International Journal of Life Science and Agriculture Research
ISSN (Print): 2833-2091, ISSN (Online): 2833-2105
Volume 04 Issue 10 October 2025
DOI: https://doi.org/10.55677/ijlsar/V04I10Y2025-06
Impact Factor: 7.88 , Page No : 614-619

Chemical Composition of Editan (*Lasianthera africana*) Leaf Meal and Nutrient Digestibility of the Leaf Meal by Finisher Broiler Chickens

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ABSTRACT

This study investigated the chemical composition of editan (*Lasianthera africana*) leaves and the nutrient digestibility of finisher broiler chickens fed editan leaf meal (ELM). The sun-dried editan leaves were milled and analyzed for their proximate composition, minerals, amino acid concentration and anti-nutritional composition. One hundred and fifty (150) day old unsexed Abor acre chicks were randomly assigned to five (5) dietary treatments (T1-T5) containing 0, 5, 6, 7 and 8 % editan leaf meal (ELM) respectively and each treatment was replicated three times with 10 birds giving a total of 30 birds per treatment. Feed and water were given *ad libitum* which lasted for 56 days. The experiment was arranged in a Completely Randomized Design (CRD). At the end of the 8th week, two (2) birds per replicate were transferred to the metabolic cage. Both the feed and the feacal output collected during the trial period were analyzed. The results showed that the crude protein, crude fibre, ether extract, ash, dry matter, carbohydrate and gross energy contents of the ELM were; 19.74 %, 15.69 %, 2.81 %, 7.91 % 89.40 %, 43.25 % and 3.995 kcal/g respectively. The macro and micro minerals analysis and amino acids profile revealed that Editan (*Lasianthera africana)* leaf meal is rich in dietary nutrients and when added to the diets of broiler chickens improves nutrient utilization but as the inclusion level increases, it depresses nutrient digestibility which in-turn affected their growth as shown in the final body weights. The results of the nutrient digestibility showed that all the parameters measured were significantly ($p<0.05$) affected. Percentage digestibility of crude protein, ether extract, ash, dry matter and nitrogen free extract were significantly higher in T2 with 5 % ELM compared to (T1) without ELM in the diet. Therefore, it could be concluded that ELM up to 5 % can be substituted for palm kernel cake (PKC) in the diet of broiler chicken without any adverse effect.

Published Online: October 21, 2025

KEYWORDS: Finisher broiler, chemical composition, nutrient digestibility, anti-nutrients and Editan leaf meal.

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INTRODUCTION

The use of plant-based feed ingredients in broilers diet has become more popular due to concerns about the sustainability and cost of animal-based feed ingredients One of such vegetable-based feed is Editan *(Lasianthera africana),* a plant species commonly found in West Africa countries and specifically in Nigeria, particularly in tropical rainforest of the South Eastern part of the country, such as Akwa Ibom and Cross River States. The plant is also found in the tropical rainforest of other countries like Cameroon, Gabon and Congo and from Rubiaceae family, which has been reported to be fungicidal, bacteriostatic (Itah, 1996; 1997), antidiabetic (Ekanem, 2006) and antiplasmodial (Okokon *et al.,* 2007) containing alkaloids, terpenes, saponins, tannins, flavonoids, anthraquinones and cardiac glycosides.

The leaves of *Lasianthera africana* have been used as herbs in several generations to quench bacterial skin infections, gonorrhea and abdominal disturbance. *Lasianthera africana* leaf meal, has been suggested as a potential feed ingredient in broiler diet (Unah *et al*., 2022). However, the bioactive compounds present in *Lasianthera africana* leaf meal may also have potential benefits for improving nutrient digestibility in broilers. Broilers in Nigeria are the most abundant livestock species which is reported to account

for more than 60 % of the total poultry population in the country (Biswas *et al.,* 2011). In intensive poultry enterprise, feed is the major component cost and the ultimate challenge is to reduce cost of input to a minimum without compromising the quality of the products (Ziggers, 2011). Thus, adequate knowledge of poultry nutrition and of course micro-nutrients (vitamins and minerals) in alternative feed ingredients like leaves is imperative for good ration formulation (Adegbenro *et al.,* 2012).

Vegetable-based feeds are a rich source of essential plant amino acids, vitamins and minerals. 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 (Fasuyi, 2006).

The overall effect of *Lasianthera africana* leaf meal on digestibility appears to be dependent on the level of inclusion in the diet and specific bioactive compounds present in the leaf meal. Several other factors are also involved such as; age and health status of birds, composition of the diet and the processing method used to prepare the leaf meal. Therefore, the current study was undertaken to examine the nutritive and ant-i nutritive contents of Editan (*Lasianthera africana*) leaves and the effect of editan leaf meal (ELM) substituted for PKC on the nutrient digestibility of finisher broilers chicken.

MATERIALS AND METHODS

Experimental site

The study was carried out at the Poultry Unit of Teaching and Research Farm of the University of Uyo, Uyo, Akwa Ibom State, Nigeria. Uyo is located within the tropical rainforest zone of Nigeria, between latitude 5.32°N and longitude 7.54°E. The mean altitude is 38.1m above sea level. It has an average rainfall of about 2200mm to 3500mm and with the average temperature 22.5°C to 32.2°C. The area has two distinct seasons: wet season (March – November) and dry season (November – March). Sunshine is between 1400 to 1500 hours per year, relative humidity is from 71% to 80% annually (University of Uyo Meteorological Station, 2014).

Processing of the Test Material (Editan Leaf meal)

Mature fresh editan (*Lasianthera africana*) leaves were separated from the stalk by hand plucking, washed with clean water to remove the dirt and then sundried for three (3) days to reduce the moisture content. The dried leaves were ground using hammer mill and stored in polyethene bags at room temperature. The ground editan leaves (now editan leaf meal), were used with other feed ingredients (maize, soybean, palm kernel cake, fishmeal and bone meal) to formulate a concentrate diet as shown on Table 1.

Laboratory Evaluation of the Test Material

Samples of the dried editan (*Lasianthera africana*) leaves were analyzed for their proximate (AOAC, 2005), mineral (AOAC 1980), amino acids (AOAC 2006) contents while the gross energy was determined by the use of the Gallenkamp Ballistic Calorimeter (AOAC, 2005). The metabolizable energy of the test material was evaluated using the equation described by Paauzenga (1985): ME (kcal/kg) =37x%CP+ 81.8X%EE+35.5X%NFE. The anti-nutrients were determined using the non-laborious spectrophotometric method of Bradbury *et al.* (1999), Maya (1982) and Markkah *et al* (1993).

Digestibility Study

A total of one hundred and fifty (150) unsexed day-old Arbor Acre strain raised on deep litter were randomly assigned to five dietary treatments (Table 1) in a Completely Randomized Design (CRD) each having 30 chicks and each treatment was replicated three (3) times with ten (10) birds per replicate. Starter and finisher diets were formulated and the processed editan leaf meal was included in the diets as a substitute for PKC at 0, 5, 6, 7 and 8 % respectively (Table 1) at both the starter and finisher phases. The experiment lasted for 56 days. The percentage nutrient digestibility of each of the diets was thereafter evaluated. At the end of the 8th week, two (2) birds were randomly picked per replicate (6 per treatment) and transferred into metabolic cages. They were kept in the cages for 7 days. The birds were allowed to acclimatize for three days while feaces were collected during the last four days. Birds were fed with a known quantity of experimental diets with clean water supplied *ad libitum*. Feacal droppings from each treatment were taken daily (days 4 – 7), weighed, sun-dried to constant weight and milled. Feacal samples for each treatment was bulked and 10 % obtained for laboratory analyses. The dietary and feacal samples were subjected to proximate analysis using the procedure described by AOAC (1990). Values obtained were used to calculate the apparent nutrient digestibility and the metabolizable energy.

Table 1: Composition of experimental finisher diets (%)

Parameters	ELM0 (T1)	ELM5 (T2)	ELM6 (T3)	ELM7 (T4)	ELM8 (T5)
Maize	56.00	56.00	56.00	56.00	56.00
Soybean meal	24.00	24.00	24.00	24.00	24.00
Palm Kernel Cake	14.00	9.00	8.00	7.00	6.00
Editan Leaf Meal (ELM)	-	5.00	6.00	7.00	8.00
Fishmeal	2.00	2.00	2.00	2.00	2.00

Bone Meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Nutrient (%)					
ME (Kcal/Kg)	2978.04	2977.82	2977.78	2977.73	2977.69
Crude Protein	20.26	20.35	20.36	20.38	20.40
Crude Fibre	4.30	4.34	4.34	4.35	4.36
Ether Extract	4.07	3.81	3.76	3.71	3.66
Phosphorus	0.86	4.61	5.38	6.12	6.87
Calcium	0.98	4.75	5.51	6.26	6.99

*To provide the following per kilogram of feed: Vit. A 10,000iu, Vit.D_3; 2000iu, Vit E; 5iu, Vit K 2mg, Riboflavin 4.20mg; Vit B12 0.01mg, Panthotenic acid 5mg; Nicotic acid 20mg; Folic acid 0.5mg; Choline 3mg; Magnesium 56mg; Fe 20mg; Cu 10mg; Zn 50mg; Co 125mg**.**

Data Analysis

Data obtained from laboratory analyses of feed and feacal samples in nutrient digestibility by finisher broiler fed concentrate containing graded levels of dietary editan leaf meal were subjected to analysis of variance in a Completely Randomized Design according to Steel and Torrie (1990) using SPSS version 20.0 and the differences between the treatment means were separated using the Duncan Multiple Range Test of the same software.

RESULTS AND DISCUSSION

The result of the laboratory evaluation of the proximate composition and gross energy of ELM is presented in Table 2. The crude protein, ether extract, crude fibre, ash, dry matter, carbohydrate and gross energy of editan were 19.74 %, 2.81 %, 15.69 %, 7.91%, 89.40%, 43.25% and 3.995kcal/g respectively. The values for crude protein, crude fat, carbohydrate and dry matter were numerically lower than 22.11%, 5.42%. 47.47%, and 90.02% as reported by Okezie *et al*. (2017) for protein, fat, carbohydrate and dry matter respectively while the crude fibre content, ash, and gross energy values were higher than 8.74 %, 7.19% and 3.491kcal/g as also reported by Okezie *et al*. (2017). The variations observed in the study could be as a result of the stage of maturity, the specie of editan plant, soil type, processing method and the season of harvest. From the result editan leaf meal when consumed in adequate amount can serve as a source of dietary protein in animal diet. The crude fibre content was higher in the ELM compared to 8.74 % recorded by Okezie *et al* (2017). The high fibre content of the leaf can limit the nutritive value and utilization of protein by animal but could also functions in maintaining bowel movement. The fat content was low although dietary fat is a major determinant of palatability in feed. Antia *et al* (2006) has reported that vegetables fat and oil lower blood lipids, hence contributing to a reduction in the occurrence of diseases associated with damage of coronary artery (Ononogbu, 2002). The ash content was between the range of other vegetables (7.19-9.63g/100g) as reported by Adetuyi *and* Osagie (2011) as the method of processing and the age of the plant may influenced the ash content of the leaf. The dry matter content of 89.40 % obtained was lower than 90.022% as reported by Okezie *et al* (2017). The carbohydrate and the gross energy values could serve as a source of energy to the animal.

Table 2: Proximate composition (%) and gross energy of editan leaf meal

Parameter	Composition
Dry matter	89.40
Crude protein	19.74
Crude fibre	15.69
Ether extract	2.81
Ash	7.91
Nitrogen free extract	43.25
Gross energy (Kcal/g)	3.995

The results of the macro and micro mineral composition of editan leaf meal is presented in Table 3. The values for the macro minerals were 0.28 %, 0.97 %, 0.25 %, 0.27 % and 0.38 % for sodium, potassium, calcium, magnesium and phosphorus respectively. The values obtained for the micro minerals were 45.76 mg/kg, 1.03 mg/kg, 9.84 mg/kg, 68.26 mg/kg and 179.26 mg/kg for

manganese, cobalt, copper, zinc and iron respectively. Nutritionally, minerals are very important in animal system for diverse metabolic activities as reported by Grosvernor and Smolin (2002). The mineral composition determined on the Editan leaf meal revealed that all the macro and micro mineral values were in line with Okezie *et al*. (2017) and Ayeni (2024) who reported for editan leaf meal and some selected tropical leaves respectively. The high mineral content in the leaf especially for the potassium, phosphorus, manganese, zinc and iron are evidence of the high ash content and the high levels of zinc and iron are important components of the haemoglobin and myoglobin for the transport of oxygen and cellular processes for growth and division (Kozat, 2007) and also play a role in the control of infection and cell mediated immunity (Bhaskaran, 2001). Zinc is required for collagen formation; it protects the liver and is also required for bone development.

Table 3: Macro (%) and micro (mg/kg) mineral composition of editan leaf meal

Macro minerals	**Composition**
Sodium	0.279
Potassium	.0.963
Calcium	0.251
Magnesium	0.268
Phosphorus	0.384
Micro minerals	
Manganese	45.76
Cobalt	1.03
Copper	9.84
Zinc	68.26
Iron	179.26

The result of the amino acids profile of the ELM is presented in Table 4. The lysine and methionine contents of the Editan leaf meal are considered to be high which when added to the animal diets contribute to upset the limiting amino acids in the diet of poultry and this makes the leaf a good substitute for conventional feed sources in animal nutrition.

Table 4: Amino acids profile (%) of air- dried Editan leaf meal

Parameters	**Composition**
Alanine	6.42
Arginine	5.56
Aspartic acid	10.69
Cysteine	1.57
Glutamic acid	13.89
Glycine	5.83
Histidine	2.59
Isoleucine	6.75
Leucine	9.46
Lysine	7.18
Methionine	1.88
Phenylalanine	5.72
Proline	5.86
Threonine	4.82
Tryptophan	1.54
Tyrosine	4.22
Ornithine	0.43
Cystine	0.54
Serine	4.25
Valine	7.09

The result of the anti-nutrient of the present study is shown in Table 5. The values were 0.22 %, 0.39 %, 0.01 % and 0.42 % for oxalate, phytate, tannin and saponin respectively. Antinutritional factors are chemical substances produced by plants that have the potential of affecting the availability of nutrients by interfering with metabolic processes (Genede and Ratta, 2014). The levels of anti- nutrients obtained in the study were lower than those reported by Okezie *et al* (2017). The tannin level was low as tannins are

said to reduce feed efficiency and weight gain in chicks (Dei *et al*., 2007). Therefore, low levels of these anti-nutrients in ELM would lead to better feed efficiency and weight gain. The anti-nutrients were found to be below the permissible levels as reported by Ilelaboye *et al.* (2013) for safe leaf meals.

Table 5: Anti-nutrients composition (%) of editan leaf meal

Parameters	Composition
Oxalate	0.22
Phytate	0.39
Tannin	0.01
Saponin	0,42

The result of the nutrient digestibility of the finisher broiler chickens fed graded levels of dietary ELM is presented in Table 6. Modern broiler flocks require a balanced diet consisting of essential nutrients to achieve optimal reproductive efficiency, feed conversion and immune response. Proper feeding provides the birds with fat, carbohydrate, protein, vitamins, minerals and water. The proper amount of these nutrients needed in diet depends on breed, age and production stage of the birds. The results on Table 7 showed significant difference ($p<0.05$) on all the parameters measured for nutrient digestibility. Percent crude protein, crude fat, ash, dry matter, nitrogen free extract and gross energy decreased significantly ($p<0.05$) as the dietary inclusion of ELM in the finisher broiler diets increased from 5 to 8 %. This is in line with the report of Okon and James (2015) and Brown (2007) whose findings revealed that 10 % ELM in the diets of broiler chickens resulted in a significant decrease in crude protein and ether extract digestibility due to high level of fibre in the diet which may reduce dry matter digestibility. Also, Tewe (1991) reported that high fibre content and presence of anti-nutritional factors are major factors limiting the utilization of leaf meal in poultry. The results of this study also revealed that feeding broilers birds with 5 % ELM improves the apparent nutrient digestibility of the birds which is in line with the study conducted by Okon and James (2015) who reported that feeding broiler diet with 5% Editan leaf meal did not significantly affect nutrient digestibility.

Table 6: Final body weight and nutrient digestibility (%) of finisher broiler chickens fed graded levels of dietary editan leaf meal

Parameters	ELM0	ELM5	ELM6	ELM7	ELM8	SEM
Final body weight (g)	1628.00^{a}	1417.15^{b}	1375.63^{b}	1318.57^{b}	1171.48^{c}	37.52
Crude Protein	92.34^{b}	93.26^{a}	91.89^{bc}	91.29^{cd}	90.74^{d}	0.28
Ether extract	92.88^{ab}	93.23^{a}	92.16^{bc}	91.85^{c}	90.76^{d}	0.29
Crude Fibre	41.52^{bc}	37.38^{c}	45.32^{b}	46.55^{b}	55.65^{a}	1.96
Ash	74.79^{b}	79.35^{a}	74.68^{b}	74.33^{b}	73.26^{b}	0.89
Dry Matter	72.66^{b}	77.42^{a}	72.18^{b}	69.59^{c}	68.32^{c}	0.77
Nitrogen Free Extract	75.51^{b}	79.52^{a}	72.18^{b}	71.58^{c}	70.53^{c}	0.89
Gross energy	93.33^{b}	94.33^{a}	93.09^{bc}	92.35^{cd}	92.05^{d}	0.24

$^{a-d}$ Means on the same row with different superscript are significantly different ($p<0.05$). SEM = standard error of mean. ELM0 = 0 % editan leaf meal. ELM5 = 5 % editan leaf meal. ELM6 = 6 % editan leaf meal. ELM7 = 7 % editan leaf meal. ELM8 = 8 % editan leaf meal.

CONCLUSION

From the study, it is pertinent to know that editan leaf meal is rich in some nutrients as it is observed in the improvement of the nutrient digestibility at 5% inclusion level and could also be due to the presence of some bioactive compounds like flavonoids and alkaloids. and the minimal amount of anti-nutrient in Editan which made it suitable for inclusion up to 5% in broilers diets. Farmers should consider supplementing up to 5% Editan leaf meal in broiler diets to optimize nutrient utilization, specifically for crude protein, crude fibre, and gross energy. It is therefore recommended.

REFERENCES

1. Adegbenro, E., Ansari, J., Khan, S. H., Haq, A. and Yousaf, M. (2012). Effect of the levels of *Azadirachta indica* dried leaf meal as phytogenic feed additive on the growth performance and haemato-biochemical parameters in broiler chicks. *Journal of Applied Animal Research.* 40: 336-345.
2. Adetuyi, F. O. and Osagie, A. U. (2011). Nutrient, antinutrient, mineral and bioavailability of okra (*Abelmoschus esculentus* L) Moench variety. *American Journal of Food and Nutrition.* 1(2): 49-54.

3. Antia, B. S. Akpan, E. J. Okon, P. A. and Umoren, I. U. (2006). Nutritive and anti-nutritive evaluation of sweet potatoes (*Ipomoea batatas*) leaves. *Pakistan J. Nutr.* 5(2): 166-168.
4. AOAC. (1980). Official Methods of Analysis. *13th Edition*. Association of Official Analytical Chemists. Washington D.C.
5. AOAC. (1990). Official Methods of Analysis. *15th Edition*. Association of Official Analytical Chemists. Washington D.C
6. AOAC. (2005). Official Method of Analysis.*18th Edition*. Association of Official Analytical Chemists. Washington D.C., Method 935.14 and 992.24.
7. AOAC. (2006). Official Method of Analysis.*18th Edition*. Association of Official Analytical Chemists. Gaithersburgs, MD.
8. Ayeni, A. O. (2024). Nutritional values of selected tropical leaves and their composite mixes. Proceeding of the 49th Conference of Nigeria Society for Animal Production 24-27 March, 2024, University of Ibadan, Nigeria. Pp. 1601-1604.
9. Bhaskaran, P. (2001). Immunobiology of mild nutrient deficiency. *British Journal of Nutrition.* 85:75-80.
10. Biswas, A., Ahmed, M., Bharti, V. K. and Singh, S. B. (2011). Effects of anti-oxidants on physio-chemical and haematological parameters in broiler chicken at high altitude. *Asian-Aust. Journal of Animal Science*. 24 (2): 246-249.
11. Bradbury, M., Egan, S. and Bradbury, J. (1999). Determination of all forms of cyanogens in cassava roots and cassava products using picrate paper kits. *Journal of the Sciences* of *Food and Agriculture*. 79:593 - 601.
12. Brown, A. C. (2007). Chemistry of Food Composition: Understanding Food: Properties and preparation 3rd Edn., Wadsworth Publishing Co., United States. Pp. 46-49.
13. Dei, H. K., Rose, S. P. and Mackenzie, A. M. (2007). Shea nut (Vitellaria paradoxa) meal as a feed ingredient for poultry. *Poultry Science*. 63(4): 611-624.
14. Duncan, D. B. (1995). Multiple Range and Multiple F-Test. Biometrics, 11, 1-5.
15. Ekanem, A. (2006): Antidiabetic activity of ethanolic leaf extract and fractions of *Lasianthera africana* on alloxan diabetic rats. M.Sc. thesis, Univ. of Uyo, Nigeria.
16. Fasuyi, A. O. (2006). Nutritional potentials of some tropical vegetable meals: chemical characterization and functional properties. *Afr. J. Biotechnology*. 5(1): 49 - 53.
17. Gemede, H. F. and Ratta, N. (2014). Antinutritional factors in plant foods: potential health benefits and adverse effects. *International Journal of Food Science and nutrition*. 3 (4): 284 - 289.
18. Grosvernor, M. B. and Smolin, L, A, (2002). Nutrition: From Science to Life. Harcourt College Publishers, New York, USA.288-371.
19. Ilelaboye, N. O. A., Amoo, I. A. and Pikuda, O. O. (2013). Effect of cooking methods on mineral and anti-nutrient composition of some green leafy vegetables. *Arch. Appl. Sci. Res. J*. 5(3): 254 – 260.
20. Itah, A. Y. (1996). Screening of plant's parts for fungicidal properties. *Trans. Nig. Soc. Bio. Conserv.* 4(1): 26 – 40.
21. Itah, A. Y. (1997). Bactericidal and bacteriostatic effect of edible leafy vegetable extract on growth of canned food borne bacteria. *Trans. Nig. Soc. Bio. Conserv.* 6:103 – 111.
22. Kozat, S. (2007). Serum T3 and T4 concentrations in lambs with nutritional myodegeneration. *Journal of Veterinary internal Medicine*. 21(5):1135-1137.
23. Markkah, H. P. S., Blammer, M., Borowy, N. K. and Becker, K. (1993). Gravimetric determination of tannins and their correlation with chemical and protein precipitation methods. *Journal of Food Science Agriculture.* 61: 161- 165.
24. Maya, J. A. (1982). Phytate, its chemistry occurrence, food interaction, nutritional significance and method analysis. *Journal of Agriculture and Food Chemistry*. 30(1): 1-9
25. Okezie, E., Ugbogu, A. Odungide, A. and Atani, C. (2017). Proximate, antinutritional and mineral estimation of some selected consumed green vegetables in Afaha Eket, Akwa Ibom State, Nigeria. *A Journal of Food Sciences and Technology*. 5(5):182 - 191.
26. Okokon, J. E., Antia, B. S. and Essiet, G. A. and Nwidu, L. L. (2007). Evaluation of *in vivo* antiplasmodial activity of ethanolic leaf extract of *Lasianthera africana. Research Journal of pharmacol*ogy. 1(2): 30 -33.
27. Okon, I. E. and James, U. S. (2015). Comparative evaluation of nutritional values of some wild plants' leafy vegetables in South Eastern Nigeria. *International Journal of Research in Applied, Natural and Social Sciences*. 3(2): 21-26.
28. Ononogbu, I. C. (2002). Lipids in human existence. 1st edition." AP express publishing company, Nsukka: 1-5
29. Pauzenga, U. (1985). Feeding Parent Stock. Zootech. International. Pp. 22-25
30. Steel, R. G. and Torrie, J. H. (1980). Principles and procedures of statistics. A biometrical approach, *2nd edition*. McGraw-Hill, New York.
31. Tewe, O. O. (1991). Detoxification of cassava products and effects of residue toxins on consuming animals. In: Machin, D. and Nyvold, S. (eds), Roots, tubers, plantains and bananas in animal feeding. FAO Animal Production and Health Paper No. 95 Rome Italy: FAO. Pp. 81–95.
32. Unah, U. L., Afolabi, K. D,, Ekpo, K. O. and Okung, V. (2022). Effect of graded levels of dietary Editan (*Lasianthera africana*) leaf meal on productivity of broiler chickens. *Journal of Biology, Agriculture and Healthcare*. 12(10): 26– 32.
33. Ziggers, D. (2011). Optimising nutrient density in a volatile market. *All about feed*, 2 (3): 18 – 22.