



**SNS COLLEGE OF ALLIED HEALTH SCIENCES**

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**DEPARTMENT OF CARDIAC TECHNOLOGY**

**COURSE NAME : BIOCHEMISTRY**

**TOPIC : AMINO ACIDS**



# AMINO ACIDS



- Organic compounds that combine to form proteins, 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.
- Amino acids play an important role in building and repairing the tissues, the formation and function of [enzymes](#), food digestion, the transportation of molecules, etc.



# SOURCES

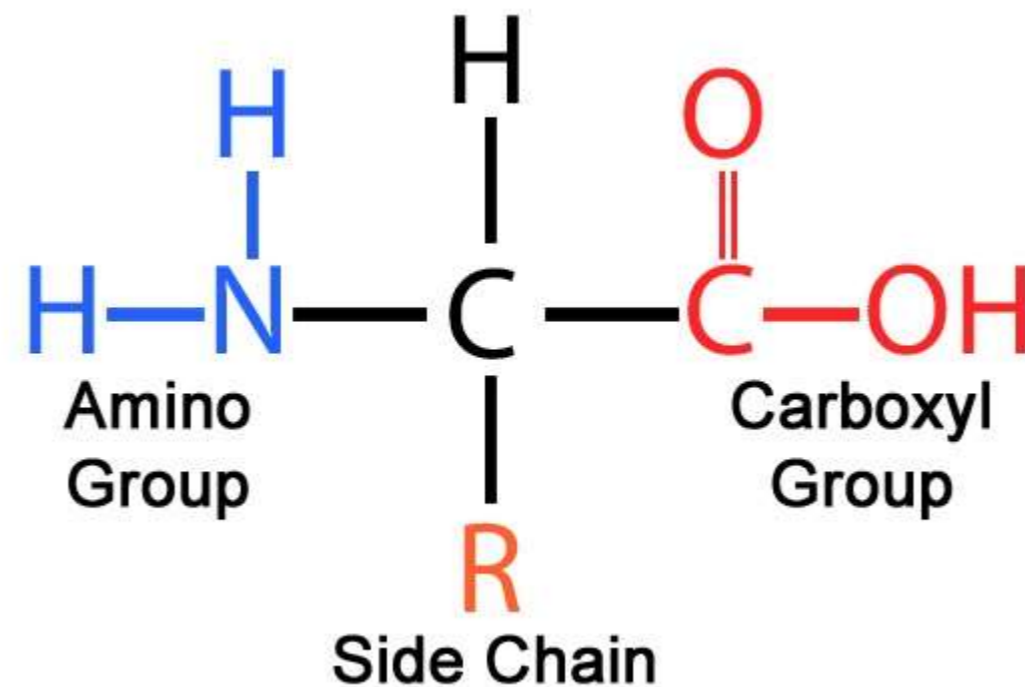


- Foods rich in amino acids include plant-based products like broccoli, beans, beetroots, pumpkin, cabbage, nuts, dry fruits, chia seeds, oats, peas, carrots, cucumber, green leafy vegetables, onions, soybeans, whole grain, peanuts legumes, lentils, etc.
- Fruits rich in amino acids are apples, bananas, 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  $\alpha$ -amino (alpha amino) acids.
- The general structure of  $\alpha$ -amino acids is shown in . The  $\alpha$ -amino acids are so called because the  $\alpha$ -carbon atom in the molecule carries an amino group ( $-\text{NH}_2$ ); the  $\alpha$ -carbon atom also carries a carboxyl group ( $-\text{COOH}$ ).



# 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 one atom other than carbon
- Eg: Tryptophan, Histidine, Proline

### **Amine group containing amino acids:**

- Derivatives of amino acids in which one of the carboxyl groups 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-dicarboxylic amino acids:**

Eg: Aspartic and Glutamic acid

## **Diamino-monocarboxylic amino acids:**

Eg: Lysine, Arginine, Histidine.



# Functions of Essential Amino acids



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



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





# Functions of Non-Essential Amino acids



- Alanine - removes toxins from our body and in the production of glucose
- Cysteine - antioxidant and provides resistance to our body; it is important for making collagen. It affects the texture and elasticity of the skin
- Glutamine - healthy brain function, necessary for the synthesis of DNA and RNA.
- Glycine - maintaining the proper cell growth, healing wounds - acts as a neurotransmitter.
- Glutamic acid - neurotransmitter, development and functioning of the human brain.
- Arginine - synthesis of proteins and hormones, detoxification in the kidneys, healing wounds, and maintaining a healthy immune system.



- Tyrosine - production of the thyroid hormones -T3 and T4
- Serine - promoting muscle growth and in the synthesis of immune system proteins.
- Asparagine - 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 - metabolism
- Proline - 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.



# Assessment



1. Structure of Amino acids?
2. Classification based on?
3. Difference between essential and non essential amino acids?
4. Any 5 essential amino acids and its role?
5. Any 5 non - essential amino acids and its role?



**THANK YOU**