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Tropical Christmas bush (*Alchornea cordifolia)* Leaf Meal as Unconventional Protein Supplement in the Diet of Broiler Chicks

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Abstract

In an effort to reduce the cost of animal feeds, alternative sources of feed ingredients are being sought. In this study, one hundred and five (105) day-old broiler chicks of Anak 2000 strain used for the study were selected from a brooding stock and allotted to five treatment groups in a deep litter house feeding trial in a Completely Randomized Design, to evaluate the effect of *Alchornea cordifolia* Leaf Meal (ACLM) on the growth performance of broiler chicks. The chicks were grouped into five treatments having 0, 3, 6, 9 and 12% ACLM which were replicated thrice. Feed and water supply were *ad libitum.* Also medication, vaccination scrupulous sanitation, regular disinfection of the pens and other standard management practices were adopted. Result show that, initial weights of the birds were 41.90, 42.80, 41.0, 40.00 and 40.00 g for treatments 0, 3, 6, 9 and 12% ACLM respectively did not vary significantly ($p>0.05$). However, significant differences ($p<0.05$) occurred between the final weights 1096.20, 903.00, 796.74, 724.92 and 571.200 g for treatments 0, 3, 6, 9 and 12% ACLM respectively. Daily weight gain, daily feed intake and feed conversion ratio, showed similar trends for birds on 0, 3,6, 9 and 12% ACLM which were different in values and differed significantly ($p<0.05$) from the values for birds on 0% ACLM. Results confirmed that ACLM could not substitute soya bean as feed ingredient for broiler chicks.

Key words: *Alchornea cordifolia*, Leaf Meal, Broiler, Soya Bean Meal, Performance

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Introduction

Animal protein demand and supply gap among Nigerians has continued to widen, resulting in sub- optimal animal protein intake and consequently predisposing the people to deplorable animal protein malnutrition. This nutritional adversity is traceable to geometric increase in the Nigerian human population without a commensurate increase in livestock production, over dependence on imported livestock products, ignorance, inadequate technical skills, diseases and parasites, environmental stress and high cost of ingredients used to formulate monogastric livestock feeds. Also, the increasing awareness of people on the need for animal protein intake further increases their demand. The conventional protein feedstuffs (soyabean, 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. Similarly, the competition between man and livestock for feed grains (Tegbe, *et al.*, 1984 and Madubuike, 1992) and inadequate production of farm crops to meet human and livestock needs (Babatunde, *et al.*, 1990) have been implicated as remote causes of poor animal protein intake among Nigerians. Consequently, research reports show that feed is a critical input in monogastric livestock production as it constitutes 70-80% of cost of monogastric production (Madubuike and Ekenyem, 2001).

The replacement of expensive conventional protein 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. But supplementation of animal protein for monogastric animals is expensive and not easily affordable (Antia *et al.*, 2006). Feed supplementation with native herbs/shrubs is viable and provides additional proteins, minerals, energy and improves the overall nutritional status in developing countries (Guillion and Champ 1996). It becomes imperative to identify means of reducing the cost of feed items with a view to reducing the cost of livestock products and by extension make them available to and affordable by consumers. Some conducted researches on unconventional feedstuff showed that, *Amaranthus cruentus* (Fasuyi, *et al.*, 2008; Farooqi, *et al.*, 1999), Afzelia *africana* (Obun and Ayanwale, 2008), Cajanus cajan (Karsin *et al.*, 2008), and a host of others have been successfully used as protein sources in monogastric animals nutrition. Efforts have been made to reduce the dependence on conventional sources of protein e.g. soyabean and groundnut cake which are major protein sources and maize which is the major energy source as their prices have continued to gallop, resulting from competition of monogastric livestock with man for these materials. Leaves of many legumes, shrubs and weeds used in feeding monogastric livestock reduced their cost of production. For instance, *Leucaena leucocephala* (Udedibie and Igwe, 1989), *Microdesmis puberula* (Esonu, *et al.*, 2003), *Chromolaena odorata* (Ekenyem *et al.*, 2009), *Ipomoea asarifolia* (Ekenyem, 2004), *Alchornia mudiflora* (Opara, 1996) fed the leaves of the various plants on monogastric animals and reduced their cost of production.

However, the effective utilization and overall digestibility of the leaves are low as a result of the presence of anti-nutritional factors and high fibre contents (Cheeke and Myer, 1975), causing depressed feed intake, poor growth and production of watery droppings (Onwudike and Oke, 1998). *Alchornea cordifolia* commonly called Christmas bush is a perennial shrub which belongs to the family Euphorbiaceaeis plenty in supply and cost little or nothing to procure and prepare as feed material. This feeding trial was conducted to replace the costly soya bean with the readily available low-cost *Alchornea cordifolia* leaf as a means of reducing the cost of broiler production, making the products affordable by consumers. Thus with 17.94% crude protein and 16.85 %). Crude fibre, ACLM appears to have the capacity to partially replace soya bean as a protein source in broiler production.

Materials and Methods

This experiment was carried out at the Research and Teaching Farm of the Faculty of Agriculture, Niger Delta University, Wilberforce Island Amassoma, Bayelsa State. Bayelsa State is located in the Southern part of Nigeria (South, South Zone) between Delta State and Rivers State, the capital city of Bayelsa State is Yenagoa. The state Bayelsa is geographically located within Latitude 4° 15' North, 5° 23' South and Longitude 4° 22' West 6° 45'East. Fresh leaves of *A. cordifolia* were harvested from the campus of Niger Delta University, Wilberforce Island, Bayelsa State. The leaves were detached from the stem and were air and sun dried on concrete and polythene sheet for five to seven (5—7) days. After getting dried it was pounded into powder first with a mortar before grounded and sieved to obtain *Alchornea cordifolia* leaf meal (ACLM) which is to be incorporated into the diet. The powdered ACLM was then kept in a polythene sac and kept in a cool dry place. The proximate, amino acid, mineral and phytochemical were as determined by Alikwe and Owen, (2013)

The result of the proximate analysis of ACLM was the basis for formulation of the experimental diets. ACLM was incorporated at levels 0,3,6,9 and12% for Treatments 1, 2, 3, 4 and 5 respectively to replace soya bean weight for weight. Each treatment diet was fortified with vitamin premix, methionine and lysine (Table 2). Anti-nutrition factors in *Alchornea cordifolia* is presented in Table 3. The gross composition of the starting and finisher diet is shown in Table 4. The birds were housed in a dwarf walled building covered with wire gauze to protect the birds from predators and allow free flow of air. The building was partitioned into 15 pens measuring 3x1m each. The floor, which was concrete was disinfected and covered with wood shavings two weeks prior to the arrival of the birds. Plastic flat tray feeders were used at the starter stage and replaced with metal feeding trough at the finisher stage. The birds were fed *ad libitum* and standard plastic drinkers were used to provide cool clean drinking water at all stages of the experiment usually between 700-800 h for morning and 1700-1800 h for evening. Record of feed intake was always taken by subtracting the feed left over from the feed supplied the previous day before daily feeding. Also Vaccination programme against new castle disease,

gumboro, fowl pox and mareks diseases were applied appropriately while medication, scrupulous sanitation and disinfection and regular replacement of dirty litter were observed in the properly ventilated deep litter house. The zinc roofing and concrete floor provided adequate shade and ease of drainage and cleaning respectively.

A total of one hundred and eighty (105) day old unsexed broiler chicks of Anak (2000) heavy strain were purchased from Zartech hatchery, a division of Zartech Farms, Ibadan and used for the experiment. All chicks were electrically brooded. The birds were fed ad libitum with 24 % crude protein commercial broiler starter ration for one week after arrival from the hatchery prior to the commencement of the experiment to stabilize them before introducing the experimental diets. Water was also offered ad libitum with appropriate antibiotics and antistress tonic after arrival at the farm. The birds were subjected to standard broiler chick management procedure. The experimental design used for the experiment was completely randomized design in which one hundred and five (105) day old broiler chicks were randomly allotted to five dietary treatments; T_1, T_2, T_3, T_4, and T_5 of 21 chicks per treatment and each having three replicates in a deep litter house with 7 birds per replicate and each diet contained 0, 3, 6, 9, 12% of *A. cordifolia* leaf meal (ACLM). The ACLM was used in partial replacement of soyabean meal (SBM), every other ingredient remained constant. Water and experimental diets were served (ad-libitum).

After one week stabilization, data collection started at the 2nd week of their age. The starter and finisher phase, lasted for six (6) weeks. At the end of the starter phase, the experiment proceeded with the birds from the original treatment without rearrangement. The broilers were fed the same finisher diet, feed and water were served *ad-libitum*. Initial weight was taken per replicate at the start of the experiment using salter weighing scale. Live weights were also measured weekly to the end of the experiment to determine their final weights. The weight gain was calculated by subtracting the initial weight from the final weights of the birds. The daily feed intake was calculated by subtracting feed left over from the quantity supplied daily. Feed conversion ratio was calculated by dividing the daily feed intake by the daily weight gain. All data from the experiment were subjected to one way analysis of variance (Steel and Torrie, 1980), while the differences between the treatment means were compared using Duncan's multiple range test as outlined by (Onuh and Igwenma, 1998). SPSS version 17 (SPSS Inc. Chicago) was used for data analysis.

Results and Discussion

The result of proximate composition (Alikwe and Owen 2013) showed that the leaf meal contained moisture (9.96%), crude protein (17.94%), carbohydrate (39.53 %), crude fat (4.34%), energy (3.37 · kcal g^{-1}), ash (11.38%) and crude fibre (16.85 %).The results of performance characteristics of the experimental birds are shown in Table 5. Initial weights were statistically similar ($P<0.05$). The final weights of birds on 0, 3, 6 and 9% ACLM were significantly higher ($p<0.05$) than those on 12% ACLM. Table 5 shows that ACLM is not a very good protein supplement for broiler finishers Feed intake (FI) weight gain (WG), feed conversion ratio (FCR) and final body weight were significantly ($P<0.05$) affected by the dietary treatments. Average total feed intake (ATFI) varied from 1568.40 to 2175.30g. Birds placed on 3 to 12% ACLM supplements had significantly reduced feed intake compared to the control. Final live weight ranged from 571.20 g/bird in 12% ACLM diet to 1096.20 g/bird on the birds placed on control diet. Weight gain ranged from 531.2 g/bird in 12% ACLM to 1054.30 g/bird in 0% ACLM/control (Table 5*)*.It can be observed that as the ACLM concentration increased there was a decrease in both final live weight and weight gain (Table 5*)*. Average daily body weight gain was (12.65 g/bird) for the birds placed on 12% ACLM compared to the control (25.10 g/bird). Broiler finishers fed diets containing ACLM supplements had a lower degree of elevation in weight gain which was significant ($P<O.05$).The decrease in the weight gain of the broiler finishers fed graded levels of ACLM indicated a detrimental effect of feeding ACLM supplements at 3-12% (30 - 120g ACLM/kg feed) to broiler finishers and proves that ACLM is not a very good feedstuff and a very good proteins supplement for broiler finishers.

The composition of experimental diets is given in Table 4. The result of proximate composition showed that the leaf meal contained moisture (9.96%), crude protein (17.94%), carbohydrate (39.53 %), crude fat (4.34%), energy (3.37 · kcal g^{-1}), ash (11.38%) and crude fibre (16.85 %).These data are comparable with those reported by Udedibie and Opara (1998) who obtained 18.6% crude protein,16.43% crude fibre, 5.01% Crude fat except that the ash was higher and NFE contents were quite lower. The slight differences in nutrient status of ACLM might be partly due to differences in plant maturity, site, climate and genotype. The effects of ACLM on broiler performance are summarized in Table 5. Feed intake, body weight gain and FCE significantly ($P<0.05$) decreased as the level of ACLM increased. A major factor affecting feed intake in poultry is the dietary energy content (Osei, *et al.*, 1990) because birds eat to satisfy their energy requirements. In this trial however, it appears that the reduced feed intake and FCE were due to the increasing fibre content of the diets incorporating ACLM (Osei *et al*., 1990) or it may also be due to other anti-nutritional factors present in ACLM (Ranaweera *et al.*, 1981). These compounds include Phytate (1.21%), Oxalate (0.86 %), Saponin (2.04%), Phenols (1.16 %), Cardiac glycosides (0.11 %) and Hydrocyanic acid (22.30 mg/kg) (Alikwe and Owen, 2013) that can reduce palatability of diets with ACLM. Udedibie and Opara (1998) observed that at dietary level of 75 g kg^{-1}, ACLM significantly ($P<0.05$) depressed feed intake and growth rate of broilers but was able to turn the skins, shanks and beaks of the birds conspicuously yellow in white maize-based diets.

The similarity in initial weights of all the experimental birds was to reduce bias which could arise from using birds of different weights and to further guarantee the reliability of the results. The final live weight of the birds on 0, 3, 6, 9 and 12% ACLM were different ($p>0.05$). This suggests high level of rejection of the leaf meal. It further indicates that

despite the high nutritional profile of the leaf meal (Alikwe and Owen, 2013) that it does not have the ability to effectively replace soya bean meal, producing incomparable results. However, the significant ($p<0.05$) differences with the birds fed 3 to 12% ACLM may be due to the fact that the anti-nutritional factors, the energy and fibre might have contributed to the inefficiency of the feed utilization. Similar cases of depressed growth with increasing levels of feed with higher fibre levels leaf meal are documented (D'Mello *et al.*, 1987; Ekenyem, 2004). The feed intake of the birds were numerically higher among birds on 0, 3, 6 and 9% ACLM which were different ($p<0.05$) with birds also on 12% which fed the least. Also, the daily weight gain was statistically different among birds on 0, 3, 6, and 9% ACLM while birds on 12% ACLM has significantly least ($p<0.05$) gain. Weight is usually an indication of the efficiency of feed utilization and the nutritional safety level. Opara, (1996) fed the leaves of various plants on monogastric animals, which reduced their cost of production. However, the effective utilization and overall digestibility of the leaves are low as a result of the presence of anti-nutritional factors and high fibre contents (Cheeke and Myer, 1975), causing depressed feed intake, poor growth and production of watery droppings (Onwudike and Oke, 1998).Therefore, the difference could be attributed to decrease in palatability of the feed as the levels of the leaf meal increases and the insufficient consumption of digestible nutrients particularly protein and energy required to sustain rapid growth.

This result confirms earlier reports that *Alchornea cordifolia* leaves contain moderate levels of toxic factors that could impede feed utilization (Alikwe and Owen, 2013). However, the lower in feed intake with increasing levels of ACLM 6, 9 and 12% groups could also be attributed to anti- nutritional factors inherent in the plant (Nwokolo, 1987) and also agrees with Onwudike and Oke (1998) who worked on alfalfa leaf meal. Major problem of leaf meal and leaves extract utilization in monogastric nutrition is the presence of deleterious substances such as lectins, alkaloids, tannins, saponins, protease inhibitors, phytate, among others. D' Mello (1995) recommended soaking the leaves in water at 70°C for 10 minutes, while Abeke, *et al.*, (2003) recommended 20 minutes cooking beans of *Lablab purpureus.* The feed conversion ratio was different ($p>0.05$) for birds among the treatment diets and varied from 2.06 to 2.95 respectively with increased concentration of ACLM as the birds fed control diet had the best FCR (2.06) as against (2.95) in the birds fed 12%ACLM.This result reveals that the diets containing ACLM were inadequately utilized and so resulted in poor tissue and muscles formation. Feed conversion ratios decreased significantly at 3 to 12% ACLM in the diet. Similar results are reported by Querubin, *et al.*, (1986). Higher level of fibre and anti-nutritional factors in plants may be responsible for decreased nutrient utilization and ultimately decreased FCR (Muzlar *et al.*, 1978). It must also have contributed to the levels of weight loss observed which may be attributed to anti-nutritional factors level of the diet.

Conclusion and Recommendations

Alchornea cordifolia leaf meal may not be used as a cheap feed ingredient in broiler diets to substitute soya bean above 3% in broiler diets. But 6% level appears optimum considering the results on the final weight and weight gain. It is therefore recommended that further research work on this leaf meal which is rich in phytochemicals can be used as a feed additive to replace synthetic antibiotics in poultry nutrition.

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Tables

Table 1: Proximate Composition of *Alchornea cordifolia* Leaf meal*

Parameters	**Percentage composition (%)**
Moisture	9.96±0.40
Total fat	4.340±0.23
Fatty acid	3.47±0.24
Crude proteins	17.94±0.40
NFE	43.53±0.21
Total ash	11.38±0.26
Crude Fibre	12.85±0.16
Energy (Kcal/g)	3.367

Each value represents means ± standard deviation of three replicate determinations (Alikwe and Owen, 2013)

Table 2: Mineral contents of *Alchornea cordifolia* leaf meal*

Element	**Content (mg/kg)**
Calcium	288
Magnesium	22
Potassium	7.25
Cobalt	40
Manganese	58.35
Iron	192.5
Copper	32.5

Source: Alikwe and Owen (2013)

Table 3: Phytochemical and Anti-Nutrients Analysis of *Alchornea cordifolia* Leaf Meal

Phytochemical	**(Water extract)**	**Qualitative**	**Quantitative**
Alkaloids		-	
Anthraquinones	-		
Flavonoids		-	
Cardiac glycosides		+	0.11%
Saponins		+	2.04%
Steroids	-		
Tannins	-		
Triterpenoids		-	
Phenols	+		1.16%
Anti-Nutrients			
Phytate		+	1.21%
Oxalate	+		0.86%
HCN		+	22.3 mg/kg

+ = Present, - = Absent * Source: Alikwe and Owen (2013)

Table 4: Gross composition of experimental starter/finisher diets

Ingredients		**Starting**	**Phase**				**Finishing**	**Phase**		
%	$T_1(0)$	$T_2(3)$	$T_3(6)$	$T_4(9)$	$T_5(12)$	$T_1(0)$	$T_2(3)$	$T_3(6)$	$T_4(9)$	$T_5(12)$
Maize	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
SBM	1900	16.00	17.00	14.00	11.00	23.00	20.00	17.00	14.00	11.00
ACLM	0.00	3.00	6.00	9.00	12.00	0.00	3.00	6.00	9.00	12.00
Fish Meal	0.00	0.00	0.00	0.00	0.00	4.00	4.00	4.00	4.00	4.00
Crayfish Meal	13.00	13.00	13.00	13.00	13.00	0.00	0.00	0.00	0.00	0.00
PKM	5.00	5.00	5.00	5.00	5.00	8.50	8.50	8.50	8.50	8.50
Wheat Bran	7.00	7.00	7.00	7.00	7.00	7.50	7.50	7.50	7.50	7.50
Bone Meal	5.30	5.30	5.30	5.30	5.30	5.00	5.00	5.00	5.00	5.00
Salt	0.30	0.30	0.30	0.30	0.30	0.50	0.50	0.50	0.50	0.50
Premix	0.40	0.40	0.40	0.40	0.40	0.50	0.50	0.50	0.50	0.50
Lysine	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.00	100.0	100.0	100.0

*****Vitamin A 8000000 I.U, vitamin D_3 1600000 I.U, vitamin E 5000 I.U, vitamin K 2000 mg, Thiamine 1500 mg, Riboflavin B_2 4000 mg, Pyridoxine B_6 1500 mg, Niacin 15000 mg vitamin B_{12} 10 mg, Pantothenic Acid 5000 mg, Folic Acid 500 mg, Biotin 20 mg, Choline chloride 200 g, Antioxidant 125 g, Manganese 80 g, Zinc 50 g, Iron 20 g, Copper 5 g, Iodine 1.2 g, Selenium, 200 mg Cobalt 200 mg.

Table 5: Performance of broiler finishers fed experimental diet

Parameters (g/bird)	**0%**	**3%**	**6%**	**9%**	**12%**	**SEM**
Initial Live Weight	41.90 [a]	42.80 [a]	41.00 [a]	40.00 [a]	40.00 [a]	
Final Body Weight	1096.20[a]	903.00[b]	796.74[c]	724.92[d]	571.20[e]	0.88
Mean Body Weight	1054.30[a]	860.20[b]	755.74[c]	684.92[d]	531.2[e]	0.70
Average Daily Weight Gain	25.10[a]	20.50[b]	18.00[c]	16.31[d]	12.65[e]	0.21
Average Total Feed Intake	2175.30[a]	1963.6[b]	1810.30[c]	1753.52[d]	1568.40[e]	0.56
Average Daily Feed Intake	51.80[a]	46.75[b]	43.10[c]	41.80[d]	37.33[e]	0.72
Feed Conversion Ratio	2.06	2.28	2.39	2.56	2.95	0.12

[a,b,c,d] different at $P<0.05$. Source: Alikwe and Owen (2013)