venous and arterial blood. Other factors that influence the numbers are breed, age, sex, nutrition, various physiological stages like oestrous cycle, pregnancy, lactation and egg production, adrenaline production due to freight etc., changes in haemoconcentration, ambient temperature, altitude and other climatic factors. The erythrocyte counts are higher in *Bos indicus* as compared to *Bos taurus*. Crossbred cattle have values more in tune with *Bos taurus* (European cattle). Among the Indian cattle and buffaloes, the buffaloes blood shows the highest number of erythrocytes.

Table 1 : Range of erythrocytes in blood of domestic animals

Species	Millions/cu mm
Cattle, Pig, Dog, Cat	6-5
Rabbit and Chicken	6-8
Horse	7-12
Sheep	10-13
Goat	13-14
Man	5-6
Woman	4-5
Buffaloes	6-7
Camel	8-2

Formation and Fate of Erythrocytes

During prenatal life erythropoiesis, the formation of erythrocytes, takes place in yolk sac which later in prenatal life is taken up by liver, spleen and lymph nodes. During postnatal life erythrocytes are continuously formed in bone marrow as nucleated cells (to certain extent in spleen in birds) at a rate to balance destruction in blood circulation. Rubriblast by passing through various developmental stages such as prorubriblast, rubricyte metarubricyte and reticulocyte develop into erythrocyte in the bone marrow. They enter bone marrow capillary to join blood stream by diapedesis, a process of penetration without rupturing the capillary wall, mostly after extruding the nucleus (1-3% enter as nucleated reticulocytes).

For the formation of blood and blood cells (haematopoiesis) and for their maturation adequate availability of various vitamins (B_{12}, folic acid, thiamine, riboflavin, pyridoxine, nicotinic acid, pantothenic acid, biotin and ascorbic acid) minerals (iron, copper and cobalt), amino acids, water and energy are essential. Due to hypoxia or oxygen debt

in tissues due to various diseases, haemorrhage or haemolyses, a humoral factor (hormone) erythropoietin is produced in kidney and in tissues with low oxygen supply, which stimulates haematopoiesis. Polycythemia is the presence of unusually large number of erythrocytes in circulation. Plasma from animals rendered anaemic by various means induces polycythemia when injected into normal animals. This effect is due to the secretion of erythropoietin. Erythropoietin is a mucoprotein with a molecular weight of 46000 dalton.

Life span of erythrocytes from the time they enter blood stream till they are destroyed vary from species to species. A great number of erythrocytes are destroyed daily. In an animal weighing 450 kg with a blood volume of 8 per cent of body weight having 300 trillion erythrocytes with a life span of 100 days, around 3 trillion in a day or 35 million in a second are destroyed.

Table 2 : Life span of erythrocytes in domestic animals

Species	Life span (days)
Cattle, Sheep, Goat	125-150
Horse	140-155
Lamb & catves	50-100
Pig	62-71
Dog	105-122
Cat	68-77
Chicken	20-30
Duck	30-40
Rabbit	45-50
Man	120-135

Reticuloendothelial cells are stellate or Kupffer cells found in the walls of blood sinuses of the liver, spleen, bone marrow and lymph nodes. These cells are instrumental in the destruction of old exhausted erythrocytes. As the erythrocytes are destroyed, the iron moiety (0.334% of Hb or 0.04-0.05% of blood) of haemoglobin is conserved for the new haemoglobin production and iron that is not utilized immediately is stored in liver and spleen. The pigment part of the haemoglobin is converted into bile pigments, bilirubin and biliverdin which are excreted in bile by liver. The protein portion is either utilized in new haemoglobin formation or in the formation of other body proteins.

1. Haemoglobin

Biosynthesis of haemoglobin, the pigment of erythrocytes starts in the erythrocytes (Rubriblasts) and continue in the subsequent stages of cell development till the nuclear material is present. Haemoglobin is an iron containing with molecular weight from 66000 to 69000 daltons. It composed of heme, a metallic compound containing iron found in plant and animal kingdom which imparts red color to Hb and a simple protein globin. Amino acid glycine and acetate form a four carbon compound with additional glycine. This compound unites with glycine to form pyrrole. Four pyrrole molecules form into protoporphyrin which in turn unites with iron to form heme. Four heme molecules unite with protein globin to form haemoglobin. Haemoglobin varies from 13-15 g/100 ml of blood in most domestic animals except in lactating cows (11-12 g/100 ml), buffaloes (11 gm/100 ml) and chicken (6.5-9.0 gm/100 ml) (Table 3).

Table 3 : Haemoglobin concentnation of different species of domestic animals (gm/100 ml).

Buffaloes	11.33 (8-15)
Cow	11-13
Chicken	6.5-9.0
Zebu cattle	12.5
Horse	12.5
Sheep	11.0
Goat	9-12
Pig	12.0
Dog	13.5

Forms of Haemoglobin

1. Haemoglobin combines with oxygen while blood passes through pulmonary capillaries to form a bright red oxyhaemoglobin owing to the oxygen combining capacity of the iron content of haemoglobin which in turn loses oxygen to tissues while blood passes through systemic capillaries to form purplish red haemoglobin. One gram of haemoglobin carries 1.36 ml of oxygen or 15 gm of haemoglobin in 100 ml blood may carry 20 ml of oxygen.
2. Myoglobin or myohaemoglobin or muscle haemoglobin contains one heme group and one iron molecule with approximate molecular weight of 16,700 daltons has a greater affinity for

oxygen than blood haemoglobin and serves as a brief oxygen store and rapidly releases oxygen when muscle fibres contracts which are replenished while resting.

3. Carboxyhaemoglobin or carbonmonoxyhemoglobin which is bright cherry red, results when haemoglobin combines with carbon monoxide present in inspired air. Carbon monoxide has 200 times more affinity with haemoglobin due to which it prevents the carriage and supply of oxygen to tissues.
4. Methaemoglobin if formed by oxidation of ferrous iron of haemoglobin to ferric state and occurs in blood in minute quantities. Though non toxic it cannot function as respiratory pigment. Reducing compounds like ascorbic acid, glutathione etc in erythrocytes prevent accumulation of methaemoglobin. Larger amounts are formed after the administration of certain drugs like nitrites, aminopehenols, sulphonamides etc.

2. Leucocytes or White Blood Corpuscles (WBC)

Leucocytes are colorless blood corpuscles capable of amoeboid movement. Their chief function is to protect the body against microorganisms causing disease. The number leucocytes varies under different pathological conditions, physiological stages for example most bacterial infections are associated with income number of leucocyte (leucocytoines), whereas decrease number of leucocytes (leucopenets) is commonly seen in viral infections. The number of leucocytes was found to increase in swamp buffalo from $8.82 \times 10^9/l$ a short time after parturition to $16.76 \times 10^9/l$ at the age of six months. The number of WBC is less than the number of erythrocytes.

Table 4 : Ratio of leucocytes to erythrocytes in blood

Species	Leucocytes : erythrocyte ratio
Goat	1 : 1300
Sheep	1 : 1200
Horse	1 : 1000
Cattle	1 : 800
Man	1 : 700
Dog, Cat	1 : 600
Swine	1 : 400
Chicken	1 : 100

Leucocytes in blood are classified into granulocytes, (Meatrobhils, Eosinophils & Basophib) characterized by specific granules in their