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PROTEINS

~ AMINO ACIDS

Proteins are large biomolecules or macromolecules consisting of one or more long chains of amino acids. Amino acids are organic compounds that contain amine ($-NH_2$) and carboxyl ($-COOH$) functional groups, along with a side chain (R group) specific to each amino acid.

About 500 naturally occurring amino acids are known and can be classified in many ways.

The first few amino acids were discovered in the early 19th century. In 1806, French chemists Louis-Nicolas Vauquelin and Pierre Jean Robiquet isolated a compound in asparagus that was subsequently named asparagine, the first amino acid to be discovered. Glycine and leucine were discovered in 1820. The last of the 20 amino acids to be discovered was threonine in 1935 by W. Cumming Rose, who determined that essential amino acids were a necessity for optimal growth.

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CLASSIFICATION

Amino acids can be classified in 4 ways :

(1.) Based on structure

(2.) Based on side chain characters

(3.) Based on nutritional requirements

(4.) Based on metabolic fate

(1.) BASED ON STRUCTURE : they are classified further into 3 categories :

* Mono amino mono carboxylic acid ; which is further divided -
  - (i) Simple amino acids - eg. glycine
  - (ii) Branched amino acids - eg. valine
  - (iii) Hydroxyl group amino acids - eg. serine
  - (iv) Sulphur containing amino acids - eg. cystine
  - (v) Amide group amino acids - eg. glutamine
* Mono amino dicarboxylic acid - eg. glutamic acid
* di/poly amino mono carboxylic acid - eg. lysine

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(2.) BASED ON SIDE CHAIN CHARACTERS:

* Amino acids with a non-polar side chain :- eg. Alanine, Valine
Each of these amino acids has a side chain that does not bind or give off protons or participates in hydrogen or ionic bonds. Side chains of these amino acids can be thought of as 'oily' and lipid-like.

* Amino acids with a polar but uncharge-d side chain - eg. Serine, Glutamine
These amino acids are uncharged at neutral pH, although the side chains of cysteine and tyrosine can lose a proton at an alkaline pH. Serine, threonine and Tyrosine each contains a polar hydroxyl group that can participate in hydrogen bond formation. Side chains of Asparagine and Glutamine contain a carbonyl group and amide group, they can also participate in hydrogen bond formation.

* Amino acids with a charged side chain - eg. two types
(i) Amino acids with a positively charged side chain - The basic amino

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acids – lysine, Arginine and Histidine
(ii) Amino acids with a negatively charged side chain – the acidic amino acids – Glutamic acid and Aspartic acid.
they are hydrophilic in nature.

(3.) BASED ON NUTRITIONAL REQUIREMENTS:
(i) Essential amino acids: These acids cannot be synthesized in the body and have to be present essentially in the diet. Eg - Valine, Lysine and Methionine
(ii) Semi-essential amino acids: These amino acide can be synthesized in the body but the rate of synthesis is lesser than the requirement. Eg - Arginine and Histidine
(iii) The Non-essential amino acids: These amino acids are synthesized in the body, thus their absence in the diet does not adversely affect the growth. Eg - Glycine, Alanine.

(4.) BASED ON METABOLIC FATE: the carbon skeleton of amino acids can be used either for glucose production or for the production of ketone

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bodies; based on that :

(i) Both glucogenic and ketogenic amino acids : Eg - Isoleucine, Tyrosine

(ii) Purely ketogenic amino acids : Eg - Leucine and Lysine

(iii) Purely glucogenic amino acids : The remaining 14 amino acids are glucogenic. Eg - Alanine, Valine.

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PROPERTIES

Physical Properties:

- colourless
- crystalline
- May be sweet (Glycine, Valine), tasteless (Leucine) or bitter (Arginine).
- Soluble in water, acids, alkalis but insoluble in organic solvents
- High melting point (more than 200°C)

Amino acids can exist as amopholytes or zwitterions in solution, depending upon pH of the medium. The pH at which the amino acids exist as zwitterions, with no net charge on them is called Isoelectric pH or Isoelectric point. In an acidic medium, the amino acids exist as cations. In an alkaline medium, amino acids exist as anions.

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FUNCTIONS

- Incorporated into tissue proteins
- Niacin, Serotonin and melatonin are synthesized from Tryptophan.
- Melanin, thyroid hormone, catecholamines are synthesized from Tyrosine.
- GABA (neurotransmitter) is synthesized from Glutamic acid.
- Nitric oxide, a smooth muscle relaxant, is synthesized from Arginine.
- Act as precursors for haem, creatine and glutathione, porphyrin, purines and pyrimidines.

The main function of amino acids is to serve as building blocks for proteins. Each protein has unique sequences of amino acids in its own twisted and folded configuration.