



Physiological features of Indian elephant

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Kerala has reasonable population of Indian elephants and this has encouraged our institution to make many scientific contributions to the study on this largest terrestrial mammal. This animal is extensively used for temple ceremonies, processions, timber industry and also in capturing, taming and training new elephants. Thus, elephant is a common client to many veterinarians and scientists of this state. A brief report on the blood, milk and urine studies carried out in our lab and some data collected from literatures form the subject matter for the article. This could be used as a referral data by elephant lovers, practitioners and scientists.

Depending upon the size and age of an elephant, a normal heart weighs between 12 to 28 kg, which consists about 0.5% of the body weight. The slope of the heart is unique, bifid apex, i.e., ventricles are separated at the apex region. The venacavae are also peculiar with its paired nature, instead of the usual fused single vein. The enormous size of the arteries are supported by tough elastic fibres / muscle which gets calcified in older elephants. About 10% of the body weight constitutes body fluids and an elephant contains about 115 l of

blood. Normal heart rate is greater while sitting or lying (32 / minute) compared to standing (28 / minute). The skin is very thick and hence superficial veins are observed only on the exterior and interior of the ears, anterior surface of the proximal forelimbs and on the medial aspect of the distal portion of rear limbs.

Erythrocyte has an average of $93\mu\text{m}^2$ surface area and $9.3\mu\text{m}$ in thickness. The usual shape is biconcave disc and has a diameter of 8.8 to $10.5\mu\text{m}$. Platelet count averages about $637 \times 10^3/\text{mm}$.

Lately it is postulated that the previously classified bilobed or less commonly a trilobed nucleated cell with clumped chromatin is not a variation of lymphocyte but a monocyte which can bring out monocyte as the predominant leucocyte in elephant blood.

The relationship between ESR values and the time of determination is only during the first 15 minutes. Fifty percentage of the sedimentation is attained at 15 minutes. Hence ESR determined at 15 minutes can be used as a clinical tool in diagnostic aid.

The low serum icterus index is suggestive of the non-contribution of carotenoid fragments present in the bulk of the diet of elephants, viz., leaves of *Caryotta virens* and the efficient excretion of bilirubin by liver.

The brain even though occupies only a small part of the skull weighs about 3-5 kg. In proportion to the size of the body, it is smaller to human brain, even though brain size is not directly related to intelligence. Only 35% brain growth is attained at birth and the major development of brain occurs as the baby grows up. This pattern is similar to human brain growth. The cerebrospinal fluid is clear and colourless with no leucocytes and about $18/\text{mm}^3$ RBC count. The total protein is 7.8 mg/dl and glucose 150 mg/dl. The sodium, potassium and chloride level are 133 mEq/L, 3.2 mEq/L and 105 mEq/L respectively in the CSF.

Urine is clear or turbid with straw to amber in colour. The turbidness is due to calcium oxalate or calcium carbonate and amorphous phosphate crystals. The pH is alkaline ranging from 8 to 9 with a specific gravity of 1.019. An elephant urinates 8 to 12 times per day with a volume ranging from 25 to 53 l per day. The total solids is 4.46 mg/100 ml and ash of 1.23 mg / 100 ml. Urea, creatinine and uric acid were in the mean of 1025 mg%, 93 mg% and 36 mg%





respectively. Though the total sulphates were 56.7 mg%, chlorides were about 460 mg% and inorganic phosphates 35.5 mg%.

Elephant milk is thin, watery white and sweet. The fat level is high during weaning time and the lactose level decreased with advancement of lactation.

The milk is poor in Vitamins A and D but rich in B vitamins. In non-pregnant or non-nursing females, the breasts are shrunk and the nipples shrivelled. During pregnancy the glands swell and the nipples become prominent. Normally 10-12 lactiferous ducts are seen in a gland.

Rice based formulae containing cows' milk can be used to raise orphan baby elephants successfully. The recipe for one such formula is as follows: 0.5 kg dried whole milk, 0.5 kg cooked brown rice, 0.2 kg sucrose and 8.5 l water. Multivitamins and bone meal (825 mg / 100 g formula) should also be supplemented.

The milk used should be of less fat (2%). A 100 kg baby elephant requires about 400 - 500 oz. of this rice-based formula per day.

The dental formula is $I^{1/0}$, $C^{0/0}$, $PM^{0/0}$, $M^{6/6}$. The molars (24 total), six in each half jaw does not erupt all at a time. It is observed that only 2 molars wear at a time in each side of the jaw. Each tooth appear at the back of the jaw and gradually move forward and replace the preceding tooth in a lower progressive manner. The molars have ridges or laminae or lamellae or plates running across the tooth. They are parallel in Asian elephants. The definite relationship between the number of plates, time of eruption and replacement of molars with age is used for ageing of elephants.

Though the elephant breath both through the mouth and trunk, 70% of the air intake is via trunk. The pleural cavity although present in young ones, is absent in adults. Hence the lungs are directly attached to the chest wall cavity and diaphragm. Since there is no negative pleural pressure to aid inflation of lungs, respiratory movements are solely induced by the muscles of the chest and ribs. This anatomical peculiarity makes breathing a difficult process if the elephant's chest and diaphragm movements are restricted. This matter should be taken care during tranquillising elephants, where there is always a possibility of the animal falling down on its brisket and the viscera pressing on the diaphragm leading to breathing difficulty and fatal death. Even long periods of lying on a side could lead to this serious problem.

The digestion is helped by a simple stomach and it is similar to the digestion in horse. There is a distensible pharyngeal pouch that terminates in a sphincter from

Milk of elephant

Specific gravity	1.023 - 1.038
Total solids %	16.40 - 28.55
Total ash %	0.57 - 0.80
Fat %	5.80 - 19.00
Protein %	4.40 - 5.40
Casein %	1.40 - 2.50
Lactose %	3.40 - 5.40
Calcium mg%	84.60 - 178.00
Phosphate mg%	186.00 - 309.00
Vitamin C mg%	0.25 - 0.40
Chloride mg%	42.00 - 64.00
PH	8 - 9

which it can control the propulsion of fluid and food into the oesophagus. There is a sphincter at the termination of the pharyngeal pouch, through which controlled flow is regulated. The stomach is on the left side, cylindrical in shape and glandular in nature. It is usually a storage organ with less activity in the digestion of food. The microbial digestion of cellulose takes place in the huge sacculated caecum. Fermentation is also evident in the duodenum and colon, which are rich in protozoa. The digestion products are absorbed through intestinal wall. The rest of the gut is mainly concerned with consolidation of the faeces and reabsorption of water. The average length of a small intestine is 2.1 m; large intestine 12.8 m and caecum 0.6 to 1.5 m. Though the bile duct is large and sacculated, the gall bladder is absent. Young calves show coprophagia. Normally an elephant defecates 12 - 15 times per day at the rate of 5 - 8 balls at a time. Elephants digest about 44% of what they consume. The shape of the faecal bolus reflects the dimension of the rectum and the seeds, vegetation and the nutrient rich bolus is a source of nutrient for dung beetles, birds and insects. Defecation occurs throughout the day except during 4 - 5 hours in the night when the animal sleeps. Tamed animals pass large quantities of loose faeces prior to circus act, trucking or other anticipated events. Each faecal bolus averages about 1 to 2 kg in weight, 100 to 150 mm in diameter and 70 to 180 mm in length. The faecal bolus is usually green to brown in colour and is held intact with a mucous seal.

