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**M Veeraselvam**  
Department of Veterinary  
Medicine, Veterinary College and  
Research Institute, Tamil Nadu  
Veterinary and Animal Sciences  
University, Orathanadu,  
Thanjavur, Tamil Nadu, India

**P Selvaraj**  
Department of Veterinary Clinical  
Medicine, Madras Veterinary  
College, Tamil Nadu Veterinary  
and Animal Sciences University,  
Chennai, Tamil Nadu, India

**S Senthil Kumar**  
Veterinary Clinical Complex,  
Veterinary College and Research  
Institute, Tamil Nadu Veterinary  
and Animal Sciences University,  
Orathanadu, Thanjavur,  
Tamil Nadu, India

**A Senthilkumar**  
Farmers Training Centre,  
Tamil Nadu Veterinary and  
Animal Sciences University, Theni,  
Tamil Nadu, India

**TMA Senthilkumar**  
Directorate of Centre for Animal  
Health Studies, Tamil Nadu  
Veterinary and Animal Sciences  
University, Chennai, Tamil Nadu,  
India

**C Sreekumar**  
Department of Wildlife Science,  
Madras Veterinary College,  
Tamil Nadu Veterinary and  
Animal Sciences University  
Vepery, Chennai, Tamil Nadu,  
India

**R Jyothi Priya**  
Regional Research and  
Educational Centre, Tamil Nadu  
Veterinary and Animal Sciences  
University, Machuvadi,  
Pudukottai, Tamil Nadu, India

**Corresponding Author**  
**P Selvaraj**  
Department of Veterinary Clinical  
Medicine, Madras Veterinary  
College, Tamil Nadu Veterinary  
and Animal Sciences University,  
Chennai, Tamil Nadu, India

## Haematology profile of the captive Asian elephants (*Elephas maximus*) in the Tamil Nadu state of India

**M Veeraselvam, P Selvaraj, S Senthil Kumar, A Senthilkumar, TMA Senthilkumar, C Sreekumar and R Jyothi Priya**

### Abstract

Haematological parameters are very much essential for health assessment and disease diagnosis of captive elephants. Regional specific haematological profile are valuable in health care planning for captive elephants. The aim of this study was to assess and evolve the baseline reference values for haematological parameters in captive Asian elephants raised in the Tamil Nadu state of India. As part of the periodical health assessment, blood samples were collected from auricular vein for 46 apparently healthy captive Asian elephants maintained in Tamil Nadu, India. In this study it was found that the overall mean values of haemoglobin was  $12.69 \pm 0.25$  g/dL, packed cell volume was  $36.10 \pm 0.74\%$ , red blood cells was  $2.92 \pm 0.05 \times 10^6/\text{cmm}$  and white blood cells was  $13.31 \pm 0.40 \times 10^3/\text{cmm}$ . Differential count of white blood cells showed that heterophils were the most predominant cell by observed cells ( $40.39 \pm 1.23\%$ ) which was followed by lymphocytes ( $36.52 \pm 1.42\%$ ), monocytes ( $20.43 \pm 1.18\%$ ), eosinophils ( $1.04 \pm 0.23\%$ ) and basophils ( $0.02 \pm 0.02\%$ ). The mean values of erythrocyte indices were MCV  $124.43 \pm 2.14$  fl, MCH  $44.00 \pm 6.9$  pg and MCHC  $35.63 \pm 0.83$  g/dL. Most of the ranges of haematological values observed in this study were similar to that of previous reports. These haematological values would serve as baseline reference to evaluate the health and clinical conditions of captive elephant populations, as well as for planning health care measures in elephants of this region and adjoining areas.

**Keywords:** captive Asian elephant, Tamil Nadu, Haematology, reference values

### Introduction

Health issues are a major concern to the survival of captive elephants. One of the most important objectives in captive condition is maintaining psychological and physiological wellbeing of elephants. Changes in environmental, social, physical, physiological and psychological factors in captive conditions can lead to a range of health issues that could contribute to significant morbidity and mortality in elephants [1]. Elephants are prone to a variety of infectious and non-infectious diseases; but recognizing that they are even sick is itself difficult and challenging [2]. Elephants often do not manifest clinical signs of illness until disease is well advanced. Such masking of clinical signs makes identifying and treating diseases in elephants as very challenging for veterinarians and zoo managers. Clinical pathological examination including haematology, serum biochemistry and electrolyte values are most often the very valuable diagnostic tools for elephants, especially when clinical signs were nonspecific and other diagnostic techniques may not be available for immediate applications [1]. Establishment and use of region specific reference values for blood parameters will help in a better way for health care planning and for clinical management programmes. Hence, this study was undertaken to establish the base-line haematological profile for the captive elephants of Tamil Nadu state of India as such regional specific data will be more useful not only for health monitoring purposes as well as for treatment purposes. Though the haematology and serum biochemistry reference values available for Asian elephants [1, 3], the overall range tend to be very broad. Furthermore, most of the blood parameter data for Asian elephants were available from different geographical locations and hence may not be relevant across all elephant population, due to influencing factors such as feeding management, geographic, climate and management conditions which affects the values [4]. The health profile of captive elephants depends on various factors including body mass index, husbandry management, geographic location, nutrition and infectious and non-infectious diseases [5-7]. Hence, in this study was attempted to establish the baseline haematology reference values for captive Asian elephants maintained in the state of Tamil Nadu, India.

## 2. Materials and Methods

The study population consisted of 46 female captive elephants maintained in different parts of Tamil Nadu. Out of this, 24 captive Asian elephants were assessed during a health and welfare campaign for captive elephants. Remaining 22 captive elephants were privately maintained elephants and were assessed during their periodical health and veterinary examinations. The age of elephants in this study ranged from 11 years to 62 years and all the elephants were apparently healthy during the study period from August 2020 to April 2021. During sampling, the animals were positioned into lateral recumbency with the help of their care takers and blood was collected from auricular vein into EDTA tubes and blood smears were prepared for white blood cell differential count and blood parasitic screening.

Blood samples drawn in EDTA coated vacutainers were analyzed at the Clinical Medicine Laboratory, Veterinary College and Research Institute, Orathanadu, Thanjavur. The haematological examination was carried out as per the methods described by Schalm *et al.* [8]. The Erythrocyte sedimentation rate (ESR) was measured using Westgreen pipette and the reading was taken as mm/hr. The haemoglobin (Hb) was measured by acid-haematin method using haemoglobinometer and expressed in gram per cent. Packed cell volume (PCV) was estimated using microhaematocrit tube and expressed in per cent. Total red blood cell count

(RBC) and white blood cell count (WBC) was done using the haemocytometer and expressed as millions per cubic millimetre ( $\text{mm}^3$ ) and thousands per cubic millimetre ( $\text{mm}^3$ ) respectively. The smears were fixed in methanol and were used for differential leukocyte counts after staining with Giemsa stain. Erythrocyte indices like Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC) were calculated.

## 3. Results

The results of mean value, standard deviation, lower and upper values and 95% confidence interval for various haematological parameters viz. haemoglobin, erythrocyte sedimentation rate, packed cell volume, red blood cells, white blood cells and differential cell counts were presented in Table 1. The erythrocyte sedimentation rate was estimated for 30 minute and for 1 hour and the mean values were  $111.89 \pm 1.40$  mm and  $119.19 \pm 1.41$  mm respectively. Differential count of white blood cells showed that heterophils were the most predominant by observed cells ( $40.39 \pm 1.23\%$ ) and followed by lymphocytes ( $36.52 \pm 1.42\%$ ), monocytes ( $20.43 \pm 1.18\%$ ), eosinophils ( $1.04 \pm 0.23\%$ ) and basophils ( $0.02 \pm 0.02\%$ ). The blood smear studies were unremarkable and no blood parasites were found.

**Table 1:** The mean  $\pm$  standard error, lower and upper value and confidence intervals (95% & 99%) for Haematological parameters in 46 captive elephants

Parameters	Mean $\pm$ SE	Maximum value	Minimum value	95% confidence interval	99% confidence interval
Hb (g/dL)	$12.69 \pm 0.25$	17.8	10.1	12.18 to 13.19	12.02 to 13.35
ESR (mm/30 min)	$111.89 \pm 1.40$	132	84	109.00 to 111.74	108.09 to 115.68
ESR (mm/1hr)	$119.19 \pm 1.41$	136	94	116.90 to 121.47	116.19 to 121.18
PCV (%)	$36.10 \pm 0.74$	54	28.3	34.63 to 37.56	34.17 to 38.02
RBC ( $10^6$ /cmm)	$2.92 \pm 0.05$	3.74	2.1	2.81 to 3.02	2.77 to 3.06
MCV (fL)	$124.43 \pm 2.14$	161.90	90.90	120.27 to 128.58	118.97 to 129.88
MCH (pg)	$44.00 \pm 6.9$	56.74	30.33	41.97 to 46.03	41.33 to 46.67
MCHC (g/dL)	$35.63 \pm 0.83$	46.64	20.00	33.99 to 37.6	33.47 to 37.78
WBC ( $10^3$ /cmm)	$13.31 \pm 0.40$	20.8	7.6	12.51 to 14.10	12.26 to 14.35
Heterophils (%)	$40.39 \pm 1.23$	60	22	37.97 to 42.80	37.21 to 43.56
Lymphocyte (%)	$36.52 \pm 1.42$	56	12	33.72 to 39.31	32.84 to 40.19
Monocytes (%)	$20.43 \pm 1.18$	37	10	18.10 to 22.75	17.37 to 23.48
Eosinophils (%)	$1.04 \pm 0.23$	6	0	0.58 to 1.49	0.43 to 1.64
Basophils (%)	$0.02 \pm 0.02$	1	0	-0.02 to 0.06	-0.03 to 0.07

## 4. Discussion

Health management of captive elephants is always challenging task. Studies on captive elephant health and diseases are far less and hence evolving remedial measures to promote health and welfare remains challenging one. Understanding the health related parameters and evidence of diseases in captive-reared elephants will be of significant help towards enriching the management as well as their healthcare. Periodical haematological testing is helping in the health management. Haemoglobin and Packed cell volume help in understanding the animal's nutritional status, feed intake and dehydration. White blood cell evaluation helps in understanding the immune response of individual especially by observing the differential count of the leucocytes [9].

Mean levels of haemoglobin in this study was  $12.83 \pm 1.70$  g/dL and it was within the reference values reported earlier by Fowler and Mikota [1] in elephants and Silva and Kuruwita [10] in free ranging elephants in Srilanka ( $12.7 \pm 1.7$  g/dL). However the observed values were slightly higher than the mean values reported by Steyrer *et al.* [11] in African elephants

( $14.1 \pm 1.3$  g/dL.) and this variation might be due to the physiological differences between the two species of elephants. Santos *et al.* [9] reported that the mean value of haemoglobin level in Asian elephants of Myanmar as  $11.8 \pm 0.2$  g/dL and ranged from 9.2 to 16; further they observed that the haemoglobin level was increased by 3.4% in the hot season and decreased by 2.5% in the monsoon season. The mean red blood cells ( $2.92 \pm 0.05$   $10^6$ /cmm) and packed cell volume ( $36.10 \pm 0.74\%$ ) observed in this study were slightly lower than the values ( $3.2 \pm 0.71$   $10^6$ / $\mu$ L and  $38 \pm 3.3\%$ ) reported for Srilankan elephants by Silva and Kuruwita [10]. and higher than the average values ( $2.5$   $10^6$ / $\mu$ L and  $33\%$ ) reported by Janyamethakul *et al.* [10] in captive Asian elephants of Thailand. These values have been shown to be varying by geographical locations. The variations between elephants in different locations could possibly be due to the changes in their available feeding materials, water quality and nature of soil.

The erythrocyte sedimentation rate was a nonspecific indicator of diseases and responses to therapy [1]. The

estimated mean value of erythrocyte sedimentation rate in this study was  $111.89 \pm 1.40$  mm/30 min and  $119.19 \pm 1.41$  mm/1hour. Elephants have fastest ESR of any mammalian species and it was attributed to the large RBC size, formation of rouleaux and high fibrinogen and globulin levels [1, 10]. The overall mean values of MCV, MCH and MCHC determined in this study were slightly higher than the values reported Silva and Kuruwita [10] and Salakij *et al.* [3]. Environmental factors such as ambient temperature, rainfall and day length were found to influence the changes in erythrocytic indices [1]. Higher values were considered to be associated with the age of elephants as well as to the differences in geographical locations and captive conditions. Mean value of white blood cell count observed in this study was  $13.31 \pm 0.40 \times 10^3 / \text{mm}^3$  with the range of 7.6 to  $20.8 \times 10^3 / \text{mm}^3$ . The mean value of this present study was lower than the values reported by Silva and Kuruwita [10] in Sri Lankan elephants, Salakij *et al.* [3] in captive Asian elephants of Thailand, Santos *et al.* [9] in Asian elephants from Myanmar. However the value was slightly higher than the values reported by Steyrer *et al.* [11] in African elephants. Lower value was considered to be associated with the age of elephants, management conditions and immune status of animals as well as differences in their feeding patterns under captive conditions. This was in agreement with Gromadzka-Otroka *et al.* [12] who also reported of the differences in WBC count among the domestic Indian elephants.

The differential count of white blood cells in this study showed that the heterophils were the most predominant cell populations ( $40.39 \pm 1.23\%$ ) and it was followed by Lymphocytes ( $36.52 \pm 1.42\%$ ). It was in agreement with Janyamethakul *et al.* [4] who observed that neutrophils and lymphocyte were predominant in the differential count. However, this was in contrast with Fowler and Mikota *et al.* [1] who reported that the lymphocyte was the most frequently encountered predominant cell type. Possible reasons for such high proportion of heterophils could be related to the handling and restraining practices and the prevailing management practices in captive conditions. This was further supported by the observation of Cattet *et al.* [13] who reported that physically restrained bears had higher white blood cell counts with more neutrophils and fewer lymphocytes and eosinophils. The observed monocyte count in this study ( $20.43 \pm 1.18\%$ ) was similar to that of values reported by Silva and Kuruwita [10] and Jani [14]. In the current study, all normal, round and bilobed monocytes were counted as total number of monocytes counts. Eosinophils ( $1.04 \pm 0.23\%$ ) and Basophils ( $0.02 \pm 0.02\%$ ) values observed in this study were similar to that of values reported by Salakij *et al.* [3] in Asian elephants and Steyrer *et al.* [11] in African elephants. However Jani [14] found that there was any increase in the eosinophilic values in elephants which had high parasitic loads.

In this study, most of the observed haematological values were similar to that of previous reports [3, 4, 10]. The values estimated in this study may be used as regional reference range for assessing the health status of captive Asian elephants in Tamil Nadu. However, further studies to evaluate the variations associated with the age, gender and season on haematological parameters, would be of additional help in the health management of captive elephants.

## 5. Conclusion

The regional reference values for the haematological profile of 46 captive elephants maintained in Tamil Nadu were

presented. With no previous large population studies were available in Tamil Nadu, the reference range will help not only in the health monitoring, but also in diagnostic and therapeutic planning in the captive elephants.

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