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ASSESSMENTS OF GROWTH PERFORMANCE, CARCASS TRAITS, BLOOD SERUM QUALITY AND NUTRIENT DIGESTIBILITY OF CHICKENS FED LEMON BASIL LEAF MEAL

By

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Abstract

The global chicken industry is experiencing significant challenges as a result of applying artificial growth promoters (antibiotics) that have led to the emergence of antimicrobial resistance and food safety concerns among consumers. The study provides a critical evaluation of the effect of dietary supplementation of lemon basil (*Ocimum basilicum*) leaf on the performance of broiler chickens. A total of one hundred and eighty day-old broiler chicks were randomly divided into five treatment groups with three replicas each. The treatments were a control (0 g lemon basil per kg of feed) but received antibiotic medication and four supplemented treatments that were receiving 5, 10, 15 or 20 g of ground air-dried lemon basil leaf per kg of feed. The weekly growth performance was monitored, and the carcass characteristics, biochemical parameters, and nutrient digestibility at the end of the trial. The results showed that moderate supplementation (5 g/kg) was significantly ($p < 0.05$) effective in improving the feed ratio (1.78), dressing percentage (77.54%), and breast muscle yield (27.23). But, an increase in the inclusion levels (1520 g/kg) had negative impacts on the final body weight and FCR. According to serum biochemistry, supplementation of 5 g and 20 g increased levels of albumin, but alkaline phosphatase (ALP) activity at 10 g and 20 g, which is indicative of better protein metabolism and bone formation. The nutrient digestibility analysis showed that the inclusion of 20 g of nutrient significantly improved the crude protein digestibility (13.98%), relative to the control (12.39%). The study comes to the conclusion that lemon basil is a safe and effective phytogenic feed supplement in broilers and that a recommended inclusion rate of 5 g/kg of feed will yield the highest amount of growth and carcass traits, whereas a higher rate of 20 g /kg will yield the highest amount of protein utilization.

KEYWORDS: chickens, additives, leaf, powder, nutrient

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INTRODUCTION

The poultry sector in the world can be viewed as a very fundamental source of high quality animal protein, which meets the nutritional needs of the growing population. In a bid to increase productivity and health maintenance, the industry has long relied on antibiotics as growth promoters (AGPs) (Dibner and Richards, 2005; Ogle, 2013). However, the widespread and even sub-therapeutic use of antibiotics has created significant challenges in the health of the population, with the first being the emergence of antibiotic-resistant

strains and the second being the detection of drug traces in poultry products (Ayaz *et al.*, 2019; Mostafa *et al.*, 2023).

These issues have led to regulatory prohibitions on AGPs in many countries and heightened consumer interest in alternative poultry containing no antibiotics, which has led to the need to find safe, effective, and sustainable alternatives (Abd El-Ghany, 2020; Alloui *et al.*, 2014). Phytogenic feed additives (PFAs) which are products of herbs, spices and other vegetation have become of significant interest in this regard. PFAs are rich in bioactive compounds, such as essential oils, flavonoids, tannins, and saponins, which possess antimicrobial, antioxidant, anti-inflammatory, and

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immunomodulatory activity (Valenzuela-Grijalva *et al.*, 2017; Windisch *et al.*, 2008). It is possible that these properties can increase the usefulness of nutrients, gut health, and eventually increase the growth performance and welfare of livestock (Gadde *et al.*, 2018; Kikusato, 2021).

The search of natural substitutes is particularly topical in the areas where feed costs take a significant part of the overall production costs and the access to conventional veterinary drugs might be limited (Anosike *et al.*, 2020). Akinlade *et al.* (2021) highlighted the perspectives of locally available herbs in enhancing livestock health and performance and the necessity to incorporate them in production systems that are sustainable. Lemon basil (*Ocimum basilicum*) is one of the culinary herbs that belong to the *Lamiaceae* family and is known to have a characteristic aroma and flavor. In addition to cooking uses, it is rich in phytochemicals, such as linalool and citral as essential oils and rosmarinic acid as phenolics (Avetisyan *et al.*, 2017; Taie *et al.*, 2010). The compounds are known to have antioxidant and antimicrobial properties, which means that they have a future as a phyto-genic feed additive. Despite the fact that there are studies that have looked at the impact of basil on poultry, no extensive research has been conducted to establish the impact of basil on a wide range of parameters of production, including growth, carcass traits, physiological health indicators, and nutrient utilization, in a single, integrated study. Thus, this research paper will set out to offer a comprehensive evaluation of lemon basil (*Ocimum basilicum*) leaf as a nutritional supplement to broiler chicken. In particular, it analyzes the impact of graded levels of supplementation on growth performance, car-cass quality, serum biochemical indices (as health and metabolism indicators) and nutrient digestibility. The outcomes are bound to determine the effectiveness and safety of this locally accessible herb as a natural and sustainable substitute to synthetic expansion promoters in poultry dieting.

THEORETICAL UNDERPINNING

This experiment can be categorised under the following theories;

1. Antimicrobial Resistance Theory
2. Phyto-genic Theory
3. Digestive Physiology and Feed Efficiency Theory

Antimicrobial Resistance Theory

Theory of Antimicrobial Resistance suggests that excessive use of antibiotics results in selection of resistant bacteria, which may transmit resistance genes to humans and animals, and thereby reduces efficacy of clinical treatment (Ayaz *et al.*, 2019; Mostafa *et al.*, 2023).

Phyto-genic Theory

Thus Theory suggests that lemon basil acts as an antimicrobial, antioxidant, anti-inflammatory, and immunomodulatory substance owing to disruption of membrane integrity of bacteria, elimination of free radicals, suppression of pro-inflammatory cytokines, and facilitation of digestive enzyme secretion (Windisch *et al.*, 2008; Valenzuela-Grijalva *et al.*, 2017).

Digestive Physiology and Feed Efficiency Theory

Diet formulation, intestinal integrity, as well as presence of anti-nutritive and bioactive substances may affect feed digestion (Al-Kassie, 2010). Feed additives, like lemon basil, may contribute to enhanced nutrient digestibility.

MATERIALS AND METHODS

Experimental Location: The experiment was conducted in the Poultry Unit of the School of Agriculture Farms, The Federal Polytechnic Ilaro, Ogun State, Nigeria. It is located in the South-Western part of Nigeria with an elevation of 14 m above the sea level (latitude 6.895550 ° N, longitude 2.977167 ° E).

Preparation and Preparation of Lemon Basil

New leaves of lemon basil (*Ocimum basilicum citriodorum*) were collected in plants of the species that were of the age of maturity and were growing in the area of The Federal Polytechnic Ilaro. The leaves were dried by air over 21 days and ground to fine powder in disc mill and stored in plastic jar till use.

Management and Experimental Animals

One hundred and eighty day old broiler chicks (Cobb 500) were acquired in a reputable hatchery. The brooder house was disinfected and cleaned and wood shavings were given as a bedding material. The daily records of temperature and humidity were made. The chicks were brooded in one week and fed ad libitum on commercial broiler feed and water. Regular vaccinations and drug treatment were used.

Experimental Design and Diets

It was an 8-week experiment using a totally randomized design. The 180 birds were randomly assigned to 5 treatment groups with 3 replicas of 12 birds in each replica. The feeds were characterized by the presence of powdered lemon basil: T1 (Control): 0 g lemon basil / kg feed (Enrofloxacin). T2: 5 g lemon basil / kg feed. T3: 10 g lemon basil / kg feed. T4: 15 g lemon basil / kg diet. T5: 20 g lemon basil / kg feed.

Data Collection

Growth Performance

Feed consumption was assessed at the weekly level and feed ratio (FCR) was calculated. The initial weight was measured and followed up every week to find out the weight gain and the daily weight gain.

Carcass Evaluation

At the end of the 8-week trial, two birds in each replicate were randomly selected, fasted 12 hours and subsequently slaughtered. The birds were drained, skinned by hand and gutted. To ascertain dressing percentage and relative yields, weights of the eviscerated carcass, breast, thighs, and drumsticks, wings, back, neck, and internal organs (liver, heart and gizzard) were taken.

Serum Biochemistry

The sampled blood during the starter phase (4 weeks) and at the end of the finisher phase (8 weeks) was collected using the wing vein in two birds per replicate during slaughter. Serum tubes were filled with blood, which was left to clot and

centrifuged to obtain serum. The serum was also subjected to total protein (TP), albumin (ALB), globulin (GLOB), aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), creatinine (CREA), and corticosterone (CORT) by using a biochemical analyzer (Roche Cobas) by a

Nutrient Digestibility

After 2 weeks before the trial was terminated (when birds were 6 weeks old), two birds in each replicate were put in metabolic cages. Feed intake and the overall fecal output was measured after 5 days of consecutive days following a 3-day acclimation period. Fecal samples were dried at 85C until they reached a constant weight and thereafter ground and subjected to proximate composition and one of the experimental feeds. The apparent nutrient digestibility was determined by the following formula

$$[(\text{Nutrient in feed} - \text{Nutrient in feces}) / \text{Nutrient in feed}] \times 100$$

Statistical Analysis

The analysis of data was performed with the help of one-way Analysis of Variance (ANOVA) by the computer program SPSS (version 10.0). The Multiple Range Test (DMRT) was used to compare treatment means at the level of $p < 0.05$.

RESULTS AND DISCUSSION

RESULTS

Growth Performance

Table 1 demonstrates the effect of lemon basil supplementation on the growth performance. The treatments had significant impact on final body weight, weight gain, and daily weight gain ($p < 0.05$). T1 (control group) recorded the highest final weight (2189.66 g) whereas T5 (lowest weight) was 1659.37 g. It is important to note that feed intake was highest in T5 (4129 g), but this group had the lowest growth performance and higher FCR (2.66). The best FCR was observed in T2 (1.78), which was significantly better than that of the control group (1.84)

Table 1: Effect of dietary lemon basil on growth performance of broiler chickens

Parameters	T1 (0 g)	T2 (5 g)	T3 (10 g)	T4 (15 g)	T5 (20 g)	SEM	P-value
Initial weight (g)	107.00	107.00	106.00	105.66	107.13	0.65	0.95
Final weight (g)	2189.66 ^a	2100.83 ^b	1941.83 ^c	1853.16 ^d	1659.37 ^e	50.40	0.00
Weight gain (g)	2082.66 ^a	1993.83 ^b	1835.83 ^c	1729.50 ^d	1552.25 ^e	50.37	0.00
Daily weight gain (g/b/d)	49.58 ^a	47.47 ^a	43.71 ^b	41.17 ^c	36.95 ^d	1.19	0.00
Daily feed intake (g/b/d)	91.14 ^b	84.73 ^e	85.75 ^d	86.69 ^c	98.31 ^a	1.34	0.00
FCR	1.84 ^d	1.78 ^e	1.96 ^c	2.11 ^b	2.66 ^a	0.08	0.00

a-e Means within a row with different superscripts differ significantly ($p < 0.05$).

Carcass Characteristics

Table 2 shows the effects of the different treatments on carcass traits. The percentage of dressing was greatly ($p < 0.05$) improved in T2 (77.54) compared to the control group (60.97). Breast muscle yield also showed a similar trend where it was the highest in T2 (27.23%). Despite a decrease in liver weight in supplemented groups (T2–T4), which points to a potential hepatoprotective effect, kidney and thymus weight gain in some of the groups, which points to immunomodulatory activity.

Table 2: Effect of dietary lemon basil on carcass quality of broiler chickens

Parameters	T1 (0 g)	T2 (5 g)	T3 (10 g)	T4 (15 g)	T5 (20 g)	SEM	P-value
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Parameters	T1 (0 g)	T2 (5 g)	T3 (10 g)	T4 (15 g)	T5 (20 g)	SEM	P-value
Live weight (g)	2247.00 ^a	2106.00 ^b	1995.00 ^c	1752.00 ^d	1610.50 ^e	62.48	0.00
Dressing (%)	60.97 ^c	77.54 ^a	66.72 ^b	68.93 ^b	74.61 ^a	1.93	0.02
Breast (%)	23.14 ^b	27.23 ^a	25.45 ^{ab}	26.17 ^{ab}	22.10 ^b	0.61	0.01
Drum sticks (%)	9.75	9.66	10.30	9.55	10.41	0.14	0.20
Thighs (%)	10.12	10.68	10.07	10.36	10.66	0.22	0.90
Wings (%)	8.61 ^a	6.99 ^b	6.89 ^b	7.70 ^{ab}	8.37 ^a	0.23	0.02
Back (%)	12.55 ^b	12.08 ^b	11.48 ^b	12.44 ^b	14.37 ^a	0.32	0.02
Neck (%)	3.05 ^{ab}	3.64 ^a	3.03 ^{ab}	2.99 ^{ab}	2.72 ^b	0.10	0.04
Head (%)	2.29 ^a	1.61 ^b	1.68 ^b	2.40 ^a	2.48 ^a	0.11	0.00
Heart (%)	0.40	0.47	0.45	0.43	0.49	0.01	0.36
Liver (%)	2.43 ^a	2.02 ^b	1.96 ^b	1.80 ^b	2.36 ^a	0.07	0.00
Lungs (%)	0.56 ^a	0.38 ^b	0.45 ^{ab}	0.40 ^b	0.44 ^{ab}	0.02	0.03
Kidney (%)	0.13 ^b	0.24 ^{ab}	0.15 ^b	0.17 ^b	0.37 ^a	0.03	0.01
Gizzard (%)	1.89	2.02	1.96	2.31	2.41	0.11	0.48
Pancreas (%)	0.27	0.17	0.18	0.14	0.25	0.02	0.12
Duodenum (%)	1.02 ^a	0.74 ^b	0.85 ^{ab}	0.60 ^b	1.18 ^a	0.06	0.00
Jejunum (%)	1.80 ^a	1.14 ^b	1.33 ^b	1.03 ^b	2.21 ^a	0.12	0.00
Ileum (%)	2.18 ^a	1.83 ^{ab}	1.80 ^{ab}	1.54 ^b	1.64 ^b	0.07	0.03
Ceacum (%)	1.02 ^a	0.69 ^b	1.03 ^a	1.06 ^a	0.59 ^b	0.06	0.00
Proventriculus (%)	0.49 ^{ab}	0.40 ^b	0.58 ^a	0.43 ^{ab}	0.63 ^a	0.03	0.00

Serum Biochemistry

The serum biochemistry results of the starter phase are found in Table 3. Albumin levels were significantly ($p < 0.05$) elevated in T2 (2.65 U/L) and T5 (2.95 U/L) compared to the control (2.10 U/L). The level of alkaline phosphatase (ALP) also increased significantly in T3 (42.50 U/L) and T5 (45.00 U/L) compared to the control. Other parameters (total protein, globulin, AST, ALT, creatinine, corticosterone) did not show any significant difference.

Table 3: Effect of dietary lemon basil on serum biochemistry of broiler chickens

Parameters	T1 (0 g)	T2 (5 g)	T3 (10 g)	T4 (15 g)	T5 (20 g)	SEM	P-value
TP (g/dl)	5.15	3.85	3.60	6.35	4.60	0.362	0.085
Albumin (U/L)	2.10 ^b	2.65 ^a	2.15 ^b	2.55 ^{ab}	2.95 ^a	0.986	0.005
Globulin (mg/dl)	3.05	1.25	1.40	3.80	1.65	0.380	0.103
AST (U/L)	118.00	92.05	117.50	120.50	120.50	4.204	0.129
ALT (U/L)	32.00	33.50	30.50	27.00	31.00	0.767	0.100
ALP (U/L)	33.50 ^b	25.05 ^b	42.50 ^a	34.50 ^b	45.00 ^a	2.451	0.042
Creatinine (mg/dl)	1.62	1.12	0.42	1.22	0.36	0.209	0.262
Corticosterone (mg/dl)	1.75	2.47	3.37	2.67	2.57	0.207	0.177

Nutrient Digestibility

Table 5 illustrates the effect of lemon basil on the digestibility of nutrients. Crude protein (CP) digestibility and nitrogen-free extract (NFE) were greatly influenced by the addition of the extract. T1, T3, T4, and T5 had a higher ($p < 0.05$) CP digestibility than T2, with T5 having the highest value (13.98%). The values of NFE were best under T2 and T3 but dropped at elevated levels of inclusion.

Table 4: Effect of aqueous lemon basil extract on nutrient digestibility in broiler chickens

Parameters	T1 (0 g)	T2 (5 g)	T3 (10 g)	T4 (15 g)	T5 (20 g)	SEM	P-value
Moisture (%)	8.45	8.42	7.96	8.12	7.98	0.23	0.95
Fat (%)	5.59	6.46	4.15	3.99	5.23	0.33	0.06
Ash (%)	1.85	1.72	1.96	1.85	2.01	0.22	0.99
Fiber (%)	2.98	4.19	3.62	4.95	2.89	0.30	0.13
Crude Protein (%)	12.39 ^a	7.71 ^b	12.29 ^a	13.05 ^a	13.98 ^a	0.62	0.00

Parameters	T1 (0 g)	T2 (5 g)	T3 (10 g)	T4 (15 g)	T5 (20 g)	SEM	P-value
NFE (%)	68.74 ^b	71.49 ^a	70.02 ^{ab}	68.04 ^b	67.90 ^b	0.42	0.00

DISCUSSION

The findings of this study show that dietary supplementation with lemon basil (*Ocimum basilicum*) has extensive, dose-dependent effects on the performance and health of broiler chickens. The fact that there was an improved ratio of feed intake in the T2 group (5 g inclusion) means that moderate levels of this phyto-genic supplement can positively influence nutrient intake. This result is consistent with the previous studies that have indicated the beneficial effects of phytobiotics on feed efficiency due to their ability to promote secretions in the gut and balance of the gut microbiota (Cross *et al.*, 2007; Abd El-Hack *et al.*, 2018). The drop in performance at increased levels of inclusion (T4 and T5), characterized by less weight gain and worse FCR despite the increased feed intake, is an indication of a possible threshold effect. This can be due to anti-nutritional agents like tannins or high levels of essential oils which at high levels may become inedible or may cause interference with nutrient intake (Hernandez *et al.*, 2004). This explanation can also be further supported by the decrease in the water consumption at higher inclusion rates which can point to palatability problems. The positive effect on carcass quality, especially the significant rise in dressing percentage and breast yield in T2 group are expected outcomes of the increased FCR. These findings are in line with the research evidence that shows that phyto-genic additives have a potential to increase muscle deposition (Al-Kassie, 2010). The alterations in the internal organs observed (reduced liver weights in moderate supplemented samples (T2) and (T3) and (T4) could indicate the presence of a hepatoprotective effect, which could be attributed to the antioxidant property of phenolic compounds found in basil (Fathi *et al.*, 2022; Onibi *et al.*, 2017). The boost of the thymus weight, which is one of the organs of the immune system, in the T2-T4 groups suggests an immunomodulatory effect, which is a proven advantage of most phyto-genics (Jahejo *et al.*, 2019). The dramatic differences in intestinal loops (duodenum, jejunum, ileum, cecum) indicate that lemon basil affects gut morphology, and this effect might be one of the mechanisms of the enhanced nutrient absorption. This is also the same case with Akinlade *et al.* (2025), who observed that the inclusion of herbal additives in poultry diets would help increase gut health and nutrient absorption, leading to improved overall performance. The biochemistry analysis of the serum provides additional information on the physiological and safety outcomes of the supplement. The growth of the albumin concentration in the moderate and high supplementation rates can be called a positive indicator of the process of enhanced protein synthesis, possibly as a result of the improved liver functioning and the usage of amino acids. Likewise, the increase in the alkaline phosphatase (ALP) activity is not a sign of toxicity but can be a symptom of bone mineralization

and metabolic activity since ALP is one of the enzymes in the process of bone formation (Lawal *et al.*, 2023). Notably, the lack of liver (AST, ALT) and kidney (creatinine) enzyme increase in all treatments proves the idea that lemon basil supplementation, including the highest dosage of 20 g/kg, does not induce hepatotoxicity and nephrotoxicity in broiler chickens. The discovery is critical in justifying the safety of such herb as a feed additive and in line with the findings of Akinlade *et al.* (2025), who observed the safety of such herbal supplements when taken at the correct doses. The white blood cell count was the only meaningful difference during the finisher phase and was in the normal range, which again reinforced the safety and immune-modulating potential of the additive. The results of nutrient digestibility support the performance and blood data. The much greater crude protein digestibility in T5 group indicates that increased doses of the aqueous extract have the ability to stimulate protein digestion, which did not result in better growth performance during finisher phase. This difference could be explained by the energy expenditure of metabolizing the increased protein load or the palatability problems mentioned above. The enhanced nitrogen free extract (NFE) digestibility of T2 and T3 shows enhanced carbohydrate utilisation at moderate doses. This general increase in the nutrient use is probably the basis of the growth, FCR and carcass yield improvements.

IMPLICATION TO RESEARCH AND PRACTICE

This work fortified commercial broiler diet with phyto-genic leaf meal and evaluated its effects on performance, gut health and nutrient utilization of the chickens for sustainable livestock production.

CONCLUSION

This paper confirms that lemon basil (*Ocimum basilicum*) leaf is a safe and effective phyto-genic feed additive to broiler chickens. Moderate levels of supplementation (5 g/kg of feed) has a strong effect on increasing feed conversion efficiency and higher dressing percentage and breast muscle yield. Protein digestibility can be improved at higher levels of inclusion (20 g/kg). The supplement has no negative influence on liver or kidney functioning, which is proved by the serum biochemistry, and it might have immunomodulatory effects. The results endorse the application of lemon basil as a natural substitute to antibiotic growth promoters.

FUTURE RESEARCH

Characterization and isolation of lemon basil (*Ocimum basilicum*) specific bioactive compounds is required for standardization in poultry production.

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