.

The values of the methionine contents recorded were significantly (P≤0.05) different, the values ranged from 1.29g/100g in cotton seed leaf meal to 1.88g/100g in fluted pumpkin leaf meal. The values of methionine recorded in amaranthus, squach-gold, moringa and fluted pumpkin leaf meals were similar (P≥0,05), however the highest value 1.88g/100g was recorded in fluted pumpkin leaf meal and the least value 1.29g/100g was recorded incotton seed leaf meal.The values of the phenylalaninie contents recorded were significantly (P≤0.05) different, the values ranged from 3.80g/100g in amaranthus leaf meal to 5.57g/100g in squach-gold leaf meal but there were no significantly (P≥0,05) different in the values recorded for fluted pumpkin leaf meal and cotton seed leaf meal.The values of the threonine contents recorded were significantly (P≤0.05) different, the values ranged from 3.04g/100g in fluted pumpkin leaf meal to 4.19g/100g in squach-gold leaf meal.

The values of the valine contents recorded were significantly (P≤0.05) different, the values ranged from 3.65g/100g in fluted pumpkin leaf meal to 5.85g/100g in squach-gold leaf meal but there were no significantly (P≥0,05) different in the values recorded for fluted amaranthus and pumpkin leaf meal. The values of the arginine contents recorded were significantly (P≤0.05) different, the values ranged from 4.41g/100g in amaranthus leaf meal to 5.18g/100g in fluted pumpkin leaf meal but there were no significantly (P≥0,05) different in the values recorded for squach-gold leaf meal and cotton seed leaf meal. The total essential amino acid content of the leaves were also significantly(P≤0.05) different and the highest value (41.21g/100g) recorded was in squach-gold leaf meals and the least value (32.25g/100g) was recorded in amaranthus leaf meal.

The values of the alanine contents recorded were significantly (P≤0.05) different, the values ranged from 3.57g/100g in amaranthus leaf meal to 4.55g/100g in squach-gold leaf meal but there were no significantly (P≥0,05) different in the values recorded for moringa and cotton seed leaf meals.The aspertic acid content of the leaves were also significantly(P≤0.05) different and the highest value (9.06g/100g) recorded was in squach-gold leaf meals and the least value (5.18g/100g) was recorded in fluted pumpkin leaf meal.The values of the cysteine contents recorded were significantly (P≤0.05) different, the values ranged from 0.79g/100g in amaranthus leaf meal to 1.08g/100g in cotton seed leaf meal but there were no significantly (P≥0,05) different in the values recorded for moringa and squach-gold leaf meal and also for values recorded for amaranthus and fluted pumpkin.Also the values of glutamic acid contents recorded were significantly (P≤0.05) different, the values ranged from 7.00g/100g in amaranthus leaf meal to 11.04g/100g in cotton seed leaf meal but there were no significantly (P≥0,05) different in the values recorded for amaranthus and fluted pumpkin leaf meals.

The glycine content of the leaves were significantly (P≤0.05) different and the highest value (5.48g/100g) recorded was in amaranthus leaf meals and the least value (2.98g/100g) was recorded in moringa leaf meal. The proline content of the leaves were significantly (P≤0.05) different and the highest value (3.36g/100g) recorded was in squach-gold leaf meals and the least value (2.24g/100g) was recorded in amaranthus leaf meal. Also the values of serine acid contents recorded were significantly (P≤0.05) different, the values ranged from 2.00g/100g in fluted pumpkin leaf meal to 3.63g/100g in squach-gold leaf meal but there were no significantly (P≥0,05) different in the values recorded for amaranthus and fluted pumpkin leaf meals. The values of the tyrosine contents recorded were significantly (P≤0.05) different, the values ranged from 2.86g/100g in moringa leaf meal to 3.98g/100g in squach-gold leaf meal but there were no significantly (P≥0,05) different in the values recorded for moringa and fluted pumpkin leaf meal and also for values recorded for amaranthus and cotton seed leaf meals.

The total non-essential amino acid were significantly (P≥0,05) different, squash-gourd leaf had the highest value (37.57 g/100g), while fluted pumpkin leaf had the least value (30.08g/100g). The values for grand total amino acid were significantly (P≥0,05) different. Squash-gourd leaf was observed to have the highest amino acid profile with grand total amino acid content of (78.78 g/100g), while fluted pumpkin leaf had the least value (64.31g/100g).

3.4 Anti-nutrients composition of the tropical leaf meals

The results of the anti-nutrient composition of the tropical leaf meals are presented in Table 5. The statistical analysis revealed that there were significant (P≤0.05) differences among the tropical leaf meals for the parameters analysed. The values obtained for tannin content ranged from 0.12 to 0.37mg/100g. Amaranthus and moringa leaf meals were recorded to have the least and highest values respectively. The values obtained for phenol content ranged from 0.10 to 0.23mg/100g. Amaranthus leaf meal was recorded to have the lowest value, while moringa leaf meal had the highest value. The values obtained for flavonoids content ranged

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from 0.40 to 1.38mg/100g, fluted pumpkin leaf meal was recorded to have the lowest value, while Squash-gourd leaf meal had the highest value. Squash-gourd leaf meal was observed to have the highest value of trypsin terpenoid contents; 4.08mg/100g and 4.32mg/100g respectively, while amaranthus leaf meal was observed to have the lowest value; 2.55mg/100g and 1.75mg/100g respectively. The values obtained for oxalate content ranged from 1.88mg/100g in moringa leaf meal to 3.24 mg/100g in cotton seed leaf meal. The result of the Phytate content shows Amaranthus leaf meal (53.06mg/100g) and cotton seed leaf meal (6.92mg/100g) were recorded to have the highest and least values respectively. The values obtained for alkanoids content ranged from 3.00mg/100g in amaranthus leaf meal to 6.01mg/100g in cotton seed leaf meal.

The result of the saponin content shows moringa leaf meal (1.09mg/100g) and cotton seed leaf meal (0.23mg/100g) were recorded to have the highest and least values respectively.

3.5 Dietary fibre content of the tropical leaf meals.

The results of the dietary fibre fraction of the tropical leaf meals are presented in Table 6. The values of neutral detergent fibre NDF were significantly ($P \leq 0.05$) different with moringa leaf meal having the least value (40.40g/100g) and cotton seed leaf meal with highest value (78.25g/100g). Acid detergent fibre ADF values recorded were also significantly ($P \leq 0.05$) differentwith moringa leaf meal having least value (29.54g/100g) and the highest value (47.79g/100g) in fluted pumpkin leaf meal.The values of the acid detergent lignin ADL recorded were significantly ($P \leq 0.05$) different, the values ranged from 14.55g/100g in moringa leaf meal to 29.33g/100gin fluted pumpkin leaf meal however the values recorded for amaranthus and cotton seed leaf meals are not significantly ($P \geq 0.05$) different . The values of the hemicellulose contents recorded were significantly ($P \leq 0.05$) different, the values ranged from 5.77g/100g in amaranthus leaf meal to 21.072g/100g in cotton seed leaf meal.

The values of the cellulose contents recorded were significantly ($P \leq 0.05$) different, the values ranged from 14.99g/100g in moringa leaf meal to 25.66g/100g in squach-gourd leaf meal.

3.6 Bio-Physical Characteristics and pH values of the Leaf Meals

The results of the bio-physical characteristic of the tropical leaf meals were presented in Table 7. The bulk density values recorded in amaranthus, moringa, fluted pumpkin and cotton seed leaf meals were not significantly ($P \geq 0,05$) different, however squach-gold leaf meal had the highest value 0.44 and the least value 0.31 was recorded in both amaranthus and moringa leaf meals.The values of water holding capacity recorded were significantly ($P \leq 0.05$) different, the values ranged from 1.59 in moringa leaf meal to 4.68 in fluted pumpkin leaf meal. The values of the specific gravity values recorded in amaranthus, moringa, fluted pumpkin and cotton seed leaf meals were not significantly ($P \geq 0,05$) different, however squach-gold leaf meal had the highest value 0.41 and the least value 0.29 was recorded in amaranthus leaf meals.

The pH values of the tropical leaf meal were significantly ($P \leq 0.05$) different, the values ranged from 4.60 in squach-gourd leaf meal to 5.41 in cotton seed leaf meal but there were no significantly ($P \geq 0,05$) different in the values recorded for fluted pumpkin cotton seed leaf meals.

IV. DISCUSSION

The values of the crude protein obtained for the air dried leaf meals: amaranthus (30.77%), cotton seed (31.68%), fluted pumpkin (44.09%), moringa (37.20%) and squash-gourd (42.42%) meal was found to be very high compare to what was recorded by Fasuyi and Akindahunsi (2009), Apena*et al* 2004, Ifon and Basir (1980), Makkarand Becker (1997) and Adebayo *et al* 2013 respectively. The higher result may be due to the drying method which cannot denature the amino acid content of the leaf,the richness of the crude protein content can be also attributed to the soil parameters on which leafs were planted. Also, the crude protein of the leaf meals was observed to be lower than that of soyabean meal (44 %) or fish meal (60 %) used conventionally as sources of protein in chicken diets. It was also observed that the crude fibre content were higher in all the tested leaf meals than what was recorded by the following authors; Fasuyi and Akindahunsi (2009), Apena*et al* 2004, Ifon and Basir (1980), Makkarand Becker (1997) and Adebayo *et al* 2013. This may be due to the age of the leaves before harvesting.

It was also observed that the crude fibre content is higher in fluted pumpkin leaf meal than in other leaf meals. The value was recorded to be 15.32%. Meanwhile, Akoroda (1990) recorded the crude fibre content to be 13%. The high crude fibre content of leaves can limit the nutritive value and utilization of protein of the leaf. The crude fibre of amaranthus leaf meal was observed to be 9.71% and this is similar to the 8.8% that was reported by Fasuyi*et al*. (2007). Fasuyi*et al*. (2007) commented that the high fibre and bulkiness of vegetable materials which call for large quantities to be consumed to provide adequate levels of nutrients has been major drawbacks to their use as major sources of nutrients for monogastrics nutrition.

The ash content of amaranthus leaf meal which was recorded to be 19.29 % is higher than the values reported for other leaves. This might have been influenced greatly by soil parameters. This observation is similar to the report of Fasuyiand Akindahunsi (2009) which recorded the ash content of amaranthus leaf meal to be 19.30%. The fluted pumpkin ash content result of Fasuyi and Nonyerem (2007) is similar to the result of this study, the ash content of moringa, cotton seed and squash-gourd leaves as reported by Makkarand Becker (1997), Apena*et al* 2004 and Adebayo *et al* 2013 respectively were lower which may be due to the system of processing and the age of the plant.

The mineral composition determination carried out on the leaf meals revealed that all the micro and macro mineral values were in line with the results of Fasuyi and Akindahunsi (2009), Apena*et al* 2004, Ifon and Basir (1980), Makkarand Becker (1997) and Adebayo *et al* (2013). Amaranthus and fluted pumpkin leaf meals are high in iron 2.87ppm and 2.1ppm respectively. Asiegbu (1998) commented that fluted pumpkin is a good source of iron and fatty acids and it makes the leaves potentially useful as food supplements. The high value of fibre fraction may be due to fibrous nature of the leaf meals. The biophysical characteristics of the leaves were comparable with Eleasu*et al*, (2012) and Fasuyi (2006). The lysine and methionine contents of the tropical leaf meals are considered to be high. This makes them good substitutes for conventional feed sources in animal nutrition. Okereke and Akaninwor (2013) also reported the amino acid profile to be rich in lysine (3.60g/100g) and methionine (0.95g/100g). The significant differences observed indicated that amaranthus had least values of Tannin, Phenol and trypsin. Dietary tannins are said to reduce feed efficiency and weight gain in chicks (Dei *et al.*, 2007) while trypsin causes pancreatic enlargement and growth depression (Aletor and Fetuga, 1987). Therefore, low levels of these antioxidants would amount to better feed efficiency and growth.The observed values of Terpenoids, Oxalate and Phytate for Moringa appeared to be least when compared with other leaf meal. This result agrees with the findings of Makkar and Becker (1996) who reported that the anti-nutrient concentration in *Moringaoleifera*is low. On this basis, consumption of moringa appears safer than that of other common vegetables like spinach and green and purple amaranths. The levels of phytate and oxalate found in the leaf were generally higher than levels reported by Abiodun*et al*. (2012).

The presence of some anitnutritional factors (ANFs) in VLMs (Fasuyi, 2005) is of negative nutritional relevance. The presence of ANFs (phenol, oxalates and tannins) in cotton was a probable factor that militated against the digestibility of crude protein (CP) and amino acids (AAs) in VLM based diets. Higher contents of tannins in the cotton could have contributed to the poor digestibility of their CP and AAs in the cotton based diets compared to the reference Amaranthus that had little of these ANFs

REFERENCES

[1] Abiodun OA, Adegbite JA, Omolola AO (2012). Chemical and Physicochemical Properties ofMoringa Flours and Oil. Global Journal of Science Frontier Research Biological Sciences, 12(5), 12-18.

[2] Agbede JO, Aletor VA (2004). Chemical characterization and protein quality evaluation of leaf protein concentrates from Glyricidiasepium and Leucaenaleucocephala. International Journal of Food Science and Technology, 39 (3): 253-261.

[3] Akinmoladun AC, Ibukun EO, Afor E, Akinrinlola BL, Onibon TR, Akinboboye AO (2007). Chemical constituents and antioxidantactivity of Alstoniaboonei. Afr. J. Biotechnol. 6(10):1197-1201

[4] Akoroda, MO (1990). Seed Production and Breeding Potential of Fluted Pumpkin. Euplthea, 49(1): 25-32.

[5] Aletor VA, Fetuga BL (1987). Pancreatic and intestinal amylase (EC3.2.1.1) in the rat fed haemagglutininextract.II Evidence of impaired dietary starch utilization. J. Anim. Physiol. Anim. Nutr. 57(3):113-117.

[6] Aletor, VA, Adeogun OA(1995). Nutrient and anti-nutrient components of some tropical leafy vegetables. Food Chem., 53: 375-379.

[7] Aletor, VA(1993). Allelochemicals in plant food and feedingstuffs: 1. Nutritional, biochemical and physiopathological aspects in animal production. Vet. Hum. Toxicol., 35: 57-67.

[8] AOAC (2000). Chemical method of Analysis. Association of Analytical Chemists. 20th edition Washington D.C. USA.

[9] AOAC (Association of Official Analytical Chemicals) (2006) Official Method of Analysis of the AOAC (W.

http://dx.doi.org/10.22161/ijeab/4.3.32 ISSN: 2456-1878

Horwitz Editor Eighteen Edition, Washington; D. C., AOAC.

[10] AOAC (1995). Official Methods of Analysis, Association of Officials Analytical Chemist. Vol - I, 16th Ed., AOAC.International, Arlington, USA, pp: 31-65.

[11] Apena A, Atole C, Chinweike-Umeh. SN, Usigbe UE, Ojekunle MO, Ashiru AW (2004).The Nutritive Potentials Of Cotton (Gossypiumbarbadense) Leaves Nigerian Food Journal Vol.22 2004: 160-163

[12] Asiegbu JE (1998). Effects of Methods of Harvesting and Interval between Harvests on Edible Leaf Yield of Fluted Pumpkin. Sci. Hortic. (21):129-136.

[13] Beniter IV (1989). Amino acid and fatty acid profiles in aquaculture nutrition studies 1-3, In: S.S. de Silva (ed.). Fish nutrition research in Asia. Proceeding of the third Asia Fish Nutrition Network meeting. Asian Fish Society special publication 4: 166.

[14] Day RA, Underwood AI (1986). Qualitative analysis 5thed. New Delhi, Inida: Prentice Hall publication Pp 701.

[15] Dei HK, Rose SP, Mackenzie AM (2007). Shea nut (Vitellariaparadoxa) meal as a feed ingredient for poultry. In World's Poultry Science Journal, vol. 63, no.4, p. 611-624.

[16] Duncan DD(1955). Multiple range and multiple F-tests. Biometrics, 11 : 1 – 42.

[17] Egbunike GN (1997). What is Animal Science? And how can Nigeria get out of malnutrition. In: Livestock Products.

[18] Eleazu CO, Eleazu KC, Awa E, Chukwuma SC (2012). Comparative study of the phytochemical composition of the leaves of five Nigerian medicinal plants. National Root Crops Research Institute, Umudike, Umuahia, Abia State, Nigeria. Journal of Biotechnology and Pharmaceutical Research, 3(2): 42-46.

[19] Fasuyi AO (2006). Nutritional potentials of some tropical vegetable leaf meals: chemical characterization and functional properties. African journal of biothechnology vol. 5 (1), pp. 049-053.

[20] Fasuyi AO, Akindahunsi AO (2009). Nutritional Evaluation of AmaranthuscruentusLeaf Meal Based Broiler Diets Supplemented with Cellulase/Glucanase/Xylanase Enzymes. American Journal of Food Technology, 4: 108-118.

[21] Fasuyi AO (2005). Nutrient composition and processing effects of Cassava leaf (Manihotesculenta; crantz) antinutrients. Pakistan Journal of Nutrition, 4 (1): 37 – 42

[22] Fasuyi AO, Nonyerem AD(2007). Biochemical, nutritional and haematological implications of Telfairiaoccidentalis leaf meal as protein supplement in broiler starter diets. Afr. J. Biotechnol., 6: 1055-1063. |

[23] Fasuyi AO, Aletor VA(2005). Protein replacement value of Cassava (Manihotesculenta, Crantz) Leaf Protein Concentrate (CLPC) in broiler starter: Effect on performance, muscle growth, haematology and serum metabolites. Int. J. Poult. Sci., 4: 339-349.

[24] Fasuyi AO 2007. Bionutritional evaluations of three tropical vegetables (Telfairiaoccidentalis, Amaranthuscruentus and Talinumtriangulare) as sole dietary protein sources in rat assay. Food Chem., 103: 757-765

[25] Fasuyi AO,Dairo FAS,Adeniji AO(2007). Protein supplementary quality of tropical vegetable (Amaranthuscruentus) leaf meal in broiler starter diets: Bionutritional evaluation. Int. J. Agric. Res., 2: 976-986.

[26] Griffiths DO(2000). The inhibition of enzymes by extract of field beans (Viciafaba). J. Sci. Food Agric., 30: 458-462.

[27] Harborne JB (1973). Phytochemical methods.Chapman and Hall Ltd., London. 278pp.

[28] Hudson BJF, El-Difrawl EA(1981). The sapoagenins of the seeds of four ipinpecies. J. Plant Foods, 3: 181-186.

[29] Ifon ET, Basir O (1980). The nutritive value of some Nigeria leaf vegetables, particularly vitamin and mineral contents. Food chemistry, 4(4): 263-267.

[30] Igbasan FA,Olugosi AO (2013). Performance characteristics, biochemical and heamatological profiles of broiler chickens fed synthetic and herbal methionine supplemented diets, African journal of food science, vol. 7(6), pp. 159-167.

[31] Makinde FN, Sonaiya EB. (2007). Determination of water, blood and rumen fluid absorbencies of some fibrous feedstuffs. Livestock Rural Rev. Dev., Vol. 19.

[32] Makkar, HPS, Becker K (1996). Nutritional value and anti-nutritional components of whole and ethanol extracted Moringaoleifera leaves. Anim. Feed Sci, 63, 211-228.

[33] Oloruntola OD (2015). Nutritive value of processed cassava wastes in rabbit production. PhD thesis The Federal University of Technology, Akure, Nigeria.

[34] Omede AA (2010). The use of physical characteristics in the quality evaluation of some commercial poultry feeds and feedstuff. MSC. Thesis, Federal University of Technology, Owerri, Nigeria.

[35] Ruales, J, Nair BM(1993). Saponins, phytic acid, tannins and protease inhibitors in quinoa (Chenopodium quinoa, Wild) seeds. Food Chem., 48: 137-143.

[36] SAS (2008). Statistical Analysis System/STAT. Institute Inc. user's guide, version 8 for windows. SAS Campus Drive, Cary, North Caroline, USA.

[37] Shubhangi K,Kirti S, Sofiya M,Suchita G (2017). Quantitative Estimation ofTotal Phenolics and Flavonoids in Soymidafebrifuga leaves. Am J Phytomed Clin Ther Vol. 5 No. 3:20

[38] Smith C, Van Megan W, Twaalfhoven L, Hitchcock C.(1980). The determination of trypsin inhibitor levels in food

[39] Van Soest PJ, Robertson JB (1985). Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3583-3597.

Table.2: Proximate Composition of the Tropical Leaf Meals (%)

	Leaf Meals				
Parameters	*Amaranthuscruentus L*	*Cucurbitapepo*	*Moringaoleifera*	*Telfairiaoccidentalis*	*Gossypiumhirsutum*
Moisture Content	9.7±0.69^{ab}	10.61±0.01^{a}	7.37±0.03^{c}	9.35±0.02^{b}	10.77±0.04^{a}
Crude Protein	30.77±0.02e	42.42±0.01^{b}	37.2±0.01^{c}	44.09±0.01^{a}	31.68±0.12^{d}
Ether Extract	6.51±0.01^{c}	6.97±0.02b	9.13±0.03^{a}	6.11±0.00^{e}	6.48±0.08^{d}
Ash	19.29±0.01^{a}	17.01±0.06^{b}	12.75±0.03^{c}	9.94±0.01^{d}	9.28±0.02^{e}
Crude Fibre	9.71±0.01^{c}	8.10±0.01e	8.92±0.01d	15.32±0.01^{a}	11.24±0.01^{b}
Carbohydrate	24.02±0.04^{bc}	14.85±0.05^{d}	24.60±0.04b	15.19±0.08^{c}	30.57±0.06^{a}
Enery (kcal/kg)	2973.63±47.77^{d}	3331.90±100.32^{c}	3983.94±42.99^{a}	3852.58±112.26^{b}	2998±90.02^{e}

a-e = means within the same column having different superscripts are significantly different

Table 3:Mineral composition of the tropical leaf meals

	Leaf Meals				
Parameters	*Amaranthuscruentus L*	*Cucurbitapepo*	*Moringaoleifera*	*Telfairiaoccidentalis*	*Gossypiumhirsutum*
Macro Minerals (ppm)					
Calcium (Ca)	110.00±0.17^{c}	140.00±0.17^{b}	150.00±0.35^{a}	21.00±0.56^{e}	98±0.23^{d}
Phosphorus (P)	0.73±0.01^{b}	0.59±0.06^{d}	0.69±0.06^{c}	0.78±0.03^{a}	0.49±0.36^{e}
Magnesium (Mg)	12.04±0.01^{a}	9.72±0.13^{b}	9.46±0.02^{c}	9.44±0.01^{c}	7.85±0.12^{d}
Potassium (K)	46.50±0.23^{a}	9.50±0.01^{d}	30.50±0.06^{b}	12.50±0.01^{c}	8.00±0.27^{e}
Sodium (Na)	2.30±0.11^{b}	2.00±0.23^{b}	6.90±0.17^{a}	2.40±0.01^{b}	1.50±0.01^{c}
Micro Minerals (mg/kg)					
Zinc (Zn)	0.52±0.01^{a}	0.31±0.01^{b}	0.32±0.01^{b}	0.52±0.02 ^{a}	0.22±0.23^{c}

Iron (Fe)	2.87±0.01^{a}	1.62±0.06^{c}	1.84±0.01^{c}	2.10±0.17 ^{b}	0.81±0.04^{d}
Copper (Cu)	0.08±0.01^{a}	0.07±0.01^{a}	0.08±0.01^{a}	0.08±0.23^{a}	0.07±0.21^{a}
Lead (Pb)	0.04±0.01^{a}	0.03±0.01^{a}	0.02±0.01^{a}	0.03±0.01^{a}	0.04±0.22^{a}
Manganese (Mn)	0.75±0.01^{a}	0.60±0.02^{b}	0.25±0.02^{c}	0.55±0.02^{b}	0.24±0.45^{d}

a-e = means within the same column having different superscripts are significantly different

Table 4: Amino Acid Profile of the Tropical Leaf Meals

	Leaf Meals					
Parameters	*Amaranthuscruentus L*	*Cucurbitapepo*	*Moringaoleifera*	*Telfairiaoccidentalis*	*Gossypiumhirsutum*	*SEM*
Histidine	1.80^{e}	2.22^{c}	2.52^{a}	1.95^{d}	2.48^{b}	0.56
Isoleucine	3.61^{d}	4.63^{a}	3.50^{e}	3.99^{c}	4.33^{b}	0.23
Leucine	7.26^{e}	7.92^{c}	8.08^{b}	7.59^{d}	8.74^{a}	0.17
Lysine	3.24^{e}	4.11^{c}	4.75^{b}	3.73^{d}	5.12^{a}	0.25
Methionine	1.73^{a}	1.72^{a}	1.79^{a}	1.88^{a}	1.29^{b}	0.11
Phenylalanine	3.80^{d}	5.57^{a}	5.06^{b}	4.22^{c}	4.47^{c}	0.34
Threonine	3.59^{b}	4.19^{a}	3.48^{c}	3.04^{e}	3.26^{d}	0.12
Valine	3.88^{d}	5.85^{a}	4.28^{c}	3.65^{d}	5.26^{b}	1.21
Arginine	4.14^{d}	5.00^{b}	4.83^{c}	5.18^{a}	4.93^{b}	0.43
CTEAA	**32.25^{e}**	**41.21^{a}**	**37.59^{c}**	**34.23^{d}**	**39.88^{b}**	**3.42**
Alanine	3.57^{d}	4.55^{a}	4.03^{c}	4.25^{b}	3.95^{c}	0.65
Aspartic acid	8.25^{c}	9.06^{a}	7.88^{d}	5.18^{e}	8.60^{b}	0.32
Cysteine	0.79^{e}	0.99^{b}	0.93^{b}	0.80^{c}	1.08^{a}	0.43
Glutamic acid	8.48^{c}	7.00^{d}	9.39^{b}	8.79^{c}	11.04^{a}	1.85
Glycine	5.48^{a}	5.00^{b}	2.98^{e}	3.55^{d}	4.04^{c}	1.34
Proline	2.24^{e}	3.36^{a}	3.05^{b}	2.64^{c}	2.49^{d}	0.32
Serine	2.01^{d}	3.63^{a}	2.60^{b}	2.00^{d}	2.32^{c}	0.3
Tyrosine	3.33^{b}	3.98^{a}	2.86^{c}	2.87^{c}	3.32^{b}	0.11
CTNEAA	**37.15^{a}**	**37.57^{a}**	**33.72^{c}**	**30.08^{d}**	**36.84^{b}**	**5.32**
CGTAA	**69.40^{d}**	**78.78^{a}**	**71.31^{c}**	**64.31^{e}**	**76.72^{e}**	**8.48**

a-e = means within the same column having different superscripts are significantly different

CTEAA = Calculated Total essential Amino Acid, CTNEAA = Calculated Total Non-Essential Amino Acid, CGTAA = Calculated Grand Total Amino Acid and SEM = Standard Error Mean

Table 5: Anti-nutrients Composition of Tropical Leaf Meals (mg/100g)

	Leaf Meals				
Parameters	*Amaranthuscruentus L*	*Cucurbitapepo*	*Moringaoleifera*	*Telfairiaoccidentalis*	*Gossypiumhirsutum*
Tannin	0.12±0.00^{d}	0.15 ±0.01^{c}	0.37 ±0.00^{b}	0.17 ±0.01^{c}	0.42±0.01^{a}
Phenol	0.10 ±0.00^{e}	0.14 ±0.00^{d}	0.37 ±0.00^{b}	0.23 ±0.01^{c}	0.46±0.01^{a}
Flavonoids	0.57 ±0.00^{c}	1.38 ±0.01^{a}	0.53 ±0.01^{d}	0.40 ±0.00^{c}	1.22±0.01^{b}
Trypsin	2.55 ±0.01^{b}	4.08 ±0.12^{a}	3.95 ±0.01^{a}	3.95 ±0.02^{a}	3.92±0.01^{a}
Terpenoids	1.75 ±0.01^{c}	4.32 ±0.00^{a}	4.31 ±0.00^{a}	3.78 ±0.01^{a}	4.31±0.01^{a}
Oxalate	2.7 ±0.10^{b}	2.37 ±0.02^{c}	1.88 ±0.03^{d}	2.03 ±0.03^{d}	3.24±0.01^{a}

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Phytate	53.06±0.01[a]	47.97±0.01[b]	8.65±0.01[d]	19.69±0.01[c]	6.92±0.01[e]
Alkanoids	3.00 ±0.00[d]	4.99 ±0.33[b]	5.01 ±0.06[b]	4.41±0.01[c]	6.01±0.01[a]
Saponin	0.81 ±0.01[b]	0.33 ±0.00[d]	1.09 ±0.01[a]	0.66 ±0.01[c]	0.23±0.01[e]

a-e = means within the same column having different superscripts are significantly different.

Table 6: Dietary Fibre Fraction Content of the Tropical Leaf Meals

6	Leaf Meals					
Parameters	*Amaranthuscruentus L*	*Cucurbitapepo*	*Moringaoleifera*	*Telfairiaoccidentalis*	*Gossypiumhirsutum*	*SEM*
Neutral Detergent Fibre	46.83[d]	61.74[b]	40.40[e]	57.20[c]	78.25[a]	16.45
Acid Detergent Fibre	41.06[d]	43.48[c]	29.54[e]	47.79[a]	46.53[b]	11.76
Acid Detergent Lignin	21.64[b]	17.82[c]	14.55[d]	29.33[a]	21.70[b]	5.34
Hemi-cellulose	5.77[e]	18.26[b]	10.86[c]	9.43[d]	21.72[a]	2.87
Celluose	19.42[c]	25.66[a]	14.99[e]	18.66[d]	24.83[b]	5.76

a-e = means within the same column having different superscripts are significantly different
SEM = Standard Error of Means,

Table 7: Bio-Physical Characteristics and pH Values of the Leaf Meals

	Leaf Meal					
Parameters	*Amaranthuscruentus L*	*Cucurbitapepo*	*Moringaoleifera*	*Telfairiaoccidentalis*	*Gossypiumhirsutum*	*SEM*
Bulk density	0.31	0.44	0.31	0.32	0.32	0.03
Water oldingcapasity	4.31	3.22	1.59	4.68	1.77	1.52
Specific gravity	0.29	0.41	0.32	0.31	0.31	0.04
pH	4.94	4.6	5.26	5.4	5.41	0.52

a-e = means within the same column having different superscripts are significantly different SEM = Standard Error of Means,