**Chapter I**

**Introduction**

The elephant, the largest warm-blooded terrestrial animal, is also an endangered species as a result of incessant competition with humans land, food and water. Unlike the problems for African elephants (*Laxodonta* *Africana*), poaching is less of a threat for Asian elephants (*Elephas* *maximus*) because tusks are not present in all Asian males and are usually not present in females (Silva *et al*., 1993). But due to over population, tremendous growth of industrialization and agriculture production, the habitats of wild animals in the world is decreasing day by day. Therefore, everywhere of the world the wild animals are facing threats to be endangered. Moreover, these animals are prone to infect with different types of diseases since the change of habitat. While these type of animals are more important for ecological balance and maintenance of environment. For these reasons conservation of endangered animals are very much crucial globally. Otherwise, ecological balance will be hampered. For conservation of these animals health status monitoring programs is very much important. Knowledge in normal blood values of elephants is useful in evaluating their health status as well as in monitoring the course of a disease or the response to a prescribed treatment. Report on characteristics of blood of elephants is few and reports on wild or free ranging are even less common. This may be attributable to the few opportunities for collection of samples from wild or free ranging elephants.

Since 1986, *E. maximus* has been listed as [endangered](http://en.wikipedia.org/wiki/Endangered_species) by [IUCN](http://en.wikipedia.org/wiki/IUCN) as the population has declined by at least 50% over the last three generations, estimated to be 60–75 years. The species is primarily threatened by habitat loss, degradation and fragmentation (Choudhury *et al*., 2008). In 2003, the wild population was estimated at between 41,410 and 52,345 individuals. Female captive elephants have lived beyond 60 years when kept in semi natural situations, such as forest camps. In zoos, elephants die at a much younger age and are declining due to a low birth and high death rate (Sukumar, 2003). Scientific data on biochemical constituents of the blood of Asian elephant is scarce. The data available includes, serum levels of some electrolytes (Silva and Kuruwita, 1993a; 1993b), certain hormones (*Poole et al.,* 1997), some enzymes (Silva and Kuruwita, 1993a; 1993b), glucose (Ratnasooriya *et al*., 1999), triglycerides (Silva and Kuruwita, 1993a; 1993b; Ratnasooriya *et al*., 2004), total cholesterol (Ratnasooriya *et al.,* 1995; 2004) and total proteins (Silva and Kuruwita, 1993a; 1993b). It is important to collect and document whatever data possible, including those on its serum biochemistry. Such data will not only be useful in the compilation of global information on elephants but also be important in proper diagnosis of diseases and/or disorders, treatment, breeding, general well being, long time conservation and sound management of both captive and wild elephants.

Apart from free-living population of Indian elephants (*Elephas maximus*) found in several protected areas, domesticated and trained elephants are being used for drought purpose by forest department, in circus and in temples for religious occasions in India. Several diseases invariably affect health status of the elephants as like in other domesticated animals. The manifestation of illness of working elephants many a times is ignored on account of lack of awareness. In Bangladesh such type of awareness programs and monitoring of health has not provably seen. Although large number of elephant found in Chittagong Hill Tract and other parts of Bangladesh which are more prone to endangered due globalization and industrialization. Considering the above backgrounds the present study was under taken with the following objectives:

1. To observe practices in semi-wild condition
2. To study the hematological parameters
3. To study serum biochemical parameters

**Chapter II**

**Review of literature**

The Asian or Asiatic elephant (*Elephas maximus*) is the only living species of the genus [*Elephas*](http://en.wikipedia.org/wiki/Elephas) and is distributed in [Southeast Asia](http://en.wikipedia.org/wiki/Southeast_Asia) from [India](http://en.wikipedia.org/wiki/India) in the west to [Borneo](http://en.wikipedia.org/wiki/Borneo) in the east. Three subspecies are recognized — [*Elephas maximus maximus*](http://en.wikipedia.org/wiki/Elephas_maximus_maximus) from [Sri Lanka](http://en.wikipedia.org/wiki/Sri_Lanka), the [Indian elephant or *E. m. indicus*](http://en.wikipedia.org/wiki/Indian_elephant) from mainland Asia, and [*E. m. sumatranus*](http://en.wikipedia.org/wiki/Sumatran_Elephant) from the island of [Sumatra](http://en.wikipedia.org/wiki/Sumatra) (Shoshani, 5005). Asian elephants are the largest living land animals in [Asia](http://en.wikipedia.org/wiki/Asia) ([Shoshani](http://en.wikipedia.org/wiki/Jeheskel_Shoshani) *et al*., 1982).

The genus *Elephas* originated in [Sub-Saharan Africa](http://en.wikipedia.org/wiki/Sub-Saharan_Africa) during the [Pliocene](http://en.wikipedia.org/wiki/Pliocene) ranging throughout Africa into southern Asia (Haynes, 1993). The earliest indications of [domestication](http://en.wikipedia.org/wiki/Domestication) of Asian elephants are engravings on seals of the [Indus Valley civilization](http://en.wikipedia.org/wiki/Indus_Valley_civilization) dated as third millennium [BC](http://en.wikipedia.org/wiki/Anno_Domini) (Sukumar, 1993).

**2.1. Scientific classification:**

|  |  |
| --- | --- |
| Kingdom: | [Animalia](http://en.wikipedia.org/wiki/Animal) |
| Phylum: | [Chordata](http://en.wikipedia.org/wiki/Chordate) |
| Class: | [Mammalia](http://en.wikipedia.org/wiki/Mammal) |
| Order: | [Proboscidea](http://en.wikipedia.org/wiki/Proboscidea) |
| Family: | [Elephantidae](http://en.wikipedia.org/wiki/Elephantidae) |
| Genus: | [*Elephas*](http://en.wikipedia.org/wiki/Elephas) |
| Species: | ***E. maximus*** |

Binomial name: *Elephas maximus* (Linnaeus, 1758)

**2.2. Size:**

Elephants are common large animals; the dimensions of the Asian elephant are often exaggerated. On average, the shoulder height of males rarely exceeds 2.7 m (9 ft) and that of the females, 2.4 m (8 ft) (Lydekker, 1894). Average height of females is 2.24 m (7.3 ft), and average weight 2.72 t (3.00 short tons) rarely exceeding 4.16 t (4.59 short tons). Large bulls weigh up to 5.4 t (6.0 short tons) and are 3.2 m (10 ft) at the shoulder. Length of body and head including trunk is 5.5–6.5 m (18–21 ft) with the tail being 1.2–1.5 m (3.9–4.9 ft) long (Shoshani *et al*., 1982). The largest bull elephant ever recorded was shot by the [Maharajah](http://en.wikipedia.org/wiki/Maharajah) of Susang in the Garo Hills of [Assam](http://en.wikipedia.org/wiki/Assam), [India](http://en.wikipedia.org/wiki/India) in 1924; it weighed 8 tones (8.8 short tons), stood 3.35 m (11 ft) tall at the shoulders and was 8.06 m (26.4 ft) long from head to tail (Wood, 1982). There are reports of larger individuals as tall as 3.7 m (12 ft) (Lydekker, 1894).

**2.3. Ecology and behavior:**

Elephants are [crepuscular](http://en.wikipedia.org/wiki/Crepuscular) (Shoshani *et al*., 1982). They are classified as [megaherbivores](http://en.wikipedia.org/wiki/Megaherbivore) and consume up to 150 kg (330 lb) of plant matter per day (Samansiri *et al*., 2007). They are generalist feeders, and both [grazers](http://en.wikipedia.org/wiki/Grazing) and [browsers](http://en.wikipedia.org/wiki/Browsing_%28predation%29), and were recorded to feed on 112 different plant species, most commonly of the order [Malvales](http://en.wikipedia.org/wiki/Malvales), and the [legume](http://en.wikipedia.org/wiki/Leguminosae), [palm](http://en.wikipedia.org/wiki/Palmae), [sedge](http://en.wikipedia.org/wiki/Cyperaceae) and [true grass](http://en.wikipedia.org/wiki/Graminae) families (Sukumar, 1990). They browse more in the dry season with bark constituting a major part of their diet in the cool part of that season (Pradhan *et al*., 2008). They drink at least once a day and are never far from a permanent source of fresh water (Shoshani *et al*., 1982). They need 80–200 litres of water a day and use even more for bathing. At times, they scrape the soil for clay or minerals.

Adult females and calves may move about together as groups, but adult males disperse from their mothers upon reaching adolescence. Bull elephants may be solitary or form temporary 'bachelor groups' (McKay, 1973).

Cow-calf unit sizes generally tend to be small, typically consisting of three adult females which are most likely related (Fernando *et al,.* 2000), and their offspring; however, larger groups containing as many as 15 adult females may occur (Silva *et al*., 2012). There can also be seasonal aggregations containing 100 individuals at a time, including calves and sub adults. Until recently, Asian elephants, like African elephants, were thought to typically follow the leadership of older adult females, or [matriarchs](http://en.wikipedia.org/wiki/Matriarchy), but females can form extensive and very fluid social networks, with individual variation in the degree of [gregariousness](http://en.wikipedia.org/wiki/Gregariousness) (Silva *et al*., 2011). Social ties generally tend to be weaker than in African elephants (Silva *et al*., 2012).

Elephants are able to distinguish low amplitude sounds (Heffner *et al*., 1980). They use [infrasound](http://en.wikipedia.org/wiki/Infrasound) to communicate; this was first noted by the Indian naturalist [Krishnan](http://en.wikipedia.org/wiki/Madhaviah_Krishnan) and later studied by [Payne](http://en.wikipedia.org/wiki/Katharine_Payne) (Payne, 1998).

(Nowak *et al.,* 1983) reported that Asian ele­phants are quite so­cial. Cows form sta­ble herds of about 20 or more of their fe­male rel­a­tives. These ma­tri­ar­chal groups are led by the old­est fe­male, who co­or­di­nates the herd's move­ments in search of food and water. Herds may tem­porar­ily break up into smaller sub­groups, which main­tain con­tact through low fre­quency long-dis­tance vo­cal­iza­tions. Males are some­times found with these herds, es­pe­cially when a fe­male is in es­trus. Gen­er­ally only the dom­i­nant male mates with the fe­males. Males may travel alone or in tem­po­rary male groups. This species does not ap­pear to be ter­ri­to­r­ial. In the past these an­i­mals mi­grated sea­son­ally, but human ac­tiv­i­ties such as agri­cul­ture have now made this vir­tu­ally im­pos­si­ble. Like other large mam­mals, ele­phants are more tol­er­ant of cold than of ex­ces­sive heat. They spend the hottest part of the day in the shade, and dis­si­pate heat through their ears, which they flap at dif­fer­ent speeds ac­cord­ing to how hot they are. At full charge, an ele­phant can run over.

**2.4. Food habits**

Shoshani *et al.* (1982) reported that Asian ele­phants eat a wide va­ri­ety of species of veg­e­ta­tion. They pre­fer grasses, but they also con­sume bark, roots, leaves, and stems of trees, vines, and shrubs. Most of an adult's ac­tiv­i­ties in­volve mov­ing to­ward and eat­ing food. They eat in the morn­ing, evening, and night but rest dur­ing the hottest part of the day. An av­er­age day's in­take is 150 kg of veg­e­ta­tion, of which only about 44% is ac­tu­ally di­gested (with the aid of sym­bi­otic gut bac­te­ria). Ele­phants eat long grasses by pluck­ing a "hand­ful" with their trunk and putting the bun­dle in their mouth. To eat short grasses, they kick up a pile of dirt with their feet and sweep the grass into their mouth, again with the end of their trunk. Shrubs are eaten by break­ing off twigs with the trunk and in­sert­ing them into the mouth. To eat the bark off larger branches, they hold the branch with their trunk and ro­tate it while scrap­ing off the bark with their teeth - sim­i­lar to the way peo­ple eat corn on the cob. Ele­phants also drink at least once a day (140 liters of water may be con­sumed in just one day) and so are never very far from a water sup­ply.

**2.5. Hematological parameters:**

[Gromadzka-Ostrowska](http://www.ncbi.nlm.nih.gov/pubmed?term=Gromadzka-Ostrowska%20J%5BAuthor%5D&cauthor=true&cauthor_uid=2896562) *et al*. (1988) estimated hematological data were as follows: Ht = 39.2 +/- 2.36%, Hb = 10.1 +/- 0.54 g%, RBC = 2.66 +/- 0.32 x 106/mm3, WBC = 5.43 +/- 0.48 x 103/mm3. Lymphocytes, determined on blood smears were mainly leucocytes from (67.0 +/- 1.59%).

He also found that some seasonal differences in investigated parameters were observed. Ht values, WBC and neutrophils number as well as Ca, and Mg concentrations were higher during winter, whereas RBC, Na and P concentrations were lower in winter.

Silva *et al*. (1993) also reported that the elephants' packed cell volumes (31-44%), hemoglobin concentrations (9.8-15.8 g/dl), and mean corpuscular hemoglobin concentrations (28-40 g/dl). Erythrocyte counts (2.3-5.4 million/cmm), mean corpuscular volumes (81-158 fl), mean corpuscular hemoglobin’s (30-50 pg), and leukocyte counts (8-26 thousand/cmm) were higher. Lymphocytes comprised the largest proportion (44%) of leukocytes. The nuclei of granulocytes were poorly segmented, and the neutrophils (heterophils) had reddish cytoplasmic granules with demonstrable peroxidase activity. Heterophils and monocytes were present in similar proportions. There were two types of monocytes, typical monocytes with unsegmented nuclei and monocytes with segmented nuclei. The cytoplasmic granules of both types had peroxidase activity, but unlike heterophils, these granules were not visible with Romanowsky-type stains.

**2.6. Biochemical parameters:**

Schmitt, (1998) estimated normal values were glucose 89$\pm $20 mg/dl, Total rotein 8.0$\pm $0.8 g/dl, calcium 10.6$\pm $0.8 mg/dl, magnesium 2.07$\pm $0.54 mg/dl, phosphorous 5$\pm $1.2 mg/dl, potassium 4.6$\pm $0.5 mmol/l, chlorine 89$\pm $4 mmol/l, bilirubin 0.2$\pm $0.2 mg/dl, albumin 3.2$\pm $0.5 g/dl and uric acid 0.2$\pm $0.2 mg/dl.

[Gromadzka-Ostrowska](http://www.ncbi.nlm.nih.gov/pubmed?term=Gromadzka-Ostrowska%20J%5BAuthor%5D&cauthor=true&cauthor_uid=2896562) *et al*. (1988) estimated that blood plasma was rated into 5 main fractions, total plasma protein concentration was 6.98 ± 0.53 g%, A/G ratio was 0.69 ± 0.1. Plasma minerals concentration was as follows: Na, 3044 ± 194 *μ*g/ml; K, 529 ± 38.5 *μ*g/ml; Mg, 33.0 ± 3.43 *μ*g/ml; Ca, 181.0 ± 17.8 *μ*g/ml; P, 44.6 ± 6.1 *μ*g/ml. Ca:P ratio was 3.25 ± 0.34.

Silva *et al*. (1993) also reported that most of the biochemical measures were comparable to values for bovine, equine, canine, and feline species, with slight differences in the ranges. Plasma protein concentrations ranged from 6 to 11 g/dl and 10% of the elephants had concentrations above 10 g/dl. Wider ranges were observed in elephants for concentrations of plasma fibrinogen (0.13-2.70 g/dl), creatinine (1.0-3.8 mg/dl), and total and conjugated bilirubin (0.23-0.94 mg/dl and 0.07-0.76 mg/dl, respectively), although the icterus index was 2. Values for plasma urea nitrogen (3-18 mg/dl), serum glutamic pyruvate transaminase activity (4-40 U/L), serum calcium (5.5-11.0 mg/dl), and the serum calcium: phosphorus ratio (1.09-3.68) was lower in the elephant than in bovine, equine, canine, and feline species.

Wijesekera *et al*. (2008) reported that Serum potassium, calcium, magnesium and inorganic phosphorus levels of elephants were 2.92 ± 1.05, 2.38 ± 0.24, 0.75 ± 0.27, 1.30 ± 0.29.

Alwis *et al*. (2005) reported that serum bilirubin 0.26$\pm $0.05mg/dl, albumin 20.9$\pm $4.9 g/l, creatinine 3.03$\pm $0.60mg/dl, urea 15.49$\pm $3.89mg/dl, uric acid 0.25$\pm $0.09mg/dl, glutamic oxaloacetic transaminase 11.7$\pm $3.0U/l and glutamic pyruvate transaminase 3.7$\pm $2.1U/l.

Carola *et al*. (1990). The low serum potassium level in the Sri Lankan elephant may result from low desorption and/or high secretion of K+ in the uriniferous tubules of the kidney as kidneys excrete 80-90% of serum potassium. Decrease in serum potassium level occurs in diarrhoea, vomiting, diabetic acidosis and chronic kidney diseases.

**Chapter III**

**Materials and Methods**

**3.1 Site selection and time duration:**

A cross sectional study was conducted on 5 semi-captive elephants (3 males and 2 females) at Dulahazra Safari Park Cox’s Bazar, for a period of 1 month from 25th December’13 to 23th january’14. For this study official approval was taken prior to study from the department of Forestry, Chittagong.

**3.2. Contact with the responsible person:**

After official approval we made contact with the veterinarian of Safari Park and visited the Safari Park for collection of samples.

**3.3. Collection of information:**

Relevant information about the elephant such as demographic (age, sex and type), body condition, nutritional status, housing and feeding, breeding, vaccination, medication, de-worming and all other management systems were collected by face to face interviewing the veterinarian with a pre-structured questionnaire.

**3.4. Collection and preservation of sample:**

Semi- captive rearing 5 elephants were selected for current study. The blood samples were collected when the animal were in sitting position without sedation. A 5-10ml of blood was collected from a vein on the posterior side of each ear with a sterilized needle connecting to a 12 ml syringe. All samples were collected taking aseptic precautions.

For hematological analysis blood sample were mixed with anticoagulant (ethylene di-amine tetra acetate, 5-10 mg for 5 ml of blood). After collection of blood the samples were carried within an ice box from Safari Park to Chittagong Veterinary and Animal Sciences University (CVASU). For biochemical analysis blood samples were kept at 25$℃$ for 1-2 hours followed by storage at 4$℃$ for overnight before serum separation. Then blood sample are labeled accordingly. Serum samples were stored at -20$℃$ until the further testing being performed.

**3.5. Hematological analysis:**

Hemoglobin (Hb), packed cell volume (PCV), erythrocyte sedimentation rate (ESR), total erythrocyte count (TEC), total leukocyte count (TLC), differential leukocyte count (DLC) Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were determined as per procedures set by (Shastry, 1983).

**3.6. Biochemical analysis:**

Serum samples were subjected to determined glucose, serum total protein (STP), calcium (Ca), potassium (K), magnesium (Mg), phosphorus (P), bilirubin, triglyceride (Tg), albumin, glutamic pyruvate transaminase (GPT), glutamic oxaloacetic transaminase (GOT), chlorine (Cl) and uric acid (UA) using a biochemical analyzer (Haemolyzer 3000®), according to the protocol of Randox Laboratories LTD, UK. All these tests were performed in Biochemistry laboratory of CVASU.

**3.7. Statistical analysis:**

Raw data were sorted out and imputed into MS Excel-2007 and exported into Stata-11.0. For descriptive analysis (Mean, SD, percentage, minimum and maximum value).

**Chapter 4**

**Results and Discussion**

The study recorded nine hematological parameters and thirteen biochemical parameters of Asian elephants at Dulahazra Safari Park, Cox’s bazar. Blood samples were collected from 5 (3 male and 2 female) apparently healthy animals to provide data. The hematological and biochemical profiles were determined using procedures, which are widely used and claimed to be reliable and sensitive. The results are represented as mean $\pm $ SD. The results obtained are summarized in table 1 and 3.

**4.1. Management practices:**

Semi- captive rearing system was recorded in this study.One shed is used in rainy season and another time keeps in top place in the park area. Green grass 50 kg, banana tree 200 kg, boiled rice 4 kg, wheat bran 4 kg, jiggery 50 gm and salt 50 gm were given per day per elephant. Rabies and tetanus vaccine are provided if injured. Ivermectin inj (s/c, 1ml/80 kg) Nytroxinil inj (s/c, 1ml/70kg), Endex (1bol/100kg) are used as deworming program every three month interval. The feeding practices of this study were nearby agreed with earlier study (Shoshani *et al*., 1982). According to Shoshani *et al.* (1982), Asian ele­phants eat a wide va­ri­ety of species of veg­e­ta­tion. They pre­fer grasses, but they also con­sume bark, roots, leaves, and stems of trees, vines, and shrubs. . An av­er­age daily in­take is 150 kg of veg­e­ta­tion, of which only about 44% is ac­tu­ally di­gested (with the aid of sym­bi­otic gut bac­te­ria).

**4.2. Hematological analysis:**

Table 1: Hematological parameters of elephants

|  |  |  |  |
| --- | --- | --- | --- |
| Parameters | Mean$\pm $SD | Minimum | Maximum |
|  Hb (g$\%$) | 9.48$\pm $0.58 | 8.6 | 10 |
| PCV ($\%$) | 30$\pm $3.80 | 29 | 34 |
| ESR (mm in 1st hour) | 34.8$\pm $9.20 | 21 | 46 |
| TEC (106/mm3) | 1.91$\pm $0.30 | 1.59 | 2.25 |
| TLC (103/mm3) | 9.77$\pm $5.37 | 5.25 | 19 |
| MCV (fl) | 159.72$\pm $32.09 | 128.89 | 213.84 |
| MCH (pg) | 50.81$\pm $9.93 | 38.22 | 61.73 |
| MCHC (g$\%$) | 32.13$\pm $5.59 | 27.65 | 41.67 |
| DLC ($\%$) |  |  |  |
| Lymphocyte | 44.2$\pm $12.17 | 25 | 56 |
| Monocyte  | 3.2$\pm $0.84 | 2 | 4 |
| Neutrophil | 45.8$\pm $10.92 | 30 | 60 |
| Eosinophil | 6.8$\pm $4.21 | 1 | 11 |
| Basophil | 0 | 0 | 0 |

*N=5 (3 male and 2 female)*

The table 1 shows the hematological parameters of elephants, irrespective of age, sex and type. The hematological parameters include hemoglobin, packed cell volume, erythrocyte sedimentation rate, total erythrocyte count and total leukocyte count were 9.48$\pm $0.58$\%$, 30$\pm $3.80$\%$, 34.8$\pm $9.20 mm in 1st hour, 1.91$\pm $0.30 million/cmm and 9.77$\pm $5.37 thousand/cmm respectively. Which do not coincided with the earlier studies who reported higher mean for all parameters (Gronsadzka-Ostriwsja *et al.,* 1988).

 In this study mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration were 159.72$\pm $32.09 fl, 50.81$\pm $9.93 pg and 32.13$\pm $5.59 g$\%$ accordingly. This was similar to that previously reported in Asian elephants (Silva *et al.,* 1993).

Table 2: Hematological parameters between male and female elephants

|  |  |  |
| --- | --- | --- |
| Parameters | Male (Mean$\pm $SD | Female (Mean$\pm $SD |
| Hb (g$\%$) | 9.33$\pm $0.70 | 9.7$\pm $0.43 |
| PCV ($\%$) | 30.5$\pm $2.12 | 32.5$\pm $2.12 |
| ESR (mm in 1st hour) | 40.33$\pm $4.93 | 26.5$\pm $7.70 |
| TEC (106/mm3) | 2.0$\pm $0.34 | 1,78$\pm $0.26 |
| TLC (103/mm3) | 12.22$\pm $5.88 | 6.10$\pm $1.20 |
| DLC ($\%$) |  |  |
| Lymphocyte | 41.67$\pm $14.43 | 48$\pm $11.31 |
| Monocyte | 3.33$\pm $0.58 | 3$\pm $1.42 |
| Neutrophil | 49.67$\pm $9.07 | 40$\pm $14.14 |
| Eosinophil | 5.33$\pm $5.13 | 9$\pm $1.42 |

*N=5 (3 male and 2 female)*

According to table 2, in this study hemoglobin, packed cell volume, lymphocyte and eosinophil were lower in male than female. On the other hand erythrocyte sedimentation rate, total erythrocyte count, total leukocyte count, neutrophil and monocyte were higher in male than female.

**4.2. Biochemical analysis:**

Table 3: Biochemical parameters of elephants

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameters | Mean$\pm $SD | Minimum | Maximum | Normal value |
| Glucose (mg/dl) | 98.88$\pm $38.32 | 66.2 | 164.5 | 89$\pm $20 |
| TP (g/dl) | 7.32$\pm $0.60 | 6.3 | 7.8 | 8.0$\pm $0.8 |
| Calcium (mg/dl) | 20.44$\pm $9.06 | 14.2 | 34,3 | 10.6$\pm $0.8 |
| Magnesium (mg/dl) | 1.3$\pm $0.4 | 0.6 | 1.6 | 2.07$\pm $0.54 |
| Potassium (mmol/l) | 7.76$\pm $0.86 | 7.3 | 8.9 | 4.6$\pm $0.5 |
| Phosphorous (mg/dl) | 6.56$\pm $0.58 | 5.6 | 7.1 | 5$\pm $1.2 |
| Chlorine (mmol/l) | 116.32$\pm $33.82 | 94.4 | 173.2 | 89$\pm $4 |
| Bilirubin (mg/dl) | 0.04$\pm $0.06 | 0 | 0.1 | 0.2$\pm $0.2 |
| Triglyceride (mmol/l) | 1389.4$\pm $90.48 | 1319 | 1543 | \_ |
| Albumin (g/dl) | 6.92$\pm $1.69 | 5.2 | 9.3 | 3.2$\pm $0.5 |
| GPT (U/L) | 12.68$\pm $3.65 | 9 | 18.2 | \_ |
| GOT (U/L) | 26.89$\pm $6.77 | 18.3 | 36.4 | \_ |
| Uric acid (mg/dl) | 6.56$\pm $7.16 | 0.7 | 18.7 | 0.2$\pm $0.2 |

*N=5 (3 male and 2 female)*

According to table 3, serum levels of glucose, calcium, potassium, phosphorus, chlorine, albumin, bilirubin and uric acid were 98.88$\pm $38.32 mg/dl, 20.44$\pm $9.06 mg/dl, 7.76$\pm $0.86 mmol/l, 6.56$\pm $0.58 mg/dl, 116.32$\pm $33.82 mmol/l, 6.92$\pm $1.69 g/dl, 0.04$\pm $0.06 mg/dl and 6.56$\pm $7.16 mg/dl respectively recorded in this study was slightly higher than that of normal value (Schmitt, 1998). On the other hand total protein 7.32$\pm $0.60 g/dl and magnesium 1.3$\pm $0.4 mg.dl were slightly lower than that normal value of elephants (Schmitt, 1998). This result also agreed with those reported by (Wijesekera *et al*., 2004) and (Silva *et al*., 1993). These differences could be due to the differences in their major habitats (semi-captive/semi-wild or free range rearing) or due to species or subspecies differences. Striking differences are reported with certain physiological parameters between the Sri Lankan elephant and the African elephant (eg in serum chemistry and haematology) (Brown & White, 1976; 1980) and other subspecies of Asian elephants (eg body temperature, serum cholesterol level, serum glucose level) (Ratnasooriya *et al*., 1992b; 1995; 1999).

Calcium, phosphorus levels reported in this study are also comparable and lower than theat reported by (Wijesekera *et al*., 2008). Glutamic pyruvate transaminase 12.68$\pm $3.65 U/L and glutamic oxaloacetic transaminase 26.89$\pm $6.77 U/L recorded in this study were lower than that of (Alwis *et al*., 2005).

Table 4: Biochemical parameters between male and female elephants

|  |  |  |
| --- | --- | --- |
| Serum parameters | Mean$\pm $SD (Male) | Mean$\pm $SD (Female) |
| Glucose | 115.23$\pm $42.71 | 73.1$\pm $9.75 |
| Total protein | 7.67$\pm $0.15 | 6.8$\pm $0.71 |
| Calcium | 24.6$\pm $9.95 | 14.2$\pm $0 |
| Magnesium | 1.47$\pm $0.12 | 1.05$\pm $0.68 |
| Phosphorous | 6.29$\pm $0.59 | 1.05$\pm $0.68 |
| Potassium | 8.23$\pm $0.76 | 7.05$\pm $0.35 |
| Chlorine | 120.97$\pm $45.24 | 109.35$\pm $17.89 |
| Bilirubin | 0.07$\pm $0.06 | 0 |
| Triglyceride | 1346$\pm $38.43 | 1454.5$\pm $125.2 |
| Albumin | 5.77$\pm $0.55 | 8,65$\pm $0.92 |
| GPT | 10.27$\pm $1.12 | 16.3$\pm $2.68 |
| GOT | 26.57$\pm $3.03 | 27.35$\pm $12.79 |
| Uric acid | 10.03$\pm $7.65 | 1.35$\pm $0.92 |

*N=5 (3 male and 2 female)*

Table 4 shows that glucose, calcium, magnesium, chlorine, potassium, total protein and uric acid levels were higher in the male. On the other hand phosphorous, triglyceride, albumin, GPT and GOT were lower in male. None of the parameters recorded for Sri Lankan elephant showed a gender difference as record for serum electrolytes (Wijesekera *et al.,* 2004) or the lipids (Ratnasooriya *et al*., 2004).

**Chapter V**

**Conclusion**

Management practices of semi-captive elephant is close to standard level. Erythrocyte sedimentation rate, total erythrocyte count, total leukocyte count, neutrophils, monocytes was higher in male as compared to female. Similarly total protein, calcium, magnesium, potassium chlorine, bilirubin and uric acid were found higher as compared to female. Although the present study was limited with few hemato-biochemical parameters it may be concluded that such data are extremely useful directly in proper diagnosis and treatment, captive breeding and general welfare, and indirectly in the long term conservation and efficient management of our majestic animal.

**Chapter VI**

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