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INVESTIGATING THE UNEXPLORED IMPACT OF *Justicia insularis* MEAL-BASED ON BROILER CHICKEN PERFORMANCE AND NUTRIENT DIGESTIBILITY

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ABSTRACT

The study was conducted using one hundred and sixty (Abor acre) broiler chickens to assess the impact of Justicia insularis leaf meal (JILM) on the broilers' growth performance and nutrient digestibility coefficient. The experiment involved formulating four diets labelled T1, T2, T3, and T4 during the starter and finisher phases. The control diet (T1) contained 0 % Justicia insularis leaf meal, while diets T2, T3, and T4 included Justicia insularis leaf meal at 2.5 %, 5.0 %, and 7.5 %, respectively. The birds were divided into four groups of forty birds, and each group was randomly allotted to one of the experimental diets using a completely randomized design. The birds were further subdivided into four replicates of ten birds per replicate. Feed and water were provided ad libitum. Data collected were analyzed using Statistical Package for Social Sciences (SPSS) and means separated using Duncan's Multiple Range Test. The results indicated a significant difference in the birds' final body weight, weight gain, and feed conversion ratio at both the starter and finisher phases. The feed intake of the birds at the starter and finisher phases were statistically similar. Birds in the T4 group recorded the lowest and best feed conversion ratios. The nutrient digestibility coefficient of crude protein, crude fibre, ether extract, ash, and nitrogen-free extract showed significant differences across treatment at both phases. The highest significant nutrient digestibility coefficient across treatment was recorded in T4 in all the parameters, followed by T3, T2, and T1. It was, therefore, concluded that 7.5% Justicia insularis leaf meal level could enhance growth performance and nutrient digestibility in broiler chicks at both starter and finisher phases.

Keywords: Broiler chicken, Growth performance, *Justicia insularis*, Nutrient digestibility, Starter and finisher

INTRODUCTION

The livestock sector, particularly in developing countries, is grappling with a significant challenge due to the remarkable surge in the human population and insufficient animal protein intake (Ekpo and Okon, 2023). Among various animal protein sources, the poultry industry stands out for its widespread contribution to egg and meat production (Essien *et al.,* 2022; Essien *et al*., 2023). Regrettably, this industry's growth and sustainability are hindered by multiple constraints, with economic factors taking the forefront – notably, the scarcity and high costs of feed ingredients. Feed expenses constitute 70 – 80 % of poultry production costs (Obioha and Anikwe, 1982). Cereal grains form the bulk of commercial poultry feeds. The supply of grains (maize and soybean) does not meet the demand for these products due to stiff competition between humans and livestock in their consumption (Essien and Udedibie, 2007; Essien and Sam, 2018). This has compelled researchers to explore readily available and cheaper feed ingredients that could serve as substitutes for the grains. In recent times, leaves from various plant species that have been processed and incorporated into poultry diet have yielded tremendous results in monogastric, especially layer and broiler production (Essien and Sam, 2018; Banjoko *et al.*, 2018, Olumide and Akintola, 2018; Ekpo and Okon, 2022, Christopher *et al*., 2023). Leaves from browse plants and legumes have been reported to contain essential nutrients (Okon *et al.*, 2023a; Okon *et al.*, 2023b). *Justicia insularis*, popularly known as "weed of plantation" or "Meme" in Efik and Ibibio, is a multipurpose herbaceous plant with great potential. The plant is 30 – 50cm long and has opposite and ascending branches. The leaves are simple and opposite, while the flowers are white, pink, or purple. *Justicia insularis* is found in cultivated land, gardens, and coastal areas. It grows abundantly in Southern Nigeria, especially in Akwa Ibom State. The leaves of *Justicia insularis* is used in most homes as soup for both adults and babies. It aids digestion and is a weaning agent (Telefo *et al.*, 2004). Traditionally, the leaves are harvested and squeezed in water to extract the juice as a drink to treat anaemic patients. Studies by Adeyemi and Babatunde (2014) highlighted the nutritional composition of *Justicia insularis* leaf meal to consist of 15.95 % ash, 4.48 crude protein, 2.14 % lipid and nitrogen-free extract 18.36 MJ/Kg in addition to minerals such as calcium, manganese, potassium, phosphorous, magnesium sodium, copper, iron, and zinc. In addition to the rich nutrient composition, the plant's phytochemistry reveals an appreciable amount of bioactive

compounds that are not limited to phenols, flavonoids, alkaloids, terpenoids, and steroids. These compounds could be responsible for their varied biological and pharmacological activities, such as antioxidant, anti-inflammatory, hypoglycemic, antiviral, and antibacterial. (Ekpo and Okon, 2023; Okon *et al*., 2023a; Okon *et al*., 2023b). In order to assess the efficacy of nutrient contents in this plant, of which there is a paucity of information on its usage in broiler chickens' production, this research was conducted to determine the effect of *Justicia insularis* leaf meal on growth performance and nutrient digestibility of broiler chickens.

MATERIALS AND METHODS

The research was conducted at the Poultry Unit of the Teaching and Research Farm of Akwa Ibom State University, Obio Akpa Campus, Oruk Anam Local Government Area, Akwa Ibom State. Obio-Akpa is located between latitude 50170N and 50271N and between longitude 70271N and 70581E. The rainfall ranges from 3500 to 5,000mm, the average monthly temperature is 250 C, and the relative humidity is between 60 and 90 % (SLUS-AK, 1994).

Processing and Source of Experimental Leaf

The leaves of *Justicia insularis* used in this research were harvested within the university environs. The stalks were removed, and the leaves were sundried for five days until they became crispy while the green colour remained. The dried leaves were ground using a manual blender (Corona 1016, Landersy Y. CIA, South Africa). The leaf meal was later analyzed for its proximate and phytochemical composition according to the methods described by AOAC, 2005).

Experimental Diet

Four experimental diets labelled T1, T2, T3, and T4 were formulated and compounded for the experiment at the starter and finisher phases. T1 (control) had zero *Justicia insularis* leaf meal, while T2, T3, and T4 contained 2.5 %, 5.0 %, and 7.5 % of *Justicia insularis* leaf meal, respectively. Tables 1 and 2 present the ingredients composition of the experimental diets.

Management of Experimental Birds and Design

A total of one hundred and sixty-day-old (Abor acre) broiler chickens were used for the experiment. The birds were purchased from a reputable Uyo, Akwa Ibom State poultry distributor. The pens were cleaned and disinfected a week before the arrival of the birds. On arrival, the chicks were weighed to obtain their initial weight using a sensitive balance (Model

SF 400), divided into four groups of forty birds, and each group was assigned one of the experimental diets in a completely randomized design. Each group was divided into four replicates of ten (10) birds per replicate housed in a pen measuring 2 m x 2 m. Wood shaving was used as litter material. Feed and water were provided *ad libitum*. All routine medication and vaccines were administered. The experiment lasted for 56 days.

Table 1: Ingredient Composition of Broiler Starter Diets

Ingredients	**T_1**	**T_2**	**T_3**	**T_4**
Maize	50.00	50.00	50.00	50.00
Soya bean meal	28.00	25.50	23.00	20.50
JILM	0.00	2.50	5.00	7.50
Fish meal	3.00	3.00	3.00	3.00
Wheat offal	8.00	8.00	8.00	8.00
Palm kernel cake	6.00	6.00	6.00	6.00
Bone meal	4.00	4.00	4.00	4.00
Premix	0.25	0.25	0.25	0.25
Common salt	025	025	025	025
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated chemical composition (% DM)				
Crude protein	23.12	23.31	23.41	22.23
Crude fibre	4.21	4.23	4.33	4.35
Ether extract	3.56	4.01	4.21	4.26
Ash	4.52	5.36	5.41	5.51
ME (kcal/kg)	2911.31	2910.41	2902.01	2904.03

JILM – *Justicia insularis* leaf meal, ME – Metabolizable energy

Nutrient Digestibility Trial

A nutrient digestibility trial was conducted on the 23rd and 49th days of the experiment. Two birds per replicate were randomly selected and housed separately in appropriate metabolic cages for seven (7) days. The birds were allowed to acclimatize for three days before the commencement of four days of feeding and excreta collection. A total of 1000 g of feed was given to the birds, and excreta collected per bird per day were oven-dried at 850C until a constant weight was obtained. The faeces were bulked according to each treatment and taken to the laboratory for proximate composition analysis for dry matter, crude protein, ash, ether extract, and crude fibre using the standard method of AOAC (2005).

$$\text{Nutrient digestibility} = \frac{\text{Nutrient in feed intake} - \text{Nutrient in faeces voided}}{\text{Nutrients in feed intake}} \times 100$$

Table 2: Ingredient Composition (%) of Broiler Finisher Diets

Ingredient	T_1	T_2	T_3	T_4
Maize	55.00	55.00	55.00	55.00
Soyabean meal	26.00	23.50	21.00	18.50
JILM	0.00	2.50	5.00	7.50
Fish meal	3.00	3.00	3.00	3.00
Wheat offal	6.00	6.00	6.00	6.00
Palm kernel cake	5.00	5.00	5.00	5.00
Bone meal	4.00	4.00	4.00	4.00
Premix	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Calculated chemical composition (% DM)				
Total	100.00	100.00	100.00	100.00
Crude protein	20.45	20.31	20.10	19.34
Crude fibre	4.00	4.03	4.11	4.13
Ether extract	3.51	3.63	4.01	4.10
Ash	4.53	5.17	5.13	5.17
ME (kcal/kg)	2899.43	2895.36	2890.31	2887.51

JILM – *Justicia insularis* leaf meal, ME – Metabolizable energy

Data Collection

The weight gain of the experimental birds was calculated by subtracting the initial weight from the final weight using a 20 kg capacity weighing balance (Hana Spring) platform scale. The feed intake of the birds was calculated by subtracting the quality of leftover feed from the quantity of feed fed the previous day. The feed conversion ratio was calculated by dividing the daily feed intake by daily weight gain.

Data Analysis

Data collected from various parameters measured were subjected to a one-way analysis of variance using SPSS (2007). Where significant means were observed, the Duncan Multiple Range Test (Duncan, 1955) was employed for mean separation.

RESULTS AND DISCUSSION

The results of the proximate composition of *Justicia insularis* leaf meal are presented in Table 3. Results showed that the leaf meal contains crude protein (23.50 %), crude fibre (5.38 %), ether extract (4.33 %), ash (14.81 %), and Nitrogen free extract (52.33 %). This result showed that *Justicia insularis* contains an appreciable amount of crude protein (23.50 %), which could serve as a source of protein in non-ruminant diets. However, the crude protein value in this study differed from the value of 4.48% reported by Adeyemi and Babatunde (2014) and 10.15%

reported by Keke *et al*. (2023) for *Justicia secunda.* This result also indicated a rich amount of ash in *Justicia insularis*, which is close to the value reported by Adeyemi and Babatunde (2014). The disparities in the proximate composition of the leaf meal could be a result of the following factors: differences in soil characteristics in terms of fertility, mineral content and texture, varied climatic conditions of the area cultivated, differences in analytical procedure carried out at the period of evaluation (Ekpo *et al.,* 2020; Solomon *et al*., 2022; Okon *et al*., 2022). The phytochemical analysis revealed that *Justicia insularis* contains tannin, alkaloid, terpenoid, Stenoid flavonoid, and phenol (0.21, 0.34, 0.21, 0.16, 2.13, and 1.34 mg/100g) respectively. These compounds could be crucial in managing ailments such as fever, diabetes, inflammation, dysentery, arthritis, etc. (Okwu, 2003).

Table 3: Proximate and Phytochemical Composition of *Justicia insularis* Leaf Meal

Parameters	Composition (%)
Dry matter	88.56
Crude protein	23.15
Crude fibre	5.38
Ether extract	4.33
Ash	14.81
Nitrogen free extract	52.33
Phytochemical composition (mg/100g)	
Flavonoid	2.13
Tannin	0.21
Alkaloid	0.34
Phenol	1.34
Terpenoid	0.21
Steroid	0.16

The results of the growth performance of broiler chickens at the starter phase are presented in Table 4. Significant ($P \leq 0.05$) differences occurred in the birds' final body weight and weight gain values at the starter phase. The highest significant ($P \leq 0.05$) values were recorded, followed by T3, which was significantly higher than T2 and T1. T1 recorded the least final body weight and body weight gain. The feed intakes of the birds at the starter phase were statistically similar ($P > 0.05$). The feed conversion ratio of the birds at the starter phase indicated a significant difference in their values across treatments. T4 had the best and the lowest feed conversion ratio. The experimental diets positively influenced the final weight, weight gain, and feed conversion ratio of broiler finisher birds. Significant variations were observed in final body weight, weight gain, and feed conversion ratio values. The results followed the same trend as in the starter phase, with T4 recording the highest significant ($P \leq 0.05$) final body weight and

weight gain values. These results indicated that the diets were adequate in nutrients, especially protein, which is needed for growth and production. Okwu (2003) reported that phytochemical compounds enhance the secretion of digestive enzymes, creating an enabling environment for effective gut functioning to aid digestion and the absorption and utilization of nutrients. Okwori and Attah (2016) reported that protein in leaves positively affects feed intake, digestibility, and nutrient absorption, thus resulting in better performances in animals.

The diet did not influence the feed intake of the birds at the finisher phase. The birds recorded similar feed intake values. The non-significant (P>0.05) effect on the feed intake of the broiler chickens indicated that the diet was palatable. The feed conversion ratio of the birds indicated a significant difference in their values. Birds in T4 had the best and the highest feed conversion ratio. The feed conversion ratio shows the ability of the birds to convert feed to flesh. The feed conversion ratio of chicken is economically important and serves as a price determinant for broiler producers. This result could suggest that nutrients in the feed were enriched by adding *Justicia insularis* leaf meal.

Table 4: Performance Characteristics Starter of Broiler Chickens Fed *Justicia insularis* Leaf Meal (JILM)

Parameter	T_1	T_2	T_3	T_4	SEM
Initial body weight (g)	40.03	40.06	40.04	40.05	0.01
Final body weight (g)	831.43^{d}	855.56^{c}	891.71^{b}	950.11^{a}	1.25
Body weight gain (g)	791.40^{d}	815.5^{c}	851.67^{b}	910.06^{a}	1.31
Daily weight gain (g)	28.24^{d}	29.13^{c}	30.41^{b}	32.50^{a}	1.02
Feed intake (g)	55.51	55.81	56.51	56.31	0.01
Feed conversion ratio (g)	1.97^{d}	1.92^{c}	1.85^{b}	1.73^{a}	0.01
Mortality	0.00	0.00	0.00	0.00	0.00

abcd: means in the same row not sharing a common superscript are significantly different (P<0.05), SEM = Standard Error Mean

Table 5: Performance Characteristics of Finisher Broiler Chickens Fed *Justicia Insularis* Leaf Meal (JILM)

Parameter	T_1	T_2	T_3	T_4	SEM
Initial body weight (g)	825.51	823.61	826.53	824.81	0.01
Final body weight (g)	2351.11^{c}	2391.51^{c}	2511.52^{b}	2598.31^{a}	1.25
Body weight gain (g)	1525.60^{c}	1567.90^{c}	1684.99^{b}	1773.50^{a}	1.31
Daily weight gain (g)	54.49^{c}	55.99^{c}	60.18^{b}	63.34^{a}	1.02
Feed intake (g)	125.11	124.51	124.51	123.25	0.01
Feed conversion ratio (g)	2.30^{c}	2.23^{c}	2.01^{b}	1.95^{a}	0.01
Mortality	0.00	0.00	0.00	0.00	0.00

abc: means in the same row not sharing a common superscript are significantly different (P<0.05), SEM = Standard Error Mean

The nutrient digestibility of the broiler chicken at the starter and finisher phases is presented in Tables 6 and 7, respectively. In the starter phase, the nutrient digestibility of the birds indicated significant (P≤0.05) differences in all the parameters measured across treatments. Digestibility was superior in T4, followed by T3 and T2. T1 had the least apparent digestibility coefficient. The digestibility of the nutrient increased with increased levels of *Justicia insularis* in the diet. This could result from the rich nutrient profile of *Justicia insularis* and some phytochemical compounds that could aid in the digestion of nutrients. The nutrient digestibility of broiler chickens in the finisher phase followed the same trend. Significant (P≤0.05) differences existed across treatments in all the parameters determined. T4 had the highest significant (P≤0.05) value, followed by T3 and T1.

It was observed that the digestibility of nutrients in the finisher phase indicated higher values than in the starter phase. Although the high digestibility recorded by birds in T4 could result from rich nutrient content in a feed, it was observed that older birds digest nutrients more than the younger ones. This inference could suggest a better morphological, structural, and physiological development of the gastrointestinal tract and its contents. Moreover, phytochemicals have been reported by Upah *et al.* (2021) to initiate the modulation of intestinal morphology, thereby increasing the intestinal length, which is positively correlated to an increase in the villi's length, thus increasing the surface area available for absorption of nutrients.

Table 6: Apparent Nutrient Digestibility of Starter Broiler Chickens Fed *Justicia insularis* Leaf Meal (JILM)

Parameter	T_1	T_2	T_3	T_4	SEM
Dry matter	86.16^{b}	88.32^{a}	87.31^{a}	88.56^{a}	0.01
Crude protein	78.18^{c}	81.36^{b}	85.51^{a}	89.63^{a}	1.03
Crude fibre	67.70^{c}	81.81^{b}	76.30^{a}	76.51^{a}	1.11
Ether extract	81.23^{c}	87.31^{b}	90.17^{a}	90.32^{a}	0.04
Ash	78.54^{b}	79.01^{b}	80.13^{b}	81.56^{a}	0.03
Nitrogen free extract	70.21^{d}	71.81^{c}	74.39^{b}	86.14^{a}	0.03

abc: means in the same row not sharing a common superscript are significantly different (P<0.05), SEM = Standard Error Mean

Table 7: Apparent Nutrient Digestibility of Finisher Broiler Chickens Fed *Justicia Insularis* Leaf Meal (JILM)

Parameter	T_1	T_2	T_3	T_4	SEM
Dry matter	89.56^{b}	89.16^{a}	90.13^{a}	90.34^{a}	0.01
Crude protein	80.36^{b}	87.92^{b}	89.03^{a}	90.38^{a}	0.03
Crude fibre	70.11^{c}	75.71^{b}	78.91^{ab}	80.31^{a}	0.03
Ether extract	78.31^{c}	81.37^{b}	81.49^{b}	83.44^{a}	1.01
Ash	81.31^{c}	80.41^{c}	86.03^{b}	87.93^{a}	1.02
NFE	73.55^{b}	73.67^{b}	74.74^{b}	79.11^{a}	0.01

abc = means in the same row not sharing a common superscript are significantly different ($P<0.05$), SEM = Standard Error Mean

Conclusion

The findings of this study indicate that the incorporation of *Justicia insularis* leaf meal in the diet of broiler chickens at levels up to 7.5 % can improve broiler performance.

REFERENCES

Adeyemi, O. T. and Babatunde, O. (2014). Chemical composition and antioxidant capacity of the leaf extract of *Justicia insularis*. *International Journal of Physical Science*, 9(20): 454 – 458.

AOAC (2005). Official Method of Analysis 15th Edition, Association of Official Analytical Chemists. Washington. D. C, USA

Banjoko, O. J., Olumide, M. D., Oladipo, T. A. and Ajayi, O. A. (2018). Anticoccidial effects of dietary *Vernonia amygdalina* leaf meal in broiler chicken production. *Nigerian Journal of Animal Production,* 45(3): 282 – 289.

Christopher, G. I., Idiong, C. I., Ekpo, J. S., Okon, U. M. and Uwem, U. U. (2023). Growth performance and economics of feeding sole concentrate, sole forage, and their mixtures to weaner rabbits. *Nigerian Journal of Animal Science*, 49(5): 87 – 93.

Duncan, D. B. (1955). Multiple range and multiple F-tests. *Biometrics*, 11: 1-42.

Ekpo, J. S. and Okon, U. M. (2022). Performance and lipid profile of growing pigs fed *Vernonia amygdalina* and *Jathropha tanjorensis* leaf meal supplementation. *Livestock Research for Rural Development,* 34(12): 1 – 6.

Ekpo, J. S. and Okon, U. M. (2023). Organoleptic quality, pork characterization, and hematological indices of growing pigs fed supplemental diets containing bitter leaf and hospital too far. *AKSU Journal of Agriculture and Food Sciences,* 7(1): 9-20

Ekpo, J. S., Sam, I. M. and Okon, U. M. (2020). Performance, carcass and relative organ weights of young boars fed graded dietary levels of raw *Icacinia manni* (earth ball). *Journal of Agriculture, Resources and Development,* 19: 18-24 https://dx.doi.org/10.4314/jard.v19i1.3

Essien, C. A. and Udedibie, A. B. I. (2007). Effect of two-stage cooking on haemagglutinin and antitryptic activity of jack bean and its nutrition value for young growing rabbit. Editors*: Proceedings of the 32nd conference of Nigerian Society for Animal Production (NSAP*), pp. 192-194

Essien, C. A. and Sam, I. A. (2018). Growth response, Carcass and internal organ characteristics of finishing broiler chickens fed *Anthonotha macrophylla* (African Bean) leaf meal. The *International Journal of Science and Technology*, 6(1):83 – 87.

Essien, C. A., Sam, I. M. and Okon, U. M. (2023). Growth performance and nutrient digestibility of finisher broiler chickens fed pepper fruit leaf meal as feed additive. *In; Proceedings of the 48th Annual Conference of Nigerian Society for Animal Production (NSAP),* pp. 1090-1093

Essien, C. A., Sam, I. M., Okon, U. M. and Ndak, U. U. (2022). Effect of moringa (*Moringa oleifera*) leaf meal on the performance, carcass characteristics and lipid profile of finisher broiler chickens. *AKSU Journal of Agriculture and Food Science*, 6(3): 213 – 223.

Keke, C. O., Nwaogu, L. A., Igwe, C. U., Ekeke, K. L. and Nsofor, W. N. (2023). Phytochemical and nutritional composition of ethanol-water leaf extract of *Justicia secunda* and *Jathropha tanjorensis*. *GSC Biological and Pharmaceutical Sciences,* 23(03):042-053.

Obioha, F. C. and Anikwe, P. C. N. (1982). Utilization of ensiled and sundried cassava peels by growing swine. *Nutrition Report International,* 26(6): 961 – 972.

Okon, U. M., Ekpo, J. S., Essien, C. A and Eyoh, G. D. (2022). Influence of *Monodora myristica* and *Xylopia aethiopica* seed as feed additives on the performance of New Zealand weaned Rabbit. *Nigerian Journal of Animal Science and Technology*, 5(1):76-83.

Okon, U. M., Ekpo, J. S. and Christopher, G. I. (2023a). Effect of *Monodora myristica* (African nutmeg) as feed additive on rabbit's carcass composition and serum lipid profile. *Animal Research International*, 20(2): 4957-4965

Okon, U. M., Ekpo, J. S., Essien, C. A., Thabethe, F. and Nuamah, E. (2023b). Serum lipid profile and organoleptic characteristics of meat from rabbits fed diets containing selim pepper (*Xylopia aethiopica*) and African nutmeg (*Monodora myristica*). *Nigerian Journal of Animal Science,* 25 (2):223-235

Okwori, A. I. and Attah, S. (2016). Essentials of forage crop production, management and Utilization in the tropic ISSN: 978 – 978 – 978 – 961 – 682 – 4. Jalin Publishers Nig. Ltd. High level, Makurdi, Benue State, First Edition Pp. 106.

Okwu, D. E. (2003). The potentials of *Occmium gratissimum Pengularian extensa* and *Tetrapleura tetraptera* as spice and flavouring agents. *Nigeria Agricultural Journal,* 34:143-148.

Olumide, M. I. and Akintola, A. S. (2018). Effect of scent leaf meal (*Ocimum gratissimum*) supplementation on performance, carcass and meal quality of broiler chickens. *Nigerian Journal of Animal Production,* 45 (3): 228 – 236.

SLUS-AK (1994). Soil land use studies Government print office Uyo, Akwa Ibom State, Soil Survey Staff key to soil taxonomy. Soil Management support service (SMSS). Tech monogr. No. 19.306p

Solomon, F. E., Essien C. A. and Eyoh, G. D. (2022). Effect of *Xylopia aethiopica* on Growth and Carcass characteristics of Broiler chickens. *Nigerian Journal of Animal Science Technology*, 5(3): 10 – 21.

SPSS (2007)**.** Statistical Package for Social Sciences (SPSS) 17.0 for windows, SPSS inc. USA.

Telefo, P. B. Moundipa, P. E. Tchouanguep, F. M. (2004). Inductive effects of the leaf mixture extract of *Aloe buettneri*, *Justicia insularis*, *Dicliptera vertiallata* and *Hibiscus marcranthus* on in vitro production of estradiol. *Journal of Ethnopharmacology,* 91:3.

Upah, S. O., Okutri, A. I. and Orayaga, K. T. (2021). Performance and nutrient digestibility and economics of production of finisher broiler fed diets containing *Euphorbia heterophylla* leaf meal. *Nigeria Journal Animal Production,* 48(5): 223 – 238.