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Haematological Parameters of Guinea Fowl (Numida meleagris) Fed Forage-Based Diets in Aliero, Kebbi State, Nigeria

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Abstract

Blood parameters reflect the health and physiological status of poultry. This study evaluated the effect of forage-based feeding on the haematological parameters of guinea fowl (Numida meleagris) in Aliero, Kebbi State, Nigeria. Forty-five guinea fowls were allotted to five treatments: T1 (Brachiaria and Centrosema species), T2 (Lablab purpureus and Panicum maximum), T3 (Leucaena leucocephala and Chloris gayana) and T4 (Cassia tora), each combined with conventional feed, and T5 (control; conventional feed only). Blood was collected from the wing vein of three birds per treatment at three and six weeks. Haemoglobin, red blood cell count, packed cell volume, white blood cell (WBC) count, differential counts and platelets were determined. Data were analysed by one-way analysis of variance at each sampling time, and means were separated by Duncan's multiple range test. Haemoglobin, red blood cells, packed cell volume, differential counts and platelets did not differ significantly among treatments at either time ($P > 0.05$). The WBC count differed significantly at three weeks ($P < 0.001$) and six weeks ($P = 0.003$), being lowest in the control (24.30 and 23.97 × 103/µL) and highest in birds fed Cassia tora at six weeks (131.64 × 103/µL). At both times only T2, T3 and T4 differed significantly from the control. The forage-based diets did not impair the red blood cell indices. The WBC counts in the forage groups were unusually high and need confirmation before they are interpreted as an immune benefit.

Keywords: Blood profile; Forage; Guinea fowl; Haematology; Numida meleagris; White blood cells

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INTRODUCTION

Guinea fowl (Numida meleagris) provide meat, eggs and income to rural households in West Africa (Koney et al., 2023; Konlan et al., 2024). The bird is hardy and makes good use of fibrous feed (Ayorinde, 1991), yet feed remains the largest cost in poultry production, at about 75% of the total (Idahor et al., 2024). Forages are one possible way of reducing this cost, but they differ widely in nutrient composition, fibre content and digestibility (Gohl, 1981; Murphy & Colucci, 1999), and some contain antinutritional factors, as reviewed for the related Senna obtusifolia by Diarra (2021). Giving poultry access to pasture or forage has been compared with conventional feeding in chickens (Fanatico et al., 2005), but evidence for guinea fowl is scarce.

Haematological parameters are widely used to assess the health and physiological status of animals and to judge whether a diet is suitable (Jain, 1986). In guinea fowl, blood indices have been proposed as clinical indicators and as markers for selecting breeding stock (Penkov et al., 2019). Packed cell volume, haemoglobin and mean corpuscular haemoglobin concentration have been suggested as markers of genetic variation in Nigerian guinea fowl, and blood values in the species are affected by strain, sex and production system (Adedibu et al., 2014; Okoro et al., 2011; Obese et al., 2018). Baseline blood data for free-range guinea fowl are available (Nalubamba et al., 2010), and diet is known to alter the blood profile of poultry (Iheukwumere et al., 2008). To our knowledge, however, the effect of forage-based feeding on the blood profile of guinea fowl has received little attention under local conditions in north-western Nigeria. This study provides baseline haematological data for guinea fowl fed four combinations of locally available forages together with conventional feed. The aim was to determine the effect of forage-based feeding on the haematological parameters of guinea fowl.

MATERIALS AND METHODS

Study location

The experiment was conducted at the Pasture Research Unit, behind the Animal Science Laboratory of Abdullahi Fodiyo University of Science and Technology, Aliero, Kebbi State, Nigeria (12°16′42″ N, 4°27′6″ E).

Experimental birds and ethical approval

Forty-five guinea fowls of similar age (between the range of 6-8 weeks) and of different sex and breeds were used for the experiment. Local birds were purchased from village markets in Aliero, Dodoru, Jega and Tambuwal, while improved birds were obtained from a reputable farm in Zamfara State. Ethical clearance was obtained from the Department of Animal Science, Faculty of Agriculture, Abdullahi Fodiyo University of Science and Technology, Aliero, and the birds were housed in well-ventilated pens with standard dimensions, equipped with feeders and drinkers. The pens were cleaned regularly, and the birds were provided with fresh water ad-libitum.

Treatments and experimental design

The birds were allotted to five treatments (9 birds per treatment): four forage-based treatments (T1 to T4), each combined with conventional feed, and a control fed conventional feed only (T5). The treatments were: T1, Brachiaria species and Centrosema species; T2, Lablab purpureus and Panicum maximum; T3, Leucaena leucocephala and Chloris gayana; T4, Cassia tora; and T5, conventional feed only (control). Each treatment was replicated three times and three birds were allocated to each replicate to make a total of nine birds per treatment and forty-five birds for the entire experiment. Each replicate contained two local and one improved bird, giving six local and three improved birds per treatment. The forages were grown in the pens, and the birds were introduced into

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the forage plots and offered conventional feed (commercial poultry feed) ad libitum. Control birds were also housed in pens but received commercial poultry feed only. The experimental period was six weeks.

Blood collection and haematological analysis

Blood samples were collected at the middle (week 3) and end (week 6) of the experiment, between 07:00 and 09:00 h. At each sampling, one bird was selected from each replicate, making a total of three birds per treatment. Different birds were sampled at the two sampling times. About 5 mL of blood was drawn from the wing vein using a hypodermic needle and syringe, transferred into pre-labelled bottles containing ethylenediaminetetraacetic acid (EDTA) as anticoagulant, and submitted to the AMA Laboratory, Birnin Kebbi, for analysis. Red blood cell count (RBC), haemoglobin (Hb), white blood cell count (WBC) and packed cell volume (PCV) were determined, together with differential leucocyte counts (heterophils, basophils, lymphocytes, monocytes and eosinophils) and platelet count (Olaniye et al., 2012). Blood cell counts were done manually.

Statistical analysis

Data at each sampling time were subjected to one-way analysis of variance (ANOVA) with treatment as the factor, using SPSS version 25.0. Means were separated using Duncan's multiple range test, and differences were considered significant at $P < 0.05$.

Results and Discussion

The haematological parameters at three and six weeks are presented in Tables 1 and 2.

Table 1. Haematological parameters of guinea fowl fed forage-based diets at three weeks

Parameter	T1	T2	T3	T4	T5	SEM	P-value
Haemoglobin (g/dL)	11.55	10.58	10.39	11.20	12.00	0.376	0.702
RBC ($\times 10^{12}$/L)	3.69	3.35	2.80	3.31	2.66	0.176	0.344
PCV (%)	34.82	35.97	37.51	38.64	34.87	0.770	0.483
WBC ($\times 10^3$/µL)	31.29^b	129.40^a	126.15^a	127.64^a	24.30^b	13.151	<0.001
Heterophils (%)	35.90	38.60	38.65	38.50	26.13	2.774	0.616
Basophils (%)	1.29	0.96	1.05	1.81	1.33	0.227	0.842
Platelets ($\times 10^3$/µL)	38.03	93.00	35.43	35.50	29.63	8.304	0.055
Lymphocytes (%)	56.23	57.01	52.57	55.63	45.13	4.536	0.945
Monocytes (%)	6.52	1.61	2.82	1.70	21.79	3.658	0.392
Eosinophils (%)	4.87	2.74	1.05	2.42	2.44	0.478	0.136

Values are treatment means (n = 3 birds per treatment). SEM = standard error of the mean; RBC = red blood cell count; PCV = packed cell volume; WBC = white blood cell count. Means in the same row with different superscripts differ significantly (Duncan's test, $P < 0.05$). T1 = Brachiaria + Centrosema + conventional feed; T2 = Lablab + Panicum maximum + conventional feed; T3 = Leucaena + Chloris gayana + conventional feed; T4 = Cassia tora + conventional feed; T5 = control (conventional feed only).

Table 2. Haematological parameters of guinea fowl fed forage-based diets at six weeks

Parameter	T1	T2	T3	T4	T5	SEM	P-value
Haemoglobin (g/dL)	10.90	11.56	11.18	11.43	11.80	0.299	0.929
RBC ($\times 10^{12}$/L)	3.17	3.31	3.18	3.43	3.17	0.077	0.824
PCV (%)	33.29	36.96	36.91	38.31	36.60	0.819	0.429
WBC ($\times 10^3$/µL)	64.73^b	128.73^a	126.49^a	131.64^a	23.97^b	13.204	0.003
Heterophils (%)	34.00	37.14	40.07	38.62	27.50	2.749	0.684
Basophils (%)	1.17	1.17	1.17	1.10	1.27	0.104	0.995
Platelets ($\times 10^3$/µL)	36.73	92.33	36.67	38.17	30.67	8.150	0.062
Lymphocytes (%)	54.23	58.01	55.23	58.20	46.67	4.448	0.949
Monocytes (%)	6.20	1.81	3.33	1.88	21.80	3.647	0.404
Eosinophils (%)	4.40	2.47	1.03	2.67	2.93	0.469	0.274

Values are treatment means (n = 3 birds per treatment). SEM = standard error of the mean; RBC = red blood cell count; PCV = packed cell volume; WBC = white blood cell count. Means in the same row with different superscripts differ significantly (Duncan's test, $P < 0.05$). T1 = Brachiaria + Centrosema + conventional feed; T2 = Lablab + Panicum maximum + conventional feed; T3 = Leucaena + Chloris gayana + conventional feed; T4 = Cassia tora + conventional feed; T5 = control (conventional feed only).

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Red blood cell indices

Haemoglobin, RBC and PCV did not differ significantly among treatments at three or six weeks ($P > 0.05$). Haemoglobin ranged from 10.39 to 12.00 g/dL at three weeks and from 10.90 to 11.80 g/dL at six weeks, RBC from 2.66 to 3.69 × 1012/L and 3.17 to 3.43 × 1012/L, and PCV from 34.82 to 38.64% and 33.29 to 38.31%. These indices describe the oxygen-carrying capacity of the blood and the activity of red cell formation, so the similarity among groups indicates that the forage-based diets did not impair erythropoiesis and supplied adequate nutrients for normal blood formation. The PCV values were close to the 35.71 to 37.14% reported for Nigerian guinea fowl by Adedibu et al. (2014), whereas haemoglobin was lower than the 13.61 to 14.19 g/dL they reported. Similar blood profiles among birds on different diets have been reported when nutrient needs were met (Adeyemo & Longe, 2007).

Differential counts and platelets

Heterophils, basophils, lymphocytes, monocytes and eosinophils did not differ significantly among treatments at either sampling time ($P > 0.05$). Heterophils ranged from 26.13 to 40.07% and lymphocytes from 45.13 to 58.20%. Monocytes were numerically much higher in the control (about 21.8% at both times) than in the forage groups (1.61 to 6.52%), but the large standard errors (3.65 to 3.66) indicate high variation between birds, probably because of the small sample, and the difference was not significant. Platelet counts in T2 were about 93 × 103/µL against 30 to 38 × 103/µL in the other groups. The difference approached but did not reach significance ($P = 0.055$ at three weeks and $P = 0.062$ at six weeks), so it should not be interpreted as an effect of the diet.

White blood cell count

The WBC count was the only parameter affected by treatment, at three weeks ($P < 0.001$) and at six weeks ($P = 0.003$). At three weeks, T2, T3 and T4 recorded similarly high values (129.40, 126.15 and 127.64 × 10^3/µL), about five times the control (24.30 × 10^3/µL), whereas T1 (31.29 × 10^3/µL) did not differ from the control. At six weeks the control was again lowest (23.97 × 10^3/µL) and T4 was highest (131.64 × 10^3/µL), followed by T2 (128.73 × 10^3/µL). T2, T3 and T4 differed significantly from the control and from T1, whereas T1 (64.73 × 10^3/µL) did not differ from the control. The T1 mean at six weeks was highly variable: one bird had a count of 138.1 × 10^3/µL, similar to the birds in T2 to T4, while the other two had 22.71 and 33.37 × 10^3/µL, close to the control.

White blood cells defend the body against infection and take part in the immune response (Campbell, 1995), and a higher count could indicate immune stimulation by contact with forage materials. The result should nevertheless be interpreted with caution. The means for T2, T3 and T4 (126 to 132 × 103/µL) were about five times the control means (24.30 and 23.97 × 103/µL), a very large increase. Counts of this size are more often associated with infection, inflammation, parasitism or stress than with a beneficial immune response, and they may also reflect the counting method, since avian erythrocytes and thrombocytes are nucleated and can be counted as leucocytes unless the method accounts for them (Campbell, 1995). In addition, the forage-fed birds were kept in pens where the forages were grown, whereas the control birds were not, so the forage groups also differed from the control in contact with plant material, soil and associated pathogens or parasites. The increase therefore cannot be attributed to the nutrient content of the forage alone. The elevation was similar in T2, T3 and T4, which include both grasses and legumes, and in T1 it was absent at three weeks and seen in only one of three birds at six weeks. This points to a common cause acting on individual birds, such as infection or parasitism, rather than a species-specific effect of the forage. Absolute differential counts, health records, parasite load and an independent repeat count would be needed to resolve this. Differences in haematological values among birds fed alternative feed resources have also been reported in broilers and attributed to differences in feed composition, environment and management (Iheukwumere et al., 2008).

CONCLUSION

Haemoglobin, red blood cell count, packed cell volume, differential leucocyte counts and platelets of guinea fowl were not significantly affected by the forage-based diets at three or six weeks, which indicates that these diets did not impair blood formation under the conditions of this study. The white blood cell count was higher in the forage-fed groups than in the control ($P < 0.05$, with T2, T3 and T4 differing significantly at both sampling times), but the increase was unusually large, so this finding needs confirmation and should not yet be taken as evidence of improved immunity. Further studies should use more birds per treatment, report absolute differential counts, record health status and parasite load, and compare birds kept under identical environmental conditions.

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