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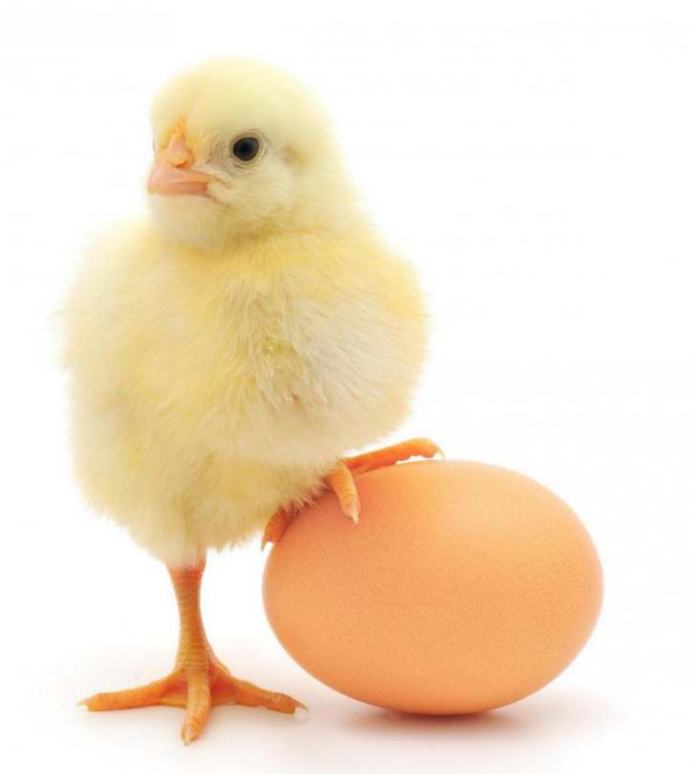

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Indices of Health; Clinical Haematology and Body Weights of Free-range Guinea Fowl (*Numida meleagris*) from the Southern Province of Zambia

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Abstract: Very little is known about the indices of health in free-range helmeted guinea fowl (*Numida meleagris*); particularly body mass and haematological values. The objective of the study was to determine baseline haematological and body mass values of free-range guinea fowls in Zambia. Body weights were measured and blood samples were collected from 90 clinically healthy adult guinea fowl. The blood was tested for total erythrocyte count, Packed Cell Volume (PCV), total plasma proteins, haemoglobin content, total leukocyte count, differential leukocyte counts. Erythrocyte indices were also calculated. The study revealed the following results in male guinea fowl 2.65±0.09 x 10^{12}/l erythrocytes, haemoglobin content 14.2±0.54 g/dl, packed cells volume 40.8±0.66%, total plasma protein 3.8±0.07 g/dl, 22.4±1.7 x 10^{6}/l leucocytes (1.1% basophils, 2.2% eosinophils, 16.5% heterophils, 79.7% lymphocytes and 1.0% monocytes) and body weights 1.24±0.02 kg. Statistically significant differences between male guinea fowl and female guinea fowl were only found in PCV, haemoglobin and bodyweight values where males had higher PCVs and haemoglobin content and lower body weights. The paper provides comprehensive information on haematological values of adult free-range guinea fowls in Zambia that will be a useful reference resource.

Key words: Poultry, guinea fowl, haematology, bodyweights, Zambia

INTRODUCTION

Helmeted Guinea fowl (*Numida meleagris*) are native to Africa and are distributed widely in the wild or domesticated on the continent. In Zambia, guinea fowl represent a low proportion of the total poultry produced but are kept extensively in the Southern Province of the country. The birds lay eggs seasonally during the months of September to March the following year. Despite its hardiness, importance and economic potential to alleviate rural household poverty, little research has been done on the guinea fowl in Africa in preference to research on domestic chickens *(Gallus gallus domesticus)*.

The demand for poultry meat in Zambia has increased as indicated by the increased off-take from hatcheries (ZNFU report, 2010). Most of these are in the form of chickens kept under intensive management systems fed on commercially formulated diets. However, more people are now opting to eat organic poultry meat due to the well-known benefits compared to meat raised through more intensive production systems. Organic poultry meat comes in the form of village chickens, guinea fowls and hunted wild birds. The organic domestic fowl are commonly kept under an extensive management system where they scavenge for food.

Haematological values and body weight are widely used as indices of health in large animal practice, but are not yet used widely in poultry medicine. They indicate an objective assessment of health and disease in any animal species; therefore it is important to have baseline data on these clinically important indices. Values published from other continents may not be directly applicable to Zambia and Africa since differences have been shown in haematological values in birds even within Africa (Cooper *et al*., 1996). It is therefore ideal and imperative to have Zambian values for all veterinary species in order that haemograms may be interpreted correctly compared to local normal values.

Avian haematological values have been shown to change due to a number of factors including breeding (Gayathri and Hegde, 2006), stress (Bedanova *et al*., 2007; Gross and Siegel, 1983), season (Hauptmanova *et al*., 2006), toxicoses (Fourie and Hattingh, 1979), disease (Anderson and Stephens, 1970; Fudge, 2000b).

The heterophil/lymphocyte ratio is a reliable indicator of stress in poultry due to an increase in the number of heterophils and decrease in lymphocytes (Shini *et al*., 2008). Differences in erythrocyte values between males and females have been attributed to the effect of androgens that lead to higher erythropoiesis (Priya and Gomathy, 2008).

This study was therefore undertaken to fill the knowledge gap in avian indices of health. To the best of the authors' knowledge, this is the first comprehensive report of haematological values and body weights of the helmeted guinea fowl (*Numida meleagris*) in Zambia and Central/Southern Africa and contributes significantly to the current dearth of knowledge on avian haematology.

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MATERIALS AND METHODS

Between December 2009 and August 2010, 90 clinically healthy adult helmeted Guinea fowls (*Numida meleagris*) were bought from Southern Province of Zambia and sampled. The birds were acclimatized to the new environment for at least five days prior to sampling. During acclimatization, they were fed commercially prepared broiler grower's mash and *ad libitum* access to fresh water. These birds were subjected to physical examination to determine their health status which also included body weight and body parts length measurement. All sampling was carried out in the morning between 9 am and noon in order to reduce on diurnal variability that has been reported (Azeez *et al.*, 2009).

Blood samples were collected from the brachial vein near the *junctura cubiti*. Blood was stored in an Ethylene Di-amine Tetra Acetic Acid (EDTA) tube for haematological examination and two thin blood smears were prepared directly from blood at the venipuncture site without anticoagulant.

Packed Cell Volume (PCV) was determined by duplicate capillary tube blood samples that were centrifuged at 12000 g in a Microhaematocrit Centrifuge (Hawksley MHC) and read with a Hawksley haematocrit reader. Total Plasma Protein (TPP) values were determined by use of a refractometer.

Enumeration of erythrocytes was carried out by diluting blood 1:101 in a red blood cell pipette with Natt Herrick solution and counting the number of Red Blood Cells (RBC) using an improved Neubaeur haematocytometer (Fudge, 2000a). Haemoglobin (Hb) was determined using a spectrophotometer at 540 nm using the Drabkin's solution as previously described (Fudge, 2000b).

This facilitated the calculation of erythrocyte indices, Mean Corpuscular Haemoglobin Concentration (MCHC); Mean Corpuscular Value (MCV); Mean Corpuscular Haemoglobin (MCH) using standard formulae.

Thin blood smears were stained with Giemsa and examined microscopically under oil immersion and a minimum of 50 fields were examined for cellular characterization. Leucocytes were counted according to the estimated cell count protocol as described by Fudge (2000a) and Walberg (2001). For each blood smear a minimum of 200 leukocytes were counted for determination of differential leucocyte values. To reduce on variations the differential leucocyte counts and duplicate total counts were done by one person. Mean haematological values, body weights and Standard Errors of the Mean (SEM) were calculated for tabulation.

Statistical analysis: Statistical analysis and data graphing was done using MINITAB® Release 14 software for Windows®. Group means were compared using the one way Analysis of Variance (ANOVA) and paired T test. Linear regression was used to determine correlation. Significant differences were defined as those with $p \leq 0.05$.

RESULTS

The haematological values of Zambian guinea fowl established by this study are outlined in Table 1 that shows the mean of each of these values in male and female guinea fowl. Male guinea fowl had a statistically significantly higher PCVs (40.8%±0.66 (SEM); range 25-49, n = 49) and Hb (14.2 g/dl±0.54 (SEM); range 8.05-22.93, n = 49) content than females (PCV(38.1%±0.48 (SEM); range 30-45, n = 40) and Hb (12.4 g/dl±0.29 (SEM); range 9.08-16.85, n = 40)) but there was no significant difference in erythrocyte counts between males and females (Table 1). Female guinea fowl had higher TPP than males but the difference was not statistically significant. Total and differential leucocyte counts did not reveal any significant differences between male and female guinea fowl.

Average overall body weights for Zambian guinea fowl was 1.29 kg (±0.02(SEM); 0.19(SD); range 0.82 kg-1.85 kg; n = 90). There were statistical differences in the body weights for the guinea fowl between males (1.24 kg±0.02 (SEM); range 0.93-1.56, n = 49) and females (1.36 kg±0.04 (SEM); range 0.82-1.88, n = 41) (Fig. 1).

There was a positive correlation between PCV and Hb ($r = 0.65$, $p<0.01$) and PCV and RBC counts ($r = 0.675$, $p<0.01$). There was no correlation between body weights and PCV but, a positive overall correlation between body weight and TPP ($r = 0.453$; $p<0.01$) (Fig. 1). The correlation between body weight and TPP was stronger in females ($r = 0.518$; $p<0.01$) than males ($r = 0.129$; $p = 0.377$).

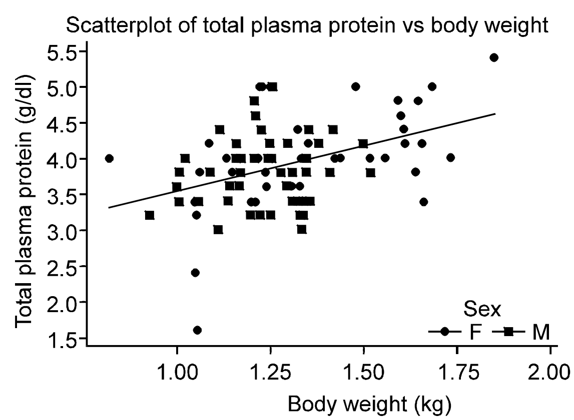

Fig. 1: Scatter plot of body weights of male and female guinea fowl and total plasma proteins showing a moderate positive correlation ($r = 0.453$; $p<0.01$)

Table 1: Haematological data for Zambian helmeted guinea fowl (*Numida meleagris*)

		Male			Female		
Blood parameter	Unit	n	Mean±SEM	SD	n	Mean±SEM	SD
Haematocrit	%	49	40.8 (0.66)	4.62	40	38.1 (0.48)	3.03
Plasma protein	g/dL	49	3.8 (0.07)	0.47	40	4.03 (0.11)	0.72
Haemoglobin	g/dL	49	14.2 (0.54)	3.30	40	12.4 (0.29)	1.71
Erythrocyte count	(x 10^{12}/L)	49	2.65 (0.09)	0.54	40	2.44 (0.10)	0.43
MCHC	g/dL	49	34.3 (0.81)	5.70	40	32.4 (0.67)	4.20
MCH	pg/cell	49	52.3 (1.90)	10.90	40	51.1 (1.72)	7.31
MCV	fl	49	155.4 (4.24)	24.40	40	161.8 (5.42)	23.00
Leucocyte count	(x 10^9/L)	49	22.4 (17.10)	10.26	41	21.42 (18.37)	10.71
Heterophils	%	49	16.5 (2.26)	7.02	41	15.6 (2.28)	6.90
Lymphocytes	%	49	79.7 (4.04)	16.10	41	80.1 (5.16)	15.60
Basophils	%	49	1.1 (0.09)	0.63	41	0.9 (0.08)	0.59
Eosinophils	%	49	2.2 (0.21)	0.79	41	2.3 (0.26)	0.85
Monocytes	%	49	1.0 (0.16)	0.40	41	0.7 (0.17)	0.40

MCHC = Mean Corpuscular Haemoglobin Concentration; MCV = Mean Corpuscular Value; MCH = Mean Corpuscular Haemoglobin pg/cell; SEM = Standard Error of the Mean

DISCUSSION

There are no published data on the haematology and body weights of helmeted guinea fowl in Zambia or the sub-region and thus this study provides the first comprehensive study on these indices of health. The haematological values from this study are generally higher than findings by Cooper and co-workers (1996) in Tanzania although they only examined 11 guinea fowl. The findings are however, comparable to findings from guinea fowl in Nigeria by Olayemi (2009).

Differences in packed cell volume and erythrocytic indices between male and female guinea fowl from this study are similar to findings in other avian species by Oyewale (1988), cited by Olayemi *et al.* (2006) and ducks (Okeudo *et al.*, 2003) in Nigeria. There was however, no significant difference in the RBC counts between the males and females and this could be due to a stress induced disproportionate decline in the RBC counts in both males and females as shown by Bedanova *et al.* (2007). Alternatively, it may be explained by the larger size of erythrocytes as noted with females having a higher mean MCV than males as noted by Miller *et al.* (1961) in swine.

Great variations in RBC counts have been observed in poultry by other researchers (Chubb and Rowell, 1959 cited by Khan and Zafar, 2005; Fudge, 2000a). In this study, only the Hb and MCH had great variation among the RBC indices.

However, wide variations in WBC counts were observed. In the current study the total leucocyte value of 21.4-22.4 x 10^9/L observed in the guinea fowl was significantly higher ($p<0.001$) than the values observed the Nigerian laughing doves (Olayemi *et al.*, 2006) but comparable to findings in Nigerian ducks (Okeudo *et al.*, 2003). The wide variation in WBC counts may be due to handling stress at sampling or simply due to natural biological random variations and such variations have also been reported by other researchers (Gross and Siegel, 1983). The higher proportion of lymphocytes in the differential counts of this study is in general agreement with other avian species (Fudge, 2000a; Okeudo *et al.*, 2003). Similar to findings in guinea fowl by Kundu *et al.* (1993), cited by Priya and Gomathy (2008) and in ducks (Okeudo *et al.*, 2003), female guinea fowls had higher TPP than males but in this study the difference was not significant. The body weights of free-range guinea fowl in Zambia from this study are significantly lower than body weights of guinea fowl published elsewhere (Nahashon *et al.*, 2006). There is however, very limited data on guinea fowl in general and particularly on their body weight characteristics. Regression analysis did not reveal and correlation between body weight and haematological values such as erythrocyte indices as was shown by Hauptmanova *et al.* (2006) in common pheasants. The lack or correlation between body weight and haematological values from this study is similar to findings by other researchers (Dawson and Bortolotti, 1997). This study however, demonstrated a positive correlation between TPP and body weights in female guinea fowl. A similar observation was made in turkeys (Priya and Gomathy, 2008) and it was attributed to the influence of oestrogen.

No haematological values were obtained from juvenile birds as these are never/rarely sold by villagers who rear these birds. Age related changes and differences have been demonstrated in other avian species and thus it would be desirable in future to carry out determination of these indices of health in juvenile and sub-adult guinea fowl in order to determine if there are differences as described by other researchers in other species (Hawkey *et al.*, 1984; Prinzinger and Misovic, 2010).

It can be concluded that the results presented in this paper highlight the unique haematological values of free-range guinea fowl in Zambia and show the differences with other poultry. They also form an important resource as baseline reference haematological values for guinea fowl in Zambia and the sub-region.

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