SNS COLLEGE OF ALLIED HEALTH SCIENCES

SNS Kalvi Nagar, Coimbatore - 35

Affiliated to Dr MGR Medical University, Chennai

DEPARTMENT OF OPERATION THEATRE & ANESTHESIA TECHNOLOGY

COURSE NAME : BIOCHEMISTRY

TOPIC : AMINO ACIDS

AMINO ACIDS

- Amino Acids are the organic compounds that combine to form proteins, hence they are referred to as the building components of proteins.
- These biomolecules are involved in several biological and chemical functions in the human body for the growth and development of human beings.
- There are about 300 amino acids that occur in nature.
- Amino acids play an important role in performing several biological and chemical functions in different parts of our body.
- Including building and repairing the tissues, the formation and function of enzymes, food digestion, the transportation of molecules, etc.

SOURCES

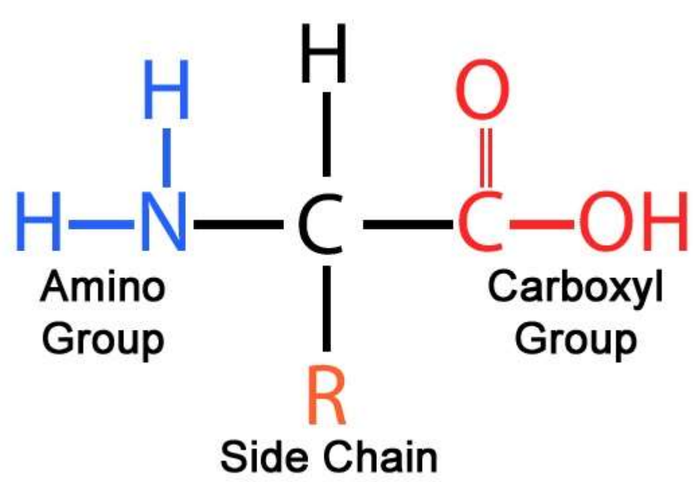
- Foods rich in amino acids include plant-based products like broccoli, beans, beetroots, pumpkin, cabbage, nuts, dry fruits, chia seeds, oats, peas, carrots, cucumber, green leafy vegetables, onions, soybeans, whole grain, peanuts legumes, lentils, etc.

- Fruits rich in amino acids are apples, bananas, berries, figs, grapes, melons, oranges, papaya, pineapple, and pomegranates.

- Other animal products include dairy products, eggs, seafood, chicken, meat, pork etc.

Structure of Amino acids

- The common property of all proteins is that they consist of long chains of α-amino (alpha amino) acids.
- The general structure of α-amino acids is shown in . The α-amino acids are so called because the α-carbon atom in the molecule carries an amino group (—NH_2); the α-carbon atom also carries a carboxyl group (—COOH).



General structure, Classification, Significance

Based on Structure & Chemical nature

1. Aliphatic side chain **Glycine, Alanine, Valine, Leucine, isoleucine**
2. OH group containing AA **Serine, Threonine**
3. "S" Containing AA **Cysteine, Methionine**
4. Acidic amino acids **Aspartic acid, Asparagine, Glutamic acid, Glutamine**
5. Basic amino acids **Histidine, Arginine, Lysine**
6. Aromatic amino acids **Phenylalanine, Tyrosine, Tryptophan**
7. Imino acids **Proline**

Based on Polarity

- Hydrophilic (polar)
- Hydrophobic (Non-polar)

Based on Metabolic fate

- Glucogenic
- Ketogenic
- Both

Nutritional Classification

- Essential
- Nonessential
- Semi essential

Phenylalanine, **V**aline **T**ryptophan	PVT.
Threonine **I**soleucine **M**ethionine	TIM
Histidine **A**rginine **L**eucine **L**ysine	HALL

Classification

Based on

- R group
- Polarity and R group
- Distribution in protein
- Nutritional requirements
- Number of amino and carboxylic groups

Based on R-Group

Simple amino acids:

- These have no functional group in their side chain.
- Example: Glycine, Valine, Alanine, Leucine, Isoleucine

Hydroxy amino acids:

- These have a hydroxyl group in their side chain
- Eg: Serine, Threonine

Sulfur containing amino acids:

- Have sulfur in their side chain
- Eg: Cysteine, Methionine

Aromatic amino acids:

- Have benzene ring in their side chain
- Eg: Phenylalanine, Tyrosine

Heterocyclic amino acids:

- Having a side chain ring which possess at least on atom other than carbon
- Eg: Tryptophan, Histidine, Proline

Amine group containing amino acids:

- Derivatives of amino acids in which one of carboxyl group has been transformed into an amide group
- Eg: Asparagine, Glutamine

Branched chain amino acids:

- Amino acid having aliphatic side-chains with a branch
- Eg: Leucine, Isoleucine, Valine

Acidic amino acids:

- Have carboxyl group in their side chain
- Eg: Aspartic and Glutamic acid

Basic amino acids:

- Contain amino group in their side chain
- Eg: Lysine, Arginine

Imino acid:

Amino acids containing a secondary amine group

Eg: Proline

Based on Polarity and R Group

Amino acids with non polar R group:

- These are hydrocarbons in nature, hydrophobic, have aliphatic and aromatic groups
- Eg: Alanine, Valine, Leucine, Isoleucine, Proline [Aliphatic R groups]
- Eg: Phenylalanine, Tryptophan, Methionine [Aromatic groups]

Amino acids with polar but uncharged R Group:

- These amino acids are polar and possess neutral pH value.
- Eg: Glycine, Serine, Threonine, Cysteine, Tyrosine, Glutamine, Asparagine.

Negatively charged amino acids:

- Their side chain [R Group] contain extra carboxyl group with a dissociable proton.
- And renders electrochemical behaviour to proteins
- Eg: Aspartic acid and Glutamic acid.

Positively charged amino acids:

- Their side chain have extra amino group
- Rendering basic nature to protein,
- Eg: Lysine, Arginine, Histidine.

Distribution in protein

Standard protein amino acids:

- The amino acids that are used to form proteins, recognized by ribozyme autoaminoacylation systems
- Eg: Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, and Valine

Non standard protein amino acids:

- These amino acids are not required to build proteins. have a vital role as metabolic intermediates.
- Eg. Hydroxyproline, Hydroxylysine, Carboxyglutamate, Diaminopimelate.

Non standard non protein amino acid:

- These are the derivative of amino acids and have role in metabolism.
- Eg: Alpha amino butyrate, Citruline, Ornithine, Beta-alanine.

Based on nutritional requirements

Essential amino acids:

- Essential amino acids cannot be made by the body. As a result, they must come from food.
- Eg: Arginine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, and Valine.

Non essential amino acids:

- An amino acid that can be made by humans and so is essential to the human diet.
- Eg: Alanine, Asparagine, Aspartic acid, Cysteine, Glutamic acid, Glutamine, Glycine, Proline, Serine, and Tyrosine.

On basis of number of amino and carboxylic groups

Monoamino- monocarboxylic amino acids

Eg: Glycine, Alanine, Proline, Phenylalanine, Methionine, Serine, Threonine

Monoamino-dicarboxyli amino acids:

Eg: Aspartic and Glutamic acid

Diamino-monocarboxylic amino acids:

Eg: Lysine, Arginine, Histidine.

Functions of Essential Amino acids

- Phenylalanine helps in maintaining a healthy nervous system and in boosting memory power.
- Valine acts as an important component in promoting muscle growth.
- Threonine helps in promoting the functions of the immune system.
- Tryptophan is involved in the production of vitamin B3 and serotonin hormones. This serotonin hormone plays a vital role in maintaining our appetite, regulating sleep and boosting our moods.
- Isoleucine plays a vital role in the formation of haemoglobin, stimulating the pancreas to synthesize insulin, and transporting oxygen from the lungs to the various parts.

- Methionine is used in the treatment of kidney stones, maintaining healthy skin and also used in controlling invade of pathogenic bacteria.
- Leucine is involved in promoting protein synthesis and growth hormones.
- Lysine is necessary for promoting the formation of antibodies, hormones, and enzymes and in the development and fixation of calcium in bones.
- Histidine is involved in many enzymatic processes and in the synthesizing of both red blood cells (erythrocytes) and white blood cells (leukocytes).

Functions of Non-Essential Amino acids

- Alanine functions by removing toxins from our body and in the production of glucose and other amino acids.
- Cysteine acts as an antioxidant and provides resistance to our body; it is important for making collagen. It affects the texture and elasticity of the skin
- Glutamine promotes a healthy brain function and is necessary for the synthesis of nucleic acids – DNA and RNA.
- Glycine is helpful in maintaining the proper cell growth, and its function, and it also plays a vital role in healing wounds. It acts as a neurotransmitter.
- Glutamic acid acts as a neurotransmitter and is mainly involved in the development and functioning of the human brain.
- Arginine helps in promoting the synthesis of proteins and hormones, detoxification in the kidneys, healing wounds, and maintaining a healthy immune system.

- Tyrosine plays a vital role in the production of the thyroid hormones -T3 and T4, in synthesizing a class of neurotransmitters and melanin, which are natural pigments found in our eyes, hair, and skin.
- Serine helps in promoting muscle growth and in the synthesis of immune system proteins.
- Asparagine is mainly involved in the transportation of nitrogen into our body cells, formations of purines and pyrimidine for the synthesis of DNA, the development of the nervous system and improving our body stamina.
- Aspartic acid plays a major role in metabolism and in promoting the synthesis of other amino acids.
- Proline is mainly involved in the repairing of the tissues in the formation of collagen, preventing the thickening and hardening of the walls of the arteries (arteriosclerosis) and in the regeneration of new skin.

THANK YOU