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# Utilization of *Chromolaena odorata* leaf meal as a supplement in broiler chickens' diet

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## Abstract

*The utilization of Chromolaena odorata leaf meal (COLM) supplementation was studied in 120 broiler chickens for 42 days. The birds were randomly assigned to four dietary treatment groups in three replicates in a completely randomized design. The diets were supplemented with COLM at 0%, 2%, 4% and 6% levels. The results showed that COLM contained 19.61% crude protein, 2.90% crude fat, 10.78% crude fibre, 10.89% ash and 10.89% carbohydrate. The results of the phytochemical analysis showed that COLM contained 3.15mg/g oxalate, 2.09% phytate, 0.60% saponin, 6.30% flavonoid, 0.60mgGAE/g total phenol, 0.002% tannin and 1.66% alkaloid. The supplementation of COLM significantly affected ($p<0.05$) average weight gain, final body weight and feed conversion ratio (FCR) but no significant difference ($p>0.05$) was observed in average feed intake. All the haematological parameters were similar ($p>0.05$) across the treatment groups except platelets where birds fed higher levels of supplements of COLM had significantly higher ($p<0.05$) values than the control (0% COLM) and 2% COLM supplementation group. The results of serum chemistry showed significant difference ($p<0.05$) in creatinine and glucose. It can be concluded from this study that the inclusion of COLM as feed supplements was non-toxic and did not suppress the growth of broilers.*

***Keywords**: Utilization, Chromolaena odorata, supplementation, haematology, serum chemistry*

## Description of Problem

Dietary protein, especially animal protein, has been found to be critically limiting in the diet of the people in the developing nation (1). This situation has led to high increase in diseases and malnutrition in both infants and adults. Broiler production is one of fastest sources of animal protein all over the world today and this could be attributed to the high rate of feed utilization, feed efficiency and fast growth rate of the birds (1). It has been demonstrated that tropical plants containing certain phytochemicals are possible source of vital nutrients to livestock in the tropics (2). *C. odorata* commonly known as Siam weed is one of those plants rich fairly in these phytochemicals. The phytochemical screening of the leaves of C. *odorata* revealed the presence of alkaloids, cyanogenic glycosides, flavonoids (aurone, chalcone, flavone and flavonol), phytates, saponins and tannins (3, 4). *Chromolaena odorata* is very rich in protein which could make it an unconventional source of protein for ruminants and non-ruminants (3). The nutritive value assessment of C. *odorata* by (5) showed that it is a plant that has good potential for feeding livestock due to its high crude protein (CP) which maybe more than 25% when found on a virgin, fallowed farmland, low fibre and low extractable phenolic contents. Its dry matter (DM) and Crude protein CP contents are highly degradable, and the protein contains about 56% amino acids (5). This has placed a

demand on C. *odorata* to be considered as a potential feed supplement for livestock in the tropics where feed for livestock production is always a problem.

Feed cost account for about 70% of the total cost of production hence there is the need for the use of alternative feed ingredients with much potentials to reduce the cost of feedstuff. Also, since the ban on the use of antibiotic growth promoters and global clamour cum desire for organic agriculture, there is an urgent need to source for plant ingredients cum extracts to fit in for use especially to enhance feed intake and effective nutrient utilization without adverse effect on the physiological make-up of the animals.

*Chromolaena odorata* is a plant with much phytochemical properties. It is rich in protein, minerals and vitamins which makes it a potential source as antioxidant thus it has a very high potential as feed supplement/additive. The leaves have carbohydrates (1.10%), Protein (24.08%), Lipid (14.00%), fiber (50.26%), Ash (10.98%) and moisture contents of 5.65% and energy content of 220.20 kcal (6). The relative abundance and availability of *Chromolaena odorata* has been reported (6). *Chromolaena odorata* can thrive well in all ecological zones in Nigeria (6). However, it is important to evaluate the contributions of the supplements on the physiological response of broiler chickens to validate the potentials of *C. odorata* as it relates to performance and health status of broiler chickens. The reported presence of anti-nutritional factors in COLM as reported by (6) has made it necessary to determine the safety limit for optimum production.

## Materials and Method

### Experimental site

The experiment was conducted at the Teaching and Research Farm, Babcock University, Ilishan-Remo, Ogun State, Nigeria. The farm is in the rain forest vegetation zone of south-western Nigeria on latitude 6˚54'N from the equator and longitude 3˚42'E from the Greenwich Meridian and the mean annual temperature is about 27$^{o}$C. The climate is humid with an average annual rainfall of about 2400mm and peak rainfall occurs in the period of June to September (Google Earth, 2018).

### Preparation of *Chromolaena odorata* leaf meal

*Chromolaena odorata* leaves were harvested within the campus of Babcock University, Ilishan-Remo, Ogun State, Nigeria. The leaves were then defoliated from the stem and air dried under room temperature. The dried leaves were then mashed into powdery form by blending the leaves into leaf meal and then sieving the particles using a 2mm plastic sieve.

### Chemical analysis of *Chromolaena odorata* leaf meal

The test ingredient (*Chromolaena odorata* leaf meal) was then analyzed for dry matter, crude protein, crude fibre, ash, crude fat and carbohydrates using the procedure of (7). The saponin content of the sample was determined by double extraction gravimetric method described by (8). Phytate content of the sample was determined according to the method outlined by (9). Tannin content of the sample was determined using methods described by (10). The oxalate content of powdered sample was determined by the modified method of (11). Alkaloid content of samples was determined using the gravimetric method of Harborne (8).

### Experimental birds, management, and design

One hundred and twenty (120) one-day-old chicks (Abor acre) were purchased from a reputable hatchery in Ibadan, Oyo State, Nigeria. The birds were given uniform feed for

a period of 7 days. The birds were raised on deep litter before transferring them to the cages for the study. The commercial starter diet fed to the birds during the period of acclimatization contained 22.13% crude protein and 3000.70 kcal/kg of Metabolizable Energy.

The chicks were individually weighed and allocated randomly to four dietary treatments in a completely randomized design. Each treatment was replicated three times. The average weight of the birds at the start of the experiment was 185 g. The birds were placed and reared in metabolic cages. Treatment diets were administered from 7 to 42 days of age. Feed and water were given *ad libitum* throughout the experimental period. Chickens were vaccinated against Gumboro and Newcastle diseases. They were protectively medicated against coccidiosis at 3 days of age and at the third week.

**Table 1: Composition of experimental diet (starter phase: 7-28 days)**

| Ingredients | Treatment 1 | Treatment 2 | Treatment 3 | Treatment 4 |
|---|---|---|---|---|
| Maize | 54.50 | 54.50 | 54.50 | 54.50 |
| Fish Meal | 5.00 | 5.00 | 5.00 | 5.00 |
| Soya oil | 3.00 | 3.00 | 3.00 | 3.00 |
| Wheat offal | 3.00 | 3.00 | 3.00 | 3.00 |
| Soyabean Meal | 30.00 | 30.00 | 30.00 | 30.00 |
| Methionine | 0.20 | 0.20 | 0.20 | 0.20 |
| Dicalcium Phosphate | 3.75 | 3.75 | 3.75 | 3.75 |
| Lysine | 0.10 | 0.10 | 0.10 | 0.10 |
| Salt | 0.20 | 0.20 | 0.20 | 0.20 |
| Premix | 0.25 | 0.25 | 0.25 | 0.25 |
| *Chromolaena odorata* Leaf meal (COLM) | 0.00 | 2.00 | 4.00 | 6.00 |

**Table 2: Composition of experimental diet (finisher phase: 28-42 days)**

| Ingredient | Treatment 1 | Treatment 2 | Treatment 3 | Treatment 4 |
|---|---|---|---|---|
| Maize | 64.00 | 64.00 | 64.00 | 64.00 |
| Wheat offal | 9.25 | 9.25 | 9.25 | 9.25 |
| Soyabean Meal | 20.00 | 20.00 | 20.00 | 20.00 |
| Fish Meal | 3.00 | 3.00 | 3.00 | 3.00 |
| Dicalcium Phosphate | 3.00 | 3.00 | 3.00 | 3.00 |
| Salt | 0.20 | 0.20 | 0.20 | 0.20 |
| Methionine | 0.20 | 0.20 | 0.20 | 0.20 |
| Lysine | 0.10 | 0.10 | 0.10 | 0.10 |
| Broiler Premix | 0.25 | 0.25 | 0.25 | 0.25 |
| *Chromolaena odorata* Leaf meal (COLM) | 0.00 | 2.00 | 4.00 | 6.00 |

**Data Collection**

**Body weight gain**

The body weight gain of the birds was obtained by weighing the birds with the use of electric weighing scale on a weekly basis after the initial body weight of the birds was determined.

Weight gain (g) = Final body weight (g) – initial body weight (g)

Daily weight gain (g) = Weight gain (g) / Number of days of the experiment.

**Feed intake**

This was taken and recorded for each treatment per replicate on daily and weekly basis by subtracting the feed leftover from the feed offered per replicate. The feed intake for each bird per replicate was determined by calculating the average feed consumed per replicate.

Feed intake (g) = Feed offered (g) – Feed leftover (g)

Daily feed intake (g) = Total feed intake (g) / Number of days of the experiment

**Feed conversion ratio (FCR)**

Feed conversion ratio is a ratio or rate of measuring the efficiency at which the bodies of livestock convert the feed into the desired output. This was obtained by dividing the total feed intake by the total body weight gain per treatment.

Feed conversion ratio (FCR) = Total feed consumed (kg) / body weight gain (kg)

**Blood Collection**

Blood sample was collected on the 42$^{nd}$ day. The blood was collected from the veins in the wing side of the birds through a process known as brachial venipuncture into sample bottles containing ethylene-diamine-tetra-acetic acid (EDTA) for haematological parameters and plain bottles for serum biochemical analysis. One bird was picked randomly from each of the three replicates of every treatment for the blood sampling.

The direct measurements of erythrocytes values; {Haemoglobin (Hb), Packed cell volume (PCV), Red blood cells (RBC)}, Mean Corpuscular Haemoglobin (MCH), absolute erythrocyte indices; {Mean Corpuscular Haemoglobin Concentration (MCHC), White Blood Cells (WBC),Mean Corpuscular Volume (MCV)} were calculated. Platelets and differential counts (neutrophils and lymphocytes) were analyzed as described by (12, 13, 14).

For the relative microscopic differential count (M- diff), blood smear was stained with Giemsa stain, one hundred cells of neutrophils, eosnophils, monocytes, basophils and lymphocytes were counted. The serum biochemical assay was carried out using standard chemical procedures: Total serum protein by Golgberg refractometer method (15), urea nitrogen (14), serum enzymes (AST, ALT) by spectrophotometric method (16).

**Data collection and analysis**

All data collected were subjected to Statistical analysis using Analysis of Variance (ANOVA) Procedure of Statistical Package for Social Sciences (SPSS, 2005). The Statistical difference was obtained, treatment means were compared, and significant means were separated using Duncan Multiple Range test of the same software.

**Results**

Table 3 shows that COLM had crude protein of 19.61%, crude fat of 2.90%, dry matter of 96.34%, crude fibre of 10.78%, ash of 10.89% and carbohydrate of 10.89%. Table 4 shows the phytochemical screening of COLM and the analysis revealed that it has oxalate of 3.15mg/g, phytate of 2.09%, saponin of 0.60%, flavonoid of 6.30%, phenol of 0.60mg/g, tannin of 0.002% and alkaloid of 1.66%.

**Table 3: Proximate composition of *Chromolaena odorata***

| Nutrient | |
|---|---|
| Crude Protein (%) | 19.61 |
| Crude Fat (%) | 2.90 |
| Moisture (%) | 3.66 |
| Crude Fibre (%) | 10.78 |
| Ash (%) | 10.89 |
| Carbohydrate (%) | 10.89 |
| Phosphorus (%) | 52.16 |

**Table 4: Phytochemical analysis of *Chromolaena odorata***

| Parameters | |
|---|---|
| Oxalate (mg/g) | 3.15 |
| Phytate (%) | 2.09 |
| Saponin (%) | 0.60 |
| Flavonoid (%) | 6.30 |
| Total Phenolic (mgGAE/g) | 0.60 |
| Tannin (%) | 0.002 |
| Alkaloid (%) | 1.66 |

**Table 5: Performance characteristics of broiler chickens fed *Chromolaena odorata* leaf meal supplements**

| Parameters | T1 (0%) COLM | T2 (2% COLM) | T3 (4% COLM) | T4 (6% COLM) | SEM (±) |
|---|---|---|---|---|---|
| Initial Body Weight (g) | 144.47 | 177.20 | 173.87 | 160.93 | |
| Final Body Weight (g) | 1563.27$^{ab}$ | 1668.73$^{b}$ | 1506.13$^{a}$ | 1553.27$^{a}$ | 7.54 |
| Avg. Weight Gain | 1197.60$^{ab}$ | 1237.86$^{b}$ | 1124.93$^{a}$ | 1116.60$^{a}$ | 7.54 |
| Avg. Feed Intake (g) | 2218.93 | 2216.37 | 2233.77 | 2205.20 | 145.24 |
| FCR | 1.85$^{ab}$ | 1.79$^{a}$ | 1.99$^{b}$ | 1.97$^{ab}$ | 0.05 |

*Avg. Weight Gain – Average Weight Gain, Avg Feed Intake – Average feed intake, FCR – Feed Conversion Ratio a-d Means in the same row with different superscript are significantly (P<0.05) different SEM- Standard error of the means.

The results presented in Table 5 showed that average feed intake, final body weight and body weight gained of the birds in the control group were not significantly different (P>0.05) from those fed with COLM supplements. However, birds fed with 2% supplements of COLM had significantly higher (p<0.05) final body weights when compared with birds fed 4% and 6% supplements of COLM.

The results below of the study carried out to evaluate the effects of *Chromolaena odorata* on the hematological profile of broiler chicken are presented in Table 6.

**Table 6: Haematological Profile of birds fed *Chromolaena odorata* leaf meal supplements**

| Parameters | T1 (0%) | T2 (1%) | T3 (2%) | T4 (3%) | SEM (±) |
|---|---|---|---|---|---|
| PCV (%) | 28.33 | 32.67 | 30.33 | 30.67 | 0.84 |
| Hb (g/dl) | 9.44 | 10.89 | 10.11 | 10.22 | 0.28 |
| RBC ($x10^6$ul) | 3.19 | 3.39 | 3.46 | 3.07 | 0.07 |
| WBC ($x10^3$ul) | 13,950.00 | 13,866.67 | 14,200.00 | 16,516.67 | 644.86 |
| PLATELET | 171,333.33$^c$ | 193,333.33$^d$ | 147,000.00$^b$ | 118,666.67$^a$ | 8,789.16 |
| LYM (%) | 64.00 | 64.67 | 70.67 | 67.67 | 1.22 |
| HETER (%) | 30.00 | 28.67 | 23.00 | 26.33 | 1.26 |
| MON (%) | 3.00 | 2.67 | 3.33 | 3.00 | 0.25 |
| EOS (%) | 2.33 | 4.00 | 2.67 | 3.00 | 0.37 |
| BA (%) | 0.67 | 0.33 | 0.00 | 0.00 | 0.13 |

a-d Means in the same row with different superscript are significantly($P<0.05$) different
Hb-Haemaglobin, RBC- Red Blood Cells, WBC-White Blood Cells, PCV- Pack Corpuscular Volume, PCV- Pack Corpuscular Volume, SEM- Standard error of the means

**Table 7: Serum biochemical profile of birds fed *Chromolaena odorata* leaf meal supplements**

| Parameter | T1 | T2 | T3 | T4 | SEM (+/-) |
|---|---|---|---|---|---|
| AST (I.U/L) | 23.54 | 33.04 | 30.66 | 30.66 | 2.06 |
| ALT (I.U/L) | 7.56$^a$ | 6.73$^a$ | 9.23$^a$ | 15.31$^b$ | 1.94 |
| CHOL (mg/L) | 53.03 | 54.86 | 62.26 | 67.48 | 3.35 |
| ALB (g/L) | 2.15 | 1.73 | 1.75 | 1.63 | 0.11 |
| T.P. (g/L) | 3.04 | 3.35 | 2.05 | 2.24 | 0.31 |
| GLOBULIN (g/L) | 0.89$^b$ | 1.62$^c$ | 0.30$^a$ | 0.62$^b$ | 0.28 |
| ALP (I.U/L) | 37.41$^a$ | 42.50$^{ab}$ | 56.38$^b$ | 54.51$^b$ | 4.61 |
| CRT (mg/L) | 1.17$^c$ | 0.97$^{ab}$ | 1.07$^{bc}$ | 0.90$^a$ | 0.06 |
| UREA (mg/L) | 6.28 | 6.27 | 6.59 | 6.26 | 0.08 |
| GLUC. (I.U/L) | 127.45$^a$ | 142.11$^{ab}$ | 144.42$^b$ | 150.99$^b$ | 4.97 |

a-d Means in the same row with different superscript are significantly ($P<0.05$) different
SEM- Standard error of the means
*AST - Aspartate aminotransferase, ALT - Alanine aminotransferase, CHOL. – Cholesterol, ALB – Albumin, T.P. – Total Protein, ALP - Alkaline phosphatase, CRT – Creatinine, GLUC. - Glucose

Tables 6 and 7 showed the haematological and serum biochemical parameters of broilers whose diets were supplemented by different levels of COLM. There was no significant difference ($p>0.05$) in the haematology except for platelets where birds fed higher supplements of COLM (45 and 6%) had significantly higher ($p<0.05$) values than the control and the birds fed 2% COLM supplementation (Table 6).

Also, as presented in Table 7, COLM supplementation had no significant effect ($p>0.05$) on AST, cholesterol, albumin, total protein and urea. The values of globulin was significantly higher ($p<0.05$) among birds fed 2% COLM supplementation but lowest at 4% COLM supplementation. The creatinine value was also significant ($p<0.05$) with least value obtained among birds fed 6% supplement of COLM. The values of glucose increased

significantly ($p<0.05$) as the inclusion of COLM supplementation increased.

**Discussion**

The crude protein content of 19.61% obtained in this study which is lower than the crude protein of 25.80% and 26.20% reported by Apori et al. (5) and Ngozi et al. (17) respectively but higher than the 18.67% reported by Aro (18). The crude fibre content of 10.78% obtained is also lower than 31.1% and 26.57% reported by Apori et al. (5) and Ngozi et al. (17) respectively but almost similar to the 11.86% reported by (18). The ash composition (10.89%) was similar to the 10.9% reported by (5) but higher than the 6.17% and 3.63% reported by Ngozi et al. (17) and (18) respectively. The differences obtained in the nutrient composition may be due to the age at which the leaves were harvested, nutrient content of the soil and the geographical location.

COLM has been reported to contain anti-nutritional factors including cyanogenic glycosides, phytate, saponins and tannins (17) which are known to cause growth depression in broilers. The value of 0.002% of tannin obtained in this study is however in contrast with the tannin value of 14.3% reported by (19).

The results obtained as the birds whose diets were supplemented with COLM compared favourably with the control for feed intake and feed conversion ratio was in contrast with the report of (19) which stated that the inclusion of COLM had an adverse effect on the performance of broiler chickens by reducing feed intake, body weight gain, feed conversion efficiency, water consumption and carcass yield. The contrast may be as a result of higher percentage of tannin present in the COLM used in the study of (19).

The report on performance is however in agreement with the conclusion of (20), they stated that the inclusion of COLM significantly affected final body weight and birds fed higher levels of COLM in the present study also had significantly lower final body weight when compared with birds whose diets were supplemented with just 2% COLM. The results in this study also agreed with the findings of (21) who studied the performance and economy of production of broiler chickens fed COLM. They reported that birds fed above 4% COLM had significantly lower body weight ($p<0.05$) when compared to birds fed 4% COLM and below.

The values on haematology and serum biochemistry were also in agreement with the report of (19) who observed that the inclusion of COLM had no significant effect on the haematological and biochemical indices of broiler chickens but the values of platelets, creatinine and glucose were significantly influenced by the supplementation of COLM in this study. Also, the present study also showed a contrast with the report of (22) who reported that platelets decreased with an increasing level of COLM. However, all the values for haematology and serum biochemistry obtained in this study were within the normal range reported by (23).

The significance of the creatine values was also reported in the study of (24) but the trend of the significance was in contrast with this study. They reported an increase in the values of creatinine as the inclusion of COLM increased btu least values were obtained at higher level of supplementation in this study. This contrast may be as a result of the difference in the levels of inclusion at the starter and finisher phases of the broilers. However, the values obtained were within the normal range. Higher values than normal may signify kidney malfunction and extent of muscle wastage. The within range of the serum creatinine of the broilers in this study suggested that the birds were not surviving at the expenses of body reserves. Hence

there was no weight losses observed in the study.

The present findings also reveal that the supplementation of COLM had no significant effect on the levels of serum cholesterol, this was in agreement with the findings of (20) who observed non-significant effect of COLM in cholesterol concentration in laying birds. The present study was however in contrast with the findings of (25) who reported reductions in total cholesterol, glucose and triacylglycerol when rats were fed Chromolaena odorata leaf extract. The contrast might be because of the use of Chromolaena odorata leaf extract while the whole leaf was processed into meal in this study. (26) reported hypoglycemic and hypolipidemic properties of Chromolaena odorata leaf extract.

**Conclusion and Applications**

1. The results of this study revealed that supplementation of COLM did not suppress growth but inclusion up to 2% significantly improved FCR and average weight gain.
2. Supplementation of broiler diets with COLM up to 6% level has no deleterious effects on the health of the chickens and this has been elicited on broiler chickens as evidenced by the within physiological range for all the haematological and serum biochemical indices studied.
3. Inclusion of COLM up to 6% in broiler diet is safe for broiler chickens.

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