

Statistical Study and Analysis of Plasma Proteins

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ABSTRACT

Serum albumins are important in regulating blood volume by maintaining the oncotic pressure (also known as colloid osmotic pressure) of the blood compartment, bovine serum albumin (cattle serum albumin) or BSA, often used in medical and molecular biology laboratories. Serum albumin is the main protein of human blood plasma. It binds water, cations (such as Ca^{2+} , Na^+ and K^+), fatty acids, hormones, bilirubin, Thyroxin (T4) and pharmaceuticals (including barbiturates), its main function is to regulate the oncotic pressure of blood. Alpha and beta globulins function as enzymes and proteins that transport compounds in the body. Gamma globulins act as the antibody defence against antigen invasion (Aarons and Rowland, 1981; Aggeler *et al.*, 1967) Gamma globulins are manufactured in cells of the immune system known as lymphocytes and plasma cell, Blood plasma, which is usually about 4% of the body weight, consists of many constituents including H_2O , nutrients and metabolites, proteins, various hormones and electrolytes (Aarons and Rowland, 1981). The normal total plasma protein concentration ranges from 5.5 to 8.9 g/dL in domestic-animal species, and it is a complex mixture including simple proteins, glycoproteins and various lipoprotein thousands of antibodies (immunoglobulins) are also present in plasma, although under normal conditions the amount of any one is usually quite low.

Keywords: Monoclonal Gammopathy, Plasma Proteins Electrophoresis, Polyclonal Gammopathy, Serum Albumins Serum Proteins.

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INTRODUCTION

Plasma proteins are important complementary constituents in the diagnosis of gastrointestinal, hepatic, renal, or infectious diseases. Determination of plasma proteins image seldom leads to a specific diagnosis (e.g., monoclonal gammopathies) but will help the clinician to evaluate the nature, severity, and progress of a disease (Table 1). Blood plasma contains 8% solids, which has 7% albumin. The different plasma proteins are albumins, globulins, and fibrinogen. Usually, total plasma proteins are 6 to 8 g / 100 mL of blood. The proteins present in human blood plasma are a mixture of simple proteins, glycoproteins, lipoproteins (Banfield *et al.*, 1983). And other conjugated proteins called "Plasma Protein". The Functions of Plasma Proteins; Plasma proteins are a crucial component of blood that perform many functions in the human body. They are produced in the liver and circulate in the blood, which is vital in maintaining our overall health. Plasma protein is vital in our body. Here are the primary functions.

FUNCTIONS OF PLASMA PROTEINS

Protein Nutrition

Osmotic pressure and water balance

The most abundant plasma protein in the blood is albumin, which plays a crucial role in maintaining fluid balance in the body (Gibaldi *et al.*, 1978). Albumin helps to regulate the amount of fluid Table 2, in the blood vessels, preventing excessive fluid build-up in the tissues. It creates an oncotic pressure, which draws fluid back into the blood vessels. It prevents fluid from accumulating in the tissues, which can lead to edema, a condition where excess fluid builds up in the body (MacKichan, 1984). Albumin is also involved in maintaining blood pressure. It helps to prevent a drop in blood pressure by regulating the amount of fluid in the blood vessels (Bjornsson *et al.*, 1979a). When there is a decrease in blood volume, albumin draws fluid back into the blood vessels, which helps to maintain blood pressure, During protein loss from the body, as in kidney diseases, an excessive amount of water moves in to the tissues, producing edema Osmotic pressure is the force that drives the movement of water molecules from a region of low solute concentration to a high solute concentration, while oncotic pressure is the force exerted by proteins in the blood that draws water into the blood vessels (Hansen and Christensen, 1977).



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IMMUNE FUNCTION

Plasma proteins play a crucial role in the immune system. Globulins are the primary type of plasma protein Table 3, involved in immune function, as they help to fight off infections and diseases (MacKichan, 1984). There are three types of globulins-alpha, beta, and gamma-and each has a unique function. Alpha and beta globulins transport and bind various substances in the blood, such as metal ions and lipids. They also play a role in the immune system by recognizing and attacking foreign invaders, such as bacteria and viruses. Gamma globulins, also known as immune globulins, are the antibodies produced by the immune system in response to an infection or disease (Hansen and Christensen, 1977). They recognize and neutralize foreign invaders, such as bacteria and viruses, helping to prevent the spread of infection.

FUNCTIONS OF PLASMA PROTEINS

Buffering action: Plasma proteins help maintain the body's pH by acting as ampholytes. At normal blood pH, they act as acids and accept protons.

Transport

One of the essential functions of plasma proteins is to transport lipids and lipid-soluble substances throughout the body (Koch-Weser and Sellers, 1976). Plasma proteins transport various substances in the blood, including hormones, drugs, and fatty acids.

Blood Coagulation

Fibrinogen is a plasma protein that plays a crucial role in blood clotting. When an injury or trauma occurs, fibrinogen is converted to fibrin (Liegler *et al.*, 1969). Which forms a clot to stop bleeding. This process is essential for preventing excessive bleeding and promoting wound healing.

Types of Plasma Proteins

The three significant plasma protein fractions are albumin, globulin, and fibrinogen. Albumin -55.2% α_1 -globulin -5.3% (α_1 -antitrypsin, thyroxine binding globulin, transcortin, etc.) α_2 -globulin -8.6% (haptoglobin, ceruloplasmin, α_2 -macroglobulin, etc.) β -Globulin -13.4% (β_1 -transferrin, β -lipoprotein, etc.) γ -Globulin -11.0% (antibodies, etc.) fibrinogen -6.5% (Figure 1).

Albumin

It is the most abundant class of plasma protein (2.84.5 g/100 mL) with the highest electro heretic mobility. It is soluble in water and is precipitated by fully saturated ammonium sulfate. Albumin is synthesized in the liver and consists of a single polypeptide chain of 610 aa with amolecular weight of 69,000.

Globulins

By electrophoresis (Griner *et al.*, 1971) plasma globulins are separated into α_1 , α_2 , β , and γ -globulins (Gibaldi *et al.*, 1978).

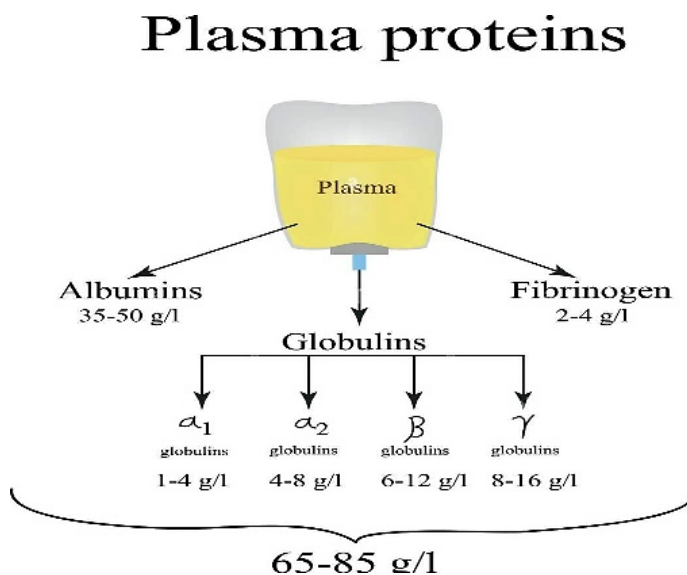


Figure 1: Illustration of plasma proteins.

Table 1: Plasma proteins and clinical significance case study 1.

Protein molecular weight (g/mol)	Concentration in serum (g/L)	Half-life (days)	Function	Common causes for increased (↑) or decreased (↓) concentrations
Transthyretin (Prealbumin) 54,000	0.2 to 0.4	2	• Binds Thyroid Hormones and Retinol (Transport Protein).	↓ Malnutrition.
Albumin 68,000	35 to 53	15-19	• Most Important Transport Protein. • Major Contributor to Oncotic Pressure. • Protein Reserve of Organism.	↓ Catabolism ↓ Hepatopathy (Decreased Synthesis) ↓ Protein Loss (Nephrotic Syndrome).

Table 2: Plasma proteins and clinical significance case study 2.

Protein	Molecular Weight (g/mol)	Concentration in Serum (g/L)	Half-life (days)	Function	Common Causes for Increased (↑) or Decreased (↓) Concentrations
Transthyretin (Prealbumin)	54,000	0.2-0.4	2	<ul style="list-style-type: none"> • Binds thyroid hormones and retinol (transport protein). 	↓ Malnutrition
Albumin	68,000	35-53	15-19	<ul style="list-style-type: none"> • Most important transport protein. • Major contributor to oncotic pressure. • Protein reserve of organism. 	↓ Catabolism ↓ Hepatopathy (decreased synthesis) ↓ Protein loss (nephrotic syndrome).

Table 3: Plasma proteins and clinical significance case study 3.

Zone	Protein	Molecular Weight (g/mol)	Concentration (g/L or as given)	Half-life (days)	Function	Common Causes for Increased (↑) or Decreased (↓) Concentrations
α ₁	α ₁ -lipoprotein (Apo A-I)	180,000-360,000	1.0-1.6	-	<ul style="list-style-type: none"> • High-Density Lipoprotein (HDL) • Cholesterol transport to liver. 	↑ Dyslipidemia.
α ₁	α ₁ -antitrypsin	54,000	0.9-2.0	4	<ul style="list-style-type: none"> • Lysosomal protease inhibitor (mostly elastase). • Hereditary deficit causes emphysema and cirrhosis. 	↑ Acute inflammation ↓ Hereditary antitrypsin deficiency.
α ₁	Orosomucoid (α ₁ -acid glycoprotein)	40,000	0.5-1.2	5	<ul style="list-style-type: none"> • Binds lipophilic compounds (e.g., progesterone and drugs). • Regulates immune response. 	↑ Inflammation.
α ₁	α ₁ -fetoprotein	69,000	Below 7.5 µg/L	3.5	<ul style="list-style-type: none"> • Produced by fetal liver and yolk sac. • Main protein of fetal serum. • Detectable in serum of pregnant women. 	↑ Hepatoma ↑ Some GIT malignancies ↑ Pregnancy ↑ In fetus.
α ₂	Haptoglobin	85,000-1,000,000	0.3-2.0	2	<ul style="list-style-type: none"> • Binds liberated hemoglobin (in intravascular hemolysis). 	↑ Acute inflammation ↓ Hepatopathy ↓ Intravascular hemolysis (increased consumption).
α ₂	α ₂ -macroglobulin	800,000	1.3-3.0	5	<ul style="list-style-type: none"> • Protease inhibitor (thrombin, trypsin, chymotrypsin, pepsin). • Transport of small proteins (cytokines, growth factors) and divalent ions (e.g., Zn²⁺). 	↑ Acute inflammation Marker of nephrotic syndrome (not filtered through glomerular membrane).
α ₂	Ceruloplasmin	160,000	0.2-0.6	4.5	<ul style="list-style-type: none"> • Redox activity (oxidation of Fe²⁺ to Fe³⁺). • Binds copper (up to 90% of serum copper). 	↓ Wilson's disease (hepatolenticular degeneration).

These proteins are synthesized in the liver, whereas γ -globulins are formed in the cells of the reticuloendothelial system.

α_1 -globulin

This fraction includes several complex proteins containing carbohydrates and lipids. Lipoproteins are soluble complexes that contain no covalently bound lipids (McElnay and D'Arcy, 1983). These proteins act mainly as transport carriers for different lipids in the body.

A₂-globulins

This fraction also contains complex proteins such as α_2 -glycoproteins, plasminogen, prothrombin, haptoglobin, caeruloplasmin (transports Cu), and α_2 -macroglobulin.

B-Globulins

This fraction of plasma protein contains these different β -lipoproteins, which are very rich in lipid content. It also has

Table 4: Plasma proteins and clinical significance case study 4.

Zone	Protein	Molecular Weight (g/mol)	Concentration	Half-life (days)	Function	Common Causes for Increased (↑) or Decreased (↓) Concentrations
β_1	Transferrin	77,000	2.0-3.6 g/L	7	<ul style="list-style-type: none"> • Transport of iron. 	<ul style="list-style-type: none"> ↑ Iron deficiency ↓ Malnutrition ↓ Hepatopathy ↓ Inflammation.
β_1	Hemopexin	57,000	0.5-1.1 g/L	3-7	<ul style="list-style-type: none"> • Binds liberated heme (in intravascular hemolysis). 	-
β_1	β -lipoprotein (Apo B-100)	2,750,000	0.7-0.9 g/L	3	<ul style="list-style-type: none"> • Low-Density Lipoprotein (LDL). • Cholesterol transport from liver to tissues. • High and variable molar weight. 	-
β_1	C4 (complement protein)	206,000	0.1-0.4 g/L	1	<ul style="list-style-type: none"> • Part of complement cascade. 	<ul style="list-style-type: none"> ↑ Inflammation ↓ Autoimmune disorders.
β_2	C3 (complement protein)	180,000	0.8-1.4 g/L	1	<ul style="list-style-type: none"> • Part of complement cascade. 	<ul style="list-style-type: none"> ↑ Inflammation ↓ Autoimmune disorders.
β_2	β_2 -microglobulin	11,800	0.001-0.002 g/L	-	<ul style="list-style-type: none"> • Soluble part of leukocyte receptors. 	<ul style="list-style-type: none"> ↑ Hematologic tumor ↓ Tubular resorption disorder.
β_2	Fibrinogen	340,000	1.5-4.5 g/L	-	<ul style="list-style-type: none"> • Coagulation cascade, fibrin precursor. • Only in plasma, not in serum. 	<ul style="list-style-type: none"> ↑ Inflammation ↑ Pregnancy.
β_2	C-reactive protein (CRP)	111,000	1.5-5 mg/L	1	<ul style="list-style-type: none"> • Complement activation. 	<ul style="list-style-type: none"> ↑↑ Acute bacterial inflammation (up to 400 mg/L) (↑) Acute viral inflammation (may rise to 20-40 mg/L).

transfer in (siderophilin), which transports nonheme iron in plasma.

γ-Globulins

These are also called Immunoglobulins and have antibody activity. Based on their electrophoretic mobility (O'Reilly and Goulart, 1981), they are classified as IgG, IgA, and IgM. Immunoglobulins are clinically significant components of IgG. Two different types of lymphocytes involved with immunoglobulin formation are "T-cells of *Thymus*" and "B-cells" that originate from "bone marrow."

Fibrinogen

It is a fibrous protein with a molecular weight of 340,000. It has six polypeptide chains which are held together by disulfide linkages. Thrombin converts fibrinogen into fibrin Table 4, which plays a vital role in the clotting of the blood. Fibrinogen is a Complex protein that is involved in the blood clotting process. It is synthesized by the liver and is converted to fibrin during the clotting process (Koch-Weser and Sellers, 1976). Fibrin helps to form a clot, which is necessary to stop bleeding after an injury in addition to these three main types of plasma proteins, there are also a number of other proteins that are found in smaller quantities in the blood plasma, including lipoproteins, which transport lipids throughout the body, and enzymes, which catalyse biochemical reactions (Tables 1-4).

Acute Phase Response

C-reactive protein, serum amyloid A, and fibrinogen levels all quickly rise as part of the acute phase response, which is the body's initial reaction to surgical trauma (MacKichan, 1984). These proteins aid in mobilizing the body's immune response to the site of damage and are involved in tissue healing and inflammation.

CONCLUSION

In this paper a statistical report has been presented on plasma Proteins and Clinical Significance plasma proteins play a dominant role in the pathogenesis of a variety of diseases and clinical syndromes (O'Reilly, 1980). The names of some proteins have become the names of diseases; the specific items discussed in this paper include albumin, fibrinogen, globulins, liver disease, pregnancy, infancy and old age, haemorrhagic disorders, amyloidosis, and other topics (Stewart *et al.*, 1991). The treatment of these complex subjects is aimed at the person without specialized education Separating serum proteins by electrophoresis is a valuable diagnostic tool as well as a way to monitor clinical progress (McElnay and D'Arcy, 1983). Current research regarding blood plasma proteins is centred on performing proteomics analyses of serum/plasma in the search for biomarkers. It is observed in this study Blood proteins, also termed plasma proteins, are proteins present in blood plasma. They serve many different functions, including transport of lipids,

hormones, vitamins and minerals in activity and functioning of the immune system. Other blood proteins act as enzymes, complement components, protease inhibitors or kinin precursors. Contrary to popular belief, haemoglobin is not a blood protein, as it is carried within red blood cells, rather than in the blood serum.

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ABBREVIATIONS

BSA: Bovine Serum Albumin; **IgG:** Immunoglobulin G; **IgA:** Immunoglobulin A; **IgM:** Immunoglobulin M; **T4:** Thyroxine; **H₂O:** Water; **Cu:** Copper; **aa:** Amino acids; **g/dL:** Grams per deciliter.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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