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Composition and effect of *Desmodium triflorum* leaf meal on the growth of broiler starter chicks

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Abstract
A total of eighty (80) day old Chi broiler chicks were allocated to four dietary treatments. Each treatment had two (2) replicates of ten (10) chicks per replicates in a complete randomized design (CRD) experiment which lasted for four weeks to investigate the effect of *Desmodium triflorum* leaf meal (DTLM) on the growth of broiler starter chicks. The control diet T_1 did not have any inclusion of DTLM, while the others were formulated with different level of DTLM inclusion. Daily feed intake increased progressively in all treatments, but there was no significant difference ($p>0.05$) among the treatments. There was no mortality recorded in the bird receiving 15% DTLM. The 5% level of DTLM inclusion was the most cost effective. It is recommended the DTLM at 15% level of inclusion has the potential to improve the growth and general health performance of chicks with no harmful effects.

Keywords: Composition, *Desmodium triflorum*, Growth, Broiler, Chicks.

Introduction
Poultry has the potential to bridge the demand and supply gap of protein of animal origin in Nigeria because poultry ranks highest in converting feeds to meat in a short period. Of all farm animals poultry can yield the quickest returns. If given good conditions in incubation, day old chicks are produced during 21 days. A day old broiler chick if given adequate management may weigh 2.5kg and above in 8 weeks. In terms of nutritive value, poultry eggs ranks second to cow's milk and it is the most economically produced animal protein. The poultry industry can adjust to the variety of economic factors e.g. feeds availability, number of birds, and feed cost. Other livestock requires longer time to adjust; even among these poultry, the broiler is suggested to bridge this protein demand and supply gap due to its potentials.

Broiler birds are probably the most universal and important of all poultry as producers of meat for human consumption. Broiler meat contributes to the daily dietary needs of children and adults; it is a source of vitamins such as niacin, riboflavin, vitamin B6 and also a source of minerals such as potassium, calcium and magnesium (Kekeocha, 1984) [13]. Broiler meat contains high quality protein. Broiler birds are known for storage of excess fat in their body. This has health and economic implications but the degree of fatness is a function of genetic, environmental and nutritional factors (Kekeocha, 1984) [13]. Lack of dietary protein can retard growth in children and in adults; it can be contributing factor in chronic fatique, depression, slow wound healing and the decreased resistance to infections (Iyangbe and Orewa, 2009) [12].

It has been estimated that the daily minimum crude protein required of an adult in Nigeria varies between 65 and 85 grams per person; however, it is recommended that 35 grams of this minimum required should be obtained from animal products (Oloyede 2005, Britton 2003) [19, 5]. A review of the data of food supplies available for consumption in different countries shows that the per caput protein intake in developing countries, Nigeria inclusive is comparatively low, not only in the total protein supply deficient but the quality of dietary protein available is inferior to that consumed in developed countries (Brown, 2005) [4]. A hard working adult farmer needs approximately 3,500 calories and 50 grams of protein per day; a one- year old child needs about 1000 calories and 15 grams of protein per day. Yet these qualities of essential nutrients are missing in the diets of many rural Africans which are based on staples of grains.

Proper nutrition is a very important pre-requisite for a successful livestock farming. Well-fed birds are not only more resistant to diseases but also produce better carcass. For maximum efficiency in growth and product, it is necessary to provide the chicks with rations that are properly balanced. In order to ensure this, a good knowledge of the nutrient composition of the ingredients and the right proportion in which they are to be mixed is essential. The rations should be such that they satisfy the nutritional requirements of the birds with regards to protein, fats, carbohydrates, minerals, vitamins and water (Fielding, 1990) [10]. The high cost of animal feedstuff particularly of protein origin tends to suggest that alternative protein sources are explored for poultry feed in order to achieve favorable economic returns. The conventional protein feedstuffs (soybean, palm kernel and groundnut cake) are continually being competed for by man to meet up their ever increasing protein requirements, thus, resulting in escalating cost of the conventional protein sources.

The replacement of expensive conventional feed ingredients with cheap locally available and non- human competitive substitutes in feed formulation offers a veritable means of reducing the total feed cost of poultry production. Supplementation of animal protein for monogastric animals is expensive and not easily affordable (Umoren *et al*, 2005) [26]. Feed supplementation with native legumes is viable and provides additional proteins, minerals, energy and improves the overall nutritional status in developing countries

(Guillion and Champ, 1996) [11].

It is therefore imperative that animal nutritionist find a way of enhancing productivity at the least cost. This can be achieved by the use of some cheap, unconventional feed sources to replace the costly conventional ones. This problem starts from the under production of cereals and legumes which form the bulk of ingredients used in ration formulation. There is therefore the need to make frantic efforts to raise more livestock species on less competitive feed resources which can be converted efficiently to meat. The alternative feed sources that should be searched for should be far from human and individual interest for food and raw materials. One feed resource that has roused enormous interest in recent times is the leaf meal. Studies done at various stations have shown that leaf meals of various legumes and shrubs can be of greater value in poultry diets if added in the diets at levels up to 10% (Udedibie and Igwe, 1989, D' mello *et al*,1987) [25, 8].

Leaf meals from some tropical legumes and plants are cheap sources of protein and also some vitamins, minerals, and carotenoids which causes the yellow colour of broiler skin, shank, and egg yolk (D' mello *et al*, 1987) [8]. There is need to increase animal protein intake of Nigerians by increasing livestock and indeed, broiler production. This can be possible by the use of unconventional feedstuffs which are not competed for by man since the cause of bridging the animal protein demand and supply gap is traced to high cost of feed. *Desmodium triflorum* leaf which is commonly available in this study area and obtained at a very low or no cost may have the potential to reduce the high cost of poultry feed; improve production thereby increasing the production of animal protein.

Desmodium triflorum (the three- flower beggar weed) fabaceae/leguminosae, a medicinal plant is a very small terrestrial, annual, prostrate herb, up to 50 cm long, slender branches and rooting at nodes. Its leaves are small, alternate, stipulate and trifoliate. Flowers are irregular, bisexual, very small and bright purplish blue in colour. This plant is found on a wide range of soils and most commonly in dry, distributed along road sides in the tropics. The useful parts of the plant are the leaves, roots and whole plant. *Desmodium triflorum* leaf contains chemical constituents such as vitexin, genistin, fucostesrol (Yoganarasimhan, 1996) [27]. The leaves are used in diarrhea and convulsion (Yoganarasimhan, 1996) [27]. The fresh leaves of the plant are applied to wounds and abscesses that are usually very difficult to heal. The fresh juice of the plant is also recommended for use in dysentery. Dried powder of the whole plant, *Desmodium triflorum* leaf is taken on empty stomach to cure bone fracture (Prusti and Behera, 2007) [21]. The nutritive value of *Desmodium triflorum* leaf meal has not been widely studied and essentially not at all in broilers. Very little is known about the use of the leaves in broiler diets. The present study is, therefore, undertaken to evaluate the nutritive value of *Desmodium triflorum* leaf meal on the growth of broiler starter chicks.

Materials and Methods

Experimental Site: - This study was carried out at the poultry unit of the Teaching and Research farm of the Department of Animal Science, Faculty of Agriculture and Forestry, Cross River University of Technology (CRUTECH) Obubra Campus Cross River State between the periods of November to December, 2015. The location of this study lies along longitude 8^0 – 9^oE and latitude 6^0-7^0 N of the equator. The location has an annual rainfall of about 500- 1070mm, with a warm weather and ambient temperature of about 21^0- 30^0C (Mfam, 2002) [16].

Experimental materials: - Materials that was used for this research include; weighing scale, wood shavings, feeders and drinkers of different sizes suitable for different growth stages of the birds, spade, sack bags, brooms, newspapers, izal, kerosene, stoves, lanterns, wooden planks for placing of drinkers, polythene bags and detergents.

***Desmodium Triflorum* Leaf Meal Production: -** *Desmodium triflorum* leaves were harvested from the University environment. The cut leaves were air dryied and allowed to dry for a period of 3-4 days under shady conditions after which the leaves were separated from the twigs before milling in a hammer mill to produce the leaf meal.

Experimental Birds and Management: - Eighty healthy day- old broiler chicks of known strain were purchased from a commercial distributor at Calabar, and transported to the laboratory under a healthy condition. The birds were randomly distributed to 4 treatment diets. Each treatment were replicated thrice with 10 birds each and allocated to each of the 4 experimental diets. The birds were housed in deep litter poultry house partitioned into pens. Each pen contained a feeder and drinking trough, stove, electric bulbs. Lanterns were used as a source of heat and light respectively. On arrival, the chicks were given New Castle Disease Vaccine (NCDV) intra-ocular with an anti-stress (vitalyte). Other vaccines that were given were; gumboro vaccine at 10 days of age, and Lasota 21 days of age. Coccidiostat and antibiotics were given when disease symptoms were observed. Feed and water were given ad libitum throughout the duration of the experiment which lasted for 4 weeks (28 days).

Compositions of Experimental Diets: - The experimental diets were formulated to meet the standard requirements in accordance with the recommendations of NRC. There were 4 treatments; T_1, T_2, T_3 and T_4 containing 0%, 5%, 10% and 15% levels of inclusions of *Desmodium triflorum* leaf meal, respectively.

Table 1: Proximate Composition of *Desmodium triflorum* on dry matter basis

	Unit	Average	Minimum	Maximum
Dry matter	%	30.2	25.0	35.4
Crude Protein	% Dm	11.7	8.8	13.6
Crude Fiber	% Dm	29.8	26.1	35.0
Ether Extract	% Dm	2.9	2.0	4.5
Ash	% Dm	8.5	7.3	10.6

Source: Calvino (1952) [6]

Table 2: Composition of Starter Diet

Ingredient	T_0	T_5	T_{10}	T_{15}
Maize	50.45	45.86	41.24	36.60
Soya bean meal	38.55	38.14	37.76	37.40
W/ offal	5.00	5.00	5.00	5.00
Fish meal	1.00	1.00	1.00	1.00
DTLM	0.00	5.00	10.00	15.00
Bone meal	3.50	3.50	3.50	3.50
Vitamin premix	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated composition of nutrients:				
Crude protein	23.00	23.00	23.00	23.00
Crude fiber	4.38	5.72	7.09	8.40
M.E/kcal	3137.90	3022.87	2957.86	2970.97

W/offal= Wheat Offal; DTLM= *Desmodium triflorum* leaf meal; M.E= metabolizable energy

Chemical Analysis: - The proximate analysis on the *Desmodium triflorum* leaf meal and the four diets were analyzed for crude protein, crude fibre, ether extract, ash and moisture according to AOAC (2006) [2]. Metabolizable energy was determined using Panzenga (1985) [20] equation: ME = (37 × % CP) + (81 × % EE) + (35.5 × % NFE). Mineral composition of *Desmodium triflorum* leaf meal for major minerals such as calcium, potassium, sodium, phosphorus, magnesium and the minor minerals such as manganese, iron, zinc, cobalt, and cupper were analyzed. Phytochemical analysis and the presence of anti-nutritional factors of *Desmodium triflorum* leaf meal were also analyzed.

Performance Characteristics: - Daily feed intake was taken by the difference between quantity of feed given and the left over. An initial body weight of each bird was taken before assigning them to their different treatment. Weekly body weight was subsequently taken using a weighing scale. Data that were collected are initial body weight, weekly body weight, daily feed intake, live weight and feed intake was used to calculate weight gain and feed conversion ratio which is the quantity of feed consumed per unit increase in live weight (i.e. FCR= feed consumed divided by weight gain). Mortality was recorded.

Experimental Design and Statistical Analysis: - A completely randomized design (CRD) was used. The data obtained was subjected to statistical analysis using the analysis of variance (ANOVA), according to the method of Snedecor and Cochran (1987); while treatment means was separated using the Duncan Multiple Range Test (DMRT) as outlined by Steel and Torrie (1980) [24].

Results

Proximate Composition of *Desmodium triflorum* on dry matter basis is presented in Table 1, while the Composition of Starter Diet is presented in Table 2. Thable 3, represent the proximate composition of *Desmodium triflorum*. The mean crude protein and crude fibre, were 17.50%, 5.11% respectively for *Desmodium triflorum*.

The values of 4.96%, 9.03% and 8.76% were obtained for ether extract, Ash and moisture respectively. These values indicate that the vitamins, minerals and high dry matter (DM) content was available for the chick's performance. The proximate composition of experimental diets is presented in Table 4. The phytochemical screening of *Desmodium triflorum* leaves is presented in Table 5. The result of the phytochemical screening shows that *Desmodium triflorum* leaves contains the following components; alkaloids 3.58 ± 0.087, phenolic 1.40 ± 0.001, steroids 0.65 ± 0.003, flavonoids 3.80 ± 0.003, saponins 1.06 ± 0.002, tannins 2.86 ± 0.004 and Glycosides 1.42 ± 0.003. Some macro and micro minerals were also determined in *Desmodium troflorum* leaves and they are presented in Table 5. The result of the macro and micro minerals shows the following values; major minerals (mg/100g): Sodium 48.00, Potassium 890.00, Phosphorus 159.00, Calcium 87.10 and Magnesium 24.00 while micro nutrients had the following values: Iron 4.35, Cobalt 0.29, Zinc 12.99, Manganese 2.01 and Copper 0.27. Feed intake of broiler chicks in groups T_1, T_2, T_3 and T_4 fed on ration formulated at recommended protein level using different percentages of *Desmodium triflorum* leaf meal (DTLM) is shown in Table 6. The average weekly feed intake was relatively higher in T_4 (288.7g), the 15% level while the lowest feed intake was recorded in T_2 (270.5g), the 5% level of inclusion.

Table 3: Proximate composition of *Desmodium triflorum* leaves.

Constituents	Moisture	Crude protein	Crude fibre	Ether extract	Ash	Nitrogen free extractives	Metabolizable energy (kcal/kg)
Proportion (%)	8.76	17.50	21.39	4.96	9.03	38.36	2411.04

Table 4: Proximate composition of experimental diet (%).

Constituents	Experimental diets			
Moisture	7.51	8.48	7.72	7.59
Crude protein	21.86	21.44	21.00	19.50
Crude fibre	2.53	4.04	4.70	5.11

Ether extract	3.52	2.93	2.53	2.52
Ash	7.00	6.99	8.39	7.58
Nitrogen free extractives	57.58	56.12	55.66	57.70
Metabolizable energy (kcal/kg)	3137.90	3022.87	2957.86	2970.97

Table 5: Chemical components of *Desmodium triflorum* leaves (%).

Phytochemical							
Constituents	**Alkaloids**	**Phenolic**	**Steroid**	**Flavonoids**	**Saponins**	**Tannins**	**Glycosides**
Proportion	3.58 ± 0.087	1.40 ± 0.001	0.65 ± 0.003	3.80 ± 0.003	1.06 ± 0.002	2.86 ± 0.004	1.42 ± 0.003
Minerals (Major)							
Constituents	Sodium	Potassium	Phosphorus	Calcium	Magnesium		
Proportion	48.00	890.00	159.00	87.10	24.00		
Minerals (Minor)							
Constituents	Iron	Cobalt	Zinc	Magnese	Copper		
Proportion	4.34	0.29	12.99	2.01	0.27		

Table 6: Summary of Growth Performance of broiler chicks

	T_1	**T_2**	**T_3**	**T_4**	**SEM**
Initial weight (g)	48.90	52.00	45.00	45.00	
Final weight (g)	555.50	480.00	535.00	535.00	37.76^{ns}
Average daily weight gain (g)	18.09	15.28	17.49	17.49	1.37^{ns}
Average daily feed intake (g)	40.38	38.67	39.20	41.24	1.13^{ns}
FCR	2.23	2.53	2.27	2.36	0.18^{ns}
Mortality (%)	15.00	5.00	0.00	0.00	

ns = Not significant
SEM = Standard error of mean

Discussion

The proximate composition of *Desmodium triflorum* is presented in Table 3. The mean crude protein of 17.50% reported for *Desmodium triflorum* was more than 15.5% reported by Aduku (2012) [1] and 11.7 reported by Calvino (1952) [6]. This variation may be due to the soil type, location of study and stage and season of harvest. The crude fibre level of 21.39% was lower than 35.0% reported by Calvino (1952) [6] and 29.3% reported by Aduku (2012) [1]. These differences could be attributed to the age and season of harvest since it is known that forage gets more fibrous as it advances in age and dry season forages are more fibrous. The values of 4.96%, 9.03% and 8.76% were obtained for ether extract, Ash and moisture respectively. These values indicate that the vitamins, minerals and high dry matter (DM) content was available for the chick's performance. The proximate composition of experimental diets is presented in Table 4. The crude protein reported for these experimental diets ranged from 19.50 – 21.86% CP. The values are less than 23% CP obtained in the calculated diets but fell within the range of 21 – 24% CP reported to be suitable for broilers crude protein requirement at the starter phase (Fielding, 1990) [10]. The crude fibre content of the experimental diets ranges from 2.53 – 5.11% and these values are consistent with the 5% crude fibre maximum requirement recommended for broiler starter (Aduku, 2012) [1]. The metabolizable energy of 2970.97 – 3137.9 kcal/kg is within the level of 3000kcal/kg recommended for broiler starter (Aduku, 2012) [1].

The phytochemical screening of *Desmodium triflorum* leaves is presented in Table 5. The result of the phytochemical screening shows that *Desmodium triflorum* leaves contains the following components; alkaloids 3.58 ± 0.087, phenolic 1.40 ± 0.001, steroids 0.65 ± 0.003, flavonoids 3.80 ± 0.003, saponins 1.06 ± 0.002, tannins 2.86 ± 0.004 and Glycosides 1.42 ± 0.003. These values are similar to values of 3.78 ± 0.089, 1.37 ± 0.002, 0.63 ± 0.004, 3.82 ± 0.003, 1.05 ± 0.003, 2.87 ± 0.004 and 1.43 ± 0.003 for alkaloids, phenolic, steroids, flavonoids, saponins, tannins and glycosides respectively reported by Rikita (2013) [22] and Earratt (2013) [9]. Some few variations observed in this analysis may be attributed to certain factors that affects anti-nutritional factors such as soil type and age of the leaves used for the analysis reported by Ogieva (1988) [17].

Some macro and micro minerals were also determined in *Desmodium troflorum* leaves and they are presented in Table 5. The result of the macro and micro minerals shows the following values; major minerals (mg/100g): Sodium 48.00, Potassium 890.00, Phosphorus 159.00, Calcium 87.10 and Magnesium 24.00 while micro nutrients had the following values: Iron 4.35, Cobalt 0.29, Zinc 12.99, Manganese 2.01 and Copper 0.27. these values obtained in this determination are similar with few variations to values of Sodium 47.96, Potassium 974.00, Phosphorus 158.00, Calcium 86.16 and Magnesium 23.11 for major while micro minerals were Iron 4.35, Cobalt 0.28, Zinc 13.08, Manganese 2.02 and Copper 0.28 reported by Arun *et al.* (2003) [3].

Feed intake of broiler chicks in groups T_1, T_2, T_3 and T_4 fed on ration formulated at recommended protein level using different percentages of *Desmodium triflorum* leaf meal (DTLM) is shown in Table 6. The average weekly feed intake was relatively higher in T_4 (288.7g), the 15% level while the lowest feed intake was recorded in T_2 (270.5g), the 5% level of inclusion. It was observed that feed intake of broiler chicks rapidly increased with their age and difference in the daily and between weeks for feed intake were not significantly affected ($p > 0.05$). The slightly higher feed intake observed in T_4 may be due to the lower crude protein level of the diet.

The results indicate that these levels of DTLM inclusion had no negative effect on feed intake. These findings disagree with Olugbemi *et al.* (2010) [18] where they had a significant

difference ($p < 0.05$) in feed intake when they used *Moringa oleifera* at 15% level of inclusion. Feed intake of broiler chicks in groups T_1, T_2, T_3 and T_4 fed on ration formulated at recommended protein level using different percentages of *Desmodium triflorum* leaf meal (DTLM) is shown in Table 7. The average weekly feed intake was relatively higher in T_4 (288.7g), the 15% level while the lowest feed intake was recorded in T_2 (270.5g), the 5% level of inclusion. It was observed that feed intake of broiler chicks rapidly increased with their age and difference in the daily and between weeks for feed intake were not significantly affected ($p > 0.05$). The slightly higher feed intake observed in T_4 may be due to the lower crude protein level of the diet. The results indicate that these levels of DTLM inclusion had no negative effect on feed intake.

These findings disagree with Olugbemi *et al.,* (2010) [18] where they had a significant difference ($p < 0.05$) in feed intake when they used *Moringa oleifera* at 15% level of inclusion. The effect of DTLM leaves on the weekly live body weight of broiler chicks (Table 8) shows that there was no significant difference ($p > 0.05$) across the treatments. However, the highest weekly live weight of 339.5g and 315.4g was recorded in T_4 and T_3 15% and 10% DTLM respectively and the lowest value of 313.5g was recorded in T_2 (313.5g) 5% DTLM level of inclusion. The high live weight value of birds in T_4 is understandable because the birds ate more feed.

The weekly weight gain of broiler birds is shown in Table 9. The average weekly weight gains were 126.65, 107.00, 122.50 and 122.50 for T_1, T_2, T_3 and T_4 respectively. The results were not significantly ($p > 0.05$) different. However, there was a remarkable positive effect in weight gain. The non-significance ($p > 0.05$) between the control and the leaf meal shows that the highest 15% level of inclusion did not have any effect on the live body weight which may suggest that at this chick phase, the nutrients available in the test ingredient and the control were similar in providing nutrients for the broiler chicks.

The non-significance ($p > 0.05$) difference observed here agrees with Olugbemi *et al* (2010) [18] who reported a non-significant ($p > 0.05$) effect when they fed diet with the same 5%, 10% and 15% levels of *Moringa oleifera* leaf meal. Better weight gain occurred in weeks 2 for T_1 (227.5g), week 2 for T_3 (166.5g) and week 4 for T_4 (153.0g). The trend was not consistent and could be as a result of chance occurrence. The weekly Feed Conversion ratio of broiler chicks is shown in Table 10. The differences in the weekly Feed Conversion ratio indicate that with the advancement of broiler age, the FCR was improved with increase in the test ingredient. T_1 had a high conversion in Week 4, while T_3 had 3.02 in Week 4, T_2 had 4.14 in Week 4 and T_4 had 3.63 in Week 3. The most efficient was recorded in T_3 (2.24) with 10% level of DTLM inclusion, though it did not differ significantly ($p > 0.05$) across the treatments. This result agrees with Kakengi *et al* (2007) [14] who reported that *Moringa oleifera* leaf meal diet was highly preferred by chickens because of its palatability but there was no significant difference ($p > 0.05$) in feed intake and feed conversion ratio among treatments.

Mortality was observed to be in T_1, 3 chicks (0% DTLM) and T_2, 1 chick (5% DTLM). The absence of mortality in T_3 and T_4 could be attributed to the levels of inclusions of DTLM since they are known to possess some medicinal components that are phagocytic in nature. For example Alkaloids, which often have pharmacological effect and are used as medication, as recreational drug, exert anti-asthma, anti-cancer and reduce unwanted side effects in the body (Mansche, 2006) [15]. Flavonoids are most commonly known for their anti-oxidant, anti-inflammatory, anti-microbial, anti-allergic, anti-cancer and anti-diarrheal activities (Cushnie and Lamb, 2005) [7].

Conclusion

It has been established in this study that *Desmodium triflorum* leaf meal (DTLM) can be used up to 15% in broiler starter diets without any harmful effects. The proximate analysis and mineral analysis reveals the presence of available nutrients that are necessary for the chick's performance. The phytochemical screening shows that there are constituents that are medicinal in nature. The results obtained from the growth performance showed that there was a progressive weight gain in the various treatments throughout the period of the study, and mortality was non-existent in the birds receiving the higher levels of DTLM. Based on this study, it is recommended that DTLM could be incorporated in broiler starter diets up to 15% since these leaves grows widely in this part of the world and can be obtained at little or no cost for this will assist in reducing the bulk of protein/energy sources for raising broilers.

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