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Blood Cell Characteristics and Hematological Values of Free Ranging-Red Jungle Fowl (*Gallus gallus*) in Northeastern, Thailand

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Abstract: Blood cell characteristics and hematological values were studied in thirty-three healthy free ranging-red jungle fowl (*Gallus gallus*) (male, n = 17; female, n = 16), at the age of 2-3 years, which had been free ranged at Nakhonratchasima Zoo, Nakhon Ratchasima province northeastern, Thailand. The results revealed the following information: the morphologic features of blood cells from red jungle fowls were similar to those of other species of chicken. TRBC, Hb, PCV, MCV, MCH, MCHC, TWBC, lymphocyte, heterophil, monocyte, eosinophil, basophil, thrombocyte of Red Jungle Fowl were 4.43 ± 0.67 ($3.76-5.10$) $\times 10^6$ cells μL^{-1} , 13.63 ± 2.28 ($11.35-15.91$) g %, 41.34 ± 6.71 ($34.63-48.05$) %, 93.57 ± 7.97 ($85.60-101.54$) fl, 30.80 ± 2.24 ($28.56-33.04$) g dL^{-1} , 30.41 ± 1.60 ($28.81-32.01$) pg, $9,140 \pm 3,839.27$ ($5,300.73-12,979.27$) cells μL^{-1} , 74.6 ± 20.27 ($54.33-94.87$) %, 21.83 ± 19.18 ($2.65-41.01$) %, 2.00 ± 1.47 ($0.53-3.47$) %, 3.50 ± 1.34 ($2.16-4.84$) %, 1.67 ± 2.79 ($0-4.46$) %, respectively. Width and length of red blood cell of red jungle fowls were 6.70 ± 0.57 and 10.65 ± 0.59 μm . Diameter of heterophil, lymphocyte, monocyte, eosinophil, basophil and thrombocyte of red jungle fowls were 10.85 ± 0.75 , 5.60 ± 0.48 , 9.35 ± 1.04 , 8.25 ± 0.91 , 7.63 ± 1.40 and 4.25 ± 0.72 μm , respectively. Moreover, total red blood cell, hemoglobin concentration and packed cell volume of males red jungle fowl were higher than females ($p < 0.05$). Finally, MCV, MCH and MCHC of the male and female red jungle fowl were not significantly different ($p > 0.05$).

Key words: Red jungle fowl (*Gallus gallus*), blood cell characteristic, hematology

INTRODUCTION

Red jungle fowl (*Gallus gallus*) is considered the progenitor of the modern chicken breeds used today in commercial agriculture (Daghir, 1995). The exact time and place of domestication are unclear and this may have occurred more than once during human history. It's believed that the modern chicken derives from birds kept by the people of the Harappan culture (2500-2100 B.C.), primarily for fighting purposes. These birds were found in central and south India (*Gallus gallus sonnerati*), East India (*Gallus gallus murghi*), Burma and Malaysia (*Gallus gallus spadiceus*) and Thailand and Cambodia (*Gallus gallus gallus*) (Appleby *et al.*, 1992). Nakhonratchasima Zoo collected red jungle fowl (*Gallus gallus gallus*) from secondary forests and keeps them both in cages for show and free ranging inside the border of the Zoo. At present, Nakhonratchasima Zoo has about one thousand free ranging red jungle fowl.

In general, documents about blood cell characteristics and hematological values of free ranging red jungle fowl are limited. Therefore, the objective of this study was to establish the hematological values of the free ranging red

jungle fowl. Basic knowledge from this study is important to assess the general health, clinical pathological diagnosis and in-depth study of this bird.

MATERIALS AND METHODS

Birds: Thirty-three healthy free ranging red jungle fowl (male, n = 17; female, n = 16), at the age of 2-3 years, which had been free ranged at Nakhonratchasima Zoo, Nakhon Ratchasima province northeastern Thailand, were separated from the unhealthy fowl and then taken for the study. The experiment was performed during May-July, 2005. Blood samples were collected from the jugular vein using a 3 mL syringe, 23-gauge needle and 1.5 inch of length then placed in microtube with EDTA for determining hematological values (Ritchie *et al.*, 1994). The samples were cooled to approximately 4°C, using icepacks and transferred to the laboratory of Faculty of Technology, Mahasarakham University within 12 h of blood collection.

Hematological techniques: Differential White Blood Cell Count (WBC) counts were performed on blood films

prepared, fixed in 95% ethyl alcohol for 5 min. and then were stained with Giemsa-Wright and then took photos with camera under light microscopy. Total Red Blood Cell (TRBC) and Total White Blood Cell (TWBC) were determined by manual method using a hemocytometer (Campbell, 1995). Packed Cell Volume (PCV) was investigated by the standard manual technique using microhematocrit capillary tubes and centrifuged 2,500 rpm. for 5 min. Hemoglobin concentration (Hb) was measured by the Cyanmethemoglobin method (Ritchie *et al.*, 1994) then Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) was calculated (Campbell, 1995), respectively.

Statistical analysis: The results were given as mean \pm SD, hematological values between males and females were compared by t-test from SAS system (SAS, 1990) and a level of significance set at $p < 0.05$.

RESULTS AND DISCUSSION

Blood cell characteristic of red jungle fowl: Mature erythrocytes of red jungle fowl were homogeneous in size, shape and color. They were typically oval shaped with an oval nucleus and dark-staining chromatin (Fig. 1-5). The morphologic features of the blood cells from the red jungle fowl were similar to those of other species of avian. Moreover, the morphology of white blood cell and thrombocyte of red jungle fowl is shown in Fig. 1-5.

Normal values of red jungle fowl: The hematological values of thirty three healthy red jungle fowl, at the age of 2-3 years, which had been free ranged at

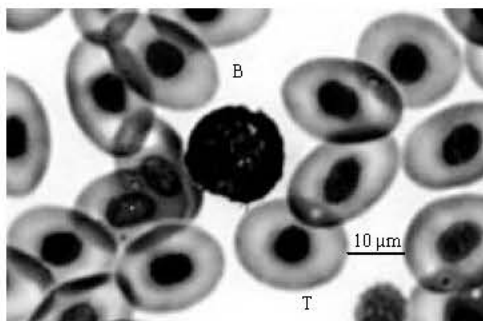


Fig. 1: The basophil (B) of red jungle fowl tend to be round cells. The cytoplasmic granules often hide the nucleus. The cytoplasmic granule has a slightly basophilic stain using the Giemsa-Wright's stain method; Thrombocytes were a small and round cell (T).

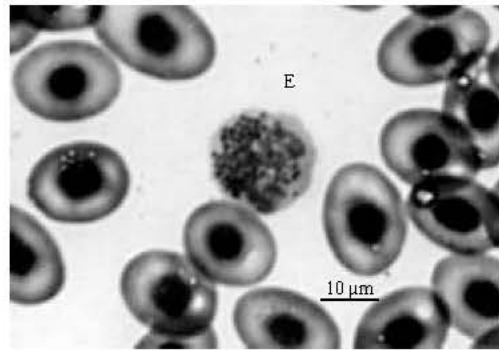


Fig. 2: Eosinophil (E) of red jungle fowl were round in shape, with abundant amounts of cytoplasm containing numerous round granules. The cytoplasmic granules of eosinophil were smaller than heterophil

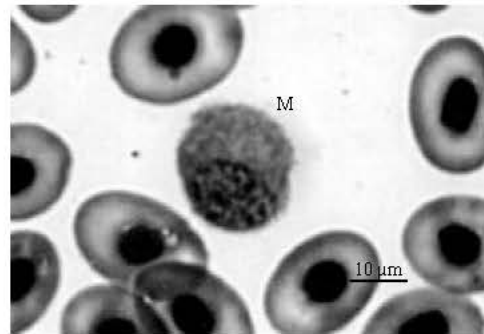


Fig. 3: The monocyte (M) of red jungle fowl were the largest leukocyte found in the peripheral blood film. The nuclei vary from round to bilobed and cytoplasm coloured blue-gray

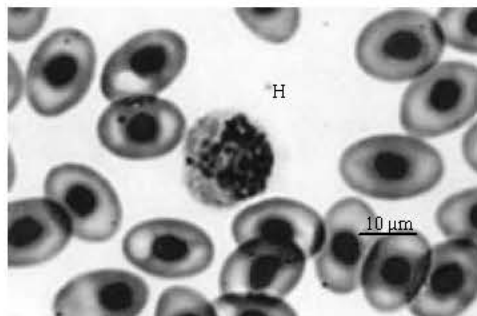


Fig. 4: The heterophil (H) was a single round to irregularly cell with spindle shape cytoplasmic granules. Mature heterophils have a lobed nucleus

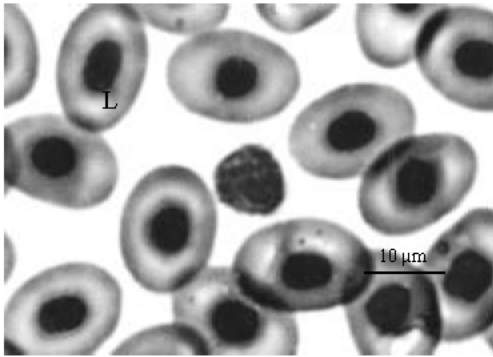


Fig. 5: The Lymphocyte (L) comprised an average 70% of the leukocytes found in the normal clinically red jungle fowl evaluated in this study. The lymphocyte was a typically a round cell show in the blood film. The nucleus is usually round and centrally located

Nakhonratchasima Zoo, Nakhon Ratchasima province, northeastern Thailand are shown by the following: TRBC, Hb, PCV, MCV, MCH, MCHC, TWBC, lymphocyte, heterophil, monocyte, eosinophil, basophil, thrombocyte

of red jungle fowl were 4.43 ± 0.67 (3.76-5.10) $\times 10^6$ cells μL^{-1} , 13.63 ± 2.28 (11.35-15.91) g %, 41.34 ± 6.71 (34.63-48.05) %, 93.57 ± 7.97 (85.60-101.54) fl, 30.80 ± 2.24 (28.56-33.04) g dL^{-1} , 30.41 ± 1.60 (28.81-32.01) pg, $9,140 \pm 3,839.27$ (5,300.73-12,979.27) cells μL^{-1} , 74.6 ± 20.27 (54.33-94.87)%, 21.83 ± 19.18 (2.65-41.01) %, 2.00 ± 1.47 (0.53-3.47) %, 3.50 ± 1.34 (2.16-4.84) %, 1.67 ± 2.79 (0-4.46) %, respectively. (Table 1).

Comparative hematological values between male and female red jungle fowls: TRBC, Hb and PCV of the male was higher than the female red jungle fowls ($p < 0.05$). Whereas, MCV, MCH and MCHC of the male and the female red jungle fowls were not significantly different ($p > 0.05$) (Table 2).

Diameter and dimension of white and red blood cells of red jungle fowls: The width and length of the red blood cells of the red jungle fowls were 6.70 ± 0.57 and 10.65 ± 0.59 μm . The diameter of heterophil, lymphocyte, monocyte, eosinophil, basophil and thrombocyte red jungle fowls were 10.85 ± 0.75 , 5.60 ± 0.48 , 9.35 ± 1.04 , 8.25 ± 0.91 , 7.63 ± 1.40 and 4.25 ± 0.72 μm , respectively. (Table 3).

Table 1: Hematological values of free ranging-red jungle fowl (*Gallus gallus*) in Nakhonratchasima zoo northeastern, nakhon ratchasima, Northeastern Thailand

Parameters	Red jungle fowl (n = 33)	Range (mean \pm SD)	Reference*
Erythrocyte (10^6 cells μL^{-1})	4.43 ± 0.67	3.76-5.10	3.05 \pm 0.83
Hemoglobin (g%)	13.63 ± 2.28	11.35-15.91	11.70 \pm 0.23
PCV (%)	41.34 ± 6.71	34.63-48.05	34.90 \pm 5.80
MCV (fl)	93.57 ± 7.97	85.60-101.54	121.1 \pm 25.20
MCH (g dL^{-1})	30.80 ± 2.24	28.56-33.04	39.20 \pm 7.10
MCHC (pg)	30.41 ± 1.60	28.81-32.01	30.40 \pm 0.31
White blood cell (10^3 cells μL^{-1})	$9,140 \pm 3,839.27$	5,300.73-12,979.27	-
Lymphocyte (%)	74.6 ± 20.27	54.33-94.87	-
Heterophil (%)	21.83 ± 19.18	2.65-41.01	-
Monocyte (%)	2.00 ± 1.47	0.53-3.47	-
Eosinophil (%)	3.50 ± 1.34	2.16-4.84	-
Basophil (%)	1.67 ± 2.79	0.0-4.46	-

*Adapted from Teare (2002)

Table 2: Comparative hematological values between male and female free ranging-red jungle fowls (*Gallus gallus*) reared in Nakhonratchasima zoo, Nakhon Ratchasima, northeastern, Thailand

Parameters	Males	Females
Erythrocyte (10^6 cells μL^{-1})	$4.70 \pm 0.16^*$	4.11 ± 0.14
Hemoglobin (g %)	$44.22 \pm 1.69^*$	38.13 ± 1.20
PCV (%)	$14.46 \pm 0.54^*$	12.65 ± 0.54
MCV (fl) ^{ns}	93.89 ± 1.36	93.39 ± 2.57
MCH (g dL^{-1}) ^{ns}	30.94 ± 0.34	30.73 ± 0.74
MCHC (pg) ^{ns}	30.36 ± 0.37	30.45 ± 0.61

*Within row in each parameter, mean \pm SE with no common superscript differ significantly ($p < 0.05$), ns = non significantly ($p > 0.05$)

Table 3: Diameter and dimension of white and red blood cells of red jungle fowl (*Gallus gallus*) reared in Nakhonratchasima zoo, Nakhon Ratchasima, northeastern, Thailand

Parameters	Diameter (n = 20)	Cell width (n = 20)	Cell length (n = 20)
Red blood cell (μm)	-	6.70 ± 0.57 10.65 ± 0.59	(10.65-11.24) (6.13-7.27)
Heterophil (μm)	10.85 ± 0.75	-	-
Lymphocyte (μm)	5.60 ± 0.48	-	-
Monocyte (μm)	9.35 ± 1.04	-	-
Eosinophil (μm)	8.25 ± 0.91	-	-
Basophil (μm)	7.63 ± 1.40	-	-
Thrombocytes (μm)	4.25 ± 0.72	-	-

After studying the blood cell characteristics of free ranging-red jungle fowl (*Gallus gallus*), the blood cell characteristics and dimension of red jungle fowl were found to be similar with those of domestic fowls as reported by Ritchie *et al.* (1994), including red blood cell width and length (i.e., 6.13-7.27 and 6.5-7.9 μm ; 10.65-11.24 and 10.7-13.0 μm , respectively). Hematological values of the red jungle fowl at Nakhonratchasima Zoo differed from reference values of Teare (2002) i.e., erythrocyte (4.43 ± 0.67 vs $3.05 \pm 0.83 \times 10^6$ cells μL^{-1}), hemoglobin (13.63 ± 2.28 vs 11.70 ± 0.23 g dL^{-1}), packed cell volume (41.34 ± 6.71 vs 34.90 ± 5.80 %), MCV (93.57 ± 7.97 vs 121.1 ± 25.20 fl) and MCH (30.80 ± 2.24 vs 39.20 ± 7.10 pg), respectively. Moreover, hematological values i.e., erythrocyte (4.43 vs 3.0×10^6 cells μL^{-1}), hemoglobin (13.63 vs 9.00 g dL^{-1}), PCV (41.34 vs 30 %), MCV (93.57 vs 115.0 fl), MCH (30.80 vs 41.0 pg), MCHC (30.41 vs 29.0 %); percentage of heterophil (21.83 vs 28 %), lymphocyte (74.6 vs 60.0 %), monocyte (2.00 vs 8.0 %), eosinophil (3.50 vs 4.0 %) and basophil (1.67 vs rare) of red jungle fowl in this study differed from domestic fowl as reported by Jain (1993). The above documentation indicates that mainly the hematological values of red jungle fowl are different from those of the domestic chickens. Therefore, it is important to investigate the hematological values of each species in order to interpret the results accurately for a particular individual. The diameter of white blood cells i.e., heterophil, lymphocyte, monocyte, eosinophil, basophil, thrombocyte; total white blood cell count; percentage of lymphocyte, heterophil, monocyte, eosinophil and basophil of red jungle fowl in this study was first seen in this report. Finally, erythrocyte, hemoglobin and packed cell volume of male red jungle fowl were higher than females. This was similar to the report of Sturkie (1965), he explained that hemoglobin concentration and packed cell

volume were influenced by androgen. In conclusion, Blood cell characteristic, dimension and hematological values of red jungle fowl at Nakhonratchasima Zoo are both similar and different from those domestic fowl that are reported in textbooks or reference values taken from an international data base, even if those domestic chickens developed from red jungle fowl.

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