GROWTH PERFORMANCE AND NUTRIENT RETENTION OF BROILER FINISHERS FED VARYING DIETARY INCLUSION LEVELS OF *Telfairia occidentalis* LEAF MEAL (TOLM).

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ABSTRACT
Effect of varying dietary inclusion levels of *Telfairia occidentalis* leaf meal (TOLM) on growth performance, nutrient retention and true metabolizable energy of finishing broilers were determined. A total of 120 Anak broiler strains at (28) days of age of mixed sexes were used in this study. The birds immediately after four weeks of brooding were randomly assigned to four dietary treatments, having 30 birds per treatment. Each treatment was replicated thrice with 10 birds per replicate. TOLM was included in the feed and fed *ad libitum* to the birds in completely randomized experimental design (CRD).The inclusion levels of TOLM in the feed were as follows : $\mathbf{T_1}$ (control diet) = 0 % TOLM, $\mathbf{T_2}$ = 0.5 % TOLM, $\mathbf{T_3}$ = 1 % TOLM and $\mathbf{T_4}$ = 1.5 % TOLM. Results obtained showed significant differences ($p<0.05$) in favor of the treatment groups in average daily weight gain, average daily feed intake, final body weight and feed conversion ratio values. Furthermore, nutrient retention with reference to ash, fiber, crude protein and ether extract values were significant ($p<0.05$). True metabolizable energy values among the treatments were also significant. However, weight gain and nutrient retention values of birds on TOLM diet were the highest ($p<0.05$). Body weight gain, nutrient retention and true metabolizable energy values increased significantly ($P<0.05$) as the level of TOLM in the diet increased. In conclusion 1.5 % inclusion level of *Telfairia occidentalis* leaf meal (TOLM) was recommended to be used by farmers because of the increased weight gain and nutrient retention values recorded in T_4.
Keywords: Finishing broilers, *Telfairia occidentalis*, leaf meal, feed intake, body weight.

INTRODUCTION

In the tropics, poultry production has been set back by the shortage and elevated cost of energy and protein feed sources (Melesse *et al*., 2011). However, in contemporary poultry production such as broilers, feed has been a major cost, accounting for about 70% of the total production cost (Sugiharto, 2019). Production of towering energy and protein conventional feed ingredients used in poultry production are affected by adverse climatic factors. Atawodi *et al.* (2008) reported that protein sources are further stressed as the limiting factors in poultry feed production in the tropics. Therefore, there is a need to look for non-conventional and less competitive plant protein sources that will serve as alternatives in poultry production. One of these alternatives is leaf meal of some tropical legumes and plants. Leaf meals can be utilized in poultry diets due to their remarkable quantity of vitamins, minerals and towering crude protein contents and this may be beneficial in reducing the proportion of conventional and expensive protein rich feed ingredients which are used in poultry production. Leaf meals may be defined as the dried and ground products of plant leaves. Compared with agro-industrial by-products, the content of crude protein in leaf meal is much higher (Tesfaye *et al*., 2013; Sugiharto *et al*., 2018a).

One of the broadly cultivated vegetable in the subtropics and tropics that can be utilized as leaf meal in broiler nutrition is *Telfairia occidentalis* (fluted pumpkin). *Telfairia occidentalis* is a leafy vegetable generally grown for its nutritional benefits in the tropics. In addition, the leaves have antioxidant properties and contain elevated levels of vitamins, including vitamin E, A, C, B_2 and K that are used as food supplements (Nwakanma *et al.,* 2014; Mohammed *et al.,* 2016). High essential amino acids content of *Telfairia* leaves compete favorably with those of important legumes (Asiegbu, 1988) and its high content of minerals and vitamins especially Fe, Mg and K, carotene and vitamin C are remarkably making the leaves potential food supplement. Ladeji *etal*.(1995) reported that *Telfairia. occidentalis leaves* contains 8.4% total ash, 3.0% crude lipid, 30.5% crude protein and 87.3% crude fibre.
The utilization of leaf meal as ingredient in broiler nutrition has been carried out and well documented (Mustafa, 2019; Abdulsalam *et al*., 2015; Aroche *et al*., 2018). Imasuen *et al*. (2014) supplemented the diet of broilers with *Telfairia occidentalis* leaf meal and recorded variations in body weight gain in favor of the birds fed TOLM diets. In another research work conducted by Ladokun *et al*. (2016) oral administration of *Telfairia occidentalis* leaf extract to laying birds significantly enhanced their haemathological indices, hen day and internal egg qualities. Furthermore, addition of pumpkin leaf extract to the drinking water of broiler finisher birds significantly enhanced their average daily weight gain and feed conversion ratio (Alabi *et al*., 2017). Nworgu (2006) fed *Telfairia occidentalis* leaf extracts to broilers at growing and finishing stage and discovered

that it stimulated feed intake and weight gain. Considering the nutritional quality of *T. occidentalis* as one of the possible alternatives for protein sources in broiler nutrition, this study was designed to achieve the following objectives:

- To determine the effect of varying dietary inclusion levels of *T. occidentalis* leaf meal on growth performance of finishing broilers.
- To evaluate the effect of varying dietary inclusion levels of *T. occidentalis* leaf meal on nutrient retention and true metabolizable energy of finishing broilers.

MATERIALS AND METHODS

Location and duration of study

The study was carried out at the Poultry Section of the Department of Animal Science Teaching and Experimental Farms, University of Nigeria, Nsukka Enugu State. It is located on latitude $6^0$25N and $07^0$24E (Ofomata, 1975) and on altitude of 430m above sea level (Breinholt *et al.*, 1981) in the derived savanna region of south Eastern Nigeria. The climate of the study area is a typical humid tropical type with a relative humidity range of 56.01-103.83%. Average diurnal minimum temperature ranges from 22^0C - 24^0C. The average maximum ambient temperature ranges from 33^0C and 37^0C (Okonkwo and Akubuo, 2007). The annual rainfall ranges from 1567.05mm-1846.98mm (Metrological Center, Crop Science Department, University of Nigeria, Nsukka Enugu State). The study lasted for 4 weeks.

Experimental materials

The *Telfairia occidentalis* leaves used in this research were obtained from Mmuogbunam farm Nimo, Njikoka Local Government Area of Anambra State. Other feed ingredients such as maize, groundnut cake, fishmeal, lysine, premix, methionine were purchased from Chidera feedmill limited, Nsukka, Nigeria. Freshly harvested *Telfairia occidentalis* leaves were harvested and spread on a clean concrete floor and allowed to sundry gradually until a constant moisture content of 10% was attained. The material was sun-dried for 5-7 days, after which it was taken to the mill for grinding. The milled sun-dried leaves retained their green color implying that necessary pigments, vitamins, protein and mineral were adequately preserved. The milled material was collected in jute bags and tied air-tight to prevent insect attack. The material was also stored in clean, well ventilated room before feed formulation to ensure nutrient preservation. The material (TOLM) was also analyzed to obtain its proximate compositions before its application in feed formulation.

Experimental Animals and Management

One Hundred and twenty (120) day old Anak broiler strains were purchased from Fidan Breeders, Ibadan, Nigeria. The chicks were brooded for 4-weeks and then transferred to a ventilated, deep-litter pen bedded with wood shavings to start the study. The birds were randomly assigned to four dietary treatments, having 30 birds per treatment. Each treatment was replicated thrice with 10 birds per replicate. TOLM was included in feed and fed *ad libitum* to the birds in completely randomized design (CRD). The inclusion level of TOLM in the feed were as follows: T_1 (control diet) = 0 % TOLM. T_2 = 0.5 % TOLM. T_3 = 1 % TOLM and T_4 = 1.5 % TOLM. The birds were routinely vaccinated against common diseases. Litter was regularly turned to maintain friable bedding condition. Water and feed were served *ad libitum*.

Table 1: Percentage ingredients composition of broiler finisher diet

Ingredients (%)	**Treatments**			
	T_1	T_2	T_3	T_4
Maize	38	38	38	38
Groundnut cake	16	16	16	16
Soybean meal	13	12.5	11.5	11.5
Wheat offal	26	26	26.5	26
Fish meal	2.0	2.0	2.0	2.0
Oyster shell	2.0	2.0	2.0	2.0
Bone meal	2.0	2.0	2.0	2.0
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
TOLM	-	0.5	1.00	1.50
Total	**100**	**100**	**100**	**100**

Table 2: Proximate compositions of experimental diets containing *Telfairia occidentalis* leaf meal (TOLM)

Compositions (%)	**T_1**	**T_2**	**T_2**	**T_4**
Crude protein	21.00	21.19	21.89	21.99
Crude fiber	6.55	7.20	8.05	9.40
Ether extract	3.10	3.26	3.90	4.4
Ash	6.11	9.90	11.80	13.98
Moisture	15.38	15.00	15.02	14.87
Met.energy Kcal.kg^{-1}	2770.00	2799.00	2828.00	2900.00

Parameters Measured

The following data were collected**:**

Initial body weight and body weight gain (g)

At the beginning of the experiment, the birds were weighed and also weighed on weekly basis throughout the experimental periods. Weight gained at the end of the previous week was subtracted from that of the present week in order to get the body weights of birds gained for the week. A box on a top pan balance was used to weigh the birds and it was done in batches.

Feed intake (g)

On each day throughout the experimental periods, f**e**ed was weighed before being given to the birds, then, the difference between the feed provided the preceding day and left over feed in the feeding trough the next morning was divided with the number of birds in each replicate in order to get the daily feed intake per bird for each replicate.

Average daily feed intake (ADFI)

This was obtained by dividing the total feed intake of the birds with the number of days the feeding trial lasted.

Average daily weight gain (ADWG)

This was obtained by dividing total weight gained per bird per replicate with the number of days the feeding trial lasted.

Final body weight (FBW)

Weights of the birds at end of trial periods.

Feed conversion ratio (FCR) = $\frac{\text{Feed consumed(g)}}{\text{Weight gain (g)}}$

Nutrient Retention

Three birds were randomly selected from each replicate and housed in a battery cage system. These birds were allowed to acclimatized in the cage after which they were starved for 36 hours to clear the alimentary canal and they were fed 95% of their *ad libuum* feed intake. Smooth faeces collection trays were placed under the cages for collection. The faeces were collected each day before given another feed for a 5 days period. During the collection, each collected droppings were oven dried at 60^{o}C for 72 hours, after which they were allowed to cool and weighed and then milled. The proximate components of the droppings were then determined using A.O.A.C (1990) method of analysis. The percentage retention of the mineral, nitrogen, fiber and energy were calculated using the general formula.

$$\frac{A\times B - C\times \mathbf{B}}{A\times B} \times 100\ \%$$

Where A= Feed intake during period of metabolic studies

B= Percentage of parameter in feed

C= Dry percentage of parameter in dropping

True Metabolizable Energy

After the nutrient retention analysis, the birds were starved again to empty their alimentary canals of feed residues. Three birds were randomly selected from each replicate, forced-fed a known weight of the feed under test (30g) and placed in a wire cage over a faecal collection tray under the floor for a specified period of time. 24 hours after putting the birds in the cages, their feacal materials were collected for each treatment group, the collected feacal material was frozen, oven dried and weighed. Samples of the feed and feacal materials were ground and assayed for gross energy content. True metabolizable energy was calculated by applying the formula:

TME (Kcal/g) = (FI ×Gef)-(Yf-Ye) /FI

Where F1=feed input (g)

Gef= Gross energy of the feed stuff

$Y_{F=}$ Energy excreted by the fed bird

$Y_{e=}$ Energy excreted by the unfed bird

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) by Steel and Torrie (1980). Significant differences existed were determined by applying the Duncan New Multiple Range Test as outlined by Obi (2002)

RESULTS

Table 3 shows the growth performance of finishing broilers fed varying dietary inclusion levels of *Telfairia occidentalis* leaf meal (TOLM). From the results, values of final body weight, average daily weight gain, average daily feed intake and feed conversion ratio were significant ($p<0.05$). Final body weight values of T_2 and T_3 were the same ($p>0.05$), but significantly higher ($p<0.05$) than the value observed for birds on the control and also lower than T_4 that was the highest. Average daily weight gain followed the same trend as observed for final body weight. Average daily feed intake of treatment 1, 2 and 3 were statistically the same, but significantly lower than the value observed for birds on T_4 that was the highest. Feed conversion ratio of treatment 2, 3 and 4 were similar ($p>0.05$), but significantly lower than the value observed for birds on the control which was the highest.

Table 3: Growth Performance of finishing broiler fed varying dietary levels of *Telfairia occidentalis* leaf meal (TOLM)

Parameters	**Treatments**				
	1	2	3	4	SEM
Initial body weight (g/bird)	767.00	773.00	770.00	767.00	3.21
Final body weight (g/bird)	2590.00^{c}	2753.00^{b}	2880.00^{b}	3027.00^{a}	74.00
Av. daily weight gain (g/bird)	53.89^{c}	70.71^{b}	75. 35^{b}	81.91^{a}	3.21
Av. daily feed intake (g/bird)	149.80^{b}	154.33^{b}	160.27^{b}	170.00^{a}	4.95
Feed conversion ratio	2.77^{a}	2.18^{b}	2.13^{b}	2.01^{b}	0.29

^{abc}Row means with different superscript are significantly different ($p<0.05$), **SEM**=Standard Error of the Mean, **Av. daily weight gain=**Average daily weight gain, **Av. Daily feed intake=**Average daily feed intake, **g/bird=**gram/bird

Table 4 shows the nutrient retention and true metabolizable energy of broiler finishers fed *Telfairia occidentalis* leaf meal (TOLM). Values for ash, fibre, crude protein and ether extract and true metabolizatble energy were significant ($p<0.05$). T_4 ash value was the highest ($p<0.05$) followed by T_3, T_2 and T_1 respectively. Fibre values for T_1, T_2 and T_3 were the same ($p>0.05$), but different from value observed for birds on T_4 that was the highest. Crude protein values among the treatments followed the same trend as observed for ash values. Ether extract values for treatment 3 and 4 were the same, but differed significantly from treatment 2 and 1 that were the lowest. Treatment 2 ether extract value differed ($p<0.05$) from value observed for birds on T_1. True metabolizable energy values of treatment 1 and 2 were the same ($p>0.05$), but lower ($p< 0.05$) from values observed for birds on treatment 3 and 4.Treatment 3 true metabolizable energy value was different from treatment 4 that was the highest ($p<0.05$).

Table 4: Nutrient retention and true metabolizable energy of broiler finishers fed *Telfairia occidentalis* leaf meal (TOLM)

Parameters(%)	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Ash	79.05^{d}	81.85^{c}	83.90^{b}	87.15^{a}	0.50
Fibre	78.85^{b}	78.05^{b}	80.08^{b}	83.85^{a}	1.15
Crude protein	70.30^{d}	71.85^{c}	73.40^{b}	75.25^{a}	0.71
Ether extract	65.80^{c}	73.55.^{b}	81.40^{a}	83.20^{a}	2.62
True metabolizable energy	3.15^{c}	3.19^{c}	3.38^{b}	4.61^{a}	0.47

^{abcd}Row means with different superscript are significantly different .**SEM**=Standard Error of Mean

DISCUSSIONS

Table 3 shows the growth performance of finishing broilers fed varying dietary inclusion levels of *Telfairia occidentalis* leaf meal (TOLM). Generally; there was a progressive increase in the body weight gain as the level of *Telfairia occidentalis* leaf meal in the diet increased. Birds on *Telfairia occidentalis* leaf meal diet significantly ($P<0.05$) had higher values for final body weight, average daily weight gain and average daily feed intake when compared with values observed for birds on control diet. This could be attributed to the increased rate of body metabolism due to towering level of minerals, vitamins and well-balanced amino acids content of TOLM (Fasuyi and Noyenrem, 2007). Increase in body metabolism culminates into improve nutrient digestion, absorption and utilization in the body of animal and thus resulting to increase in growth and weight gain. Generally, vitamins and minerals functions as co-enzymes and co-factors which are also known as 'help molecules' for various enzymes catalyzed reactions that are involve in catabolism, anabolism and inter-conversion of materials in the body of animals. Variation ($p<0.05$) in feed intake and body weight gain in favor of birds fed *Telfairia occidentalis* leaf meal could also be linked to the antioxidant content of *Telfairia occidentalis* leaves. It has been confirmed that *Telfairia occidentalis* leaves contains antioxidant properties (Nwakanma *et al.,* 2014; Mohammed *et al.,* 2016). Anti-oxidants cushions the negative effects of reactive oxygen species that are implicated in oxidative stress which negatively affect feed intake and weight gain in farm animal. Improvement in weight gain recorded in favor of birds on TOLM indicates that TOLM did not present any deleterious effect on the birds.The observed increase ($P<0.05$) in body weight gain in favor of birds fed TOLM in this work agrees with the findings of Imasuen *et al*. (2014) who supplemented the diet of broilers with *Telfairia occidentalis* leaf meal and recorded variations in body weight gain in favor of the treatment groups. Furthermore, improved weight gain and feed intake observed in favor of broilers fed TOLM in this work was also in tandem with Nworgu (2006) who fed *Telfairia occidentalis* leaf extracts to broilers at growing and finishing stage and discovered that it stimulated feed intake and weight gain.

Table 4 shows the nutrient retention and true metabolizable energy values of broiler finishers fed varying dietary inclusion levels of TOLM. There was increase in amount of nutrient and energy retained as inclusion level of TOLM increased in the diet. This increase could be attributed to the availability and quantity of nutrients such as fats, fibre, protein, mineral and vitamins contained in TOLM. However, the increase in the value of ether extract retained could be attributed to essential fatty acid content of *Telfairia occidentalis* leaf meal with oleic and linoleic acids constituting over 60% of its fatty acid compositions (Asiegbu, 1988). This observation might have led to increase in true metabolizable energy since fat and oil also serve as energy sources to birds. In the same vein, Olomu (1995) earlier reported that high value obtained in true metabolizable energy could be linked to better nutrient intake and utilization enhanced by inclusion of *Telfairia* in broiler diet as fibre serves as energy diluents and it has been reported that *Telfairia. occidentalis* leaves contain 8.4% total ash, 3.0% crude lipid, 30.5% crude protein and 87.3% crude fibre (Ladeji *et al*., 1995).

CONCLUSION AND APPLICATION

In conclusion, higher inclusion level of 1.5% TOLM was observed not to have any deleterious effect on birds, therefore T_4 (1.5%) was recommended because of highest significant values of growth, nutrient retention and true metabolizable values recorded. Better performance of birds on TOLM in terms of improved body weight gain and nutrient retention suggests that TOLM can be used by farmers to enhance poultry production.

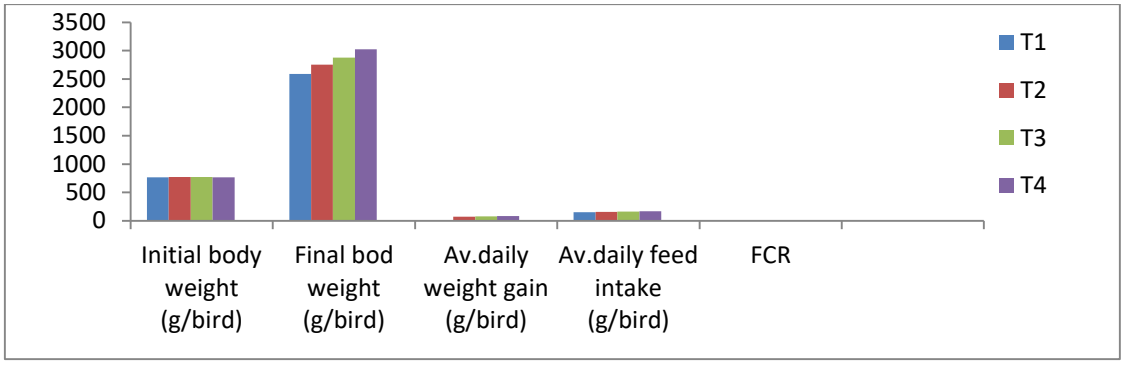

Fig 1: Bar-char reprinting the growth performance of the birds

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