formed protein is called an antibody and specifically combines with the antigen which triggered its synthesis.

Immunoglobulins are classified into three major classes called IgM, IgA, and IgG. Each class has many sub groups which are produced by specific cells by normal individuals. Each complete immunoglobulin is made up of two pairs of polypeptide chains, a pair of light (short) and a pair of heavy (long) chains.

Albumins

These constitute about 50% of the total plasma proteins and possibly are involved in fatty acid binding and anion transport. They serve to control the osmotic pressure of the blood as well as maintain the buffering capacity of the blood pH. Serum albumin is approximately 67,000 daltons in molecular weight and is a typical globular protein.

Fibrinogen

The third important protein in blood plasma is fibrinogen. Blood serum is devoid of it. Fibrinogen accounting for about 4% of the total plasma protein and it plays an unusually vital role in blood clotting.

The plasma proteins exert an osmotic pressure which influences the exchanges of fluid between blood and tissues. Plasma proteins also combine with many substances e.g. iron, thyroxine and steroid hormones to form transportable complexes from which active compounds are released at the appropriate sites.

Haemoglobin

One of the most important protein in the blood with obvious implications is haemoglobin. It is a respiratory protein of all vertebrates, which is localized exclusively in erythrocytes. It transports oxygen from the lungs to all parts of the body, by virtue of its property to combine reversibly with molecular oxygen.

Haemoglobin is a conjugated protein with a molecular weight of about 65,000 daltons. It is composed of four heme groups attached to a protein called globin. It has a common cyclic tetrapeptide called a porphyrin.

To form heme groups, one iron is firmly chelated by the electron pairs of the nitrogen atoms of the four pyrrole residues. In hemoglobin, four heme groups are conjugated with a protein called globin.

Ferrihaemoglobin, the reduced form of haemoglobin, combines reversibly with oxygen to form oxyferrohemoglobin according to the reaction.

$$Hb_4 + 4\ O_2 \rightarrow Hb_4\ (O_2)_4$$

Table 5 : Plasma proteins in domestic animals (g/100 ml)

Animal	Total plasma protein	Fibrinogen	Albumin	Globulin
Cow	8.32	0.72	3.63	3.97
Sheep	5.74	0.36	3.07	2.31
Goat	7.27	0.60	3.96	2.71
Horse	6.84	0.34	3.25	3.25
Dog	6.72	0.52	3.57	2.63

Blood sugar content of domestic animals.

Horse	72.7 mg/100 ml
Cattle	45.9 mg/100 ml
Dog	59.9 mg/100 ml

Blood Hb Concentration

Indian Cattle Hb	9.1 gm/100 ml (7-12 gm)
European cattle	12 gm/100 ml (95-13.5 gm/100 ml)
Buffaloes	12.9 g/100 ml (7-15 gm/100 ml)

Blood volume

The total volume of blood in the vascular system approximates 8% of the body weight in an adult human being. Infants have a larger blood volume in proportion to their body weight as blood although there are exceptions. Thus an adult pig may have 4 to 5% of body weight as blood whereas the values may be as high as in case of thoroughbred horses. Animals that are more excitable and active usually have greater blood volumes. Blood volume varies with the age, weight, sex, breed, and physiological state of the animal. There is an increase in blood volume during pregnancy.

Blood volume helps in understanding and interpreting various hematological values and is important in blood transfusion and to differentiate anemias.

It is not feasible to bleed the animal completely to determine blood volume of the body. Indirect methods using dye dilution techniques are used to estimate blood volume.

The blood volume is not affected even when large volume of water is ingested. The excess amount of water is got rid of by enhanced urine output. Similarly during haemorrhage, considerable amount of blood is lost which is soon restored to normal volume. After haemorrhage, the fluids from the tissues move into the blood vessels to restore the blood volume. At the same time the urine output is also lowered considerably to make good of the losses. Apart from restoring the fluid volume of blood, the loss of erythrocytes is also compensated by their increased rate of production in the spleen and bone marrow.

Anticoagulants

Anticoagulants are used to prevent blood from coagulation and clotting for transfusion and analytical works.

Heparin, a conjugated polysaccharide, is a natural anticoagulant produced by basophilic mast cells present throughout the body especially in the connective tissue surrounding capillaries in lungs and other tissues. Heparin helps to maintain the normal fluidity of the blood. Heparin was first isolated from the liver (hence its name) but was subsequently demonstrated in extracts from many other organs eg. lungs. Heparin is normally secreted by group of connective tissue cells called mast cells present in the small vessels of circulatory system. Chemically heparin is a polysaccharide derived from glucosamine and glucuronic acid. Heparin inhibits coagulation of blood both *in vitro* and *in vivo*. One mg of heparin will prevent coagulation of 10-20 ml of blood at room temperature (one unit of heparin is 0.01 mg of heparin sodium). Heparin is generally used as an anticoagulant to keep body fluid *in vitro* for the purposes of hematological analysis. Heparin is administered in cases of commencing or developed thrombosis. Heparin is rapidly destroyed by an enzyme heparinase in the liver. The basophils in blood also produces heparin but in insignificant quantities.

Sodium citrate in 0.2 to 0.4% of blood prevents coagulation by forming insoluble calcium salts by citrate and is normally used as anticoagulant for blood needed for transfusion. For analytical work, sodium, (4mg/5ml of blood) potassium and ammonium (6mg/5ml of Blood) salts of oxalates, ethylenediamino tetra acetic acid (EDTA) etc. are used as anticoagulant.

Table 6 : Amounts of various anticoagulants which are sufficient to prevent the coagulation of 10 ml of blood

1. Sodium citrate	60 mg
2. Sodium oxalate	16 mg
Sodium ± fluoride	10 mg
3. Sodium oxalate	30 mg
Potassium ± oxalate	8 mg
4. Ammonium oxalate	12 mg
5. Heparin	1 mg or 100 I.U.
6. E.D.T.A.	10 mg

Plasma volume is determined by injecting Evans Blue dye (T-1824) or radioactive iodine ^{131}I) into the blood and then find out the dilution which these substances have undergone over a period of time using the formula. Amount injected/Concentration per ml of plasma. Erythrocyte or red cell volume is similarly determined by injecting radioactive phosphorus (^{32}P) iron ^{58}Fe) chromium (^{51}Cr) or by injecting previously tagged erythrocytes with the above substances and find out the dilution which the tagged erythrocytes have undergone with time.

Blood volume is arrived at by

$$\text{Blood volume} = \text{Plasma volume} \times \frac{100}{-(\text{Venous PCV})\left(\begin{array}{c}\text{Correction factor for}\\ \text{true PCV and body PCV}\end{array}\right)}$$

$$\text{Red cell volume} \times \frac{100}{(\text{Venous PCV})\,\text{Correction factor for true PCV and body PCV}}$$

The packed cell volume (PCV) of venous blood is the venous PCV minus the trapped plasma which the packed cells contain. The