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Scent leaf (*Ocimum gratissimum*) meal improved the growth performance and lowered blood cholesterol level of cockerels

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Abstract
This study was conducted to evaluate the effect of scent leaf meal on the growth performance, blood and serum parameters of growing cockerels. A total of ninety-six (96) Isa-brown day-old cockerel chicks were used in a completely randomized design experiment. The birds were randomly allotted to four dietary treatments consisting of basal diets supplemented with scent leaf meal (SLM) at the rate of 0% (control), 1%, 2% and 3% representing T_1, T_2, T_3 and T_4 respectively. The experiment lasted for 15 weeks, including one week acclimatization period. Results showed that scent leaf meal improved feed intake only during the grower phase, but significantly improved body weight, FCR and PI at both chick and grower phases. Treatment had no effect on hematologic parameters, but significantly reduced serum cholesterol levels in a dose-dependent manner. Other serum parameters were not affected by SLM treatment. Overall, including of SLM in the diets of cockerels significantly improved growth performance of the birds, and dose-dependently reduced the blood cholesterol level without any deleterious effect on blood and serum parameters.

Keywords: Blood parameters, cockerels, feed conversion ratio, performance, scent leaf, serum

1. Introduction

Poultry production is one of the major contributors to the growth of agricultural GDP in Nigeria with the sector estimated at over ₦80 billion and holding up to 165 million birds as at 2013 (USDA, 2013; Oyediji, 2015) [21, 19]. This is in addition to the role of poultry products in meeting the protein needs of the populace. In the poultry industry, cocks are important for egg fertilization, and are also a good source of poultry meat which is most preferred to other breeds because of its good taste. The development of the sector is, however constrained by many factors including disease, the outbreak of which sometimes causes serious setbacks in the enterprise. Over the years, synthetic antibiotics have been the mainstay of the industry, and have been very helpful in controlling infections and promoting growth of birds. However, the resistance of microbial pathogens to the antibiotics as a result of continuous usage, recently called for a global attention and a search for alternatives. Of greater concern is the trend in antimicrobial resistance of human pathogens to the synthetic drugs arising from residual effects of consuming products from birds raised on synthetic antibiotics. Consequently, various non-synthetic substances, including enzymes, inorganic acids and herbs have been explored for their medicinal properties (Adams, 2005) [2].

Scent leaf, which is widely grown as a perennial herb in tropical Africa, and rich in phytochemicals such as alkaloids, tannins, phytates, flavonoids, oligosaccharides, thymol and saponin, has been studied for its antimicrobial and antioxidant properties. For instance, Ogunleye (2019) [17] reported the efficacy of scent leaf in improving feed utilization and reducing mortality due to coccidiosis in broilers. Odoemelam *et al*. (2018) [15] similarly compared the effects of scent leaf meal and synthetic antibiotics on the performance of broiler finisher birds, and concluded that scent leaf meal can effectively replace synthetic antibiotics since the effects are similar. Olumide *et al*. (2018) [18] further observed that scent leaf meal fed to broilers at 400g/100kg improved the livability of the birds. There is, however, limited information on the effect of the herb on productive performance and hematologic parameters of cockerels.

Cocks play a significant role of egg fertilization in poultry production and thus efforts to improve their production performance cannot be over emphasized. This study aimed at evaluating the effect of scent leaf meal on the growth performance and blood parameters of growing cockerels.

2. Materials and Methods
2.1 Experimental site
The experiment was conducted in the livestock section of the Kabba College of Agriculture, Kabba, Kogi State, Nigeria. Kabba is located in the Southern guinea savannah ecological zone of Nigeria, between latitude 07º5ºN and longitude 6º08ºE of the equator with an elevation of 424 m above the sea level. The mean annual rainfall is about 1100 mm per annum with an annual temperature range of 18-32 ºC.

2.2 Test material and management of experimental birds
To obtain the scent leaf meal used for the experiment, fresh scent leaf (*Ocimum gratissimum*) leaves were harvested from the horticultural unit of the College. The leaves were cleaned, air-dried at 25 ºC and ground into powder with a hammer mill. The proximate and phytochemical compositions of the scent leaf are shown in Table 1 below.

Table 1: Proximate and phytochemical constituents of scent leaf (*Ocimum gratissimum*).

Parameter	Concentration (%)
Proximate composition	
Crude protein	15.55
Crude fat	3.57
Crude fibre	8.34
Total ash	11.5
Carbohydrate	54.32
Moisture	19.63
Phytochemical constituents	
Alkaloid	6.81
Saponin	9.87
Flavonoid	16.75
Phenol	8.97
Tannin	5.47

A total of ninety-six (96) Isa-brown day-old cockerel chicks were used for the experiment. The chicks, which were housed in deep litter pens, were provided with adequate lighting, as well as feed and water ad *libitum*. The housing and management of experimental birds were in accordance with the guidelines of Ahmadu Bello University on animal research. The birds were randomly allotted to four treatments in a completely randomized design experiment. The treatments were scent leaf meal (SLM) added to commercial feed (Vital®) as basal diet at the rate of 0%, 1%, 2% and 3%, representing T_1, T_2, T_3 and T_4 respectively. The birds were fed chick mash from day one to 8 weeks, and later fed grower mash from 8 - 15 weeks of age. Each treatment was replicated four times, with six birds in a pen as one replicate. The experiment lasted for 15 weeks, including one week acclimatization period.

2.3 Data collection
The initial body weights of the chicks were recorded on day 8, after which it was recorded weekly whereas feed intake was recorded daily. Daily feed intake was, however aggregated weekly for data analysis. Feed conversion ratio was calculated as the ratio of feed intake to body weight gain. Performance index (PI) of the birds was calculated as follows (North, 1984) [10]:

$$PI = \frac{\text{Live body weight (kg) x 100}}{\text{FCR}}$$

Where, PI = performance index; FCR = feed conversion ratio
Performance parameters were measured for both the chick and the grower phases, whereas serum and haematological assessment were done at the end of the experiment. At the 15th week, blood samples were collected from 3 randomly selected birds per replicate in each treatment group (12 birds/per treatment), via the brachial vein, into heparinized bottles for haematological assessment; and non-heparinized bottles for serum evaluation. The samples were immediately transported in insulated boxes to the laboratory for analysis. The serum separation was done using standard protocols (Elliot *et al*., 2008) [7] and the obtained serum sample was stored at -20ºC for biochemical assays. All blood and serum analyses were done at the Department of Animal Production and Health, Federal University of Technology, Akure. The packed cell volume (PCV) was measured using a Hematocrit reader, whereas total leucocyte counts, erythrocyte and haemoglobin concentrations were measured with automated cell counter. The mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated using the formula of Jain (1986) [8] as follows:

MCV (fL) = 10 x PCV (%)/RBC counts (millions/µl)

MCH (pg/cell) = haemoglobin (g/100 ml)/RBC counts (millions/µl).

MCHC (g/dl) = haemoglobin (g/100 ml) x 100/PCV (%).

Serum parameters such as aspartate transaminase, alanine transaminase, alkaline phosphatase, total protein, albumin, triglyceride, cholesterol and creatine were measured using standard kits and automatic analyzer (Humalyzer300, Merck®, Germany). All tests were performed according to manufacturer's instructions. Globulin was obtained by calculating the difference between total protein and albumin.

2.4 Statistical analysis
Performance data were subjected to repeated measures ANOVA whereas blood and serum parameters were analysed in single factor ANOVA using SAS software (SAS, 2001) [20] as shown in the following models:

$$y_{ijk} = \mu + t_i + p_k + (t*p)_{ik} + \epsilon_{ijk}$$

Where, y_{ijk} = observation ijk; μ = overall mean, t_i= the effect of treatment i, p_k= effect of period k, $(t*p)_{ik}$= the effect of interaction between treatment i and period k, ϵ_{ijk}= random error with mean 0 and variance, σ_ϵ^2,the variance between measurements within pens.

$$Yij = \mu + \alpha i + Eij$$

Where, *Yij* = observed response; μ = overall mean; αi = treatment effect; *Eij* = random error
Treatment differences were considered significant at $P < 0.05$. Tukey's procedure was used to separate treatment mean difference of each response variable.

3. Results and Discussion

3.1 Effect of SLM on growth performance of experimental birds

Effect of scent leaf meal on the production performance of cockerel chicks is shown in Table 2. Birds in the control group, and those treated with 1% scent leaf meal (SLM) had the highest feed consumption rate during weeks 2, 3 and 4 but dropped below birds treated with 2% and 3% SLM in week 5. The feed consumption of the birds, however improved steadily between weeks 5 and 6 of the experiment. The birds treated with 2% and 3% SLM had a near steady improvement in feed consumption from 2nd to 6th week of the experiment. Overall, birds treated with 1% SLM had the highest cumulative feed consumption per bird during the chick phase, although this was not significant. However, during 8 to 15 weeks of age (grower phase), feed consumption increased linearly, thou non-significantly, as the level of SLM in the diet increased (Table 3). Reduced feed intake of chicks fed high SLM-supplemented diets may therefore have resulted from the reduced acceptability of the feed perhaps due to the presence of antinutritonal factors such as saponin (9.8%) in SLM. As the birds grow, their ability to handle such factors may have increased, hence the improvement in feed intake during the grower phase.

The result of this study is in agreement with the observation of Nweze and Ekwe (2012) [12] who reported significant differences in feed intake of broiler finisher birds drenched with scent leaf water extract. Nworgu (2016) [13] and Ogunleye (2019) [17] similarly reported progressive reduction in total feed intake of pullet chicks and broilers respectively as the level of SLM increased in their diet. In contradiction, however, Odoemelam *et al*. (2013) [14] observed no significant difference in the feed intake of broilers fed scent leaf-supplemented diets. Adebayo *et al*. (2019) [3] also noted no effect of scent leaf fed at the rate of 10 mg/kg, on feed intake of West African dwarf goats. The difference in observations could be due to variations in feed quality, form of test material used or age/specie of experimental subjects.

Birds fed SLM-supplemented diets had significantly higher body weights, better efficiency of feed utilization and improved performance index than birds in the control group both at the chick and grower phases (Tables 2 and 3). Furthermore, the improvements in performance parameters were dietary SLM dose-dependent, increasing as the SLM in the diets increased particularly during the chick phase. The phytochemical properties and the mineral composition of SLM may have been responsible for the enhanced feed utilization and improved performance of the birds. For instance, saponins, which is abundant in the SLM used in the current study, are natural products that have been used to improve the penetration of micromolecules such as proteins through cell membranes (Alexander, 2016) [4]. Furthermore, alkaloids and saponins have antibiotic potentials that may have acted as growth promoters and thus could be responsible for the improvement in growth performance observed in this study. Anugom and Ofongo (2019) [6] similarly noted enhanced final live weight, weight gain and FCR of broiler chickens administered aqueous extract of scent leaf. In catfish, scent leaf meal fed in the diet at the rate of 12g/kg also enhanced performance and feed utilization (Abdel-Tawwab *et al*., 2018) [1].

Table 2: Effect of SLM-supplemented diet on performance of cockerel chicks.

Parameter	Treatment (% SLM)				
	0	1	2	3	SEM
Average feed consumption/bird (g)	1946	1952	1862	1932	69.47
Average body weight/bird (g)	372.2^{b}	450.0^{ab}	466.6^{a}	500^{a}	17.5
FCR	5.95^{a}	4.34^{ab}	3.99^{ab}	3.86^{b}	0.18
Performance Index	5.50^{c}	10.37^{b}	11.69^{ab}	12.94^{a}	11.17

^{abc}Means within same row bearing different superscripts are significantly different at p≤0.05;
FCR = feed conversion ratio; SLM = scent leaf meal.

Table 3: Effect of SLM-supplemented diet on performance of cockerel growers

Parameter	Treatment (% SLM)				
	0	1	2	3	SEM
Average feed consumption (g)	4136.3	4622.8	4772.6	4848.9	76.5
Average body weight (g)	1200.0^{b}	1583.0^{a}	1533.5^{a}	1666.6^{a}	49.43
FCR	3.45^{a}	2.92^{b}	3.11^{ab}	2.91^{b}	0.17
Performance Index	24.27^{b}	37.09^{a}	33.72^{ab}	37.80^{a}	214.5

^{ab}Means within same row bearing different superscripts are significantly different at p≤0.05;
FCR = feed conversion ratio; SLM = scent leaf meal.

Ogbu and Amafuele (2015) [16] reported better performance of broiler chicks fed scent leaf whereas Nte *et al*. (2016) [11] noted improved FCR in broiler chicks administered aqueous extract of scent leaf at the rate 100ml/L. Odoemelam *et al*. (2013) [14] and Adebayo *et al*. (2019) [3] however, did not observe any difference in weight gain of broilers and West African dwarf goats fed SLM-supplemented diets respectively.

The fact that the latter authors did not observe any difference in feed intake as aforementioned could be the reason for lack of difference in weight gain of the experimental animals.

3.2 Effect of SLM on hematological parameters of experimental birds

Hematological and biochemical indices are significant indicators of the health and nutritional status of an animal. Effects of dietary SLM on haematological parameters of cockerels are shown in Table 4. Except for the mean corpuscular haemoglobin (MCH), no significant effect of treatment was observed on the blood characteristics of treated birds. The MCH and MCV of birds fed SLM-supplemented diets were higher than the control in a non-linear manner, although the mean differences in the latter were not significant. In addition, other blood parameters such as PCV, RBC and WBC of SLM-treated birds were non-significantly lower than the control although they were all within the normal range for chickens. This observation agrees with the reports of Ogbu and Amafuele (2015) [16] and Ndubuisi-Ogbonna *et al*. (2016) [9] who also did not observe any significant effect of scent leaf on blood parameters of broilers. Contrariwise, Olumide *et al*. (2018) [18] noted a steady improvement in percentage packed cell volume, red blood cells, white blood cells and haemoglobin when broiler diets were supplemented with scent leaf at 100, 200, 300 or 400 g/100kg feed. The difference in the results obtained could be due to the level of inclusion of SLM in the diets. The high inclusion rate of SLM in the current study may probably have slightly suppressed the activity of the haemopoeitic system as evidenced by the increased level of MCH and MCV, which are common signs of macrocytic anemia. Scent leaf possesses antibacterial properties, and some antibiotics are known to suppress the activity of the haemopoeitic system leading to a drop in haematological parameters (Al-Mayah *et al*., 2005; Odoemelam *et al*., 2018) [5, 15].

Table 4: Effect of SLM-supplemented diet on haematological characteristics of cockerel growers

Parameters	Treatment (% SLM)				SEM
	0	1	2	3	
Packed Cell Volume (%)	26.5	25	24.5	25.5	0.63
Red blood cells ($mm^3 x10^6$)	2.04	1.67	1.51	1.65	1.25
Haemoglobin (g/dl)	8.8	8.3	8.2	8.5	0.07
MCV (fl)	131	151	163	155	9.67
MCH (pg/cell)	20.12^b	50.0^a	54.0^a	51.25^a	12.36
MCHC (g/dl)	33.23	33.21	33.26	33.14	1.04
White Blood Cells ($mm^3 x10^3$)	13.0	13.5	14.0	13.5	1.5
Lymphocytes (%)	56	55	56	57	0.95
Monocytes	1.2	1.3	1.25	1.15	1.66
Neutrophils (%)	29	29	29	28.5	1.89
Eosinophils (%)	1	0.5	0.5	1	0.04

^{ab}Means within same row bearing different superscripts are significantly different at $p \leq 0.05$;
MCV = mean corpuscular volume; MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration.

3.3 Effect of SLM on the biochemical parameters of experimental birds

Furthermore, SLM significantly reduced the blood cholesterol level of treated birds in a dose-dependent manner (Table 5) although treatment had no significant effect on other serum parameters. The reduced cholesterol level observed in the current study accords with the report of Olumide *et al*. (2018) [18]. Nte *et al*. (2016) [11] similarly reported significant reduction in abdominal fat of broiler chicks when an aqueous extract of scent leaf was added to their drinking water. Nworgu (2016) [13] indeed suggested that scent leaf could be a potent hypolipidaemic agent. The results of this study, therefore indicate that scent leaf is not likely to contribute to any disease associated with hyperlipidemia in chickens. Overall, the addition of scent leaf meal to the diet of growing cockerels did not have any deleterious effect on the haematologic and serum parameters of the birds.

Table 5: Effect of SLM-supplemented diet on serum characteristics of cockerel growers

Parameter	Treatment (% SLM)				
	0	**1**	**2**	**3**	**SEM**
AST (u/l)	123.69	132.23	127.61	151.52	27.52
ALT (u/l)	58.31	59.75	54.65	62.23	13.56
ALP (u/l)	669.30	685.24	612.72	730.02	209.82
Globulin mg/dl	2.96	3.01	2.97	2.24	0.68
Total Protein (mg/dl)	33.80	41.44	32.86	21.89	4.49
Albumin (mg/dl)	4.18	3.56	3.18	3.91	1.02
Creatinine (mg)	2.95	2.99	2.85	3.14	0.24
Cholesterol (mg/dl)	74.8^a	62.2^{ab}	55.2^{ab}	45.3^b	26.5
Triglycerides (mg/dl)	32.48	44.40	45.26	22.89	8.5

^{ab}Means within same row bearing different superscripts are significantly different at $p \leq 0.05$;
AST = aspartate transaminase; ALT = alanine transaminase; ALP = alkaline phosphatase.

4. Conclusion

Inclusion of SLM in the diets of cockerels significantly improved growth performance of the birds both at chick and grower phases, and also reduced the blood cholesterol level in a dose-dependent manner without any deleterious effect on blood and serum parameters. It is, however suggested that the herb be used with caution as it has a tendency to lower some blood parameters as evidenced by the results of this study.

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