



## NOTE

Wildlife Science

# Hematology and serum biochemistry parameters for rescued common palm civets (*Paradoxurus hermaphroditus*) in different age groups

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**ABSTRACT.** Currently, there are no complete parameters established for serum biochemistry and hematology for the determination of health status of rescued common palm civets (*Paradoxurus hermaphroditus*). In this study, blood samples were obtained from 18 adults and 15 juvenile civets caught on Singapore Main Island. Significant age-related differences ( $P < 0.05$ ) were noted in the hemoglobin, erythrocyte count, packed cell volume (PCV), total serum protein and globulin concentration in the adult civets showing higher values compared with the juvenile civets. The mean corpuscular volume (MCV), the alkaline phosphatase (ALP) and the phosphorus concentrations were significantly higher ( $P < 0.05$ ) in juveniles compared with adult civets.

**KEY WORDS:** age group, common palm civet, hematology, *Paradoxurus hermaphroditus*, serum biochemistry

The common palm civet (*Paradoxurus hermaphroditus*), a member of the family Viverridae, is widely distributed in South and Southeast Asia including Singapore [1, 8, 12, 16]. In Singapore, common palm civets which are regularly caught in residential areas by non-governmental organizations, pest control companies and local authorities are relocated to forest reserves after a health examination is conducted by Wildlife Reserves Singapore (WRS).

Hematological and serum biochemical values are important for evaluating the general health condition of the civets prior to their release to the wild and helpful in disease diagnosis and monitoring [13, 15]. This study is to establish a baseline hematology and serum biochemistry values for rescued common palm civets and also to investigate age-related variations of hematology and serum biochemistry values between rescued adult and juvenile civets as age-related variations had been previously reported in domestic and wild animals [4–6, 9–11, 14].

Based on the hand-rearing records at the WRS, civets are considered as adult when its body weight is  $>2.5$  kg for female and  $>3.0$  kg for male, and juvenile when its body weight is  $<2.5$  kg for female and  $<3.0$  kg for male. A total of 40 rescued common palm civets, consisting of 13 adult males, 7 adult females, 12 juvenile males and 8 juvenile females; 9 adults (5 males and 4 females) and 10 juveniles (6 males and 4 females) were chemically restrained with 5 mg/kg of Zoletil (Zoletil 100, Virbac, Carros, France). 11 adults (8 males and 3 females) and 10 juveniles (6 males and 4 females) were chemically restrained with the combination of 5 mg/kg of Alfaxalone (Alfaxan<sup>®</sup>, Rutherford, New South Wales, Australia) and 0.05 mg/kg of medetomidine (Domitor<sup>®</sup>, Orion, Espoo, Finland).

Blood was collected from the jugular vein using 23G needles. Five hundred  $\mu$ l blood were placed into EDTA tubes (Minicollect<sup>®</sup> EDTA, Greiner Bio-One, Monroe, NC, U.S.A.) and the remainder into plain tubes (Vacutite, Greiner Bio-One). Blood in plain tube was allowed to clot for a minimum of 1 hr and then centrifuged at 3,750 rpm (4222 MKII, ALC International, Cologno Monzese, Italy) for 5 min to obtain the serum. Serum total protein (TP), globulin, albumin, alanine aminotransferase (ALT), alkaline phosphatase (ALP), total bilirubin, glucose, blood urea nitrogen, creatinine, sodium, potassium, calcium, phosphorus and amylase concentrations were examined by a chemistry analyzer (Abaxis Vetscan 2, Union City, CA, U.S.A.) using the Comprehensive Diagnostic Profile rotor (Abaxis). The packed cell volume (PCV) was examined on anticoagulated blood using

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**Table 1.** Hematology parameter values of rescued common palm civets

Parameter	Adult (n=18)		Juvenile (n=15)	
	Mean ± SD	Range	Mean ± SD	Range
Hemoglobin <sup>a)</sup> (g/l)	127.56 ± 22.29	85.00–167.00	113.87 ± 15.33	91.00–132.00
Erythrocyte <sup>a)</sup> (×10 <sup>12</sup> /l)	13.31 ± 2.22	9.16–16.25	11.72 ± 1.46	9.46–13.69
MCV <sup>a)</sup> (fl)	27.91 ± 1.95	24.00–31.00	29.8 ± 2.86	26.00–36.00
MCH (pg)	9.86 ± 2.38	8.50–19.20	9.73 ± 0.66	8.30–11.00
MCHC (g/l)	336.56 ± 28.11	276.00–368.00	328.73 ± 26.63	289.00–379.00
PCV <sup>a)</sup> (%)	36.97 ± 4.85	27.00–45.50	33.80 ± 3.44	28.00–37.00
PCT (%)	0.68 ± 0.46	0.09–2.14	0.71 ± 0.31	0.22–1.37
MPV (fl)	7.01 ± 0.76	5.90–8.60	7.61 ± 1.42	5.70–11.70
RDW (%)	26.20 ± 1.66	23.60–29.50	24.63 ± 2.14	21.00–27.70
PDW (%)	29.65 ± 2.38	24.50–33.40	32.05 ± 3.05	24.20–36.40
Total Leucocyte (×10 <sup>9</sup> /l)	10.76 ± 3.40	4.40–18.56	9.75 ± 4.08	3.55–20.33
Lymphocyte (×10 <sup>9</sup> /l)	3.20 ± 1.80	1.05–8.26	3.31 ± 1.67	1.08–6.07
Monocyte (×10 <sup>9</sup> /l)	0.52 ± 0.34	0.06–1.33	0.49 ± 0.28	0.11–1.04
Neutrophil (×10 <sup>9</sup> /l)	6.34 ± 3.21	2.30–14.23	5.44 ± 3.11	1.31–12.29
Eosinophil (×10 <sup>9</sup> /l)	0.62 ± 0.36	0.07–1.37	0.44 ± 0.49	0.05–1.39
Basophil (×10 <sup>9</sup> /l)	0.09 ± 0.05	0.01–0.22	0.06 ± 0.06	0.01–0.17
Platelet (×10 <sup>9</sup> /l)	809.06 ± 383.64	130.00–1,921.00	947.13 ± 430.37	273.00–1,795.00

a) Means observed between adult and juvenile animals are significantly different at  $P < 0.05$ .

**Table 2.** Serum biochemical parameter values of rescued common palm civets

Parameter	Adult (n=18)		Juvenile (n=15)	
	Mean ± SD	Range	Mean ± SD	Range
Total Protein <sup>a)</sup> (g/l)	76.26 ± 6.22	64.00–86.00	62.87 ± 9.38	50.00–82.00
Globulin <sup>a)</sup> (g/l)	36.11 ± 11.06	17.00–58.00	24.6 ± 12.78	7.00–52.00
Albumin (g/l)	40.21 ± 8.99	25.00–54.00	38.00 ± 7.50	26.00–48.00
ALT (U/l)	132.16 ± 56.90	53.00–238.00	118.00 ± 27.95	66.00–175.00
ALP <sup>a)</sup> (U/l)	23.89 ± 14.75	6.00–63.00	82.07 ± 52.35	10.00–180.00
Total Bilirubin (μmol/l)	5.89 ± 0.42	5.00–7.00	5.07 ± 1.22	3.00–8.00
Glucose (mmol/l)	7.11 ± 2.6	3.40–12.00	8.57 ± 2.79	4.10–13.50
Blood Urea Nitrogen (mmol/l)	3.67 ± 1.64	1.90–7.60	3.87 ± 2.46	0.50–9.30
Creatinine (μmol/l)	53.11 ± 11.74	32.00–68.00	50.8 ± 25.35	29.00–109.00
Sodium (mmol/l)	143.0 ± 4.1	138.00–151.00	142.67 ± 3.18	139.00–151.00
Potassium (mmol/l)	4.60 ± 0.64	3.50–5.60	4.55 ± 0.46	3.80–5.20
Calcium (mmol/l)	2.69 ± 0.16	2.48–3.08	2.67 ± 0.13	2.44–2.90
Phosphorous <sup>a)</sup> (mmol/l)	1.66 ± 0.35	1.17–2.63	2.24 ± 0.53	1.39–3.65
Amylase (U/l)	2,995.72 ± 1,089.45	0–4,428	2,828.80 ± 739.21	1,689.00–4,177.00

a) Means observed between adult and juvenile animals are significantly different at  $P < 0.05$ .

a microhematocrit centrifuge (Mikro 20, Hettich Zentrifugen, Tuttlingen, Germany). The hemoglobin concentration, erythrocyte, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), plateletcrit (PCT), mean platelet volume (MPV), red cell distribution width (RDW), distribution width (PDW), total leucocyte, lymphocyte, monocyte, neutrophil, eosinophil, basophil and platelet counts were determined on anticoagulated blood using an automated hematology analyzer (Abaxis Vetscan HM5).

After the samples were collected, the animals anesthetized with the drug combination of alfaxalone and medetomidine were antagonized by atipamazole (Antisedan®, Orion) as reversal drug at  $5 \times$  dose of medetomidine. The animals that were anesthetized with Zoletil recovered without administration of antagonist drugs.

The mean and standard deviation for each hematological parameter were calculated using Microsoft Excel (Version 2010, Microsoft, Seattle, WA, U.S.A.). The data were analyzed using a Student's *t*-test (Version 2010, Microsoft) to test for differences in each hematologic and serum biochemistry parameters between age group. The statistic differences were considered to be significant at  $P < 0.05$ .

Of the 40 civets that were brought to WRS, 7 (2 adult females, 4 juvenile males and 1 juvenile female) civets were excluded from the present study as they exhibited various signs of illness, such as injuries, dental disease, high flea and worm infestations. The hematological and serum biochemical values of the common palm civet are presented in Tables 1 and 2. The hemoglobin, total erythrocyte count and PCV concentration of the adult civets were significantly higher ( $P < 0.05$ ) compared to juvenile civets.

Juvenile civets had significantly higher MCV value ( $P < 0.05$ ) than the adult civets. ALP and phosphorus were significantly higher in juveniles ( $P < 0.05$ ) than adults, while the total serum protein and globulins were significantly higher in adults ( $P < 0.05$ ) than the juvenile civets.

Some differences were observed in erythrocyte parameters between juveniles and adult civets. The hemoglobin concentration, erythrocyte count and PCV were higher in adults than in juveniles. The significantly higher MCV and significantly lower hemoglobin may indicate blood loss due to parasitism with regeneration of erythrocytes [5, 9]. The findings are consistent with that observed in other animal species [4–6, 14].

In this study, juvenile civets were observed to have significantly lower ( $P < 0.05$ ) mean protein concentration than adult civets. This is an expected finding as all mammalian species would have an increase of serum protein concentration with age [7, 14]. The increase of serum globulin concentration is due to increase in  $\gamma$ -globulin from antigen exposure, and the humoral response increases with age. Juvenile civets have significantly higher ( $P < 0.05$ ) ALP and phosphorus concentrations than the adult. The higher ALP in young animals probably reflects the higher activity of osteoblasts in juvenile animals [4, 11, 17]. The higher serum phosphorus concentration of juvenile civets reflects the processes of bone growth and remodeling as well as increased renal reabsorption of phosphorus due to the effects of growth hormone [4, 10, 17]. This phenomenon is compounded by lesser bone activity and repair in older animals [3].

The total leucocyte ( $10.76 \times 10^9/l$ ) and neutrophil ( $6.34 \times 10^9/l$ ) counts of the adult civets in this study were higher than the total leucocyte ( $6.26 \times 10^9/l$ ) and neutrophil ( $2.71 \times 10^9/l$ ) count of a previous study on captive adult common palm civets in a zoological garden in Thailand [16]. The high leucocyte and neutrophil counts in this study were possibly due to excitement or acute psychological stress associated with the animals being transferred from its natural habitat and placed in captivity. These apparent elevations were probably due to the redistribution of neutrophils from marginal to the circulating pool [2, 7]. The elevation of total leucocyte and neutrophil counts of the civets in this study were also likely due to the exposure to various pathogens and the infestation that induce the increase of these parameters in the rescued civets [6]. The hematological and serum biochemistry parameters obtained from this study will be useful for clinical and health assessment for both juvenile and adult wild common palm civets. However, caution is required in the interpretation for the total leucocyte and neutrophil count parameters from this study as the higher value for these parameters was due to acute physiological stress during the rescue.

To our knowledge, this study is the first dataset on hematological and serum biochemical parameters of rescued common palm civets. The results from this study will serve as baseline values for civet hematology and serum biochemistry in the assessment of health and disease in wild common palm civets.

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