



Haematological and Electrolyte Constituents of Scavenging Muscovy Ducks (*Cairina moschata*) in Makurdi, North-Central Nigeria

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Abstract

The study investigated the haematological and electrolyte constituents of scavenging Muscovy ducks in Makurdi, Benue state, North-Central Nigeria to assess their health and stress status. A total of 20 apparently healthy adult Muscovy ducks (10 birds per sex) reared on scavenging system were used for the study. Two sets of blood samples were collected from each duck at point of sacrificing and analysed for haematological and electrolyte constituents. The result showed that sex did not significantly ($P>0.05$) influence all the parameters studied with values that were comparable to other works. The overall mean haemato-biochemical values from this study were $2.00 \times 10^{12}/L$ (red blood cell), 35.85% (packed cell volume), 19.24 g/dL (haemoglobin), 98.43pg (mean corpuscular haemoglobin), 57.21 g/dL (mean corpuscular haemoglobin concentration), 187.38 fL (mean corpuscular volume), $132.00 \times 10^9/L$ (platelets), $14.56 \times 10^9/L$ (white blood cell), 43.55% (heterophils), 1.85% (eosinophils), 52.55% (lymphocytes), 2.05% (monocytes), 0.92 (heterophil/lymphocyte ratio), 2.16mg/dL (calcium), 157.00 mmol/L (sodium), 7.87mmol/L (potassium), 112.17mmol/L (chloride), and 9.37 mg/dL (phosphate). Therefore, the haematological and electrolyte constituents of the scavenging Muscovy ducks studied in comparison with available literature on healthy ducks possibly indicated normal health and low stress status of the birds.

Keywords: Blood indices, electrolytes, Muscovy, stress status, Makurdi, North-Central Nigeria.

Introduction

In Nigeria, duck population was ranked third (9,553,911) after chicken (101,676,710) and guinea fowl (16,976,907) respectively¹ with the Muscovy duck being the most dominant breed of ducks reared in Nigeria². They are mostly found around the coastal areas of Southern Nigeria³ but occur in other parts of the country. These ducks are easily identified by characteristic red fleshy outgrowths around the eyes and bills called caruncles that are more prominent in mature males. They have fast growth rates, good carcass dressed weight, are tough and hardy to diseases that easily affect chickens. Muscovy ducks are specifically equipped for scavenging systems because of their top notch foraging and incubation behaviour as well as high tolerance to warm environments⁴.

In North-Central Nigeria and precisely Makurdi, Benue state, these ducks are reared on extensive management and primarily for home consumption and supplemental income. The serious neglect of this poultry species is evident by the high preference for chicken products over ducks, which are usually considered as dirty birds due to its fondness for muddy places. Report indicates that eggs from these ducks are rarely consumed or sold by farmers but rather used primarily for breeding purposes⁵. Although, Muscovy ducks are better adapted to scavenging conditions than chickens, however, prolonged exposures to

extreme climatic factors, diverse diseases and poor nutrition may predispose them to stress that could alter haematological constituents and biochemical characteristics especially electrolytes among apparently healthy populations. Blood profiles could be influenced by sex, age, genetic makeup, climatic factors and management practice among others⁶. In animal health, blood analyses have been performed much less often in avian species in contrast to its predictable use in mammalian species⁷, thus, haematological and serum biochemical profiles offer dependable information on the health status of animals⁸.

Research efforts at generating baseline information on blood profiles of local ducks in Nigeria have shown to be inadequate thereby limiting information that could be useful in assessing overall health to guide management decisions. Previous literatures on haematological constituents of Muscovy ducks in Nigeria are very scanty as compared to the extensive documentation on exotic duck breeds found all over the world. Blood studies on Muscovy ducks in Nigeria have been reported in the South-South^{9,10}, South-West^{11,12}, South-East¹³ and North-West¹⁴. However, there is a dearth of information on haematological and electrolyte characteristics of Muscovy ducks in North-Central Nigeria, thus, prompting this research interest on these ducks in Makurdi with the aim of assessing their health and stress status.

Methodology

Experimental Birds and Procedure: Twenty (20) apparently healthy adult scavenging Muscovy ducks *Cairina moschata* comprising ten birds per sex were purchased in early February, 2020 from rural household rearers in three village settlements near the Joseph Sarwuan Tarka University, Makurdi, Benue state, North-Central Nigeria and used for the study. Makurdi is geographically located between latitude 6° 5" N and 8° 5" N and between longitude 7° 47" E and 10° E. The ages of the ducks could not be ascertained since the rearers did not keep any form of records. The birds were sampled on the basis of their breeding potential using visual appraisals of their body conformation and caruncle development while ensuring body weights of at least 1.5 kg (males) and 1.3 kg (females). The ducks were typically reared in makeshift shelters with little or no feeding, or water bath facilities provided. Feed resources that were common in the bird's environment include kitchen wastes, supplemental grains, insects, worms and toads, succulent grasses etc, which for some were more available during cropping activities.

Blood Collection: Two sets of jugular venous blood samples were collected using standard procedures from each duck at the point of sacrificing by neck slaughter into a set of test tubes. The first set of blood samples contained the anticoagulant EDTA while the second set was without the anticoagulant and were then analyzed separately for haematological and serum electrolytes constituent respectively using Erba Mannheim® Chem5Z3 digital blood analyzer. The haematological constituents determined were red blood cell (RBC), packed cell volume (PCV), haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV), platelets (PLT), white blood cell (WBC), heterophils (HET), eosinophils (EOS), basophils (BAS), Lymphocytes (LYM), Monocytes (MON) and heterophil/lymphocyte ratio (H/L). The serum electrolytes considered include calcium, sodium, potassium, chloride and phosphate.

Statistical Analysis: Statistical analysis of data was performed using IBM SPSS version 21.0 software¹⁵. The mean concentrations of haematological indices and serum electrolyte characteristics were compared between male and female using t-test analysis at 95% confidence interval with significance denoted at $p < 0.05$ or non significance at $p > 0.05$.

Results and Discussion

The haematological indices for scavenging Muscovy (Mus) ducks with respect to sex was recorded and expressed as mean±SEM (Table-1). The results indicate statistical similarity ($p > 0.05$) in the parameters between male and female Mus ducks studied even though, numerically superior values were observed between the sexes for some of the indices. Literatures on blood studies and reference values of local ducks in Nigeria are much

fewer compared to chickens which abound. Blood cellular components comprise of erythrocytes (RBC), leucocytes (WBC) and thrombocytes (PLT). RBC is manufactured in the bone marrow and contains haemoglobin that transports oxygen (and carbon dioxide) in the blood¹⁶. The statistically similar ($p > 0.05$) RBC from this study conformed with the previous findings for Mallard (Mal) ducks reared in South-West (SW) Nigeria¹⁷ and Mus ducks in South-South (S-S) Nigeria⁹. However, the significant ($p < 0.05$) effect of sex on RBC was observed in a recent study on Mal and Mus ducks in S-S Nigeria¹⁰. The pooled mean for RBC in this study was similar to the value of $2.02 \pm 0.56 \times 10^{12}/L$ obtained during the dry season for Mal ducks in S-W Nigeria¹². In contrast, these authors observed higher RBC values ($2.46 \pm 0.45 \times 10^{12}/L$) for the same ducks during the wet season. In addition, higher overall mean RBC values has been reported for Mal ducks ($2.43 \pm 0.58 \times 10^{12}/L$) in the S-W¹⁷ and Mus ducks ($2.41 \pm 0.04 \times 10^{12}/L$, $4.62 \pm 0.24 \times 10^{12}/L$) in the S-S^{9,10}. Many factors such as nutrition, breed, age, sex, moulting, laying season, and geographical location mainly influence the haematological profiles of healthy birds^{12,13,18,19}.

PCV also known as haematocrit (HCT) or erythrocyte volume fraction (EVF) expresses the percentage of red blood cells in the blood²⁰. The non significant ($p > 0.05$) effect of sex on PCV recorded in this study was in line with previous literature reports for Mus ducks in S-E¹³ and Mal ducks in S-W¹⁷ Nigeria. However, sex effect was significantly ($p < 0.05$) observed on the PCV of Mal²¹ and Mus^{9,10} ducks from S-E and S-S regions respectively. The overall mean PCV in this study (35.85 %) was comparably higher than 29.81%⁹ and 31.00%¹⁰ recorded for Mus ducks in the S-S region. In addition, the high PCV value of 43.59% has been reported in literatures for Mus¹³ and Mal²¹ ducks respectively in the S-E region. Similarly, higher PCV values of 45.00% and 50.25% respectively was recorded for Mal ducks in S-W Nigeria during the dry and wet seasons¹². The observed differences in PCV between this study and other authors could have been due to varying management conditions, climatic influences, age and physiological status of the birds.

Hb (haemoglobin) is the red blood cell pigment which gives blood its red colour and has complex structures that contain iron, protein (globin), and pigment (heme) that bound and circulate oxygen in body tissues²². MCH, MCHC and MCV are parts of the red cell indices that reflect the size and haemoglobin content of red blood cells and these have traditionally aided in the differential diagnosis of anaemia²³. MCH expresses the average content (weight) of Hb per red cell²⁴ and can be used in combination with MCV to determine if an anaemia is normo-, hypo-, or hyper chromic²³. Meanwhile, MCHC expresses the average weight of hemoglobin per unit volume of red cell²⁵. The statistical similarity ($p > 0.05$) in Hb, MCH and MCHC between the sexes of ducks in this study have been corroborated by literature findings^{9,17,21}. In contrast, the significant ($p < 0.05$) effect of sex on these parameters was reported for Mus ducks in the S-S region¹⁰. The pooled mean Hb concentrations from this study were comparably higher than the values recorded for

ducks reared in the S-E⁹, S-S¹⁰ and S-W¹⁷ which could be due to varying management conditions, geographical location and physiological status of birds. The possible effect of season on MCH and MCHC concentrations has been observed for Mal ducks in the S-W region¹². The differing management practices, seasonal effect, geographical location and physiological conditions of birds between this study and the other authors could have been partly responsible for the observed variations in MCH and MCHC recorded in this study.

MCV expresses the average volume of haemoglobin per unit size of red cell²⁶. The findings on MCV ($p>0.05$) in this study concurred with previous reports on Mal ducks in S-W¹⁷ and S-E²¹ Nigeria as corroborated by the observed comparable overall mean value of 183.06 ± 28.95 fl¹⁷. Higher MCV concentrations (196.06 ± 39.59 fl and 234.24 ± 53.80 fl) were observed for Mal ducks during the wet and dry seasons respectively¹² while lower concentration (124.74 ± 0.42 fl) was recorded for Mus ducks in the S-S region⁹. However, the significant ($p<0.05$) influence of sex on MCV was observed for Mus ducks in the S-S region⁹. These observed variations between this study and other literature may be attributed to different management practices, age, season, geographical location etc.

Platelets (PLT) also known as thrombocytes are the smallest blood cells in circulation which is responsible for stopping bleeding through the formation of blood clots. Literature is lacking on thrombocyte values of ducks in Nigeria thus limiting valuable comparisons with this study. The similarity in PLT ($p>0.05$) in this study was in line with previous findings for Egyptian Mus ducks²⁷. However, the effect of sex on PLT ($p<0.05$) was observed in Mus ducks from S-S Nigeria with a comparably higher overall mean value ($249.41\pm 4.91 \times 10^9/L$)¹⁰. The observed deviations in PLT between this study and the other authors could probably be due to differences in duck management system, age, physiological status and geographical location.

White blood cells (WBC) also known as leucocytes are divided into two groups: granulocytes (heterophils, eosinophils and basophils) and agranulocytes i.e. lymphocytes and monocytes¹⁴ and their primary function is to protect the body against infection¹⁶. The WBC result in this study ($p>0.05$) agreed with literature reports for Mus ducks in S-S Nigeria⁹ and Indonesian Mus ducks during dry and wet seasons²². In contrast, the influence of sex on WBC ($p<0.05$) was observed in Mus ducks from S-S¹⁰ and Mal ducks from S-E²¹ Nigeria. A similar effect of sex on WBC ($p<0.05$) was also observed in Indonesian local ducks during both dry and wet seasons²². The overall mean WBC from this study was similar to $12.21\pm 7.17 \times 10^9/L$ ¹⁰ and $16.96\pm 2.23 \times 10^9/L$ ¹⁷ for Mus ducks in S-S and Mal ducks in S-W Nigeria respectively which suggests considerable antibody defense activity of the birds. Literature reports have shown overall mean WBC values that were comparably lower ($6.58\pm 1.60 \times 10^9/L$) and higher ($22.55\pm 4.69 \times 10^9/L$) than this study for Mal ducks from S-W Nigeria during both dry and wet

seasons. Animals with lower WBC were exposed to high risk of disease infection while those with high counts were capable of generating antibodies in the process of phagocytosis and had high degree of disease resistance²⁸. The differences observed in WBC between this study and other works may be due to effect of season, management conditions and physiological status of the birds.

Heterophils (HET), the avian equivalent of the mammalian neutrophils are critical to the immune defense of birds²⁹ and together with lymphocyte (LYM), are the most numerous components of blood leucocytes¹⁶. Eosinophils (EOS) is particularly important in response to parasitic and allergic invasion while basophils (BAS) are the least numerous peripheral leucocytes that play important roles in defense mechanisms¹⁶. The observations for HET and EOS in this study ($p>0.05$) was previously corroborated for Mus ducks in S-E Nigeria¹³. Also, similar results on EOS ($p>0.05$) was reported for same birds in the S-S region⁹. In addition, sex did not influence HET and EOS of Indonesian local ducks²² and Indian Pekin ducks³⁰. However, the effect of sex was observed on HET of Mus ducks in S-S Nigeria⁹. This could be attributed to differences in age, management systems, geographical location and physiological condition of the birds.

The overall mean HET from this work (43.55%) was similar to 40.57 % reported for Mal ducks in the S-W region³¹ but was higher than 13.67% observed for Mus and Mal ducks in S-E Nigeria^{13,21}. Also, lower HET values (24.04% and 19.42%) have been reported for Mus ducks in the S-S⁹ and North-West (N-W)¹⁴ Nigeria respectively, while the possible influence of season was shown in Mal ducks from S-W Nigeria with values consequently lower (31.8%) in the dry season but higher (63.50%) in the wet season¹². EOS from this study was comparably higher than 0.79%³¹ and 0.88%¹² respectively for Mal ducks in the S-W region which may be an indication of considerable defense response mechanisms to parasitic or allergic invasions. In contrast, reports from literature have recorded higher EOS values of 4.00%, 6.25% and 10.50% respectively for Mus ducks in N-W¹⁴, S-E¹³ and S-S Nigeria⁹. The non detection of BAS in this study is an occurrence that may not have any serious implications, as such was also supported by previous literature for Mus and Mal ducks^{12,13,21,31}. In addition, low BAS values of 0.04 %⁹ and 1.25%¹⁴ have been reported for Mus ducks in S-S and N-W Nigeria respectively. The differences in HET, EOS and BAS between this study and other authors may have been due to varying ages, management practices, geographical location, seasonal influences and physiological status of birds.

LYM form an essential component of the immune response and undergo differentiation and proliferation to give rise to B-cells that is responsible for humoral or antibody-mediated immunity and T-cells that is responsible for cell-mediated immunity¹⁶. Monocytes (MON) and granulocytes are phagocytes derived in the bone marrow that ingest and destroy pathogenic bacteria and

cell debris as a response to tissue inflammation¹⁶. The non significant ($p>0.05$) effect of sex on LYM and monocytes (MON) in this study was in consonance with literature findings for Mus ducks in S-S⁹ and S-E¹³ Nigeria, local Indonesian ducks²² and Indian Pekin/indigenous ducks³⁰.

The overall mean LYM value from this study (52.55%) was comparably lower than the values of 65.61%, 80.09% and 65.16% and for Mus ducks from the S-S, S-E and N-W Nigeria respectively^{9,13,14}. Meanwhile MON value from this study (2.05%) was comparatively higher than 0.88% (dry season) and 1.55% (wet season) for Mal ducks in the S-W region¹², and much higher than 0.29% for Mus ducks in S-S⁹ but lower than 8.75% for Mus in N-W¹⁴ Nigeria. The deviations in LYM and MON observed between this study and other authors could be attributed to different management systems, geographical location and physiological conditions.

One of the indicators of stress³² and comfort³³ in fowls is the heterophil/lymphocyte (H/L) ratio. It has been suggested that H/L ratio was more reliable in measuring fowl comfort than blood corticosterone level, with heat stress bringing about increased ratios³⁴. The H/L ratio in this work ($p>0.05$) was similarly recorded in Mal ducks from S-W Nigeria³¹, Indonesian Mus ducks²² and Indian Pekin/indigenous ducks³⁰. Previous works on the H/L ratio of ducks from Nigeria are generally scarce. The average H/L ratio obtained in this study (0.92%) was close to 0.77% observed for Mal ducks in S-W Nigeria³¹ but lower than 1.81% and 2.10% respectively for male and female Indonesian Mus ducks²².

Similarly, higher values (1.97%) were observed for Indian Pekin ducks during the dry season³⁰. These variations between this study and other authors could be attributed to differences in breed, physiological status of the birds, management, geographical locations and climatic influences. The low H/L levels obtained in this study may be an indication of the ability of ducks to withstand stress and resist diseases. It was opined that H/L ratio generally describe a robust measure of physiological stress in birds³⁵ as birds with low H/L ratio were superior to birds with high H/L ratio in terms of survival, immune response and resistance to infection^{35,37}.

Table-2 presents the electrolyte constituents (mean \pm SEM) of scavenging Muscovy ducks in this study. The results showed similarity ($p>0.05$) in electrolytes between the sexes of ducks. Available literature on the serum electrolyte constituents of ducks in Nigeria is grossly insufficient thus limiting valuable comparisons with this current work. Calcium observations in this study ($p>0.05$) was in line with literatures for indigenous chickens of S-W Nigeria³⁸ and Czechian Mal ducks³⁹. However, sex differences ($p<0.05$) in calcium concentrations were found for Mus ducks in S-E Nigeria¹³. The overall mean calcium concentration obtained in this study (8.63mg/dL) was comparable to 7.98 mg/dL reported for Mus ducks in S-E Nigeria¹³ but lower than 13.28mg/dL and 13.83mg/dL

respectively for Indian Pekin and Indian Khaki Campbell ducks⁴⁰. The statistical similarity ($p>0.05$) in blood sodium and potassium concentrations in this study was previously corroborated by few duck studies^{13,39} however, the effect of sex ($p>0.05$) on potassium concentration was recorded in Mal ducks³⁹.

The overall mean sodium concentration (157.3mmol/l) for Czechian Mal ducks³⁹ was similar to the present work (157.00 mmol/l), however, the result of this study was comparably higher than 139.5mmol/l observed for Mus ducks in S-E¹³ but lower than 167.33mmol/l¹⁷ reported for Mal ducks in S-W Nigeria. Lower overall mean potassium concentrations (3.54 mmol/l and 2.89mmol/l) were reported for Mus ducks in S-E Nigeria¹³ and Czechian Mal ducks³⁹ respectively in comparison to the 7.87mmol/l obtained in this study. In addition, higher potassium concentration of 18.63mmol/l has also been recorded for Mal ducks in S-W Nigeria¹⁷.

The statistically similar ($p>0.05$) chloride and phosphate concentrations recorded between male and female ducks in this study concurred with observations for Czechian Mal ducks with chloride concentration (105.2mmol/l)³⁹ that was comparable to 112.17mmol/l found in this study. Similarly, the non influence of sex on chloride electrolyte was confirmed by a study on indigenous chickens in S-W³⁸ Nigeria, however, the effect of sex was observed on phosphate electrolyte of Mus ducks in S-E Nigeria¹³. The overall mean phosphate concentration (5.59 mg/dL) for Mus ducks in S-E Nigeria¹³ was comparably lower than the findings of this study (9.37mg/dL). The variations witnessed in the electrolyte concentrations between this study and other literatures cited may have been due to differences in age, breed and geographical location.

Conclusion

In conclusion, sex did not differentiate the haematological and electrolyte constituents of the scavenging Muscovy ducks studied and comparison with available literature on healthy ducks possibly indicate normal health and low stress status of the birds. The lack of established reference values for ducks according to age, sex, physiological conditions etc from substantial parts of Nigeria did not allow for conclusive interpretations of the results. The data generated from this work could serve as reference for future blood studies on ducks from the present region.

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Table-1: Haematological values (mean±SEM) of scavenging Muscovy ducks in Makurdi, North-Central Nigeria.

Parameter	Overall mean	SE	Male (n=10)		Female (n=10)	
			Mean	SEM	Mean	SEM
Red blood cell (RBC), x10 ¹² /L	2.00	0.09	1.93 ^{NS}	0.07	2.07 ^{NS}	0.16
Packed cell volume (PCV), %	35.85	1.40	37.50 ^{NS}	1.93	34.20 ^{NS}	2.00
Haemoglobin (Hb), g/dL	19.24	0.74	17.95 ^{NS}	0.68	20.52 ^{NS}	1.22
Mean corpuscular haemoglobin (MCH), pg	98.43	4.94	94.60 ^{NS}	0.68	102.26 ^{NS}	8.08
Mean corpuscular haemoglobin concentration (MCHC), g/dL	57.21	5.21	53.45 ^{NS}	7.39	60.97 ^{NS}	7.53
Mean corpuscular volume (MCV), fL	187.38	9.75	194.07 ^{NS}	13.77	180.69 ^{NS}	14.21
Platelets (PLT), x10 ⁹ /L	132.00	12.10	109.80 ^{NS}	10.07	154.20 ^{NS}	20.19
White blood cell (WBC), x10 ⁹ /L	14.56	1.08	12.62 ^{NS}	10.07	16.51 ^{NS}	1.39
Heterophils (HET), %	43.55	2.67	46.90 ^{NS}	10.07	40.20 ^{NS}	4.17
Eosinophils (EOS), %	1.85	0.23	2.30 ^{NS}	0.34	1.40 ^{NS}	0.27
Basophils (BAS), %	0.0	0.0	0.00	0.0	0.0	0.0
Lymphocytes (LYM), %	52.55	2.73	48.80 ^{NS}	3.10	56.30 ^{NS}	4.35
Monocytes (MON), %	2.05	0.15	2.00 ^{NS}	0.21	2.10 ^{NS}	0.23
Heterophil/lymphocyte (H/L) ratio	0.92	0.10	1.03 ^{NS}	0.12	0.81 ^{NS}	0.15

n: Number of observations. SE: Standard error. SEM: Standard error mean. NS: Not significant at p>0.05.

Table-2: Electrolyte values (mean ±SEM) of scavenging Muscovy ducks in Makurdi, North-Central Nigeria.

Parameter	Overall mean	SE	Male (n=10)		Female (n=10)	
			Mean	SEM	Mean	SEM
Calcium (mg/dL)	8.63	0.36	8.53 ^{NS}	0.13	8.74 ^{NS}	0.52
Sodium (mmol/l)	157.00	1.40	158.20 ^{NS}	0.69	155.80 ^{NS}	0.67
Potassium (mmol/l)	7.87	0.73	7.23 ^{NS}	0.71	8.51 ^{NS}	0.92
Chloride (mmol/l)	112.17	1.13	112.60 ^{NS}	0.54	111.74 ^{NS}	0.50
Phosphate (mg/dL)	9.37	0.40	9.54 ^{NS}	0.61	9.20 ^{NS}	0.55

n: Number of observations. SE: Standard error. SEM: Standard error mean. NS: Not significant at p>0.05.

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