

# EFFECTS OF *EUPATORIUM ODORATUM* LEAF MEAL ON GROWTH PERFORMANCE, HAEMATOLOGY, SERUM BIOCHEMISTRY AND CARCASS CHARACTERISTICS OF BROILER FINISHER BIRDS

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## ABSTRACT

The study was conducted to investigate the effects of *Eupatorium odoratum* leaf meal (EOLM) on growth performance, carcass characteristics, haematology and serum biochemical indices of broiler finisher birds. A total of one hundred and forty-four (144) day-old Ross strain commercial broiler chicks were used for the study. The birds were randomly allotted to four dietary treatments (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>) with 36 birds per treatment. Each treatment was further replicated three times with 12 birds per replicate in a Completely Randomized Design (CRD). T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> represent 0mg, 100mg, 200mg and 300mg inclusion levels of EOLM/kg of diet, respectively. The experimental diets and water were provided *ad libitum* throughout the 8 weeks' period of the study. Data were collected on growth performance (feed intake, live weight, live weight gain, FCR and percentage mortality), carcass characteristics, haematology and serum biochemical indices. All data were subjected to Analysis of Variance using statistical product and service solution (Version 23) while significant treatment means were separated using Duncan's Multiple Range Test at 5% level of significance. Results of growth performance showed that there were significant differences ( $p < 0.05$ ) in the average daily weight gain, feed conversion ratio and mortality percentage. T<sub>3</sub> and T<sub>4</sub> had the highest average weight gain (86.04g±1.11 and 86.15g±1.22) followed by T<sub>1</sub> (85.92g±1.11) with lowest from T<sub>2</sub> (79.61g±1.01). There were no significant differences ( $p > 0.05$ ) in feed intake among the treatment groups. FCR was best in T<sub>3</sub> (1.82±0.12) followed by T<sub>1</sub> (1.88±0.01) and worst in T<sub>2</sub> (2.07±0.04). Mortality percentage was highest in T<sub>1</sub> (6.03%±0.03) but lowest in T<sub>3</sub>/T<sub>4</sub> (3.4%±0.05/2.68%±0.13). Results of haematological indices were also significantly ( $p < 0.05$ ) affected by EOLM. PCV values were statistically similar in T<sub>2</sub> (31.90%±0.04) and T<sub>3</sub> (31.70%±1.33) both of which were higher than T<sub>4</sub> (28.80%±2.19). PCV value in T<sub>4</sub> did not vary with T<sub>1</sub> (25.65%±0.49). Haemoglobin values were similar in T<sub>1</sub> (9.27±0.32), T<sub>2</sub> (10.88±0.11) and T<sub>4</sub> (10.05±0.59). These values however, were significantly lower ( $p < 0.05$ ) than T<sub>3</sub> (11.63±0.73). TWBC was significantly higher in T<sub>1</sub> (52.50±6.64), T<sub>2</sub> (42.23±1.01) and T<sub>4</sub> (43.00±1.73) than in T<sub>3</sub> (80.75±0.43). Monocyte values were higher in T<sub>1</sub> (4.50±0.29), T<sub>3</sub> (5.00±1.73) and T<sub>4</sub> (8.00±1.15) than T<sub>2</sub> (3.50±0.87). However, RBC, lymphocyte, and heterophils (%) values did not significantly differ ( $p > 0.05$ ) among the treatment groups. Results on serum biochemistry showed that albumin and alkaline

phosphatase were significantly ( $p < 0.05$ ) affected by EOLM supplementation. Albumin value of T<sub>2</sub> ( $28.18 \pm 0.09$ ) was higher than values from the other groups (T<sub>1</sub> [ $26.75 \pm 0.04$ ], T<sub>3</sub> [ $27.33 \pm 0.29$ ] and T<sub>4</sub> [ $26.82 \pm 0.41$ ]). Alkaline phosphatase level (ALP) was highest in T<sub>3</sub>/T<sub>4</sub> ( $122.64 \pm 3.45/127.45 \pm 2.79$ ) followed by T<sub>1</sub> ( $102.42 \pm 5.10$ ) and the least in T<sub>2</sub> ( $82.85 \pm 9.15$ ). Results on carcass characteristics showed that T<sub>3</sub> ( $2577.24 \pm 1.50$ ) had the highest live weight (g) followed by T<sub>4</sub>/T<sub>1</sub> ( $2571.34 \pm 0.57/2566.01 \pm 1.21$ ) and the least value in T<sub>2</sub> ( $2384.44 \pm 0.57$ ). De-feathered weight, dressed weight and dressing percentage had similar trend of values. However, there were no significant differences ( $p > 0.05$ ) in breast weight (%), back cut (%), thigh (%), drumstick (%), kidney (%), heart (%), spleen (%) and liver (%). It can be concluded that dietary inclusion of EOLM at 200 mg/kg diet improved growth performance, haemato-biochemical indices in broiler finisher chickens.

## **Introduction**

Nigeria is one of the lowest animal protein consumption nation in the world, with the diet of an average Nigerian containing lower than recommended requirement by the Food and Agricultural Organisation (Egugozie, 2019). In order to accelerate nutritional well-being and economic development in Nigeria, the supply of meat must be significantly boosted through livestock farming in the next years. Food insecurity is quickly rising in some third world countries and achieving relatively self-sufficient animal protein supply necessitates intensive production of meat animals, particularly poultry, which is now produced at a small-scale subsistence levels (Wong *et al.*, 2017). However, Alemu (2020) reported that malnutrition is significantly connected to poor meat consumption, particularly among children in developing nations. Several studies recommend a supply-side approach to meet consumption needs, such as increasing herd size, livestock density and supply chain efficiency, while noting the negative impacts on land and environment as well (Godde *et al.*, 2021).

The Nigerian poultry industry comprises approximately 180 million birds and produces 300 million tons of meat and 650 million tons of eggs per year. Yet, local production only meets 30% of the demand for chicken eggs and meat. Thus, there is plenty of room for growth in the industry most of which are domiciled in the southern part of the country either in semi-intensive farms or intensive ones (FAO, 2018; Mba, 2021). Egg and meat production are major divisions of poultry production (United States Department of Agriculture – USDA, 2018). Broiler birds are those kept and reared for meat production from day-old to about eight weeks of age for good quality tender meat as source of protein in human diet. However, the profit levels in this farming enterprises have

been constrained by a number of factors critical among which is feed quality, mortality and general cost incurred. The high feed cost is partly due to competition for limited grains between humans and animals. Feed cost as a main component of input costs and profitability in broiler production necessitates a thorough examination. Farmers have been progressively designing poultry meals using locally accessible feed ingredients in recent years (Escobedo del Bosque *et al.*, 2020). Previously, broiler meat is relatively inexpensive, high in nutrients, culturally and religiously acceptable, and has a high output turnover rate (Nemeth *et al.*, 2019). But in recent years, in some developing countries like Nigeria, it is becoming expensive.

Poultry production is undergoing a continuous challenge to develop management strategies to optimize chickens' efficiency while limiting food safety concerns (Abdelli *et al.*, 2021). Traditionally, antimicrobials have been widely used for improving health and growth performance in poultry; however, the increased public awareness about the risk of developing cross resistance of pathogens to antibiotics has resulted in the gradual removal of antibiotics for therapeutic and prophylactic uses in food animals (Ricke *et al.*, 2020). The shift away from antibiotic supplementation has resulted in a tremendous growth in research focusing on the implementation of effective alternative control methods, management and dietary amendments aiming to improve animal health, welfare, and productivity (Abdelli *et al.*, 2021). A wide range of feed additives including a broad spectrum of essential oils and related compounds from botanical sources to organic acids (Zhai *et al.*, 2018), as well as probiotics and prebiotics (Al-Khalaifah, 2018), chemicals such as aldehydes (Ricke *et al.*, 2019), bacteriophages (Li *et al.*, 2020), zinc oxide (Swain *et al.*, 2016), exogenous enzymes (Torres-Pitarch *et al.*, 2019) and competitive exclusion products (Schneitz and Hakkinen, 2016) have been used in animal production.

Phytogenics such as *Eupatorium odoratum* with several biological properties have favourable influence on the health and growth of poultry (Gopi *et al.*, 2018), and are considered a modern class of feed additives that have received widespread interest in the chickens industry (Abd El – Hack *et al.*, 2016). Plants and herbal extracts contain many bioactive substance like alkaloids, flavonoids, soaps, phenolic substances and polypeptides (Al-Yasiry and Kiczorowska, 2016). The mechanism of action of these compounds was different due to the multiplicity of their types as they have antibacterial effects, immune stimuli, antioxidants and growth stimuli (Abd El-Hack and Alagawany, 2015).

In evaluating these feed resources, it is important to check its effect on the health status of the livestock (Vastolo *et al.*, 2022). In recent times, there is global utilization of herbal medicine in the treatment of various diseases affecting both humans and animals (Megersa and Woldetsadik, 2022). *Eupatorium odoratum* is one of these medicinal plants with overemphasized values. This plant may play a role in improving production and immune system of birds against different diseases (Jha *et al.*, 2022). Hence, with strong medicinal values, it could be effectively utilized as natural growth promoter, replacing antibiotics and other synthetic feed additives (Tiamiyu *et al.*, 2021). Anti-inflammatory properties of *E. odoratum* is known among herbaceous plants because it possesses chemical compounds with membrane stabilizing property (Toghyani *et al.*, 2011). Nevertheless, it is expected that compounds with membrane stabilizing properties should proffer protection to cell membranes against injurious substances and thereby exhibit anti-inflammatory properties (Akhter *et al.*, 2022).

### **Location and Duration of the Experiment**

This experiment was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Nsukka is situated at the intersection of Longitude 7° 12.5<sup>1</sup>N and Latitude 6° 45<sup>1</sup>E in the derived Savannah area (Breinholt *et al.*, 1981), with a maximum plateau altitude of 443m and a minimum of 207m above sea level (Ofamata, 1978). However, Breinholt *et al.* (1981) reported that the area has a relative humidity range of 73.1 percent to 76.6 percent, the climate is humid tropical and range of annual rainfall of 1680mm to 1700mm. The study lasted through a period of 8 weeks (56 days).

### **Management of Experimental Birds**

A total of one hundred and forty four (144) day old broiler birds were used for the experiment. The research contained 4 different treatments replicated thrice and each replicate contained 12 birds; making it 36 birds per treatment. Before the arrival of the birds, the pens measuring 12x10 m<sup>2</sup> divided into different cells were cleaned and disinfected. The birds were brooded for 4 weeks before application of the test ingredient (finisher phase) so as to get the birds acclimatized to the environment and also escape brooding stress. Their initial body weight were recorded before being

randomly placed in deep litter pens. *Ad-libitum* feed and water (containing routine vaccines/medications) were provided to the birds under the same management conditions.

### The Experimental Diet and Treatments

Fresh leaves of *Eupatorium odoratum* were harvested within the campus of University of Nigeria, Nsukka, Enugu State, Nigeria, defoliated from the stem and air-dried under room temperature. The air-dried leaves were ground into powder and sieved to become meal prior to storage for subsequent use to prepare broiler feed at various levels of inclusion. The product was incorporated into a commercial feed sourced from an Olam Company (Chikun Feed: Broiler Finisher diet) with the proximate composition outlined in Table 7.

The following were the treatment groups:

- ✚ Treatment 1: 0mg of *E. odoratum* leaf meal per kg diet.
- ✚ Treatment 2: 100mg of *E. odoratum* leaf meal per kg diet.
- ✚ Treatment 3: 200mg of *E. odoratum* leaf meal per kg diet.
- ✚ Treatment 4: 300mg of *E. odoratum* leaf meal per kg diet.

Table 1: Proximate Composition of the Experimental rations.

Composition	Broiler Starter Diet	Broiler Finisher Diet
Crude fiber (max)	5.0 %	5.0 %
Crude protein (min)	21.0 %	18.0 %
Crude fat (min)	4.0 %	5.0 %
Calcium (min)	1.0 %	0.9 %
Available phosphorus (min)	0.5 %	0.4 %
Lysine (min)	1.2 %	0.9 %
Methionine (min)	0.5 %	0.4 %
Metabolizable Energy (min)	2900 kcal/kg	3000 kcal/kg

\*As labelled by the manufacturers.

**Data Collection** Data collection were carried out based on the specific objectives of the study for growth performance, haematological indices, serum biochemistry, carcass and organ characteristics.

**Growth Performance:** Birds were weighed at day old using a sensitive scale and subsequently on a weekly basis till 8 weeks of age. From the weekly body weight, body weight gain was calculated as the final weight minus the initial body weight.

**Average Daily Weight Gain (kg):** This was the weight gained by the birds in each treatment at the end of the study and it was obtained as: 
$$\frac{\text{Final weight} - \text{Initial weight of birds/treatment}}{\text{Numbr of birds}}$$

**Average Daily Feed Intake (g):** This is the total amount of feed in g consumed per bird per treatment obtained as: 
$$\frac{\text{Feed supplied} - \text{Feed leftover/treatment}}{\text{Number of birds}}$$

**Feed Conversion Ratio:** This is a measure of the efficiency at which the broilers in each treatment converted feed into desired output (flesh) and it is equal to 
$$\frac{\text{Feed Intake/treatment}}{\text{Weight Gain}}$$

**Mortality (%):** This is the number of animals that died in each treatment during the experiment and expressed in percent calculated as: 
$$\frac{\text{Number of dead birds/treatment}}{\text{Number of live birds}} \times 100$$

**Haematological Indices:** At the end of 8 weeks of the experiment, 6 birds were selected randomly per treatment group and subjected to blood sample collection for the determination of haematological indices. Data were collected for; red blood cell count, total white blood counts, packed cell volume, haemoglobin (Hb), lymphocytes, heterophils, eosinophils and monocytes. Blood samples were collected from jugular vein of sampled birds into 1ml vials containing 2mg ethylene-diamine tetra-acetic acid (EDTA). The tests were done with the help of an automatic haematology analyzer as reported by Aikpitanyi and Egweh (2020). Data were recorded in their relevant units of measurement.

**Serum Biochemistry:** Jugular vein piercing was used to obtain blood samples from 6 birds taken randomly from each group at the end of the experiment and placed in containers without anticoagulant. Following collection, the samples were centrifuged for 15 minutes at 1500 rpm to sediment the blood cells and the supernatant frozen for serum biochemical analysis. Parameters considered were: total protein, albumin, uric acid, globulin, aspartate aminotransferase (AST),

alanine aminotransferase (ALT) and alkaline phosphatase (ALP). These were carried out according to the methods described by Bahman *et al.* (2011).

Carcass and Organ Characteristics: At the end of the experiments, one bird per replicate was randomly selected, starved of feed for 12 hours, and slaughtered for carcass evaluation. Each bird was scalded and defeathered for carcass and organ weight determination. Each part of chicken was weighed on a sensitive scale and the weight recorded in gram. Dressing percentage was calculated as the percentage of the carcass weight to the final live weight. The internal organ weights and weights of the cut parts were expressed as percentage of carcass weight. These procedures were carried out according to the methods reported by Jiwuba *et al.* (2018) and Ukam *et al.* (2020). Parameters considered were as follows; live weight, dressed weight, de-feathered weight and percentage dressing, breast cut, back cut, thigh, drumstick, kidney, heart, spleen and liver. All carcass measurement values were recorded in gram and percentages, respectively.

### **Experimental Design**

The experiment were conducted in a completely randomized experimental design (CRD) and the mathematical model used is presented below:

$$Y_{ij} = \mu + X_i + \Sigma_{ij}$$

Where:

- $Y_{ij}$  = Individual observations
- $\mu$  = Population means
- $X_i$  = Treatment effect (effects of *E. odoratum*)
- $\Sigma_{ij}$  = Experimental error

### **3.6 Statistical Analysis**

The data were subjected to analysis of variance (ANOVA) and significantly different means were separated using Duncan's New Multiple Range Test on SPSS version 23 (2015).

## **RESULTS AND DISCUSSION**

## Growth Performance of Broiler Finisher Birds fed Diets Containing *Eupatorium odoratum* Leaf Meal

Results of the growth performance of broiler birds fed diets supplemented with *Eupatorium odoratum* are shown in Table 8.

Table 2: Growth performance of broiler birds fed diets containing *Eupatorium odoratum* leaf meal.

Parameters	Treatment 1 (control)	Treatment 2 (100mg <i>E.O</i> )	Treatment 3 (200mg <i>E.O</i> )	Treatment 4 (300mg <i>E.O</i> )	p. value
IBW (g)	160.31±1.21	155.49±1.21	168.01±1.24	159.11±1.07	0.21
FBW (g)	2566.01±1.21 <sup>b</sup>	2384.44±1.04 <sup>c</sup>	2577.24±1.50 <sup>a</sup>	2571.34±0.57 <sup>b</sup>	0.00**
TWG (g)	2405.70±1.01 <sup>b</sup>	2228.95±1.51 <sup>c</sup>	2409.23±1.09 <sup>a</sup>	2412.23±1.70 <sup>a</sup>	0.00**
ADWG (g)	85.92±1.11 <sup>b</sup>	79.61±1.01 <sup>c</sup>	86.04±1.11 <sup>a</sup>	86.15±1.22 <sup>a</sup>	0.01**
TFI (g)	4531.01±0.11	4610.12±0.41	4392.51±0.40	4741.22±0.44	0.71 <sup>NS</sup>
ADFI (g)	161.82±0.06	164.65±0.06	156.45±0.07	169.33±0.09	1.00 <sup>NS</sup>
FCR	1.88±0.11 <sup>c</sup>	2.07±0.04 <sup>a</sup>	1.82±0.12 <sup>d</sup>	1.97±0.11 <sup>b</sup>	0.01**
Mortality (%)	6.03±0.03 <sup>a</sup>	5.15±0.71 <sup>a</sup>	3.41±0.05 <sup>b</sup>	2.68±0.13 <sup>b</sup>	0.00**

<sup>abcd</sup>: Means on the same row with different superscripts are significantly different (P<0.05), IBW; Initial body weight, FBW; Final body weight, TWG; Total weight gain, ADWG; Average daily weight gain, TFI; Total feed intake, ADFI; Average daily feed intake, FCR; feed conversion ratio.

Results of the growth performance shows that there were significant differences (P<0.05) in the final body weight (FBW), average daily weight gain (ADWG), feed conversion ratio (FCR) and mortality percentage. Treatment 3 recorded highest final body weight value of 2577.24±1.50g whereas the lowest value was recorded in treatment 2 (2384.44±1.04g). Treatment 3 and 4 had the highest average weight gain (86.04±1.11g and 86.15±1.22g, respectively) followed by treatment 1 (85.92±1.11g) with the lowest value from treatment 2 (79.61±1.01g). FCR was highest in treatment 3 (1.82±0.12) followed by treatment 1 (1.88±0.11) and lowest in treatment 2 (2.07±0.04). Mortality percentage was highest in treatment 1 (6.03±0.03%) but lowest in treatment

3 and treatment 4 ( $3.41 \pm 0.05\%$  and  $2.68 \pm 0.13\%$ , respectively). Feed intake was however not affected ( $P > 0.05$ ) by the test ingredient.

The significant differences obtained in FBW and FCR were similar to the reported values of Jiwuba *et al.* (2018) and Ekwe *et al.* (2017) but values for weight gain and mortality percentage differed from those of the authors. Thus, those observed differences in this study could be as a result of source of the *E. odoratum*, methods of processing or prevailing environmental conditions. However, the results of this study are in contrast with the report of Donkoh *et al.* (2002) which indicated that, the inclusion of *E. odoratum* leaf meal had an adverse effect on the performance of broiler chickens by reducing feed intake, body weight gain, feed conversion efficiency which could be as a result of higher percentage of tannin present in *E. odoratum*. Improved body weight gain recorded in this study could be attributed to the fact that *E. odoratum* leaf has a good potential for feeding of livestock due to its high crude protein level, and low extractible phenolic content (Apori *et al.*, 2000). Thus, this is in agreement with the results of Bamikole *et al.* (2004) who reported good performance for the weight gain at 30% dietary level of *E. odoratum* leaf meal. This result is also in line with the report of Alabi and Chime (2008) which showed that inclusion of *E. odoratum* leaf meal in layers mash significantly ( $P < 0.05$ ) improved FCR. The presence of water infusion of *E. odoratum* leaf meal may have initiated enzymatic activities in the gastrointestinal tract thereby improving digestion and assimilation of nutrients (Ekwe *et al.*, 2017). It was observed that reduction in mortality occurred when birds were fed *Eupatorium odoratum* at levels of 200 to 300mg and this corroborates the results of the study by Amaliah *et al.* (2019). The research work of Alisi *et al.* (2011) and Marianne *et al.* (2014), explained that *E. odoratum* contains antioxidants and is able to prevent free radicals which are believed to be the cause of various degenerative disease and organ damages that may be responsible for increased mortality in the chicken.

### **Results of the Haematological Indices of Broiler Finisher Birds fed Diets Containing *Eupatorium Odoratum* Leaf Meal.**

The results of the haematological indices of broiler birds fed diets containing *Eupatorium odoratum* leaf meal are presented in Table 9.

Table 3: Haematological indices of broiler birds fed *Eupatorium odoratum* leaf meal

Parameters	Treatment 1 (control)	Treatment 2 (100mg <i>E.O</i> )	Treatment 3 (200mg <i>E.O</i> )	Treatment 4 (300mg <i>E.O</i> )	p. value
Packed Cell Volume (%)	25.65±0.49 <sup>b</sup>	31.90±0.40 <sup>a</sup>	31.70±1.33 <sup>a</sup>	28.80±2.19 <sup>ab</sup>	0.03*
Haemoglobin (g/dl)	9.27±0.32 <sup>b</sup>	10.88±0.11 <sup>ab</sup>	11.63±0.73 <sup>a</sup>	10.05±0.59 <sup>ab</sup>	0.04*
RBC (x10 <sup>6</sup> /μl)	2.41±0.01	2.95±0.05	3.19±0.20	2.96±0.32	0.09 <sup>NS</sup>
TWBC (x10 <sup>3</sup> /μl)	52.50±6.64 <sup>b</sup>	42.25±1.01 <sup>b</sup>	80.75±0.43 <sup>a</sup>	43.00±1.73 <sup>b</sup>	0.00**
Lymphocytes (%)	55.50±7.79	46.00±1.15	51.50±0.29	61.00±4.04	0.18 <sup>NS</sup>
Heterophils (%)	30.50±6.06	26.50±0.29	33.50±3.18	22.50±6.06	0.40 <sup>NS</sup>
Eosinophils (%)	7.50±0.87	9.50±0.29	10.00±1.15	8.50±0.87	0.24 <sup>NS</sup>
Monocytes (%)	4.50±0.29 <sup>b</sup>	13.50±0.87 <sup>a</sup>	5.00±1.73 <sup>b</sup>	8.00±1.15 <sup>b</sup>	0.00**

<sup>ab</sup>: Means on the same row with different superscripts are significantly different (P<0.05), RBC: red blood cell count; TWBC: total white blood cell count.

Results of some haematological indices were also significantly (P<0.05) affected by *E. odoratum* leaf meal. For instance, PCV values were statistically similar in treatment 2 (31.90±0.40%) and treatment 3 (31.70±1.33%), both of which were significantly (P<0.05) higher than treatment 4 (28.80±2.19%). However, the value in treatment 4 did not differ from that of treatment 1 (25.65±0.49%). Hb values were higher in treatment 2 (10.88±0.11 g/dl), treatment 3 (11.63±0.73 g/dl) and treatment 4 (10.05±0.59 g/dl) compared to treatment 1 (9.27±0.32 g/dl). TWBC count was significantly higher in treatment 1 (52.50±6.64x10<sup>3</sup>/μl), treatment 2 (42.25±1.01x10<sup>3</sup>/μl) and treatment 4 (43.00±1.73x10<sup>3</sup>/μl) and highest in treatment 3 (80.75±0.43x10<sup>3</sup>/μl). Monocyte values were higher in treatment 1 (4.50±0.29%), treatment 3 (5.00±1.73%) and highest in treatment 4 (8.00±1.15%). However, lymphocyte, heterophils and eosinophil (%) values did not vary among the treatment groups.

Haematological indices are often used for the diagnosis and treatment of animal diseases. The values (Table 9) obtained in this study were within normal ranges for broilers signifying that there were no symptoms of physiological anemia in the experimental birds (Al-Nedawi, 2018). The haemoglobin and PCV values were higher ( $P < 0.05$ ) in broilers supplemented with 200g *Eupatorium odoratum*. Haemolysis results from acute inflammation from most pathogenic microorganisms which is manifested in lower haemoglobin level and PCV (Osho *et al.*, 2014). Thus, the improved values in birds fed with 200mg *Eupatorium odoratum* could be due to the inability of the organisms to cause haemolysis, resulting from the anti-inflammatory potentials inherent thereof. This improvement could also be associated with a better utilization of feed which facilitates high nutrients absorption that leads to higher haemoglobin concentration and higher percentage of PCV (Ekwe *et al.*, 2017). More so, the results of this study suggests the potential of *Eupatorium odoratum* to act as an immuno-stimulant through the alteration of the occurrences and distribution of the white blood cell counts and the differentials. The neutrophils and lymphocytes percentage could be an indication of improved immune response (Osho *et al.*, 2014). Dhabhar (2000) had stressed that higher lymphocyte and WBC counts are associated with the ability of animals to perform well under a very stressful condition. Furthermore, it means that the implication of the TWBC of birds recording  $80.75 \times 10^3/\mu\text{l}$  in treatment 3 showed a high immunity against infections. The non-significant effect of the leaf meal on the eosinophil count of the birds was an indicator that the anti-nutritional factors present in *Chromolaena odorata* leaf did not affect the blood quality of the birds (Okosun and Oyedeji, 2016). Other reports by Okwesili *et al.* (2021), Machebe *et al.* (2011) and Olabatoke and Oloniruha (2009) shows that antioxidant phytochemicals play a protective role on the lymphocytes and reduce their destruction in the blood.

### **Serum Biochemistry of Broiler Finisher Birds fed Diets Containing *Eupatorium Odoratum* Leaf Meal**

Results of the serum biochemistry of broiler birds on diets supplemented with *Eupatorium odoratum* leaf meal are shown in Table 10.

Table 4: Serum Biochemistry of broiler birds fed diets containing *Eupatorium odoratum* leaf meal.

Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4	p. value
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	(control)	(100mg <i>E.O</i> )	(200mg <i>E.O</i> )	(300mg <i>E.O</i> )	
TP (g/l)	37.11±2.22	38.74±2.17	39.85±2.81	32.10±1.38	0.14 <sup>NS</sup>
ALB (g/l)	26.75±0.04 <sup>b</sup>	28.18±0.09 <sup>a</sup>	27.33±0.29 <sup>b</sup>	26.82±0.41 <sup>b</sup>	0.01 <sup>**</sup>
Uric acid (μmol/l)	231.03±41.16	318.40±23.52	196.19±29.71	187.07±37.45	0.08 <sup>NS</sup>
ALP (Iμ/L)	102.40±5.10 <sup>c</sup>	82.85±9.15 <sup>b</sup>	122.64±3.45 <sup>a</sup>	127.45±2.79 <sup>a</sup>	0.00 <sup>**</sup>
ALT (Iμ/L)	10.09±0.28	9.61±0.15	9.54±0.05	9.87±0.11	0.16 <sup>NS</sup>
AST (Iμ/L)	64.90±13.11	83.74±3.82	88.84±0.56	74.01±11.04	0.29 <sup>NS</sup>
Globulin (g/l)	10.37±2.18	10.56±2.25	12.53±3.10	5.28±1.79	0.24 <sup>NS</sup>

<sup>abc</sup>: Means on the same row with different superscripts are significantly different (P<0.05), ALT: alanine transaminase; AST: aspartate transaminase; ALP: alkaline phosphatase; TP: total protein; ALB: albumin.

Results on serum biochemistry showed that albumin and alkaline phosphate were significantly (P>0.05) affected by *Eupatorium odoratum* supplementation. Albumin values were statistically the same in treatment 1 (26.75±0.04g/l), treatment 3 (27.33±0.29g/l) and treatment 4 (26.82±0.41g/l) but higher than treatment 2 (28.18±0.09g/l). Alkaline phosphatase value was highest in treatments 3 and 4 (122.64±3.45 Iμ/L and 127.45±2.79 Iμ/L, respectively) followed by treatment 1 (102.40±5.10 Iμ/L) and least in treatment 2 (82.85±9.15 Iμ/L).

The aminotransferases, AST, and ALT, are typically inside the liver cells and are released into the blood when liver cells are damaged; increased levels are therefore indicative of liver damage (Okwesili *et al.*, 2021). The findings of this study showed that supplementing *Eupatorium odoratum* leaf meal did not cause liver damage in the broilers. Total protein is a composite of albumin and globulin contents in the blood and are often used in diagnosing diseases and monitoring changes in the health status of farm animals (Oleforuh-Okoleh *et al.*, 2015). Low levels of albumin could be associated with presence of infection. The total protein of finisher birds in various treatments in this study were not influenced by *Eupatorium odoratum* inclusion. Moreover, albumin levels were improved among birds given 100g *Eupatorium odoratum*. Similar results were reported in the findings of Oleforuh-Okoleh *et al.* (2015) who fed *Vernonia amygdalina* leaf

extract. ALP is a group of enzyme that initiates catalytic activity for degeneration of phosphate esters and separation of phosphoric acid molecules (Knits, 2008). Nonetheless, as an enzyme responsible for dephosphorylation of a substrate, it is produced in all types of tissues in the body, but it gets activated in alkaline pH. Therefore, elevated levels of ALP can be mostly seen in liver damages (Senanayake *et al.*, 2015) at higher levels of *E. odoratum* above 200mg and may be attributed to longer duration of feeding (Oni *et al.*, 2020).

### **Carcass Characteristics of Broiler Finisher Birds fed Diets Containing *Eupatorium Odoratum* Leaf Meal**

Table 5: Carcass characteristics of broiler birds fed *Eupatorium odoratum* leaf meal

Parameters	Treatment 1 (control)	Treatment 2 (100mg <i>E.O</i> )	Treatment 3 (200mg <i>E.O</i> )	Treatment 4 (300mg <i>E.O</i> )	p. value
Live weight (g)	2566.01±1.21 <sup>b</sup>	2384.44±1.04 <sup>c</sup>	2577.24±1.50 <sup>a</sup>	2571.34±0.57 <sup>b</sup>	0.00**
De-feathered weight (g)	2053.35±1.47 <sup>b</sup>	1717.47±1.01 <sup>c</sup>	2143.81±1.12 <sup>a</sup>	2049.38±0.57 <sup>b</sup>	0.00**
Dressed weight (g)	1500.59±1.50 <sup>b</sup>	1297.33±1.01 <sup>c</sup>	1582.84±1.02 <sup>a</sup>	1489.73±0.57 <sup>b</sup>	0.00**
Dressing percentage (%)	58.22±0.02 <sup>b</sup>	54.41±0.02 <sup>c</sup>	61.68±0.02 <sup>a</sup>	57.94±0.57 <sup>b</sup>	0.00**
Breast cut (%)	32.93±1.21	32.86±1.04	33.00±1.50	32.95±0.57	1.00 <sup>NS</sup>
Back cut (%)	23.95±1.31	23.30±1.03	23.72±1.05	23.51±0.57	0.98 <sup>NS</sup>
Thigh (%)	16.50±1.23	15.71±1.04	16.60±1.07	16.40±0.57	0.94 <sup>NS</sup>
Drumstick (%)	16.54±1.21	15.59±1.02	16.70±1.50	16.55±0.57	0.89 <sup>NS</sup>
Kidney (%)	0.26±0.06	0.63±0.23	0.49±0.35	0.52±0.11	0.69 <sup>NS</sup>
Heart (%)	0.15±0.02	0.17±0.09	0.16±0.06	0.14±0.11	1.00 <sup>NS</sup>
Spleen (%)	0.06±0.02	0.06±0.03	0.06±0.02	0.06±0.05	1.00 <sup>NS</sup>
Liver (%)	1.46±0.06	1.78±0.09	1.52±0.12	1.50±0.11	0.25 <sup>NS</sup>

<sup>abc</sup>: Means on the same row with different superscripts are significantly different (P<0.05).

The results on carcass characteristics of broiler birds fed *Eupatorium odoratum* leaf meal presented in Table 11 revealed that live weight, de-feathered weight, dressed weight, and dressing percentage were significantly ( $P < 0.05$ ) influenced by the treatment administered. The highest live weight was obtained from the birds on *Eupatorium odoratum* leaf meal supplemented at 200mg while the least weight was obtained from those on 100mg of *Eupatorium odoratum*. The same trend was observed for the de-feathered weight, dressed weight, and dressing %. Results on the relative percentage of breast cut, back cut, thigh, drumstick, kidney, heart, spleen and liver showed no significant ( $P > 0.05$ ) differences among the treatment groups.

Amounts of phyto-constituents in different concentrations and methods of extractions of meal could be suggested to be responsible for the change in the carcass characteristics of broilers (Dotas *et al.*, 2014). Therefore, in relative to this study, most parameters were not significantly ( $P < 0.05$ ) affected by *Eupatorium odoratum* leaf meal diet which could be as a result of levels of inclusion or extraction method used when compared to the literature. The significant differences observed in dressed percentage is similar to the report of Oloruntola *et al.* (2021) but not in agreement with the findings of Olumide and Akintola (2018) who reported similar values in birds of both control and treated groups. The variation in the reports could be attributed to the mode of administration of the *Eupatorium odoratum*. The former researchers used leaf extract while leaf meal was used in this present study. The similarity in the internal organs suggests the support of the extract to the normal functioning of the birds' internal organs. It has been reported by Ayodele *et al.* (2016) that the presence of toxic substances in the diet could lead to an increase or decrease in the relative weight of the birds internal organs. The improved live weight, dressed weight, and dressing percentage recorded in the birds fed *Eupatorium odoratum* leaf meal agreed with the previous reports that supplementation of the broiler chicken diets with phytochemicals improved the carcass weight and dressing percentage (Kanduri *et al.*, 2013; Valenzuela-Grijalva *et al.*, 2017). This proposes that the phyto-genic supplements used in this study have bioactive compounds that can modulate metabolic reactions in the animals' body system in a similar pattern with  $\beta$ -adrenergic agonist compound (Valenzuela-Grijalva *et al.*, 2017). On this note, one could say that *Eupatorium odoratum* could improve the performance and healthy state of broilers thereby standing as a growth promoter possessing both medicinal and nutritional qualities.

## CONCLUSION AND RECOMMENDATION

The results of this study showed that *Eupatorium odoratum* leaf meal had several positive effects on the growth performance (final body weight, weight gain, feed conversion ratio and mortality reduction), haematology (packed cell volume, haemoglobin, white blood cells and monocytes) and carcass characteristics (live weight, de-feathered weight, dressed weight and dressing percentage) of broiler birds. Furthermore, serum biochemical constituent of albumin was also improved by *Eupatorium odoratum* leaf meal and the increment in alkaline phosphate which depicts the extent the body system of the birds reacted in the presence of anti-nutritional factors.

On this note, it is recommended that the use of *Eupatorium odoratum* leaf meal can improve broiler performance better at 200mg/kg diet for an efficient production and supply of animal protein. For the best result to be achieved, farmers are advised to properly process the leaf of *Eupatorium odoratum* properly in order to get rid of the anti-nutrient factors.

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