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COMPARATIVE HAEMATOLOGY OF SOME SPECIES OF APPARENTLY HEALTHY FREE-LIVING WILD BIRDS IN ZARIA, NIGERIA

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Abstract

Aim: To determine the baseline haematological parameters for some apparently free-living wild birds in Zaria, Nigeria.

Methods: 133 birds from 7 species were used for the study; 20 each of *Streptopelia senegalensis* (Laughing Dove), *Treron waalia* (Bruce's Green Pigeon), *Psittacula krameri* (Rose-Ringed Parakeet), *Poicephalus senegalus* (Senegal Parrot), and 19 *Columba guinea* (Speckled Pigeon), 16 *Streptopelia decipiens* (Mourning Collar-Dove) and, 18 *Bubulcus ibis* (Cattle Egret). Haematocrit and Natt-Herrick's method, and thin blood smear technique were used for the haematological analyses. Haemoglobin concentrations (Hb) were determined using the cyanmethaemoglobin method.

Results: *P. krameri* had significantly highest while *T. waalia* had significantly lowest ($p<0.05$) PCV values. *S. senegalensis* and *B. ibis* had highest RBC and Hb, respectively. *S. senegalensis* and *C. guinea* had significantly highest ($p<0.05$) mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH), respectively. *P. senegalus* had significantly highest ($p<0.05$) TWBC and heterophil, and also highest heterophil/lymphocyte ratio. Basophil and eosinophil values were highest for *P. krameri* and *B. ibis*, respectively. *S. decipiens* reported significantly lowest ($p<0.05$) TWBC, heterophil and lymphocyte. Monocyte, which was significantly different ($p<0.05$) was highest for both *T. waalia* and *P. senegalus*, but lowest for *S. senegalensis*.

Conclusion: There were significant interspecies differences ($p<0.05$) in some haematological values of the wild birds studied.

Keywords: Haematology, Wild birds, Zaria

INTRODUCTION

Health, in general, has a major effect on body condition and vigour, which consequently determines individual fitness. Adopting appropriate methods that enable a reliable estimation of health is therefore of significant importance to most ecological and evolutionary research. Basic haematological survey, despite the various ways employed in investigating health, is the most widely used method for health assessment (Ardia and Schat, 2008). Blood samples from birds may be influenced by physiological factors, such as age and species, locally prevailing factors in a particular region and by pathological factors (Szabo et al., 2005; Lloyd and Gibson, 2006; Oladele, 2009). The physiological and biological parameters

commonly used in evaluating the health of a bird, include haematological examinations that check the haemoglobin and haematocrit (for the evaluation of anaemia), the rate of leucocytes or white blood cells (infection indicators) and the fraction of heterophils, lymphocytes (stress indicator), as well as weight and morphometric measures (Débora et al., 2011). The haematological parameters mentioned above are widely used to evaluate the health of various avian species and are predictive of physiological changes caused by various stress factors (Moreno et al., 2002; Kilgas et al., 2006). Despite the growing number of haematological studies in birds (Uhart et al., 2003; Davis et al., 2004; Friedl and Edler, 2005; Mercurio et al., 2008), data on blood cellular composition are still only available for a limited number of bird species, and the majority of such data on wild avian blood parameters are obtained for waterfowl, raptors or wildlife maintained in zoos or aquaria came from developed countries of the world (Clubb et al., 1991). Since avian medicine is undergoing a new turn in the use of haematological indices as tools for making diagnosis of diseases (Oladele, 2009), it is important to establish reference data that will be used as aids to diagnosis in our geographical locations. This study was aimed at providing the normal baseline haematological parameters for some apparently healthy free-living wild birds in Zaria, Nigeria.

MATERIALS AND METHODS

The experiment was conducted in Zaria, Kaduna State, which is located in the Northern Guinea Savannah zone of Nigeria ($11^0$10'N, $07^0$38'E). Trees and grasses characterise the vegetation of this zone with average rainfall, ranging from 1,000 mm to 1,250 mm and temperature of 17^0C to 33^0C (Oladele et al., 2003). One hundred and thirty three (133) apparently healthy free-living wild birds from seven (7) different species were used for the study. The birds included twenty each of *Streptopelia senegalensis* (Laughing Dove), *Treron waalia* (Bruce's Green Pigeon), *Psittacula krameri* (Rose-Ringed Parakeet), *Poicephalus senegalus* (Senegal Parrot), and 19 *Columba guinea* (Speckled Pigeon), 16 *Streptopelia decipiens* (Mourning Collar-Dove) and, 18 *Bubulcus ibis* (Cattle Egret). The sampling was carried from July 2013 to May 2014. The convenient sampling method was employed using net passive netting method which involves setting up several mist-nets in the locations where birds were the most likely to forage or move, and then waiting for the birds to fly into the net. These were distributed to different parts of Zaria metropolis. The captured birds were thoroughly examined physically to establish their health status. They were taken to the Department of Biological Sciences, Faculty of Sciences, Ahmadu Bello University, Zaria for identification of species by an ornithologist. Two millilitres of blood was collected from the brachial vein of each of the wild birds and emptied into sample bottles containing ethylene diamine tetraacetic acid (EDTA). Red blood cell (RBC) and white blood cells (WBC) were counted using haemocytometers. Packed cell volume (PCV) was determined using the microhaematocrit method. Haemoglobin concentration (Hb) was measured by the cyanmethaemoglobin method (Drabkin, 1945). From the values obtained the erythrocyte indices; mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentrations (MCHC), were calculated (Zinkl, 1986). The differential leucocytes (lymphocytes, heterophils, eosinophils, basophils, and monocytes) counts were made using a light microscope (Olympus-XSZ-107BN) under high-power magnification with oil immersion after staining the slides with Wright-Giemsa stain. The heterophil to lymphocyte (H/L) ratios were calculated. Descriptive statistics was used to analyse all the data obtained. One-way Analysis of Variance (ANOVA) with Tukey's multiple comparison test was performed using GraphPad Prism Version 5.00 for Windows, GraphPad Software, San Diego California USA, www.graphpad.com. Values of $p<0.05$ was considered significant.

RESULTS

The PCV of the apparently healthy free-living wild birds was significantly different ($p<0.05$) with *P. krameri* recording the highest values of 43.65±1.72 %, while *T. waalia* had lowest value of 31.98±1.67 %. Values of Hb concentration, 17.75±5.31 g/dl, and RBC count, 4.16±0.26 $x10^{12}$/l, were highest for apparently healthy *B. ibis* and *S. decipiens*, while the lowest values for Hb concentration, 11.81±0.56 g/dl, and RBC count, 2.86±0.14 $x10^{12}$/l, were recorded for *T. waalia* and *B. ibis*, respectively. TWBC value of 3.36±0.44 $x10^9$/l was significantly highest ($p<0.05$) for *P. senegalus* while *S. decipiens* recorded lowest value of 1.33±0.25 $x10^9$/l (Table 1). For the erythrocytes indices, *C. guinea* and *S. decipens* had significantly highest ($p<0.05$) MCV and MCH values of 142.00±9.65 fl and 73.50±2.13 pg, respectively. *T. waalia* had highest value of 37.18±0.64 g/l, while *C. guinea* had lowest value of 33.89±0.57 g/l for MCHC. The MCV and MCH were significantly lowest ($p<0.05$) for *S. decipens*

and *C. guinea* with values of 89.15±2.91 fl and 47.56±3.32 fl, respectively (Table 1). Considering the differential leucocyte count, *P. senegalus* had significantly highest ($p<0.05$) heterophil counts of 0.62±0.14 x10^9/l. *T. waalia* as well as *P. senegalus* recorded significantly highest ($p<0.05$) monocyte count value of 0.13±0.03 x10^9/l, respectively. Basophil count was highest for *P. krameri*, which also had significantly highest ($p<0.05$) lymphocyte count values of 0.06±0.01 x10^9/l and 2.74±0.23 x10^9/l, respectively (Table 2). *B. ibis* had highest eosinophil count value of 0.14±0.03 x10^9/l. *S. decipiens* had lowest eosinophil count of 0.06±0.03 x10^9/l, and similar to *C. guinea*, reported lowest basophil count of 0.02±0.01 x10^9/l. Monocyte and, heterophil and lymphocyte counts recorded for *S. senegalensis* and *S. decipiens* were significantly lowest ($p<0.05$) with values of 0.04±0.01 x10^9/l and, 0.08±0.02 x10^9/l and 1.12±0.20 x10^9/l, respectively. H/L ratio was highest for *P. senegalus* but lowest for *S. decipiens* with values of 0.29±0.07 and 0.08±0.01, respectively (Table 2).

Table 1: Mean (± SE) haematological of some species of apparently healthy free-living wild birds found in Zaria, Nigeria.

	Streptopelia senegalensis (Laughing Dove) **(n = 20)**	*Streptopelia decipiens* (Mourning Collar Dove) **(n = 16)**	*Treron waalia* (Bruce's Green Pigeon) **(n = 20)**	*Columba guinea* (Speckled Pigeon) **(n = 19)**	*Psittacula krameri* (Rose-Ringed Parakeet) **(n = 20)**	*Poicephalus senegalus* (Senegal Parrot) **(n = 20)**	*Bubulcus ibis* (Cattle Egret) **(n = 18)**
PCV (%)	38.50±1.62	35.91±1.32	31.98±1.67^{a}	38.47±1.88	43.65±1.72^{a}	40.33±2.48	35.64±2.98
Hb (g/dl)	13.36±0.55	12.63±0.48	11.81±0.56	13.25±0.72	15.71±0.59	13.95±0.79	17.75±5.31
RBC (x 10^{12} /l)	3.29±0.21	4.16±0.26	3.50±0.26	2.87±0.13	3.86±0.28	3.54±0.23	2.86±0.14
TWBC (x 10^9 /l)	2.28±0.27	1.33±0.25^{a}	2.56±0.42	2.07±0.23	3.18±0.32^{a}	3.36±0.44^{a}	2.91±0.31^{a}
MCV (fl)	124.04±8.61	89.15±2.91^{a}	95.74±5.47^{b}	142.00±9.65^{ab}	130.01±13.91^{a}	116.47±6.24	128.40±12.54
MCH (pg)	73.50±2.13^{a}	31.32±1.14^{ab}	35.08±1.59^{ac}	47.56±3.32^{abc}	46.97±4.93^{abc}	40.62±2.01^{a}	44.70±3.40^{ab}
MCHC (g/l)	34.79±0.54	35.30±0.72	37.18±0.64	33.89±0.57	36.17±0.68	35.16±0.86	36.02±1.11

n = total number of birds sampled, Mean ± SE = standard error of the mean values with the same superscript alphabets along the same row are significantly different with $p<0.05$

Table 2: Mean (± SE) of differential leucocyte count, heterophil/lymphocyte ratio for some species of apparently healthy free-living wild birds found in Zaria, Nigeria.

Parameters	*Streptopelia senegalensis* (Laughing Dove) **(n = 20)**	*Streptopelia decipiens* (Mourning Collar Dove) **(n = 16)**	*Treron waalia* (Bruce's Green Pigeon) **(n = 20)**	*Columba guinea* (Speckled Pigeon) **(n = 19)**	*Psittacula krameri* (Rose-Ringed Parakeet) **(n = 20)**	*Poicephalus senegalus* (Senegal Parrot) **(n = 20)**	*Bubulcus ibis* (Cattle Egret) **(n = 18)**
Heterophils (x10^9 /l)	0.20±0.03^{a}	0.08±0.02^{b}	0.46±0.11^{b}	0.30±0.05	0.44±0.09	0.62±0.14^{ab}	0.62±0.11^{ab}
Lymphocytes (x10^9 /l)	1.93±0.24	1.12±0.20^{a}	2.30±0.52	1.56±0.16	2.47±0.23^{a}	2.46±0.35^{a}	2.05±0.21
Basophils (x10^9 /l)	0.05±0.01	0.02±0.01	0.04±0.02	0.02±0.01	0.06±0.01	0.04±0.02	0.04±0.01
Eosinophils (x10^9 /l)	0.07±0.02	0.06±0.03	0.08±0.03	0.07±0.02	0.13±0.03	0.13±0.03	0.14±0.03
Monocytes (x10^9 /l)	0.04±0.01^{a}	0.05±0.02	0.13±0.03^{a}	0.11±0.02	0.10±0.02	0.13±0.03^{a}	0.07±0.02
H/L Ratio	0.13±0.03	0.08±0.01	0.24±0.04	0.19±0.03	0.18±0.03	0.29±0.07	0.29±0.04

n = total number of birds sampled, Mean ± SE = standard error of the mean values with the same superscript alphabets along the same row are significantly different with $p<0.05$

DISCUSSION

The different species of free-living wild birds examined in this study had fairly similar mean values for PCV, RBC count and Hb concentration. This is in line with the findings in previous studies (Olayemi et al., 2006; Saleem et al., 2008; Lashev et al., 2009; Oladele et al., 2012; Azeez et al., 2013). In the studies carried out by Lashev et al. (2009) in Bulgaria, and Olayemi et al. (2006) and Azeez et al. (2013) both in Ibadan, Southern Nigeria on the *S. senegalensis*, the values reported for the PCV, Hb concentration and RBC count were relatively similar to the values for *S. senegalensis*, *S. decipiens*, *T. waalia*, and *C. guinea* reported in this study. However, the values (PCV, Hb concentration, RBC count) for *T.*

waalia were similar to the values reported for the lower limit for *S. senegalensis* by afore mentioned authors. Abdel-Rachied et al. (2014) in Cairo, Egypt, reported the values for RBC count, Hb concentration and PCV for the apparently healthy *B. ibis*. These values were similar to the values reported in this study for the apparently healthy *B. ibis*. The high PCV and RBC count obtained from the apparently healthy *P. krameri* and *S. decipiens*, respectively cannot be associated with stress, dehydration or other disease conditions, such as chronic pulmonary disease, cardiac diseases, iron storage disease, rickets, renal disease and neoplasia leading to increased production of erythropoietin. This is because stress as the causative factor for the increased RBC count can be ruled out as the avian spleen lack both storage capacity and a muscular capsule, thus making it physiologically impossible for the avian spleen to inject red cells into circulation under stressful conditions such as during blood sampling as seen in mammals (John, 1994; Latimer et al., 2003). Dehydration and diseased conditions were also ruled out as possible causes of the increased PCV and RBC count because on physical examinations obvious abnormalities were not observed. Therefore, the species with higher values of PCV and RBC count in this study may be considered as those in the upper limits of the avian range. The significantly high mean RBC value observed in the *S. decipiens* could be associated to the fact that the bird flies rapidly, hence the physiological increased need for adequate gaseous exchange (Maina, 2000). However, the exact cause of interspecies variability in the PCV and RBC count in this study and the slight differences in the Hb concentrations was not elucidated. These differences could probably be influenced by the species differences and nutrition. The TWBC value obtained for apparently healthy *S. senegalensis* in this study was similar to the value reported for the *S. senegalensis* in Ibadan, Southern Nigeria (Olayemi et al., 2006). The predominant leucocytes of the apparently healthy birds sampled in this study were the lymphocytes and heterophils, accounting on the average for up to 95% or more of the TWBC. The numbers of monocytes, eosinophils and basophils were low, though variable. The variability is most likely indicative of individual response to different immunological challenges and different stages of response to any pathology (Stein et al., 1998). It is known that basophils and monocytes usually have a very low range of variation in most species (Mitchell and Johns, 2008). This might be an additional explanation for the existence of slight significant differences in basophils, eosinophils and monocytes between species of wild birds in this study. The heterophil/lymphocyte (H/L) ratio, considered by several authors as providing important information for immune system tension following prolonged stress factors (Moreno et al., 2002; Scope et al., 2002; Williams, 2005) was highest in the apparently healthy *P. senegalus* and lowest in the apparently healthy *S. decipiens*. Scope et al. (2002) observed a considerable change in H/L proportion and increased H/L ratio following stress associated with transporting and handling of Racing Pigeon (*Columba livia domestica*). With respect to heterophils and lymphocytes, the data obtained from this study for apparently healthy *S. decipiens* was lower than that obtained by Lashev et al. (2009) and Azeez et al. (2013). The high value was assumed in their work to be associated with possible stress during restraint and rearing in captivity. Therefore, the low H/L ratio reported in this study could possibly be as a result of the adequate restrain method employed and the short time (about 15-20 minutes) used for collecting the blood samples. The wide range MCV and MCH values found in this study could be due to the significant wide range of values recorded in RBC count, Hb concentration and PCV values. It was concluded that there were significant interspecies differences ($p<0.05$) in some haematological values of the wild birds studied.

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