



RESEARCH PAPER

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Investigation of hematological and blood biochemical parameters in guinea fowl of Korhogo, Côte D'Ivoire

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Abstract

Hematological and biochemical blood analyzes have been widely used as indicators to assess animal health status. Data on hematological and biochemical blood parameters of several avian species have been studied in temperate climates, but studies of birds in our tropical environment are rare. The objective of this study is to explore the hematological and biochemical blood parameters of guinea fowl intended for consumption in the city of Korhogo. To do this, a venous blood sample was taken from 32 apparently healthy guinea fowl (17 males and 15 females) for blood count and biochemical tests. At the hematological level, mean values of red blood cells, white blood cells, pack cell volume, mean corpuscular volume and mean corpuscular hemoglobin were $3.02 \pm 0.11 \times 10^{12}/L$, $4.44 \pm 0.63 \times 10^9/L$, $27.28 \pm 1.02\%$, 123.99 ± 4.95 fl, 38.79 ± 1.83 pg respectively. They were higher in females than in males without significant difference. The mean hemoglobin of 09.98 ± 0.41 g/dL is the same for both sexes. In terms of biochemistry, mean levels of glucose, total protein, aspartate amino-transferase, uric acid, calcium and phosphorus were 2.82 ± 0.10 g/L, 4.88 ± 0.46 g/L, 83.34 ± 16.45 IU/L, 1.41 ± 0.25 mg/dL, 6.16 ± 0.55 mg/dL and 5.42 ± 0.05 mg/dL respectively. These parameters did not differ significantly by gender. Except for pack cell volume, uric acid and calcium, all hematological and serum biochemical values were within the general reference range of avian.

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Introduction

Poultry farming, particularly that of rural poultry, is a survival strategy for poor and deprived populations (Tjetjoo *et al.*, 2013). This rural poultry production represents 70% of poultry production in Côte d'Ivoire (Koné and Danho, 2008). In this poultry production, Meleagriculture is practiced for meat and eggs production (Yamak *et al.*, 2016). Compared to chicken farming, guinea fowl farming is more profitable because guinea fowl are more resistant to tropical diseases and, as a result, are better suited to traditional farming (Mishra *et al.*, 2002). In addition, its meat is higher in protein and lower in fat than broiler meat (Musundire *et al.*, 2017). In Côte d'Ivoire, Guinea fowl are commonly raised in the traditional management system by smallholder farmers (Koné *et al.*, 2018).

Despite the above-mentioned advantages of meleagriculture, little research has been done on this species in Côte d'Ivoire. However, mastery of all the biological parameters necessary for improving productivity and quality of production is necessary for guinea fowl farming. It is known that for the study of nutritional status, hematobiochemical profiles are most often used in animals, especially in birds (Adeyemi *et al.*, 2000). Hematological analyzes have been widely used as indicators to assess animal health status (Graczyk *et al.*, 2003).

The resultant changes of hematological analysis are important in assessing the response of the animal to various pathological, nutritional and physiological situations (Khan and Zafar, 2005). In birds, clinical signs of illness are often delicate, therefore, clinical chemistry is essential to assess cellular changes (Ritchie *et al.*, 1994). Furthermore, among blood biochemical parameters, elevated concentrations of total protein, serum glucose, and thyroid hormones are associated with improved nutritional status in animals (Todini, 2007; Habibu *et al.*, 2016). In addition, recent research uses the biochemical parameters of cattle blood for selection and improvement (Nguyen and Tran, 2003). Data on hematological and blood biochemical parameters of

several avian species have been studied in temperate climates, but studies on birds in our tropical environment are rare. To our knowledge, it seems that studies on the biological blood parameters in Guinea Fowl have never been conducted in Côte d'Ivoire. This work aims to explore biological blood parameters in Guinea Fowl.

Materials and methods

Description of the sampling area and Bird

The experiment was carried out from December 2020 to February 2021 in the department of Korhogo situated between 5°16 and 6°16 of longitude West, and at latitude 8°32 and 10°20 North in the northern Côte d'Ivoire.

A total of 32 guinea fowl, including 17 males and 15 females, of different ages and apparently healthy, were selected randomly for the study. The average age of the local chickens was 27.88 ± 6.30 weeks. Birds were sourced from smallholders. This is a descriptive cross-sectional study in guinea fowl intended for consumption at the poultry market in Korhogo.

Collection and analysis of blood sample

In each bird, a venous blood sample is taken from the jugular vein in tubes containing an anticoagulant, Ethyl Diamine Tetra Acetic (EDTA) and dry tubes in the morning between 7:00 and 9:00 am. These blood samples, placed in a cooler with ice, are transported before 12 o'clock on the day of the sampling to the laboratory of Peleforo GON COULIBALY University Health Centre in Korhogo for the performance of biochemical tests and blood count. Before blood in dry tubes was centrifuged at 3000 rpm for 5 minutes and the serum was aliquoted into micro bowls and was stored at -20 °C until further analyses.

Hematological parameters measured were red blood cells (RBC), packed cell volume (PCV), Hemoglobin (Hb) and total RBC indices: mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). Then, total white blood cell WBC count and its differentials (heterophils, lymphocytes,

monocytes, eosinophils and basophils). The hemoglobin concentration was determined by the cyanmethemoglobin method (Coles, 1986) while PCV was estimated by the microhematocrit method (Harr, 2006). The RBC and WBC counts were determined using the hemocytometer as described by (Swenson, 2004). The RBC indices were computed using the formulas provided by (Hochleithner, 2013).

Serum parameters including total protein, aspartate aminotransferase (ASAT), uric acid, calcium, phosphorus and glucose were determined by a semi-auto biochemical analyzer (RAYTO RT-9200) by using standard commercial diagnostic kits.

Statistical analysis

For statistical analysis, the data were entered and analyzed on STATISTICA software (Windows version 7.1). The mean values of the different biological parameters in the birds were compared using the non-parametric Mann-Whitney U test. Comparisons of the different proportions obtained of the main

blood parameters were performed by the Loglikelihood ratio test ("G" test) with the statistical software "R" version Windows 2.0.1. The level of significance was reported at less than $P < 0.05$.

Ethics

Experimental procedures and protocols used in this study were approved by the ethical committee of Health Sciences, University Peleforo Gon Coulibaly (Korhogo/Côte d'Ivoire). These guidelines were in accordance with the internationally accepted principles for laboratory use and care. Then, this study was approved by the Ministry of Animal Production and Fishery Resources in the Republic of Côte d'Ivoire.

Results

Mean values of hematological parameters

The mean values of the different hematological parameters in guinea fowl associated with the standard error on the mean (SEM) are presented in Table 1.

Table 1. Mean values of hematological parameters in Guinea fowl.

Haematological parameters	Total population n=32			Male n=17			Female n=15			p-value
	Mean \pm SEM	Min	Max	Mean \pm SEM	Min	Max	Mean \pm SEM	Min	Max	
Red blood cells ($10^{12}/L$)	3.02 \pm 0.11	2.03	4.20	2.99 \pm 0.15	2.02	4.02	3.03 \pm 0.16	2.03	4.20	0,74(NS)
Hemoglobin (g/dL)	09.98 \pm 0.41	6.70	15.50	09.98 \pm 0.50	6.90	13.90	9.98 \pm 0.69	06.70	15.70	0,85(NS)
PCV (%)	27.28 \pm 1.02	14.00	44.00	26.59 \pm 1.11	19.00	34.00	28.06 \pm 1.82	14.00	44.10	0,60(NS)
MCV (fl)	123.99 \pm 4.95	89	180	117.91 \pm 6.67	89	179	130.89 \pm 7.18	91.0	180	0,17(NS)
MCH (pg)	38.79 \pm 1.83	20.00	57.00	37.19 \pm 2.49	21.00	57.00	40.61 \pm 2.74	20.00	57.00	0,34(NS)
MCHC (g/dL)	36.45 \pm 1.20	27.00	58.00	37.10 \pm 1.65	30.90	58.00	35.70 \pm 1.78	27.00	50.00	0,43(NS)
White blood cells ($10^9/L$)	4.44 \pm 0.63	1.02	11.00	4.49 \pm 0.86	1.23	11.00	4.40 \pm 0.95	1.02	10.70	0,76(NS)
Heterophils (%)	36.09 \pm 1.47	26.00	60.00	37.29 \pm 2.01	28.00	60.00	34.73 \pm 2.15	26.00	52.00	0,24(NS)
Eosinophils (%)	7.22 \pm 0.60	2.00	14.00	7.53 \pm 0.80	2.00	13.00	6.87 \pm 0.91	2.00	14.00	0,70(NS)
Lymphocytes (%)	51.41 \pm 1.47	32.00	67.00	50.12 \pm 1.99	32.00	64.00	53.73 \pm 2.14	39.00	67.00	0,77(NS)
Monocytes (%)	3.87 \pm 0.48	1.00	11.00	3.75 \pm 0.64	1.00	11.00	4.00 \pm 0.74	1.00	04.00	0,89(NS)
Basophile (%)	1.53 \pm 0.22	0.00	7.00	1.59 \pm 0.35	1.00	7.00	1.47 \pm 0.24	0.00	3.00	0,77(NS)
Thrombocytes ($10^6/l$)	31.28 \pm 0.74	21.00	37.00	30.25 \pm 0.78	22.00	37.00	32.31 \pm 0.68	21.00	36.00	0,17(NS)

n: Total number of each subjects group; MCV: Mean Corpuscular Volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; SEM: Standard error of mean; Min: Minimum; Max: Maximum; S: Statistically different for p value < 0.05 ; NS: Not statistically significant for p value < 0.05 .

For the erythrocyte line, the mean red blood cell count was $3.02 \pm 0.1 \times 10^{12}/L$ with extremes ranging from 2.03 to 4.20. It was higher in females than in males without significant difference. The mean hemoglobin value, which was 09.98 ± 0.41 g/dl, was

the same between males and females. The extremes were 6.70 to 15.50 g/dl. Mean PCV, MCV and MCHC values were higher in guinea fowl females than in males without significant difference ($P > 0.05$). They were $27.28 \pm 1.02\%$, 123.99 ± 4.95 fl and 38.79 ± 1.83 pg

respectively. The extreme values were 14-44%, 89-180 fl and 20-57 pg respectively. In contrast to other erythrocyte indices, MCHC was higher in males than in females, with no significant difference. The mean rate in guinea fowl is 36.45 ± 1.20 g/dL with extremes ranging from 27 to 58 g/dL.

In the leukocyte line, the mean white blood cell count was $4.44 \pm 0.63 \times 10^9$ /L with extremes of 1.02 to 11×10^9 /L. It was higher in males than in females without significant difference. The mean percentage of heterophilic and lymphocyte was $36.09 \pm 1.47\%$ and $51.41 \pm 1.47\%$ respectively. It was higher in males than in females in guinea fowl at the heterophilic level as opposed to lymphocytes or the rate was higher in females. The mean eosinophils and basophils were $7.22 \pm 0.60\%$ and $1.53 \pm 0.22\%$, respectively. In both

cases, it was higher in male guinea fowls than in female guinea fowls without significant difference. Monocytes were higher in females than in males but without significant difference. Its mean value in the guinea fowl in the study was $3.87 \pm 0.48\%$. The mean thrombocytes were 31.28 ± 0.74 higher in females than in males without significant difference.

Mean values of biochemical parameters

The mean glucose level was 2.82 ± 0.10 g/L with extremes ranging from 1.50 3.79 g/L. That of ASAT was 83.34 ± 16.45 IU/L, the minimum value being 3.30 and the maximum 334.1.

The mean serum calcium and serum phosphorus levels in guinea fowl were 6.16 ± 0.55 mg/dl and 5.42 ± 0.05 mg/dL, respectively (Table 2).

Table 2. Mean values of blood biochemical parameters in Guinea fowl.

Biochemical parameters	Total population n=32			Male n=17			Female n=15			p-value
	Mean \pm SEM	Min	Max	Mean \pm SEM	Min	Max	Mean \pm SEM	Min	Max	
Glucose (g/L)	2.82 ± 0.10	1.50	3.79	2.67 ± 0.08	2.10	3.33	2.99 ± 0.18	1.50	3.79	0.058 (NS)
Total Protein (g/dL)	4.88 ± 0.46	2.00	15.00	5.41 ± 0.78	3.00	15.00	4.27 ± 0.38	2.00	7.00	0.4883(NS)
ASAT (UI/L)	83.34 ± 16.45	3.30	334.1	74.61 ± 21.08	4.10	298.8	96.84 ± 27.03	3.30	334.1	0.2057(NS)
Uric acid (mg/dl)	1.41 ± 0.25	0.25	7.83	1.56 ± 0.41	0.44	7.83	1.23 ± 0.24	0.25	3.39	0.4499(NS)
Calcium (mg/dl)	6.16 ± 0.55	0.38	10.39	5.67 ± 0.78	0.66	10.34	6.83 ± 0.79	0.38	10.39	0.4059(NS)
Phosphorus (mg/dL)	5.42 ± 0.05	4.65	5.77	5.39 ± 0.08	4.65	5.77	5.45 ± 0.04	5.26	5.70	0.9547(NS)

n: Total number of each subjects group; ASAT: Aspartate amino-transferase; SEM: Standard error of mean; Min: Minimum; Max: Maximum; S: Statistically different for p value < 0.05; NS: Not statistically significant for p value < 0.05.

All these parameters were higher in females than in males without significant difference. However, the mean of uric acid and total protein were higher in males than in females again without significant difference. Their mean values were 1.41 ± 0.25 mg/dL and 4.88 ± 0.46 mg/dL respectively.

Discussion

Hematobiochemical parameters can provide, when properly interpreted, an accurate picture of the health status of an animal at the time of collection i.e., nutritional status, disease status, or handling stress and can also reflect the quality of the animal's habitat or environment (Oyewale, 2011). This study presents the mean values of hematological parameters and

some blood biochemical parameters in guinea fowl. The mean value of erythrocyte parameters that are hemoglobin, PCV, MCV, MCH and MCHC in this study is lower than that obtained in the works of Ali *et al.*, 2019, Habibu *et al.*, 2016, King *et al.*, 2010, Obinna *et al.*, 2011 in Africa and Christev *et al.*, 2011; Straková *et al.*, 2010 in Europe. Concerning red blood cells, the mean value of our study was higher than the works of Habibu *et al.*, 2016, King *et al.*, 2010, Straková *et al.*, 2010 and inversely lower than that of Ali *et al.*, 2019; Christev *et al.*, 2011. Another study conducted in North-West Nigeria by Uko and Ataja, 1996 showed a high mean red blood cell count like ours. In the same study outside of hemoglobin, the mean value of all erythrocyte parameters was lower

than in our study. Increased red blood cell counts may reflect high oxygen-carrying capacity in a hot and humid tropical environment with higher metabolic activities and oxygen requirements. Traditional guinea fowls are very active in foraging. Also, permanent dehydration of the birds reduces the liquid part of the blood, which leads to a relative increase in the percentage of red blood cells.

In contrast to the work of Adedibu *et al.*, 2014, MCHC is higher in males than females, while red blood cells, hemoglobin, PCV, MCV and MCH are higher in females than in males. Nevertheless, the RBC, MCV, MCHC, PVC and MCH values of both sexes were within the general reference range of avian (Coles, 2005).

Only the PCV average is lower than those of these references. It is also very low compared to the work of Penkov *et al.*, 2019 during laying. Compared to other avian species, the mean of these hematological parameters is similar to that obtained in local chickens by Kokoré *et al.*, 2021a in the same locality. Differential leucocytes are used as indicators of stress response and are sensitive biomarkers that are vital for immune functions in birds (Muhammad and Oloyede, 2009). The Leukocyte Parameter mean values are consistent with the general reference values reported by Coles, 2005 and do not vary by gender.

The mean of white blood cells is much lower than that obtained by King *et al.*, 2010. On the other hand, it was higher than that of the works of Uko and Ataja, 1996 and Ali *et al.*, 2019, Obinna *et al.*, 2011 and Olayemi 2009.

The mean of RBC (4.44 ± 0.63) remains high. This high rate may be due to infections or handling stress at sampling or simply due to natural biological random variation as notified by Gross and Single 1983 et King *et al.*, 2010. Infectious bursal disease virus has been reported to cause alterations in different haematological parameters of poultry (Zeryehun, *et al.*, 2012). The glucose, ASAT, Calcium,

Phosphorus and total protein values were within the general reference range of avian (Coles, 2005). Serum protein levels of birds are considered important indicators for the determination of their health status.

The total protein level is higher in males than in females contrary to the work of Uko and Ataja, 1996, Penkov *et al.*, 2019 and Obinna *et al.*, 2011. This could be explained by the age of the guinea fowl. Guinea fowls have not yet reached the laying age, during which total proteins are very high and reach their peak in females (Penkov *et al.*, 2019).

The glucose level obtained in this study is lower than that obtained by Olowookorun *et al.*, 1980. Contrary to their work, glucose is higher in females than in males in the present study. This mean glucose level is nevertheless higher than that obtained by Kokoré *et al.*, 2021b, in local and broilers. Similarly, Weideman *et al.*, 2012 showed that Guinea Fowl have higher basal glucose levels than chickens. The mean uric acid level obtained in this study is well below the reference in birds (Coles, 2005). It is also lower than that obtained by Donaldson *et al.*, 2017. It is known that biochemical parameter values of birds are strains dependent (Hrubec *et al.*, 2002). According to Coles, 2005, normal plasma values for ASAT in most birds should normally be below 230 IU/l but can be in the range of 52-270 IU/l. The average ASAT is therefore in accordance with international standards. The average value is higher than that obtained in the work Nikolov *et al.*, 2017 in guinea fowl. The ASAT mean is therefore in line with international standards. The mean value is higher than that obtained in Nikolov *et al.*, 2017 studies in guinea fowls.

Maintenance levels of electrolytes such as calcium and phosphorus in the blood plasma are essential for many living processes. Regarding the calcium level, that of our study is below most of the reference standards in birds. It is also lower than the values obtained by Obinna *et al.*, 2011 and Onyeanus, 2007 in the rainy season. On the other hand, the mean is higher than that obtained by Onyeanus, 2007 in the dry season. The low calcium level is explained by the

season of collection, especially since the work was carried out in the dry season, but also by the mean age of the guinea fowl (27.88 ± 6.30 weeks). At this age, female guinea fowls have not yet reached the laying period or their calcium levels are increasing significantly. However, the mean value was higher in females in this study. Phosphorus levels are similar to those obtained by Onyeausi, 2007 and do not vary significantly between guinea fowl.

Conclusion

This study presented the mean values of hematological and biochemical blood parameters in guinea fowl. The mean of the erythrocyte parameters, apart from hemoglobin where the mean is the same and MCHC where the mean is higher in males, are higher in females without significant difference. For leukocyte parameters outside lymphocytes and monocytes, mean values are higher in males. In terms of the biochemical parameters measured, except for total protein and uric acid, all other parameters were higher in females without significant difference. In general, the hematological and biochemical blood profile of birds is influenced by various factors such as diet, environment, type of production and reproduction, etc. It is therefore not possible to obtain values that could be considered as reference values. Since such values are practically non-existent in guinea fowl in Côte d'Ivoire, the values presented in this article can be used as a guide to assess the health status of guinea fowl.

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