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RESEARCH ARTICLE

Determination of hematological values and detection of *Chlamydophila psittaci* antibodies in captive blue-naped parrots at the Ninoy Aquino Parks and Wildlife Nature Center

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ABSTRACT

Background: *Tanygnathus lucionensis lucionensis*, also known as the blue-naped parrot, is endemic to Luzon and Mindanao and is known for their distinctive blue crown and nape. **Aims and Objectives:** Being indigenous to the Philippines, the initial reports of hematological values and the common diseases of this subspecies are significant to be determined and studied. **Materials and Methods:** In this study, six captive blue-naped parrots at the Ninoy Aquino Parks and Wildlife Nature Center (NAPWNC) were tested to obtain initial reports for hematological parameters of the species. Using the ELISA method, the presence of *Chlamydophila psittaci* antibodies was determined to assure that there was no current infection. The study aimed to determine an initial report for the hematological values of the species and to detect the presence of antibodies against *C. psittaci* in the blood serum of blue-naped parrots held captive at the NAPWNC. **Results:** The initial reports of the parameters were as follows: Hematocrit is 44% ± 4%; total erythrocyte is 3.59×10^6 cells/mm^3 ± 0.21; Hgb is 12.86 g/dL ± 1.12; mean corpuscular volume is 121 femtoliter ± 10; mean corpuscular hemoglobin (MCH) concentration is 29.75 % ± 3.62; MCH is 36.03 picogram ± 4.8; total leukocyte is 17.95 x 10^3 cells/mm^3 ± 2.84; total heterophil is 10.85×10^3 cells/mm^3 ± 2.08; total basophil is 0.54×10^3 cells/mm^3 ± 0.38; total eosinophil is 0.15×10^3 cells/mm^3 ± 0.18; total lymphocyte is 6.00×10^3 cells/mm^3 ± 1.49; total monocyte is 0.4×10^3 cells/mm^3 ± 10.41; and thrombocyte is 29.33×10^3 cells/mm^3 ± 41.31. All of the six captive blue-naped parrots tested positive for the presence of *C. psittaci* antibodies indicating that the birds have been exposed to the bacteria but are not experiencing a current infection. **Conclusion:** The results of the hematological studies showed that these values for the blue-naped parrots do not differ from the close relative within the region. The significance of the absence of a current infection ensures validity of the initial hematological value reports obtained in this study.

KEY WORDS: Blue-naped Parrots; *Chlamydophila psittaci*; ELISA; Hematology; Philippines

INTRODUCTION

The Philippines has 75 endemic bird species threatened with extinction and 40 in the critical and endangered categories.

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Based on a review by the BirdLife International,[1] the Philippines has been identified as the most important country worldwide for biodiversity conservation.[2] *Tanygnathus lucionensis*, commonly known as the blue-naped parrot, is found off the north and east islands of Borneo, Talaud Islands, and the Philippines; however, the subspecies *T. lucionensis lucionensis* is endemic to Luzon and Mindanao.[3] They are classified into the order Psittaciformes under the family *Psittacidae* along with lorikeets, cockatoos, and hanging parakeets.[2,4] The blue-naped parrots are found in forests and forests edge up to 1000 m. They are either found singly, in pairs, or in groups.[1,5] They are known for their brilliant

green head, sky blue hind crown and nape, and mottled wings with gold and blue edging. The females are distinctively less bright than males and are of smaller stature.[2,6] The blue-naped parrot, formerly identified as an endangered species, has now been identified as lower risk according to IUCN and CITES[5] with approximately 1500–700 adult individuals in the wild.[1] The status determination of the blue-naped parrot has been difficult due to its persistence as small groups in several small habitats. However, the species is still under threat due to occurrences of habitat loss and pet-trade.

Avian hematology is similar with mammalian hematology except with some modifications.[7] These modifications are based on the nucleated red blood cells (RBCs), the presence of thrombocytes instead of platelets and heterophils instead of neutrophils found in the peripheral blood of birds.[8] Normal avian blood values have a wide range because of the numerous intrinsic and extrinsic factors that affect the parameters. The related species that has been studied in terms of hematology are the African gray parrot and the greater sulphur-crested cockatoo.[8]

Psittacosis or parrot fever is a disease caused by Chlamydophila psittaci, a Gram-negative coccus and obligate intracellular bacteria[9] and has been reported to be most common in orders Psittaciformes and Columbiformes.[10] The symptoms include abrupt onset fevers, chills, headache, malaise, and myalgia.[11] A non-specific rash, enlarged spleen, and a pulse-temperature dissociation may be observed.[12] It is a zoonosis in which birds as the main reservoir transmits the bacteria to humans [11] and transmission occurs through inhalation of infectious dust or particles from feathers and consumption of infected carcass.[11,13] Large amounts of bacteria are excreted in feces and may be airborne when the feces dries. It can also be found in oral and respiratory secretions.[14] The infected animal may remain asymptomatic and only manifest symptoms when stressed.[11,15] In the Philippines, recent researches used antibody tests to determine the presence of *C. psittaci* antibodies. In the study of Maluping *et al.,*[16] they studied different captive birds from Ninoy Aquino Parks and Wildlife Nature Center (NAPWNC). The 36 means the total population studied and only 9 have antibodies: 6 are pstitacines and 3 raptors. The remaining 27 are negative. In the study of Perez,[17] 12 eagle-owls captive at NAPWNC were tested negative for *C. psittaci*; however, it was still concluded that the birds have been exposed to the antigen in the past.

Despite of the blue-naped parrot being found in 45 islands of the Philippines,[1] there is no known or recorded normal range of the bird's hematological values. This study aims to provide an initial record of the blood values of this species as this is essential to determine species as clinically healthy or diseased. Knowing the health status will allow for the early treatment of individuals with diseases, which may help in sustaining the remaining individuals of the species, avoiding extinction. Since parrots are part of the order of Psittaciformes which are known common carriers for *C. psittaci,* it is essential to know the status for the presence of the antibody to know whether the obtained hematological values are valid and if there is no current infection. The levels of antibodies may also signify an infection which is significant information for the prevention of infecting handlers, for those birds which are kept in captivity, and future individuals which may be kept in the same cage as an untreated bird.

MATERIALS AND METHODS

Sample Population

All of the six captive blue-naped parrots (*T. lucionensis lucionensis*) came from the NAPWNC, Philippines. The birds which were used in the study were clinically normal birds free from wounds and were not in current treatment for any illnesses.

The blue-naped parrots are housed together in a permanent holding cage. They were given fruits or vegetables once daily. A floor type manner of feeding was practiced and water was provided in either a large basin and replaced daily. Only sick or weak and newly rescued birds were given dietary supplements of vitamins, minerals, and electrolytes. Ectoparasiticidal dipping of birds was done once a year. However, some birds that were found to have heavy ectoparasite load were dusted with gamma powder.

All procedures described below have been approved by the De La Salle University Institutional Animal Care and Use Committee and the Biodiversity Management Bureau, Department of Environmental Resources Management.

Blood Collection and Preparation

The collection of blood took place during the early morning to avoid diurnal fluctuations and to prevent stress in the birds. To capture the subjects, in preparation for blood collection, each bird was first, casted by approaching the bird from behind and folding the wings in normal position. The wings were then held against its body while the feet were held firmly as it was wrapped in cloth to be able to control its movement.

Drawing of blood was done through the cutaneous ulnar vein of the birds and extracted by a licensed veterinarian from NAPWNC. Using a 1 mL disposable syringe and a 25-gauge needle, approximately 0.5 mL of blood was taken from each bird. The blood was transferred into EDTA hematology tubes, shaken gently and placed in an ice chest maintained at approximately 4°C to minimize cellular degeneration. The blood samples were then analyzed within 6–8 h of blood collection.

Hematological Value Determination

The total erythrocyte, leukocyte, and thrombocyte counts were determined using the Natt and Herrick's method as

described by Thrall *et al*.[7] and Harrison and Lightfoot.[18] Duplicate readings were made for each sample and the mean was taken and recorded.

The packed cell volume (PCV) was measured using the microhematocrit method described by Coles[19] while the hemoglobin concentration was determined using the cyanmethemoglobin method. The RBC indices were calculated and expressed as femtoliter (fL) for mean corpuscular volume (MCV), picogram (pg) for mean corpuscular hemoglobin (MCH), and percent (%) for MCH concentration (MCHC) as described by Ritchie *et al*.[8]

Blood smears were prepared and stained using the Giemsa staining technique. These smears were used for the differential leukocyte count and the mean was taken after duplicated readings for each sample following the description of Coles.[19]

Detection of *Chlamydophila psittaci* Antibody

The ELISA test kit for avian *C. psittaci* (ImmunoComb©) used detects immunoglobulin G antibodies (IgG) against *C. psittaci*. IgG is produced during the later parts of the immune process and is the most abundant immunoglobulin. The ELISA test kit uses solid phase immunoassay containing antigen principle. In the process, when an antigen attaches to a solid phase, there is a direct reaction with an enzyme-linked antiserum. With this method, an estimation of an enzyme-labeled antibody, specific for an antigen is done.

The procedure provided by the manufacturer was followed when the ELISA test was conducted. The results of the blue-naped parrots were read by comparing the shade of gray of the rest result with the Combscale card. After which the results were also read using the Combscan.

Data Analysis

The mean ± SD was computed for the hematological values reported as range. For the ELISA results, the relative absorbance was computed. These results were translated into clinical results. The clinical results were evaluated based on the variability of response of parrots to the ImmunoComb© Avian *Chlamydophila psittaci* antibody test kit.

RESULTS

The obtained blood samples were tested for total RBC, white blood cell (WBC), thrombocytes, indiced, differential WBC count, and ELISA. The hematologic values were compared to that of their related species with available reference values, African gray parrot and greater sulphur-crested cockatoo. Overall, the results for the blue-naped parrot had a trend of having close values to the related species. In the RBC indices, the mean values of the blue-naped parrot were lower than of the two other related species. The total WBC and differential were in range except for the monocytes. The differing values may be explained by the factors presented in discussion of the following parameters.

There have been no studies regarding the hematology for the blue-naped parrot. This is mainly because the birds are endemic to the Philippines, which limit other researchers from conducting studies, and the birds are under the category of endangered and vulnerable according to the IUCN.[1] The results of the hematological determination for the blue-naped parrots are presented in Table 1.

The CombScan readings of the blue-naped parrots for the *C. psittaci* are <1:50 for four birds and 1:50 for two birds [Table 2]. These values correspond to the CombScale value of S1 and S2 which means that the results are low positive. However, in the variability of antibody response to the Immunocomb© Avian *C. psittaci*, African gray parrots and the cockatoo are very sensitive. A positive result does not mean that the specimen is infected; however, it is a possibility that there were previous infections. The presence of antibodies against *C. psittaci* can indicate that the specimen was exposed to the bacteria. Since all samples shared the same cage, this may mean that the birds have infected one another.

DISCUSSION

The mean value for PCV was recorded as 44% having the standard deviation of 4%. The highest value was recorded to be 47% while the lowest value was recorded to be 40%. The mean PCV for the blue-naped parrot was comparable with the established range of the African gray parrot by Harrison *et al*.[18] Since the resulting PCV of the blue-naped parrot is comparable with the range of those species within the same family, this indicates that the blue-naped parrot is not suffering from anemia (lack of RBC) nor it is suffering from hemoconcentration (overproduction of RBC).[20] The significance of the PCV of blue-naped parrot having a similar range as that of the other species may suggest that the living conditions and environment in which they are found may be similar and are conducive for survival since there are no abnormalities found in PCV. The mean PCV of the blue-naped parrot, 44% also indicates that it is not suffering from dehydration since the PCV is not higher than the usual maximum PCV value of 55%.[7] The mean value of the RBC count of the blue-naped parrot is 3.59×10^6cells/mm^3 with the range of $3.37–3.80 \times 10^6$ cells/mm^3. This overlaps with the range of RBC count of the African gray parrot which is ($3.0–3.6 \times 10^6$ cells/mm^3) according to the recorded baseline values of Ritchie *et al*.[8] in Table 1. The range of the total RBC count of the greater sulphur-crested cockatoos latter was recorded to be $2.4–3.0 \times 10^6$cells/mm^3, which is lower than that of the recorded values for the blue-naped parrot. It cannot be definitively established that the total RBC of the

Table 1: Hematologic values of the blue-naped parrots (*T. lucionensis lucionensis*)

Parameter	Units	Mean±SD (range)
Erythrocyte	10^6 cells/mm^3	3.59±0.21 (3.37–3.80)
PCV	%	44±4 (40–47)
Hb	g/dl	12.86±1.12 (11.74–13.99)
MCV	fL	121±10 (112–131)
MCH	pg	36.03±4.58 (31.45–40.62)
MCHC	%	30.31±3.62 (26.13–33.37)
Leucocytes	10^3 cells/mm^3	5.96±0.95 (5.04–6.93)
Heterophil	10^3 cells/mm^3	3.62±0.69 (2.92–4.31)
Eosinophil	10^3 cells/mm^3	0.05±0.06 (0.00–0.11)
Basophils	10^3 cells/mm^3	0.18±0.13 (0.05–0.31)
Lymphocytes	10^3 cells/mm^3	2.00±0.50 (1.51–2.50)
Monocytes	10^3 cells/mm^3	0.14±0.14 (0.00–0.27)
Thrombocytes	10^3 cells/mm^3	29.33±41.31 (25.20–33.46)

T. lucionensis lucionensis: Tanygnathus lucionensis lucionensis, PCV: Packed cell volume, Hb: Hemoglobin, MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration, fL: Femtoliter, pg: Picogram, SD: Standard deviation

Table 2: CombScan reading of blood samples from blue-naped parrots tested for *C. psittaci*

Comb value	IgG (MAT) Titer	Blue-naped Parrot
0	0	-
1	<1:50	4
2	1:50	2
3	1:100	-
4	1:200	-
5	1:400	-
6	1:800	-
>6	>1:800	-
Total		6

C. psittaci: Chlamydophila psittaci, IgG: Immunoglobulin G

blue-naped parrots is of normal range because the normal references can vary between species.[20] Factor such as the age and sex of the avian samples may be attributed to the high tRBC values obtained. According to Etim *et al.,*[21] males have higher RBC values than females. Sex can also affect blood profiles because males and females differ in cost of energy to achieve demanding energy activities such as production of gametes, and energy required to sustain themselves in deteriorating environmental conditions.[22] The mean hemoglobin concentration of the blue-naped parrots is 12.86 g/dL which is lower comparable with the established values of the African gray parrot and greater sulphur-crested cockatoo as seen in Table 1. The slight difference between the values of the blue-naped parrot and its related species is not diagnostically significant. This indicates that the blue-naped parrots are not anemic.[23] The MCV of blue-naped parrots display a lower range of 112–131 fL compared to the African gray parrot with a range of 137–155 fL and the greater sulphur-crested cockatoo with a range of 145–187 fL.[8] The MCHC of blue-naped parrots displays a lower range of 26.13–33.37% compared to the African gray parrot with a range of 28.9–34% and the greater sulphur-crested cockatoo with a range of 33.3–37.6%.[8] The MCH of blue-naped parrots displays a lower range of 31.45–40.62 pg compared to the African gray parrot with a range of 41.9–52.8 pg and the greater sulphur-crested cockatoo with a range of 53.8–60.6 pg.[8] MCHC is more commonly used than MCH.[24] The secondary erythrocyte indices of the blue-naped parrots display a consistent trend of having lower ranges than that of the related species. The slight differences between their ranges, however, are not of diagnostically significant. As stated in Thrall *et al.,*[20] normal references in avian differ from mammals by having wide ranges. It was stated that captive psittacine birds also have similar hematological values, where MCV has a range of 90–200 fL and MCHC has a range of 22–33%. The slight differences between the ranges among the species may be affected by different factors such as environmental differences or conditions, age, and sex of the specimens. Environmental factors may be characterized by the temperatures of where the birds are found, as well as the food they consume, and the conditions of the cages where they are held captive. The age of the birds affects hematological values because total erythrocytes, which are used for the calculation of indices, are directly proportional to the age of birds. The sex of the birds affects hematological values because males tend to have higher values than females. In blue-naped parrots, females are smaller than males, which affect the erythrocyte mass which could affect the indices.[6,7,20] Considering that there were no diagnostic significances between the species, the blue-naped parrots can be seen as normocytic and normochromatic.[24] This signifies that the birds are not anemic, nor they are experiencing nutritional deficiencies such as iron deficiency and are dehydration.

The mean total WBC count of the blue-naped parrot is 5.96 × 10^3 cells/mm^3 is comparable with both the established baseline values for total WBC count of both the African gray parrot and greater sulphur-crested cockatoo.[8] The similarity of the total WBC count of the blue-naped parrot may suggest that the standard species provided also exist in a similar environment that does not expose them to various stressors which could greatly increase the WBC count food or water deprivation, temperature extremes, and psychological disturbance.[22] The recorded mean absolute value for heterophils is 3.62 with the range of 2.92–4.31 10^3 cells/mm^3. This is comparable with the established baseline levels for the African gray parrot and greater sulphur-crested cockatoo which are 1.8–7.3 10^3 cells/mm^3 and 1–6.6 10^3 cells/mm^3, respectively. The mean absolute count of the blue-naped parrot is 0.05 × 10^3 cells/mm^3 with the range of 0.00–0.11 × 10^3 cells/mm^3 is comparable with the range of the established

baseline levels of the African gray parrot and greater sulphur-crested cockatoo from Ritchie *et al.*[8] The mean absolute basophil count of the blue-naped parrots is 0.18 × 10^3 cells/mm^3 with the range of 0.05–0.31 × 10^3 cells/mm^3. This mean overlaps with the ranges of the African gray parrot and greater sulphur-crested cockatoo which are 0.0–0.8 × 10^3 cells/mm^3 and 0.0–0.9 × 10^3 cells/mm^3, respectively. The mean absolute lymphocyte count of the blue-naped parrots is 2.00 × 10^3 cells/mm^3 with the range of 1.51–2.50 ×10^3 cells/mm^3. The mean is comparable with the established baseline values of the African gray parrot and greater sulphur-crested cockatoo which are 0.7–2.1 × 10^3 cells/mm^3 and 1.0–3.6 × 10^3 cells/mm^3, respectively, from Ritchie *et al.*[8] The mean absolute monocyte count of the blue-naped parrots is 0.14 × 10^3 cells/mm^3 with the range of 0.00–0.27 × 10^3 cells/mm^3. The mean absolute monocyte count is higher than both established baseline levels of the African gray parrot and the greater sulphur-crested cockatoo from Ritchie *et al.*[8] The differential WBC counts obtained from the blue-naped parrots were all comparable to the values from the related species. The heterophils displayed slightly higher values and monocytes displayed slightly higher values than the related species; however, the differences are not diagnostically significant. Higher deviation such as that seen in the heterophils may be caused by excitation during blood collection while in monocytes, higher values may be caused by zinc deficiency.[20] Major deviations which were not observed in the values obtained may indicate that the birds were well taken care of and were not exposed to factors that could cause great abnormalities in differential WBC counts. Factors that could greatly affect birds are stressors such as lack of food, tissue inflammation, and other physiologic factors.[7,19,20,23]

The recorded mean of the thrombocyte count of the blue-naped parrot is 29.33 × 10^3 cells/mm^3 with the range of 25.2–33.5 × 10^3 cells/mm^3. This value is above the established range of the greater sulphur-crested cockatoo but overlaps with the established range of the African gray parrot. Age is a factor which affects the presence of thrombocytes. According to Thrall *et al.,*[7] there are higher levels of thrombocytes that are found in younger avians than adults.

C. psittaci bacteria, which are avian strains, are zoonotic and therefore can be transmitted to humans by inhalation of infected dust.[25] The infection usually presents non-specific symptoms to more severe influenza-like illness.[10] It is, therefore, important to determine the occurrence of this organism in the avian population, as this may serve as the source of infection on humans. To the best of our knowledge, the only reported cases of *C. psittaci* in birds are from the works of Maluping *et al.*[16] and Perez.[17] In the study of Perez,[17] all 12 eagle-owls tested were negative for *C. psittaci* antibodies. The location of the eagle-owls is not along the stretch of cages where the blue-naped parrots are kept. In the study of Maluping *et al.,*[16] the birds that were positive for the antibodies include nine psittacines. The psittacine birds in NAWPC have their cages in close proximity with each other. This could mean that the proximity of the cages contributed to the spread of the infection.

CONCLUSION

A study was conducted to determine the hematological values (total RBC, RBC indices, total WBC, differential WBC, and thrombocyte count) and the presence of *C. psittaci* for six blue-naped parrots (*T. lucionensis lucionensis*) from the NAPWNC. The hematological parameters resulted in the hematocrit value overlapping with that of the representative species signifying that the avian samples are not anemic nor it is suffering from dehydration. The total RBC of blue-naped parrots having higher values than that of the representative species may be attributed sex and age of the samples. Similarly, the hemoglobin parameter displays lower values than the representative species. The RBC indices of the blue-naped parrot showed a constant trend of having a lower range than that of the representing species. The WBC counts of the blue-naped parrots were comparable with the established range of their relatives with the differential WBC count mostly in range except, the monocytes. The ELISA results using the *C. psittaci* ImmunoComb© kit tested low positive having four bird samples with S1 and two bird samples S2 from the Combscale. Since there were still antibodies against *C. psittaci* detected, it is highly suggestive that there has been a previous infection among the six blue-naped parrots.

REFERENCES

1. Bird Life International. IUCN Red List for Birds; 2015. Available from: http://www.birdlife.org. [Last accessed on 2015 Apr 03].
2. Fisher T, Hicks N. A Photographic Guide to Birds of the Philippines. London: New Holland Publishers; 2006.
3. Kennedy RS, Gonzales PC, Dickinson EC, Miranda HC Jr., Fisher TH. A Guide to the Birds of the Philippines. Oxford: Oxford University Press; 2000.
4. Rabor DS. Philippine Birds and Mammals. Quezon City: University of the Philippines Press; 1977.
5. Snyder N, McGowan P, Gilardi J, Grajal A, editors. Parrots. Status Survey and Conservation Action Plan 2000-2004. Gland, Cambridge: IUCN; 2000.
6. Gonzales PC, Rees CP. Birds of the Philippines. Quezon City: Haribon Foundation for the Conservation of Natural Resources, Incorporated; 1988.
7. Thrall MA, Baker DC, Campbell TW, DeNicola D, Fettman MJ, Lassen ED, *et al*. Veterinary Hematology and Clinical Chemistry. Philadelphia: Lippincott Williams & Wilkins; 2004.
8. Ritchie BW, Harrison GJ, Harrison LR, editors. Avian Medicine: Principles and Application. Lake Worth: Wingers Publishing, Inc.; 1994.
9. Johns JL, Luff JA, Shooshtari MP, Zehnder AM, Borjesson DL.

What is your diagnosis? Blood smear from an injured red-tailed hawk. Vet Clin Pathol 2009;38:247-52.
10. Piasecki T, Chrzastek K, Wieliczko A. Detection and identification of *Chlamydophila psitacci* in asymptomatic parrots in Poland. BMC Vet Res 2012;8:233.
11. Heddema ER, van Hannen EJ, Duim B, de Jongh BM, Kaan JA, van Kessel R, *et al*. An outbreak of psittacosis due to *Chlamydophila psittaci* genotype A in a veterinary teaching hospital. J Med Microbiol 2006;55:1571-5.
12. Compendium of measures to control chlamydia psittaci infection among humans (psittacosis) and pet birds (avian chlamydiosis), 1998. Center for disease control and prevention. MMWR Recomm Rep 1998;47:1-4.
13. Smith KA, Campbell CT, Murphy J, Stobierski MG, Tengelsen LA. Compendium of measures to control *Chlamydophila psittaci* infection among humans (Psittacosis) and pet birds (Avian Chlamydiosis), 2010 National Association of State Public Health Veterinarians (NASPHV). J Exot Pet Med 2010;20:32-45.
14. Vanrompay D, Harkinezhad T, van de Walle M, Beeckman D, van Droogenbroeck C, Verminnen K, *et al.* Chlamydophila psittaci transmission from pet birds to humans. Emerg Infect Dis 2007;13:1108-10.
15. Harkinezhad T. Molecular Epidemiology of *Chlamydophila psittaci* in Psittacine Birds and Humans and Prevention by DNA Vaccination. PhD Thesis, Ghent University, Ghent, Belgium; 2008.
16. Maluping RP, Oronan RB, Toledo SU. Detection of *Chlamydophila psitacci* antibodies from captive birds at the ninoy aquino parks and wildlife nature center, Quezon City, Philippines. Ann Agric Environ Med 2007;14:191-3.
17. Perez JM. Assessment of the Hematocrit, Erythrocyte and Thrombocyte Count and the Detection of *Chlamydophila psittaci* Antibodies in the Blood Serum of Captive Philippine Eagle-Owls (Bubo Philippensis) using ELISA Kits for Felines and Avians [Thesis]. Los Banos: College of Veterinary Medicine, University of the Philippines; 2012.
18. Harrison GJ, Lightfoot TL, editors. Clinical Avian Medicine. Palm Beach: Spix Publishing, Inc.; 2006.
19. Coles BH. Essentials of Avian Medicine and Surgery. 3rd ed. Oxford: Blackwell Publishing Ltd.; 2007.
20. Thrall MA, Weiser G, Allison RW, Campbell TW. Veterinary Hematology and Clinical Chemistry. 2nd ed. Hoboken: Wiley-Blackwell; 2012.
21. Etim N, Akpabio U, Okpongete RO, Offiong EE. Do diets affect hematological parameters of poultry. Br J Appl Sci Tech 2014;4:1952-65.
22. Jakubas D, Wojczulanis-Jakubas K, Kulaszewicz I. Factors affecting haematological variables and body mass of reed warblers (*Acrocephalus scirpaceus*) and sedge warblers (*A. Schoenobaenus*). Ann Zool Fennici 2013;50:146-57.
23. Campbell TW. Exotic Animal Hematology and Cytology. 4th ed. Hoboken: John Wiley & Sons, Inc.; 2015.
24. Voigt GL. Hematology Techniques and Concepts for Veterinary Technicians. Ames: Iowa State University Press; 2000.
25. West A. A Brief Review of Chlamydophila psittaci in Birds and Humans. J Exot Pet Med 2011;20:18-20.

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