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Blood Profile of Starter Broiler Birds Fed Diets Supplemented with Lemongrass and Pawpaw Leaf Meal

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ABSTRACT

Background and Objective: To fortify the immune system of poultry birds and create a stable immunity within and without, synthetic feed additives have been used for a long period, though with great side effects. To bypass some of the side effects and build a natural immune stability with little or no side effects, the use of plant-based materials such as leaf meal have been adopted. Thus, this research work is focused on the blood profile of starter broiler birds fed diets fortified with lemon grass and pawpaw leaf meal. **Materials and Methods:** Ninety-six days old broiler chicks of Ross 308 strain were used for the work. The experiment was carried out at the poultry site of the Federal College of Agriculture, Ishiagu in Ebonyi State, Nigeria. Four diets were compounded at 3% inclusion levels, with diet 1 containing 0% lemon grass and pawpaw leaf meal, which served as the control. Diets 2, 3, and 4 contained lemon grass and pawpaw leaf meal at the levels and ratios of 0.75:2.25, 1.50:1.50, and 2.25:0.75, respectively. Blood was collected from the birds and used for serum and hematological analysis at the end of the research work. **Results:** A superior value of 3.71 g/dL for total protein was obtained in treatment 1, which did not differ from the values of 3.57 and 3.61 g/dL reported in treatments 2 and 4. The lowest value of 3.38 g/dL was seen in treatment 3. The highest value of albumin with 2.00 g/dL was obtained in treatment 1, while the lowest value of 1.57 g/dL was obtained in treatment 3, which was similar to those of 1.72 and 1.65 g/dL found in treatments 2 and 4, respectively. The value of 7.79 U/L (T3), was superior for ALT, which did not differ from the value of 6.66 U/L (T2) and 7.04 U/L (T1), but was different in 6.33 U/L (T4), respectively. Packed cell volume had the highest levels of 34.66% in treatment 2, which was similar to those of 34.41% in treatment 4, while the lowest value of 30.34% was observed in treatment 1. A superior value for hemoglobin was reported in treatment 4 with 10.75 g/dL, but the least value of 9.03 g/dL was seen in treatment 1. Mean corpuscular volume and mean corpuscular hemoglobin values showed no significant differences across the treatment groups. **Conclusion:** It can be deduced from the present study that the inclusion of lemongrass and pawpaw leaf meal in the diet of finisher broiler up to the level of 3% in a combination of 0.75:2.25, 1.50:1.50 and 2.25:0.75 gave a positive result in terms of immune stability of the birds in those treatments and zero mortality in treatments fortified with the test ingredients.

KEYWORDS

Blood profile, starter broiler birds, fortified, lemon grass, pawpaw leaf meal

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INTRODUCTION

The emergence of drug-resistant micro-organisms, side effects of antimicrobial drugs, and the harmful residual toxicity effects of drugs observed in the food chain as well as the ban on the use of antibiotics in many countries have put pressure on the poultry industry to encourage organic livestock farming[1]. This has stimulated increased interest in the usage of consumer-accepted natural alternatives such as phytogenic feed additives (PFA) to improve productivity and enhance the immune system of the animals. The feed crises facing the Nigerian livestock industry can be minimized by harnessing the nutritional potential of leaf meals that are predominant in Nigeria. From research works carried out over the years, it has been observed that the performance and immune response of chicks fed on biological feed additives were equivalent or even superior to that of antibiotic growth promoters[2]. These are materials usually obtained from different parts of the plants such as herbs, spices, plant extracts, etc. These materials (natural in value) usually have a wide range of biologically active properties that are usually beneficial in the modern livestock sector which include anti-oxidative, anti-inflammatory, anti-microbial, and digestive enhancing effects[3]. They are also important in promoting animal performance and intestinal health and improving gut integrity in animals.

Lemon grass (*Cymbopogon citrates*) is a genus of Asian, African, Australian, and Tropical Island plants in the grass family. It is a perennial grass that belongs to the *Gramineae*, under the genus *Cymbopogon*[4]. It is of indigenous origin and has a lot of medicinal importance. All three species of lemon grass are found in India. *Cymbopogon flexuosus* is grown in East Indian States which is famous for its oil and has a good market. *Cymbopogon citrates* is found in the West Indian States and it contains less citral. *Cymbopogon pendulus* found in the Jammu Region contain higher citral, though with limited cultivation. The principal chemical constituents include citronella, geraniol and citronellol. They have various pharmacological activities such as anti-amoebic, antibacterial, anti-diarrheal, anti-filarial, antifungal, and anti-inflammatory properties. Other effects such as anti-malarial, anti-mutagenicity, anti-mycobacterial, antioxidant, and hypoglycemic have also been studied[5].

The Pawpaw plant is a widely cultivated tropical fruit tree. It is mainly cultivated for its fruit. The leaf is the most common natural source of papain, chymopapain A and B, and papaya peptidase A, has been used recurrently in the poultry sector[6,7]. Papain is proteolytic and thus capable of enhancing protein digestion. Also, the papaya leaf contains broad-spectrum phytochemicals which include alkaloids and phenols. Phenolic compounds have antioxidant activity and free radical scavenging capacity, with the mechanism of inhibiting enzymes responsible for reactive oxygen species production[8]. They also possess antibacterial, antifungal, antiviral, neuroprotective, and antifertility properties[9]. The leaves are high in vitamins, minerals, antioxidants, and enzymes that help in the digestion of carbohydrates, proteins, and fats while also reducing microbial burden[6].

This study aims to evaluate the effects of dietary supplementation with lemongrass and pawpaw leaf meal on the blood profile of starter broiler birds. The objective is to assess potential improvements in hematological and biochemical parameters for overall bird health and performance.

MATERIALS AND METHODS

Experimental site: The experiment took place at the poultry section of the Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State from September to November, 2024.

Source and processing of black plum leaf: The lemon grass leaf (6 kg) and pawpaw leaf (6 kg) that were used for the experiment were sourced from Enugu and Ishiagu, in Ebonyi State. The lemon grass and pawpaw leaf were obtained fresh and washed. The leaves were then sun-dried and later ground into a meal.

Table 1: Experimental diet with different treatments

	Treatment			
Ingredient	T1	T2	T3	T4
Maize	58.00	58.00	58.00	58.00
Wheat offal	6.90	5.40	5.40	5.40
Soya bean meal	6.00	6.00	6.00	6.00
Groundnut cake	12.00	12.00	12.00	12.00
Fish meal (72%)	1.50	1.50	1.50	1.50
Blood meal	3.50	3.50	3.50	3.50
Palm kernel cake	7.00	5.50	5.50	5.50
Lemon grass leaf meal	0.00	0.75	1.50	2.25
Pawpaw leaf meal	0.00	2.25	1.50	0.75
Limestone	1.50	1.50	1.50	1.50
Bonemeal	2.50	2.50	2.50	2.50
Methionine	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20
Finisher premix	0.35	0.35	0.35	0.35
Salt	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated value				
Crude protein (%)	19.45	19.90	19.76	19.53
M energy (Kcal/kg)	3007.90	2979.20	2975.85	2971.44
Crude fiber (%)	3.78	3.91	3.89	3.89
Ether extract (%)	4.73	4.69	4.69	4.69
Calcium (%)	1.35	1.37	1.37	1.37
Phosphorus (%)	0.54	0.56	0.56	0.56
Methionine (%)	0.61	0.59	0.59	0.59
Lysine (%)	1.11	1.09	1.09	1.09

Experimental design and management of birds: A total of ninety-six days old broiler chicks of Ross 308 strains were used for the experiment. The birds were placed into four groups. Each treatment was replicated three times in a Completely Randomized Design (CRD) with 8 birds per replicate. The birds were obtained from 'Cosin farm' in Enugu State. The birds were raised on a cemented floor covered with wood shavings as a source of litter. The pens were also divided into partitions such that each partition accommodated 8 birds. Feed and water were given *ad libitum*.

At the end of the starter phase, 4 mL of blood sample was drawn from one bird per replicate (three birds per treatment and twelve birds in all) through the wing vein using a 5 cm needle. As 2 mL of the blood sample was used for serum biochemical analysis and place in anti-coagulant free specimen bottles. The remaining blood sample (2 mL) was placed in a specimen bottle containing EDTA (ethylene diamine tetra-acetic acid) for the analysis of hematological parameters.

Four experimental diets were compounded at 3% inclusion levels, with diet 1 containing 0% lemon grass and pawpaw leaf meal, which served as the control. Diets 2, 3, and 4 will contain lemon grass and pawpaw leaf meal at the levels and ratio of 0.75:2.25, 1.50:1.50, and 2.25:0.75, respectively (Table 1).

RESULTS AND DISCUSSION

The results of the serum biochemical indices are shown in Table 2. Results showed that total protein was superior ($p<0.05$) in treatment 1 with a value of 3.71 g/dL which was similar ($p>0.05$) to the values of 3.57 and 3.61 g/dL observed in treatments 2 and 4, respectively. The lowest value of 3.38 g/dL was obtained in treatment 3. Values obtained for total protein showed a decreasing trend from control to treatment 3, while treatment 4 was higher. The value obtained for total protein in this study falls within the range of 3.1 to 5.7 g/dL reported earlier[1,10] while using moringa leaf meal and ginger root powder as supplements in the diets given to broiler birds.

Table 2: Serum biochemistry indices of starter broiler birds fed supplemental levels of lemon grass and pawpaw leaf meal

	Treatment				
Parameter	T1	T2	T3	T4	SEM
Total protein (g/dL)	3.71[a]	3.57[a]	3.38[b]	3.61[a]	0.05
Albumin (g/dL)	2.00[a]	1.72[b]	1.57[b]	1.65[b]	0.06
Globulin (g/dL)	1.71	1.85	1.81	1.96	0.04
Urea (mg/dL)	3.14	3.35	2.87	3.37	0.11
Creatinine (mg/dL^{-1})	0.88[a]	0.80[a]	0.69[b]	0.77[b]	0.02
AST (µ/L)	87.24	86.74	86.44	88.56	2.08
ALT (µL^{-1})	7.04[a]	6.66[a]	7.79[a]	6.33[b]	0.23

[ab]Means on the same row with different superscripts are significantly ($p<0.05$) different, SEM: Standard Error of Mean, ALT: Alanine transaminase and AST: Aspartate transaminase

This connotes that the diets formulated for the birds in this study were able to meet the protein requirement of the birds as it has been reported over time that the quantity and quality of protein made available to the birds determines the performance of the birds and affects its overall immune stability[3,11].

Albumin value was superior ($p<0.05$) in treatment 1 with 2.00 g/dL, which differed from the least value of 1.57 g/dL observed in treatment 3, which was also similar ($p>0.05$) to the values of 1.72 and 1.65 g/dL corresponding to treatments 2 and 4, respectively. Data obtained for albumin in this study was within the recommended range[3,12] when working with broiler birds using guava leaf/oil and lemon grass and black plum leaf meal, respectively. The result obtained for globulin had the value of 1.71 g/dL for globulin in treatment 1, which was not significantly different ($p>0.05$) from the value of 1.85, 1.81 and 1.96 g/dL obtained in treatments 2, 3 and 4, respectively. The trend displayed higher globulin values in treatments fortified with the test ingredients (lemongrass and pawpaw leaf meal). The values obtained for globulin in the present study fall within the recommended range of value of 0.85 to 2.80 g/dL[13].

Dietary effect on urea revealed that urea values were not significantly ($p>0.05$) affected across the treatments. Also, values of 3.14, 3.35, 2.87, and 3.37 mg/dL were obtained in treatments 1, 2, 3, and 4, respectively. Values for urea obtained in this study disagree with the values reported by another study by David *et al.*[3], where they reported significant differences in urea value across the treatment group. Thus, values obtained for urea in this study were within the recommended value range of 2.50 to 10.50 mg/dL[1,14].

Data reported for creatinine had a superior ($p<0.05$) value of 0.88 mg/dL in treatment 1, which was closely followed by those in treatment 2 with 0.80 mg/dL. The lowest value of 0.69 mg/dL was seen in treatment 3, which was not significantly different from those in treatment 4 with 0.77 mg/dL. The values obtained for creatinine were within the recommended value of 0.5 to 1.8 mg/dL[3]. This result revealed that there was adequate quantity and quality of protein made available to the diets of the birds. The normal range of value obtained for creatinine in this study suggests that the muscles of the birds were not affected negatively or depleted as the case may be because it has been observed by Abd Al-Jaleel[10], that muscle wasting is usually due to excess creatinine in the blood of animals with is due to creatinine phosphate catabolism during this process.

The AST values did not vary ($p>0.05$) across the treatment group with 87.24, 86.74, 86.44, and 88.56 U/L corresponding to AST in treatments 1, 2, 3, and 4, respectively. The values obtained in this work were different from the previous report by David *et al.*[3] and Sugiharto *et al.*[12], where they observed significant differences in the value of AST when phytogenic materials were offered to broiler birds. The value of 7.79 U/L was the highest ($p<0.05$) for ALT in treatment 3 which was not significantly different ($p>0.05$) from the value of 7.04 and 6.66 U/L observed in treatments 1 and 2, while the least value of 6.33 U/L was reported in treatment 4, respectively.

Table 3: Hematological indices of starter broiler birds fed supplemental levels of lemon grass and pawpaw leaf meal

	Treatment				
Parameter	T1	T2	T3	T4	SEM
Packed cell volume (%)	30.34^{c}	34.66^{a}	32.10^{b}	34.41^{a}	0.56
Hemoglobin (g/dL)	9.03^{d}	10.12^{b}	9.59^{c}	10.75^{a}	0.21
Red blood cell (×10^{6} µ/L)	3.28^{b}	3.79^{a}	3.39^{b}	3.77^{a}	0.08
White blood cell (×10^{3} µ/L)	25.24^{c}	27.48^{b}	27.03^{b}	28.67^{a}	0.40
MCV (fl)	92.57	91.55	94.72	91.39	1.06
MCH (pg/cell)	27.56	26.71	28.28	28.55	0.36

^{abcd}Means on the same row with different superscripts are significantly ($p<0.05$) different, SEM: Standard error of mean, MCV: Mean corpuscular volume and MCH: Mean corpuscular hemoglobin

The results obtained for hematological parameters are displayed in Table 3. Results for packed cell volume showed that packed cell volume had the highest value of 34.66% in treatment 2, which was not significantly different ($p>0.05$) from the value of 34.41% observed in treatment 4. The lowest value of 30.34% observed in treatment 1 varies ($p<0.05$) from the value of 32.10% obtained in treatment 3. From the results obtained, it can be seen that the values of packed cell volume in treatments with lemon grass and pawpaw leaf meal were significantly higher than that of the control. This could suggest that there is a better flow of blood to the birds in these treatments which tends to enhance better immunity and strength to the birds. The values obtained were within the recommended normal range of 22 to 37.50%[13]. This implies that there was no toxic or negative impact on the birds by the addition of the test ingredients in the diets of the birds. This work is in agreement with the report of Alnidawi *et al.*[15], who observed a higher level of packed cell volume when moringa leaf meal was supplemented in the diet of broiler birds. Hemoglobin had a higher value of 10.75 g/dL in treatment 4, which was significantly different from the lowest value of 9.03 g/dL from treatment 1. Birds in treatment 2 had a hemoglobin value of 10.12 g/dL which differed from the value of 9.59 g/dL obtained in treatment 3, respectively. Hemoglobin value in control was lower when compared to those in treatments fortified with the test ingredients. The values of hemoglobin obtained in this study fall within the recommended range of 9.20 to 13.00 g/dL as reported by Kahn and Line[13]. Simaraks *et al.*[16]. This suggests that the quality of protein in the diet of the birds was good enough to contribute to a positive state of the birds' hemoglobin level.

Values obtained for red blood cells were significantly higher in treatment 2 with 3.79×10^{6} µL^{-1}, which did not differ from the value of 3.77×10^{6} µL^{-1} obtained in treatment 4. The least value of 3.28×10^{6} µL^{-1} was seen in treatment 1 which did not vary from the value of 3.39×10^{6} µL^{-1} observed in treatment 3. Values reported in this study showed increased values with treatments fortified with the test ingredients when compared with the control. The results obtained in the present study fall within the recommended range of value (2.0 to 4.20×10^{6} µL^{-1}) as outlined by Kahn and Line[13] and Kaminski *et al.*[17]. White blood cell values were significant across the treatment group. Results obtained showed that birds in treatment 4 had a superior value of 28.67 which was significantly different from the values of 27.48×10^{3} and 27.03×10^{3} µL^{-1} observed in treatments 2 and 3, respectively. The least value of 25.24×10^{3} µL^{-1} was obtained in treatment 1. The values obtained for white blood cells in this study suggest that the immune status of the birds was sufficient to keep them in good health. The values were within the recommended range of 20.50-56.00×10^{3} µL^{-1} reported by David *et al.*[3] and Kahn and Line[13].

Mean corpuscular volume and mean corpuscular hemoglobin had values that did not differ across the treatment groups. Mean corpuscular volume had a value of 92.57 fl in treatment 1 which did not vary from the value of 91.55, 94.72, and 91.39 fl obtained in treatments 2, 3, and 4, respectively. Values for mean corpuscular hemoglobin were not significantly influenced across the treatment group. Birds in treatments 1, 2, 3, and 4 had values of 27.56, 26.71, 28.28 and 28.55 pg, respectively.

CONCLUSION

The study revealed that incorporating lemongrass and pawpaw leaf meal in broiler diets at a 3% inclusion level (0.75:2.25, 1.50:1.50, and 2.25:0.75) positively influenced blood parameters, indicating improved immune stability. Treatments supplemented with these ingredients showed no adverse effects on hematological and biochemical indices and recorded zero mortality. These findings suggest that lemongrass and pawpaw leaf meal can be beneficial feed additives for broiler health. Future studies should investigate their long-term effects on growth performance, meat quality, and nutrient utilization. Additionally, exploring different inclusion levels and combinations could help optimize poultry nutrition for better productivity.

SIGNIFICANCE STATEMENT

This study identified the potential benefits of lemongrass and pawpaw leaf meal as natural feed additives, which could be beneficial for improving broiler health and immune stability. The findings suggest that their inclusion in poultry diets positively influences blood parameters without adverse effects, supporting their suitability for sustainable poultry nutrition. This study will assist researchers in uncovering critical areas of alternative feed formulations and their impact on poultry health that have remained unexplored by many. Consequently, a new theory on the role of herbal supplements in enhancing broiler productivity may be developed.

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