SİMPLE PROTEİNS

Simple proteins are divided into:

1) protamines and histones

2) prolamines and glutelins

3) albumins and globulins.

Protamines contain 60-85 % of arginine. They are soluble in water, alkaline and acid media. Salmine, clupein, and scumbrian are their representatives.

Histones contain 20-30% of lyzine and arginine; they are soluble in weak alkaline, and weak acid media. They present the protein part of nucleoproteins.

Prolamines and glutelins are involved in crops (wheat, rye etc.); contain 20-25% glutamic acid and 10-15 % of proline. They are soluble in 60-80% water solution of ethanol. Zein from maize and glyadin from wheat are their representatives.

Albumins and globulins are proteins of blood serum. In the normal organism, plasma contains 7% proteins. 55-60% of blood plasma proteins are albumins. Albumins are water-soluble, they has pl=4.7 and negative charge at pH=8.6. Albumins perform the following functions: 75-80% of them support the blood serum osmotic pressure, transport fatty acids, steroid hormones, medicine preparations (antibiotics, heart glycosides).

Blood serum globulins are divided into 2 fractions: euglobulins and pseudoglobulins. Euglobulins fraction consists of γ-globulins, while pseudoglobulins fraction are represented by in α, β, γ-globulins.

Although in general, blood globulins belong to simple proteins, some of them are bound with some non-protein components. So, α_1 fraction is represented in blood as a complex with bilirubin and lipoproteins of high density. α_2 fraction contains Zn containing glycoproteins and haptoglobin. β globulin fraction is represented by transferrin (transporting Fe) and ceruloplasmin (transporting Cu ions), prothrombin (precursor of trombin). γ-globulin fraction is represented by antibodies which play a

protective role in organism. Scleroproteins (protenoids) are insoluble in water and weak solutions. Collagen, elastin, ceratin etc. belong to them.

Hydrolysis of simple proteins

The amino acid content analysis is carried out after hydrolysis by an acid or alkali. Hydrolysis is a decomposition of the complex compound to simple composite parts linking water to the bond cleavage spot. Hydrolysis of simple proteins is accompanied by the protein decomposition to amino acids. Acid, alkaline and enzymatic hydrolysis are used for this.

Enzymatic hydrolysis occurs in gastrointestinal tract under influence of proteolytic enzymes (peptidases or hydrolases). At the acid hydrolysis tryptophan, partly serine, threonine, cysteine, tyrosine and phenylalanine are decomposed. At the alkiline hydrolysis besides tryptophan, serine, threonine, arginine, cysteine are decomposed. The rest amino acids are subjected to racemization (loss of the optical density). The peptide bond (acid-amide) is covalent and very solid. The hydrolysis is carried out in strict conditions, with 6-12N acid, 2N alkali, at t =100° C for 10-12 hours. The egg white hydrolysis is carried out with H_2SO_4 and the hydrolysis degree is determined.

COMPLEX PROTEİNS

Complex proteins are compounds consisting of a simple protein and non-protein component. This component is called prosthetic group and it is bound with a protein molecule by covalent and non-covalent bonds.

Complex proteins are divided into following groups:

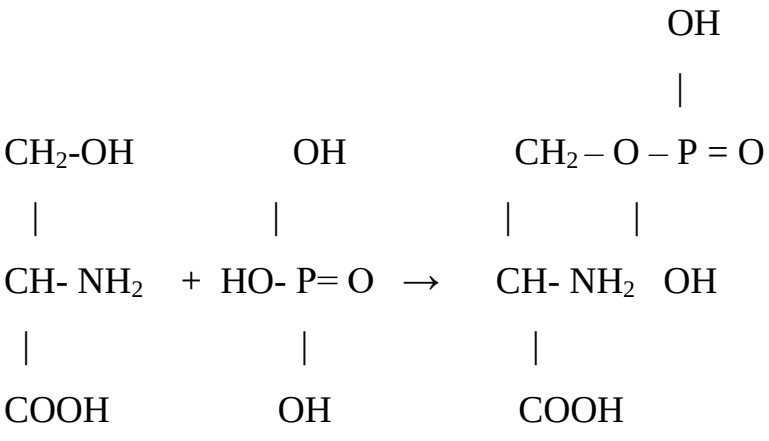
1. Metalloproteins-proteins containing metal atoms in their structure

2. Glycoproteins-proteins bound with a carbohydrate component
3. Phosphoproteins-proteins containing phosphoric acid
4. Lipoproteins-proteins containing different lipids in their structure
5. Chromoproteins- prosthetic group of these proteins composed of colored pigments
6. Nucleoproteins-composed of a protein and nucleic acids

Phosphoproteins

The phosphoric acid residue of phosphoproteins is connected by complex ester bonds to the hydroxyl group of serine and to a lesser degree to threonine. Phosphoproteins are insoluble in water, soluble in an alkaline medium and precipitated in an acid solution.

Milk caseinogen, vitelline, vitellinine, phosvitin, isolated from hen egg yolk; ovalbumin in hen egg white, ichtulin contained in fish caviar etc. belong to this protein class.



serin ***phosphoric acid*** ***phosphoserin***

A great amount of phosphoproteins are in central nerve system cells. Phosphoproteins contain phosphate which is necessary for cell vital functions. They are also a valuable source of an energetic and plastic material in embryogenesis, as well as for the further growth and development of organism.

Caseinogen of milk

Caseinogen occurs in milk in water-soluble anion forms (caseinogen calsinate). When milk is acidified (pH=4.7), the protein precipitates. Milk may be acidified in the presence of lactic acid, formed from lactose under the influence of sour milk bacteria. The calcium salt of caseinogen is water-soluble, while that of casein is insoluble. In stomach caseinogen coagulates and is converted to insoluble casein by pepsin (in adults) and rennin (in children) as a result of the protein chemical reaction.

Glycoproteins

Glycoproteins are complex proteins containing a heteroolygosacharide group besides a simple protein. The carbohydrate component forms O-glycosidic bonds (with OH groups of serine and threonine) and N- glycosidic bonds (via amide groups of asparagine). Glycoproteins are divided into 2 groups: mucins and proteoglycans. Mucins are in the structure of mucous secretions of saliva, gastric juice and intestinal juice. Proteoglycans (glucosamine-glycans) are in connective tissues of intercellular compounds. For example, hyaluronic acid, chondroitin sulphuric acid, etc. Furthermore, blood proteins (transferrin, clotting factors),hormones (thyroglobulin, gonadotropin) and some enzymes belong to glycoproteins. Glycoproteins are insoluble in water, demonstrate a good solvency in alkalies and they precipitate in an acid medium.

Metalloproteins

Metalloproteins include biopolymers that besides protein have ions of one or several metals. For example, proteins which contain non-heme Fe and also proteins binding with metal atoms in the composition of complex proteins-enzymes.

Typical representatives are Fe containing proteins- ferritin, transferrin and hemosiderin.

Ferritin is a high molecular water-soluble protein with molecular mass of 400.000. Fe content is 17-23% of the total mass (on the average 20%). It is localized especially in spleen, liver, marrow playing a role of a Fe depot in organism. Fe in ferritin is in the oxidized form.

Transferrin is a water-soluble Fe-protein (mol mass = 90.000), glycoprotein observed especially in blood-serum, in the composition of β-globulins. Fe content in transferrin is 0.013%. Transferrin molecule contains two Fe atoms: transferrin serves as a transporter of Fe in organism.

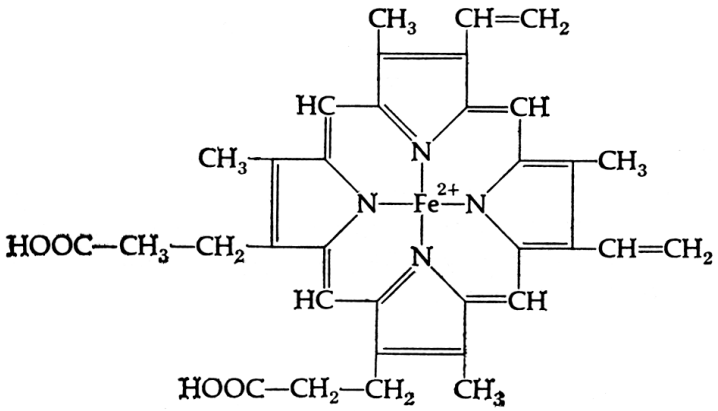
Hemosiderin is a water-soluble Fe containing protein complex, 25% of which consists of nucleotides and carbohydrates. It is localized mainly in reticulo endotheliocyte of liver and spleen. Its biological role has not been studied sufficiently.

Chromoproteins

Chromoproteins are composed of a simple protein and colored non-protein part. The main representatives of this class are hemoproteins. They include heme as a prosthetic group.

Hemoglobin, myoglobin, catalase, peroxydase, cytochromes belong to this class. Hemoglobin localizes in erythrocytes and realizes the breathing function. Hemoglobin molecule consists of four hem molecules bound by polypeptide chains 2α, 2β (α-141, β-146 amino acids).

Heme structure:



Heme makes blood red, and connecting with oxygen (oxyhemoglobin) transfers it to the tissues. In the tissues CO_2 is bound to the protein part (carb hemoglobin) and is transported back. The valency of iron in hemoglobin is 6 (it has six coordinate bonds with other substances: 4 - with heme, one – with hemoglobin protein subunit, one is left for O2 transportation to tissues). So, four of them are bound with porphyrin structure, fifth bonds connect Fe with the protein part of globin through amino acid histidine and sixth can be bound to O_2, CO etc. İn poisoning with carbon monoxide (CO), Hb becomes tightly bound to this agent forming carboxyhemoglobin (HbCO). In poisoing with nitrogen oxides, nitrobenzene a part of hemoglobin is oxidized to methemoglobin (MetHb), in which the iron takes up an oxidation state Fe (III).