

# Haematological studies of pure indigenous domestic fowl (*Gallus domesticus*) and guinea fowl (*Numida meleagris*) in North-West Nigeria

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## Key words

Chicken - Guinea fowl - Blood composition - Biochemistry - Extensive husbandry - Nigeria.

## Summary

Normal haematological and plasma biochemical values of pure indigenous domestic and guinea fowls in a natural extensive system in North-West Nigeria were investigated. The values for haematocrit, haemoglobin and erythrocytes in the indigenous domestic fowls were within lower values of range documented in literature for conventional (exotic) breeds under intensive management. Total leucocyte counts in domestic and guinea fowls were higher than values reported for exotic breeds. Plasma cholesterol and total plasma protein levels in domestic and guinea fowls were similar to values reported for exotic breeds, except alkaline phosphatase activities which were lower. The lower values of erythrocyte parameters in indigenous domestic fowls were attributed to a malnutrition-parasitism complex. The higher leucocyte count in the indigenous birds was thought to be a response to regular exposure of the birds to pathogenic organisms.

## INTRODUCTION

Most Nigerians prefer poultry meat and eggs to other sources of proteins. This probably accounted for a significant expansion of the industry in the late 1970's and early 1980's when foreign currencies were readily available to the government of Nigeria. Hence the industry depended largely on exotic breeds of the birds for its survival. However, global economic recession, especially in a developing country like Nigeria in the later part of 1983, made it impossible for Nigeria to sustain the importation of these birds and their feed, which resulted in the collapse of the industry. Therefore, for a successful and sustainable poultry industry, Nigeria must develop her parent stocks and take advantage of some good attributes of the indigenous birds. But the policy of introducing exotic breeds of animals into Nigeria for cross-breeding without first exploring the potentials of the local breeds is being seriously questioned. It has been suggested that the first step in the development of Nigeria livestock industry should be a thorough evaluation of all available local breeds with parallel studies on available cross-breeds to justify the use of exotic breeds (1).

Currently dominating the poultry industry is the domestic fowl (*Gallus domesticus*) although the guinea fowl (*Numida meleagris*)

*galeata*) is making an appreciable impact in this sector. Several investigations on the biology of the guinea fowl (16, 18, 19, 23) have been carried out with a view to improving it. This necessitated detailed haematological studies of the indigenous domestic fowl and guinea fowl in North-West Nigeria on which there is not much of information. This study is expected to provide reference values on the haematology of these birds for breeding and health related studies.

## MATERIALS AND METHODS

Indigenous domestic and guinea fowls in North-West Nigeria are basically scavengers with little or no grain supplement as food. Common watering points may be provided for those that are sheltered in an enclosure. Usually, no vaccination or medication against endemic diseases and no mineral-vitamin supplements are given.

Apparently healthy adult indigenous male and female domestic fowls (n = 112) and male and female guinea fowls (n = 78) were used for the study. Blood of the birds was obtained at a central dressing point in Sokoto Central Market, Nigeria, on December 15, 1993 through January 19, 1994. Blood collection was by exsanguination following cervical dislocation of each bird into two sets of bijoux bottles, one containing di-sodium ethylenediaminetetra-acetate (EDTA) at 1.0 mg/ml and another containing heparine at 0.2 mg/ml blood as described by Benjamin (7) for cell counts and plasma biochemistry, respectively. The collected blood was screened for haemoparasites using light microscope and QBC<sub>IT</sub>® Centrifugal Haematology System (Becton

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Dickinson Co., USA). The positive blood was discarded. Blood analyses were done on the day of collection. Haemoglobin (Hb) concentration, erythrocyte (RBC) counts and leucocyte (WBC) differential counts were carried out according to the method of Brown (8). The total WBC and thrombocyte (PLT) counts and haematocrit (PCV) determination were performed with the QBC<sub>II</sub>® machine. The RBC indices: mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated using established formulae (26).

The heparinized blood was immediately centrifuged at 12,800 x g for 5 min and the plasma separated and used for determination of cholesterol, alkaline phosphatase (AP), total plasma protein (TPP) and albumin concentrations using Blood Analyser®, Model 6300 (Ames Co., USA). The methods used for the determination of the metabolites were as described by Olowo-Okorun *et al.* (20). Globulin concentration was calculated by difference. The results were expressed as mean S.D. Tests for statistical difference between paired means were done using Student's t test (27).

## RESULTS

Values of RBC, PLT and RBC indices are summarized in table I. Male domestic fowls had higher ( $P < 0.05$ ) PCV and RBC values than female domestic fowls but Hb, MCV, MCH and MCHC values were remarkably ( $P > 0.05$ ) close in both sexes. However, female domestic fowls had more ( $P < 0.05$ ) numerous PLT than male domestic fowls. Male and female guinea fowls exhibited similar ( $P > 0.05$ ) PCV, Hb, RBC and MCH values but male guinea fowls had greater ( $P < 0.05$ ) MCV than females. Conversely, female guinea fowls possessed higher ( $P < 0.05$ ) MCHC and PLT counts than males. Male and female guinea fowls had significantly ( $P < 0.01$ ) higher PCV, Hb and RBC and lower ( $P < 0.05$ ) MCV, and PLT values than male and female domestic

fowls, respectively. MCHC in both male and female domestic and male and female guinea fowls, respectively, compared favourably ( $P > 0.05$ ).

Total WBC and differential counts are presented in table II. Female domestic and female guinea fowls consistently maintained slightly more elevated total WBC counts than male domestic and male guinea fowls, respectively, but the differences were not significant. Male and female guinea fowls had significantly ( $P < 0.05$ ) greater total WBC counts than male and female domestic fowls, respectively. Relative lymphocyte counts in female domestic and female guinea fowls were generally higher than in male domestic and male guinea fowls, respectively; however this difference was significant ( $P < 0.05$ ) only in domestic fowls. Heterophil and monocyte percentages in males of either type were higher than in females of the same type, although only heterophil differences in domestic fowls attained a significant ( $P < 0.05$ ) level. Eosinophil and basophil percentages did not show any consistent trend between sexes and bird types.

Plasma biochemical values are shown in table III. Cholesterol, AP, TPP, albumin and globulin levels were generally higher in female domestic and female guinea fowls than in the respective males. Female domestic fowls showed remarkably higher ( $P < 0.01$ ) cholesterol value than male domestic fowls but the difference between male and female guinea fowls was not significant. Conversely, female and male domestic fowls exhibited higher ( $P < 0.01$  and  $P < 0.05$ ) cholesterol values than female and male guinea fowls, respectively. AP activities in male and female domestic fowls were lower ( $P < 0.01$ ) than in male and female guinea fowls, respectively. Also AP activities between female and male domestic fowls differed significantly ( $P < 0.05$ ); no difference ( $P > 0.05$ ) in the activity of AP was observed between female and male guinea fowls. TPP values between male and female domestic fowls differed ( $P < 0.05$ ) appreciably but the values were close ( $P > 0.05$ ) in male and female guinea fowls. TPP value was higher ( $P < 0.05$ ) in female domestic fowl

Table I

Normal values for haematocrit, erythrocyte, erythrocyte indices and thrombocytes of indigenous domestic and guinea fowls in North-West Nigeria

Animal (n)	PCV (%)	Hb (g/100 ml)	RBC ( $\times 10^6/\text{mm}^3$ )	MCV ( $\mu\text{m}^3$ )	MCH (Pg)	MCHC (%)	PLT ( $\times 10^3/\text{mm}^3$ )
Male domestic fowl (55)	31.05 $\pm 3.39^{a+}$	9.38 $\pm 0.77^{a+}$	2.58 $\pm 0.51^{a+}$	120.35 $\pm 35.36^{a+}$	36.36 $\pm 2.15^{a+}$	30.21 $\pm 1.45^{a+}$	25.4 $\pm 2.4^{a+}$
Female domestic fowl (57)	28.63 $\pm 3.79^{b*}$	8.82 $\pm 1.06^{b*}$	2.42 $\pm 0.48^{b*}$	118.31 $\pm 25.36^{b*}$	36.45 $\pm 1.62^{b*}$	30.81 $\pm 1.75^{b*}$	26.8 $\pm 3.7^{b*}$
Male guinea fowl (41)	35.96 $\pm 1.33^{c++}$	10.68 $\pm 1.16^{c++}$	3.45 $\pm 0.62^{c++}$	104.23 $\pm 14.52^{c++}$	30.96 $\pm 2.24^{c++}$	29.70 $\pm 2.24^{c++}$	23.9 $\pm 2.5^{c++}$
Female guinea fowl (37)	33.04 $\pm 5.96^{c**}$	10.51 $\pm 1.04^{c**}$	3.40 $\pm 0.64^{c**}$	98.35 $\pm 13.76^{c**}$	30.91 $\pm 2.11^{c**}$	31.45 $\pm 2.00^{d*}$	24.5 $\pm 5.8^{d**}$

(n) = sample size; a, b, c, d = means with different superscripts in a column among the same bird type differed significantly; +, ++, \*, \*\* = means with different signs in a column among the same sex differed significantly

Table II

Leucocyte counts in healthy indigenous domestic and guinea fowls in North-West Nigeria

Animal (n)	TWBC (x 10 <sup>3</sup> /mm <sup>3</sup> )	Lymphocyte (%)	Heterophil (%)	Monocyte (%)	Eosinophil (%)	Basophil (%)
Male domestic fowl (55)	22.71 ±2.04 <sup>a+</sup>	51.8 ±7.3 <sup>a+</sup>	34.2 ±5.5 <sup>a+</sup>	9.1 ±1.3 <sup>a+</sup>	3.6 ±0.2 <sup>a+</sup>	1.3 ±0.1 <sup>a+</sup>
Female domestic fowl (57)	23.37 ±3.27 <sup>a*</sup>	56.2 ±6.7 <sup>b*</sup>	29.2 ±3.8 <sup>b*</sup>	8.8 ±1.6 <sup>a*</sup>	4.3 ±0.5 <sup>a*</sup>	1.5 ±0.1 <sup>a*</sup>
Male guinea fowl (41)	24.31 ±3.48 <sup>c++</sup>	53.8 ±4.9 <sup>c+</sup>	33.7 ±3.4 <sup>c+</sup>	7.4 ±1.7 <sup>c+</sup>	3.7 ±0.3 <sup>c+</sup>	1.4 ±0.2 <sup>c+</sup>
Female guinea fowl (37)	25.20 ±2.72 <sup>c**</sup>	57.0 ±6.4 <sup>c*</sup>	32.3 ±4.1 <sup>c*</sup>	6.5 ±1.9 <sup>c*</sup>	2.9 ±0.6 <sup>c*</sup>	1.3 ±0.2 <sup>c*</sup>

TWBC = total leucocytes; (n) = sample size; a, b, c = means with different superscripts in a column among the same bird type differed ( $P < 0.05$ ); +, ++, \*, \*\* = means with different signs in a column among the same sex differed ( $P < 0.05$ ).

Table III

Plasma biochemicals in healthy indigenous domestic and guinea fowls in North-West Nigeria

Animal (n)	CHL (mg/100 ml)	AP (IU)	TPP (g/100 ml)	ALB (g/100 ml)	GLB (g/100 ml)	ALB/GLB
Male domestic fowl (35)	132.4 ±34.2 <sup>a+</sup>	39.44 ±3.50 <sup>a+</sup>	4.9 ±0.61 <sup>a+</sup>	2.3 ±0.42 <sup>a+</sup>	2.6 ±0.49 <sup>a+</sup>	0.88 <sup>a+</sup>
Female domestic fowl (35)	165.1 ±43.6 <sup>b*</sup>	44.4 ±3.69 <sup>b*</sup>	6.0 ±1.22 <sup>b*</sup>	2.7 ±0.57 <sup>b*</sup>	3.3 ±0.76 <sup>b*</sup>	0.84 <sup>a*</sup>
Male guinea fowl (35)	115.6 ±31.1 <sup>c++</sup>	55.3 ±2.82 <sup>c++</sup>	4.4 ±0.39 <sup>c+</sup>	1.9 ±0.28 <sup>c+</sup>	2.5 ±0.17 <sup>c+</sup>	0.76 <sup>c++</sup>
Female guinea fowl (30)	122.2 ±25.6 <sup>c**</sup>	58.8 ±6.04 <sup>c**</sup>	4.9 ±0.44 <sup>c**</sup>	2.1 ±0.62 <sup>c**</sup>	2.8 ±0.45 <sup>c*</sup>	0.74 <sup>c**</sup>

CHL = cholesterol; ALB = albumin; GLB = globulin; (n) = sample size; a, b, c = means with different superscripts in a column among the same bird type differed significantly; +, ++, \*, \*\* = means with different signs in a column among the same sex differed significantly.

compared with the value in female guinea fowls. However, no similar result was obtained in TPP value between male domestic and male guinea fowls. Albumin values in male and female domestic fowls differed ( $P < 0.05$ ) whereas no such disparity was noticed between male and female guinea fowls. Similarly, female domestic fowls possessed a higher ( $P < 0.05$ ) albumin level than

female guinea fowls but values in male domestic and male guinea fowls were close ( $P > 0.05$ ). Globulin fraction in female domestic fowls was higher ( $P < 0.05$ ) than in male domestic fowls, but no significant difference was apparent between male domestic and male guinea fowls. Albumin/globulin ratios in male and female domestic fowls were higher ( $P < 0.05$ ) than in the respective male

and female guinea fowls. However, no such difference in the ratios between male and female birds of the same type was observed.

## ■ DISCUSSION

The observed PCV, Hb and RBC in the indigenous domestic fowls in this study are within lower values of reported range in literature (29). The low values are thought to be due to a combination of malnutrition and parasitic infestations as both conditions are known to depress these parameters (10, 12). The differences in the RBC parameters between male and female indigenous domestic fowls were likely to be influenced by hormonal factors. Domm and Taber (14) have shown that androgens (testosterone propionate) will cause an increase in RBC in capons and five-month old pullets whereas estrogen (alpha estradiol benzoate) in large amounts tended to counteract the effect of androgens. Cook and Harmon (10) also noted considerable decrease in the amount of Hb with the intensity of egg production. Indigenous domestic fowls breed throughout the year during which their hormonal levels are expected to remain high. The remarkable closeness in RBC and Hb values of male and female guinea fowls are due to seasonality in the breeding behaviour of the fowls (2, 4, 5, 18, 23, 30). According to Onuora (23), the periods of the lowest relative humidity, lowest rainfall and high temperature in Nigeria correspond with the period of lowest semen volume, poor percentage motility, lowest spermatozoa concentration and highest percentage of dead spermatozoa. Onuora (24) also reported complete cessation of semen production during the harmattan (cold-dry season) in the months of January and February in Nigeria by guinea cocks and concluded that a cyclic activity of the gonads occurs. Guinea hens lay eggs mainly during the rainy season in North-West Nigeria in the months of July through September when fertility and hatchability are highest (5). Therefore, the loss of estrogenic inhibition and androgenic stimulation on erythropoiesis as reported by Sturkie (28) could result in similar production of RBC by both male and female guinea fowls. The differences between domestic and guinea fowls of either sex in RBC values were attributable to genetic factors. Higher PLT count in domestic than in guinea fowls probably explained the faster rate of blood clotting in domestic than in guinea fowls during the period of blood sampling. Platelets are generally known to play a part in blood coagulation (26) in mammals although the role of avian thrombocytes in the initiation of blood coagulation is not clear (3, 15).

Total WBC counts in indigenous domestic fowls were higher than some previously published counts (21, 25). However, adult chickens kept in an outdoor environment usually have higher total WBC counts than those kept indoors (21), which was the case with domestic and guinea fowls in North-West Nigeria. This was probably a response to regular exposure of the birds to pathogenic organisms. There seemed to be a general heterophilia in both domestic and guinea fowls in the present study, suggesting a high contact of the birds with bacterial pathogens as previously recorded (11, 13). Newcomer (17) found consistent heterophilia when he injected adrenocortico-tropic hormone into cockerels. The stressor in this study may as well be the bacterial pathogens or a combination of pathogens and high environmental temperature (at about 30.8°C) that is usually characteristic of North-West Nigeria. Another apparent characteristic of WBC counts in

domestic and guinea fowls was eosinophilia. Eosinophilia is known to occur under certain conditions like verminous infestations, allergic states and anaphylactic shock (29). Parasitism was a more likely cause of eosinophilia in the present study as Nigeria is known to be highly endemic with parasites. Moreover, the birds were reared extensively.

Higher cholesterol levels in male and female domestic fowls than in the respective sexes of guinea fowls were because of the presumably more active cyclic activities of gonads in domestic fowls. This was corroborated by the work of Olson (22) who showed that striking changes in blood composition take place during periods of ovarian activity in birds. These include lipaemia and a significant elevation in blood calcium concentration. The AP activities recorded in this study followed similar pattern of distribution among male and female domestic and guinea fowls as reported by Olowo-Okorun *et al.* (20), but the values differed greatly in size. Although no adequate explanation could be given for the discrepancy other than genetic factors (20), the season in which their work was performed was not mentioned. Moreover, they used domestic fowls at the University of Ibadan Research Farm in South-West Nigeria and guinea fowls at the Kainji Lake Research Institute in the Middle Belt of Nigeria, which were reared intensively. Both regions usually experience distinct climatic conditions from North-West Nigeria. The differences in TPP values between sexes of domestic and guinea fowls, respectively, agreed with the earlier work of Swenson (29) that male plasma proteins are usually lower than those of female birds and the investigator suggested the involvement of gonadal hormones. Therefore, the significant difference in values of the proteins between male and female domestic fowls probably resulted from the functional state of their gonadal hormones at the time of this study. Those of the guinea fowls were presumably quiescent. Defalco (13) reported a value of 2.82 g protein per 100 ml serum in guinea hens. This was lower than the values recorded in the present study which were similar to those (4.55 and 5.02 g/100 ml plasma for males and females, respectively) reported by Olowo-Okorun *et al.* (20) where plasma, instead of serum, was used. The differences in the protein values cannot adequately be explained although it has been documented (9) that, when plasma or serum proteins from avian blood is less than 3.0 g/100 ml, this indicates hypoproteinaemia.

## ■ CONCLUSION

This study has presented the haematological values of indigenous birds in their true native form. To be compared adequately, indigenous birds must therefore be subjected to identical systems of management with exotic birds. Because of paucity of information on the haematology of guinea fowls in Nigeria, it has not been possible to make a similar comparison with published data as was done with domestic fowls.

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**Résumé**

**Uko O.J., Ataja A.M.** Etudes hématologiques et biochimiques de poule domestique (*Gallus domesticus*) et de pintade domestique (*Numida meleagris*) de races locales du Nord-Ouest du Nigeria

Les valeurs hématologiques et biochimiques de plasmas de poules et de pintades domestiques de races locales, élevées en système extensif traditionnel au Nord-Ouest du Nigeria, ont été étudiées. Les valeurs des hématocrites, de l'hémoglobine et les taux d'érythrocyte chez ces volailles locales se situaient dans les limites inférieures de celles obtenues par d'autres auteurs pour des races conventionnelles (exotiques) provenant de systèmes d'élevage intensif. La numérotation des leucocytes totaux chez les poules et les pintades domestiques était supérieure à celle observée chez les races exotiques. Les niveaux de cholestérol et de protéines plasmatiques totales chez les poules et les pintades domestiques étaient similaires à ceux signalés chez les races exotiques, à l'exception des activités des phosphatases alcalines qui étaient plus faibles. Les valeurs inférieures des paramètres d'érythrocyte chez les races locales ont été attribuées à un ensemble de malnutrition et de parasitisme. Le taux plus élevé des leucocytes chez les races indigènes a été considéré comme une réponse de la volaille face à l'exposition régulière à des organismes pathogènes.

**Mots-clés** : Poulet - Pintade - Composition du sang - Biochimie - Elevage extensif - Nigeria.

**Resumen**

**Uko O.J., Ataja A.M.** Estudios hematológicos del ave doméstica autóctona (*Gallus domesticus*) y del ave de Guinea (*Numida meleagris*) en el Noroeste de Nigeria

Se estudian los valores hematológicos y bioquímicos de plasmas del ave autóctona y de Guinea en un sistema extensivo natural, en el noroeste de Nigeria. Los valores del hematocrito, la hemoglobina y de los eritrocitos en las aves domésticas autóctonas se encontraban dentro de los límites inferiores citados en la literatura para razas convencionales (exóticas) bajo manejo intensivo. El conteo leucocitario total en las aves domésticas y de Guinea fue más elevado que los valores reportados para las razas exóticas. Los niveles de colesterol en plasma y de proteína total en plasma en las aves domésticas y de Guinea fueron similares a los valores reportados para razas exóticas, excepto la actividad de la fosfatasa alcalina, la cual fue menor. Los valores inferiores de los parámetros eritrocitarios en las aves domésticas autóctonas se atribuyen a un complejo malnutrición-parasitosis. El conteo leucocitario elevado en las aves autóctonas se explica como una respuesta a la exposición natural de las aves a organismos patógenos.

**Palabras clave** : Pollo - Gallina de Guinea - Composición de la sangre - Bioquímica - Crianza extensiva - Nigeria.