PROTEINS

Proteins are complex organic compounds of high molecular weight. In common with carbohydrates and fats they contain carbon, hydrogen and oxygen, but in addition they all contain nitrogen and generally sulphur. Proteins are found in all living cells, where they are intimately connected with all phases of activity that constitute the life of the cell. Each species has its own specific proteins, and a single organism has many different proteins in its cells and tissues.

AMINO ACIDS

Amino acids are produced when proteins are hydrolysed by enzymes, acids or alkalis. Although over 200 amino acids have been isolated from biological materials, only 20 of these are commonly found as components of proteins.

ESSENTIAL AMINO ACIDS

Plants and many microorganisms are able to synthesise proteins from simple nitrogenous compounds such as nitrates.Animals cannot synthesise the amino group, and in order to build up body proteins they must have a dietary source of amino acids.

The following **ten essential amino acids** are required for growth:

1. Arginine
2. Methionine
3. Histidine
4. Phenylalanine
5. Isoleucine
6. Threonine
7. Leucine
8. Tryptophan
9. Lysine
10. Valine

rapidly growing animals may respond to arginine because the very active metabolism of the liver results in little of the amino acid being available to the general circulation.

In the ruminant, all the essential amino acids can be synthesised by the rumen microorganisms, which theoretically makes this class of animal independent of a dietary source once the rumen microorganisms have become established. However, the supply of amino acids from microbial protein is limiting in quantity and quality for maximum rates of growth in young animals and for maximum milk production. The biological value of microbial protein is limited by its content of certain essential amino acids, particularly lysine and methionine. For maximum productivity the microbial protein must be supplemented with a supply of dietary amino acids, from foods or synthetic amino acids.

PROPERTIES OF PROTEINS

they differ in their solubility in water, ranging from insoluble keratin to albumins, which are highly soluble. All proteins can be denatured or changed from their natural state. Denaturation is modification of the unique structure of a native protein, giving rise to definite changes in chemical, physical or biological properties. Susceptibility of proteins to heat damage is increased in the presence of carbohydrates, owing to the occurrence of Maillard-type reactions (Maillard: combine protein and carbohydrates) and result in the browning of foods. The dark coloration of overheated hays and silages are symptomatic of these types of reaction.

CLASSIFICATION OF PROTEINS

Proteins can be classified into two main groups: simple proteins and conjugated proteins.

1-SIMPLE PROTEINS

These proteins produce only amino acids. They are divided into two groups, **fibrous and globular proteins**, according to shape, solubility and chemical composition.

Fibrous proteins

These proteins, which in most cases have structural roles in animal cells and tissues, are insoluble and are very resistant to animal digestive enzymes

Collagens are the main proteins of connective tissues and constitute about 30 % of the total proteins in the mammalian body

Keratins are classified into two types. The α-keratins are the main proteins of wool and hair. The β-keratins occur in feathers, skin, beaks and scales of most birds and reptiles.

Globular proteins

The group includes all the enzymes, antigens and those hormones that are proteins.

albumins, are water-soluble and heat-coagulable and occur in milk, the blood, eggs and many plants.

Histones are basic proteins that occur in cell nuclei, where they are associated with DNA

2- CONJUGATED PROTEINS

Conjugated proteins contain, in addition to amino acids, a non-protein moiety termed a prosthetic group. Some important examples of conjugated proteins are glycoproteins, lipoproteins, phosphoproteins and chromoproteins.

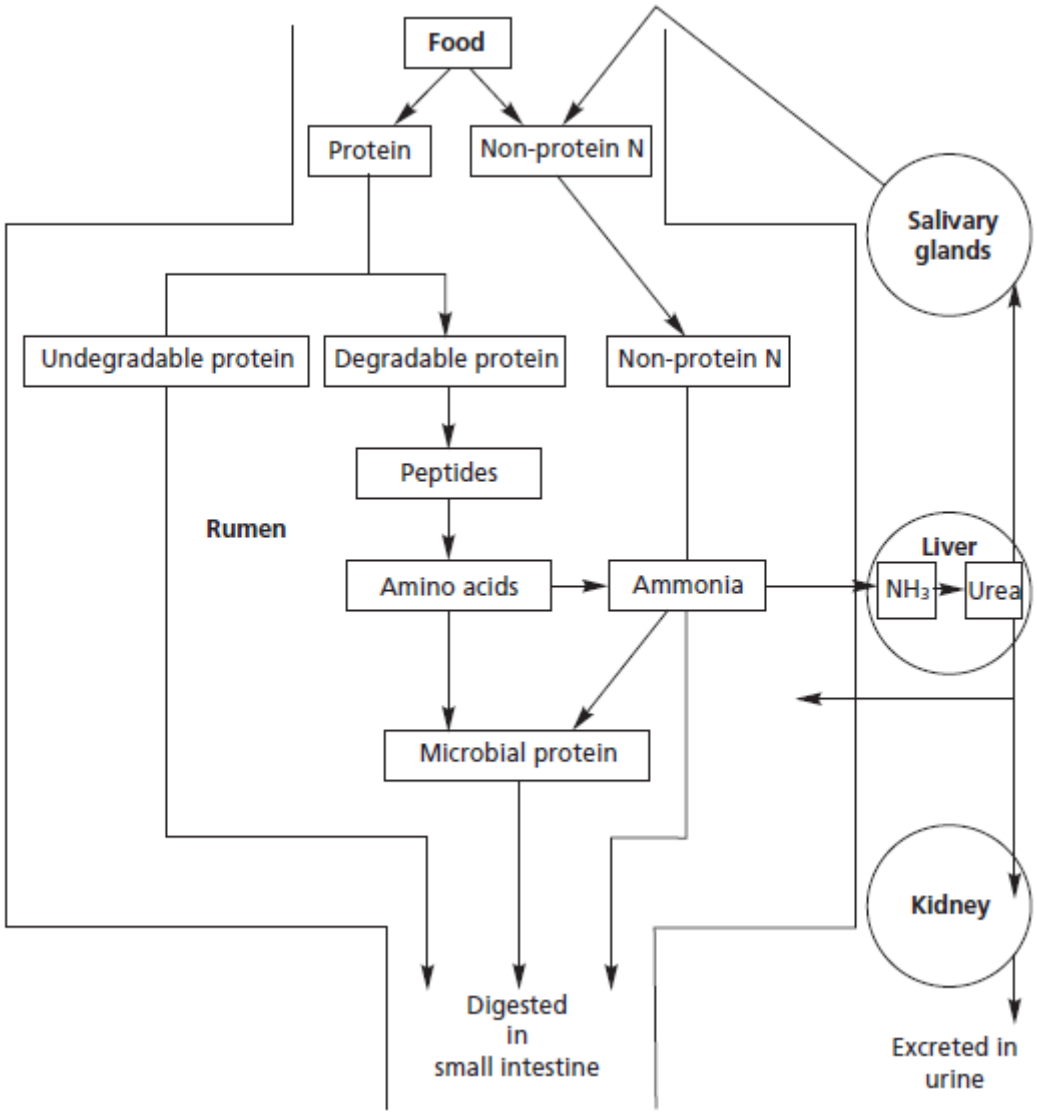
Lipoproteins, which are proteins conjugated with lipids such as triacylglycerols and cholesterol, are the main components of cell membranes and are also the form in which lipids are transported in the bloodstream to tissues.

DIGESTION OF PROTEIN IN THE RUMINANTS

Food proteins are hydrolysed to peptides and amino acids by rumen microorganisms, but some amino acids are degraded further, to organic acids, ammonia and carbon dioxide. The main proteolytic organisms are Prevotella ruminicola, Peptostreptococci species and the protozoa. The ammonia produced, together with some small peptides and free amino acids, is utilised by the rumen organisms to synthesise microbial proteins. Some of the microbial protein is broken down in the rumen and its nitrogen is recycled. When the organisms are carried through to the abomasum and small intestine, their cell proteins are digested and absorbed. An important feature of the formation of microbial protein is that bacteria are capable of synthesising essential as well as unessential amino acids.

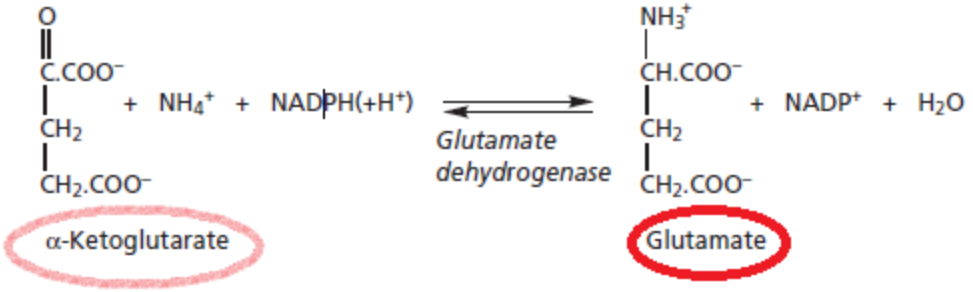
dietary protein is degraded to ammonia in the rumen, and conversely the extent to which it escapes rumen degradation and digested in the small intestine. the greater part of the protein reaching the ruminant's small intestine will be microbial protein of reasonably constant composition. The lesser part will be undegraded food protein, which will vary in amino acid composition according to the nature of the diet.

The rumen microbes thus have a 'levelling' effect on the protein supply of the ruminant; they supplement, in both quantity and quality, the protein of such foods as low-quality roughages but have a deleterious effect on protein-rich concentrates. It is possible to take additional advantage of the synthesising abilities of the rumen bacteria by adding urea to the diet of ruminants.

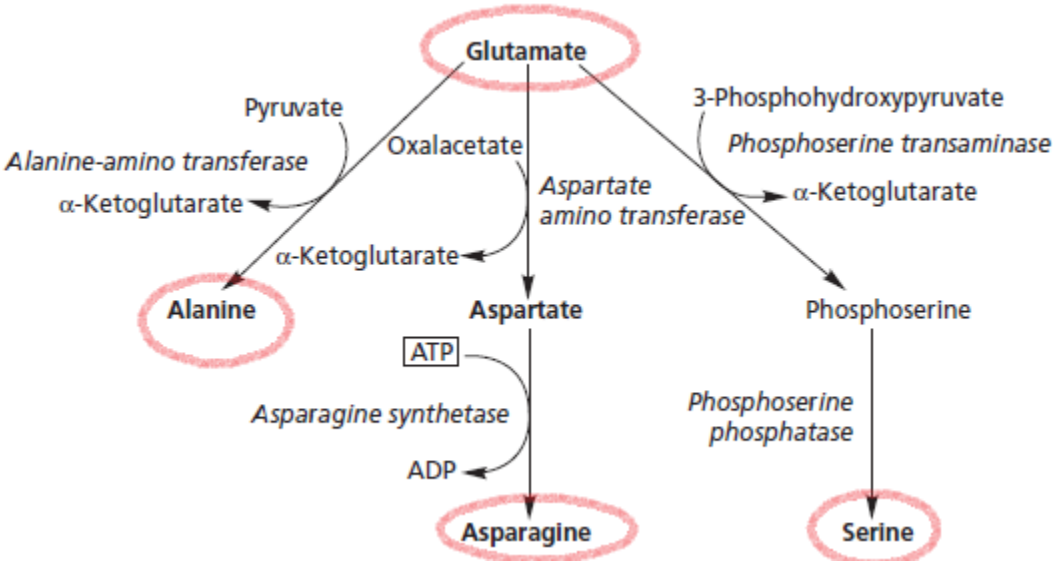


PROTEIN SYNTHESIS

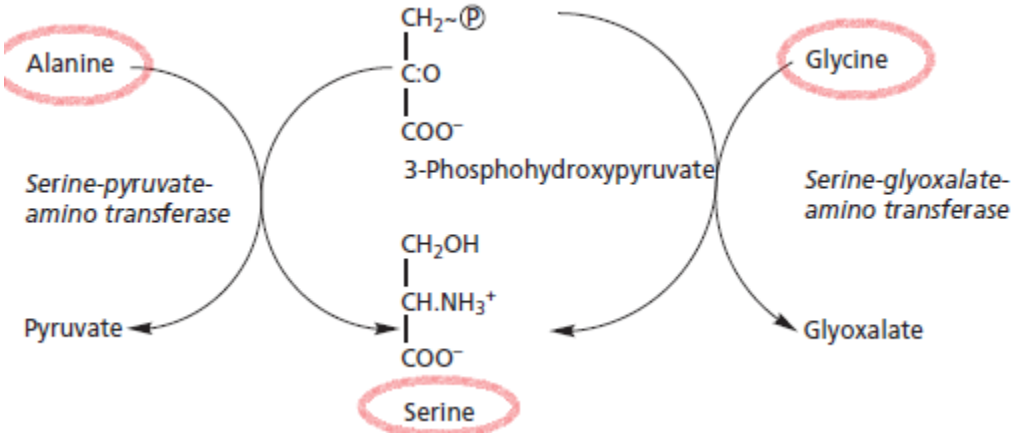
Proteins are synthesised from amino acids, which become available either from the end products of digestion or as the result of synthetic processes within the body. Direct amination may take place as in the case of -ketoglutarate, which yields glutamate:



The glutamate may undergo further amination to give glutamine but, more importantly, may undergo transamination reactions with various keto acids to give amino acids



Amino acids other than glutamate may undergo such transaminations to produce new amino acids. Thus, both alanine and glycine react with phosphohydroxypyruvate to give serine:



Glutamate is the source material of proline, which contains a five-membered ring structure. The synthesis of proline takes place in two stages and requires energy