Topic- **Amino acids**

Semester- IV

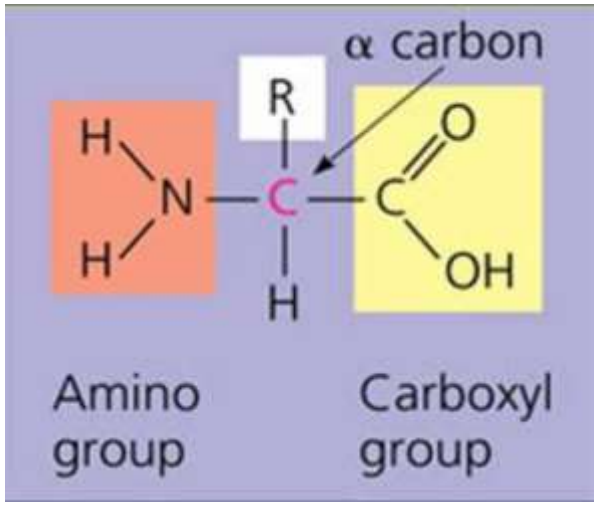
Department-Chemistry

Presented by-Dr. Bijeta Mitra

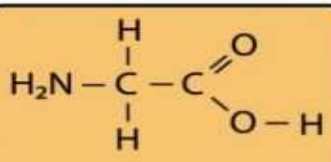
AMINO ACIDS

- Amino acids are obtained from proteins by hydrolysis, catalyzed by acid, base or enzymes such as pepsin, trypsin etc.
- Amino acids are the building blocks of proteins
- 300 amino acids occur in nature
- Out of this 20 amino acids are standard amino acids which repeatedly found in protein structure

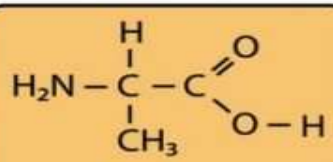
- Amino acids are a group of organic compounds containing two functional group- amino ($-NH_2$) and carboxylic acid (-COOH).
- Amino group ($-NH_2$) is basic while the carboxyl group (-COOH) is acidic in nature.
- Amino acids share many features, differing only at the R substituent.



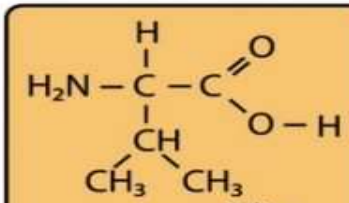
20 Amino Acid Structures



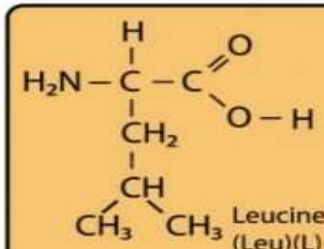
Glycine
(Gly)(G)
non-polar
$C_2H_5NO_2$



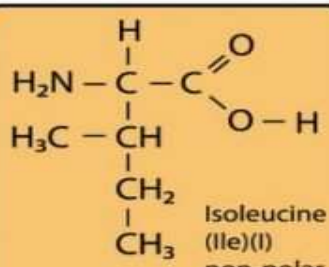
Alanine
(Ala)(A)
non-polar
$C_3H_7NO_2$



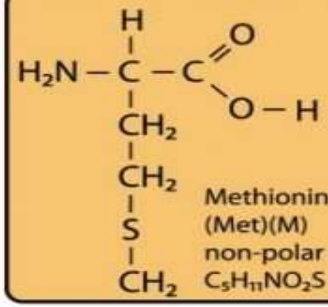
Valine
(val)(V)
non-polar
$C_5H_{11}NO_2$



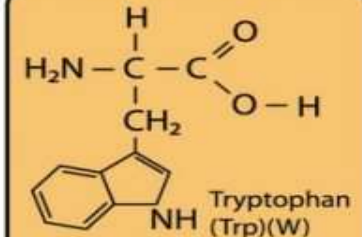
Leucine
(Leu)(L)
non-polar
$C_6H_{13}NO_2$



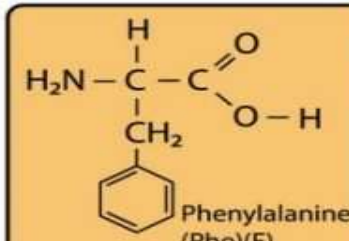
Isoleucine
(Ile)(I)
non-polar
$C_6H_{13}NO_2$



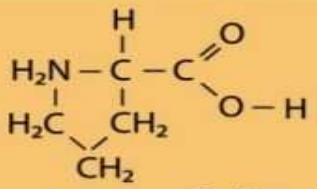
Methionine
(Met)(M)
non-polar
$C_5H_{11}NO_2S$



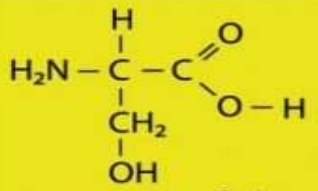
Tryptophan
(Trp)(W)
non-polar
$C_{11}H_{12}N_2O_2$



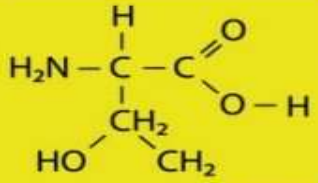
Phenylalanine
(Phe)(F)
non-polar
$C_9H_{11}NO_2$



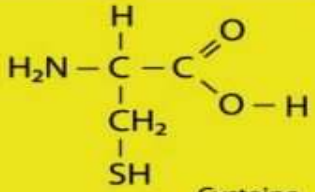
Proline
(Pro)(P)
non-polar
$C_5H_9NO_2$



Serine
(Ser)(S)
polar
$C_3H_7NO_3$

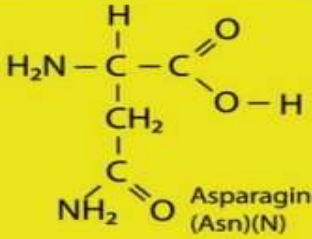


Threonine
(Thr)(T)
polar
$C_4H_9NO_3$

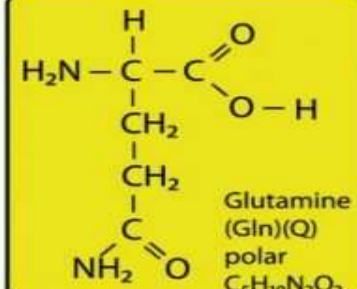


Cysteine
(Cys)(C)
polar
$C_3H_7NO_2S$

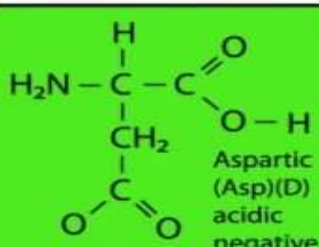
Tyrosine
(Tyr)(Y)
polar
$C_9H_{11}NO_3$



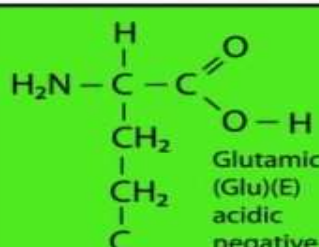
Asparagine
(Asn)(N)
polar
$C_4H_8N_2O_3$



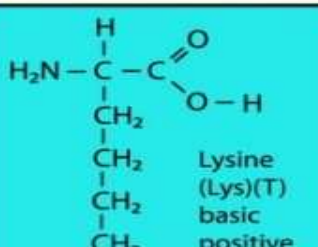
Glutamine
(Gln)(Q)
polar
$C_5H_{10}N_2O_3$



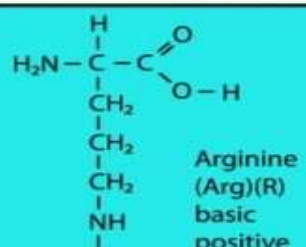
Aspartic
(Asp)(D)
acidic
negative
charge
$C_4H_7NO_4$



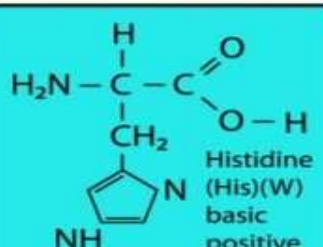
Glutamic
(Glu)(E)
acidic
negative
charge
$C_5H_9NO_4$



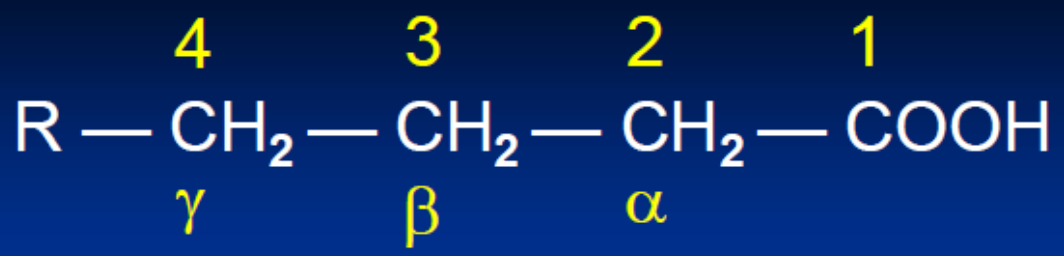
Lysine
(Lys)(T)
basic
positive
charge
$C_6H_{14}N_2O_2$



Arginine
(Arg)(R)
basic
positive
charge
$C_6H_{14}N_4O_2$



Histidine
(His)(W)
basic
positive
charge
$C_6H_9N_3O_2$

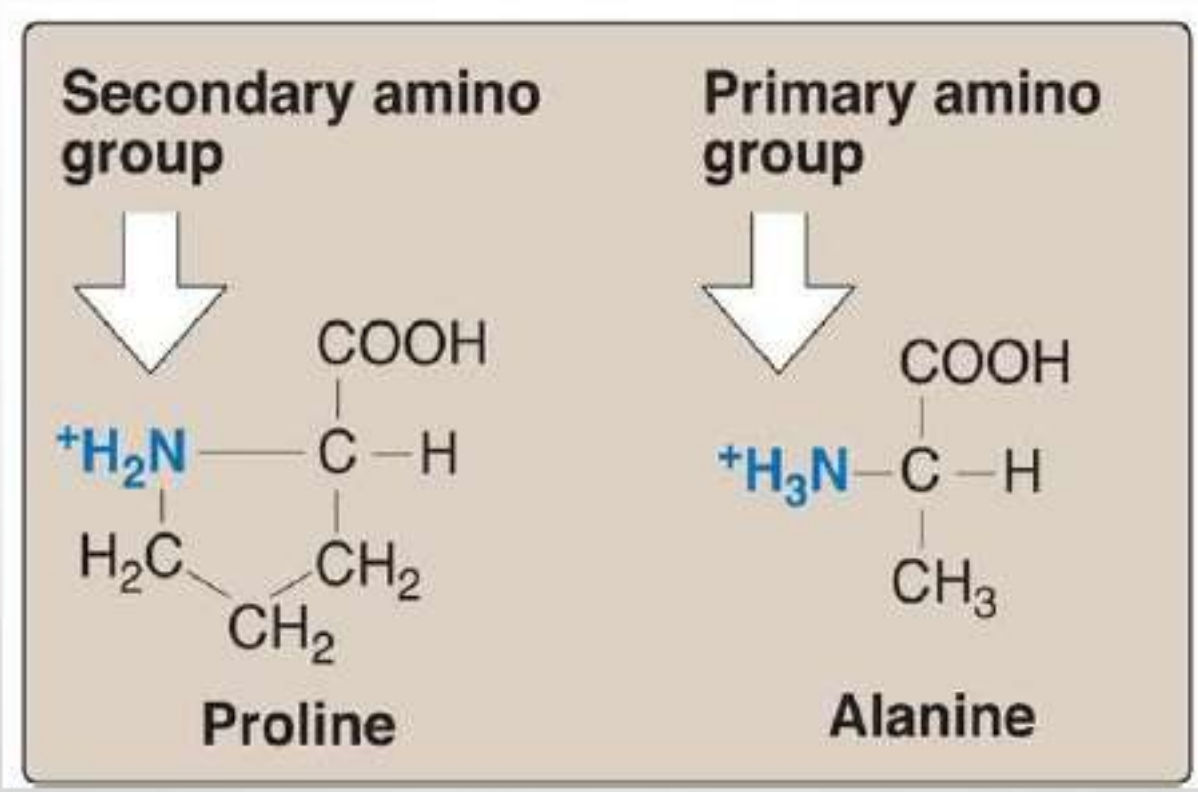


The amino group may be attached to any of the carbon atoms next to the carboxyl group

The amino acid is accordingly known as α-amino acid (2-amino acid), β-amino acid (3-amino acid), γ-amino acid (4-amino acid) etc

Most of the amino acids except Proline are α-amino acids.

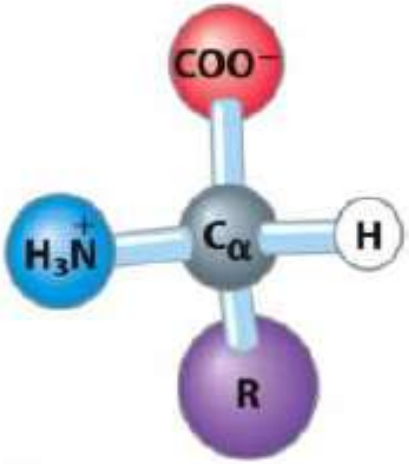
Proline is an IMINO ACID



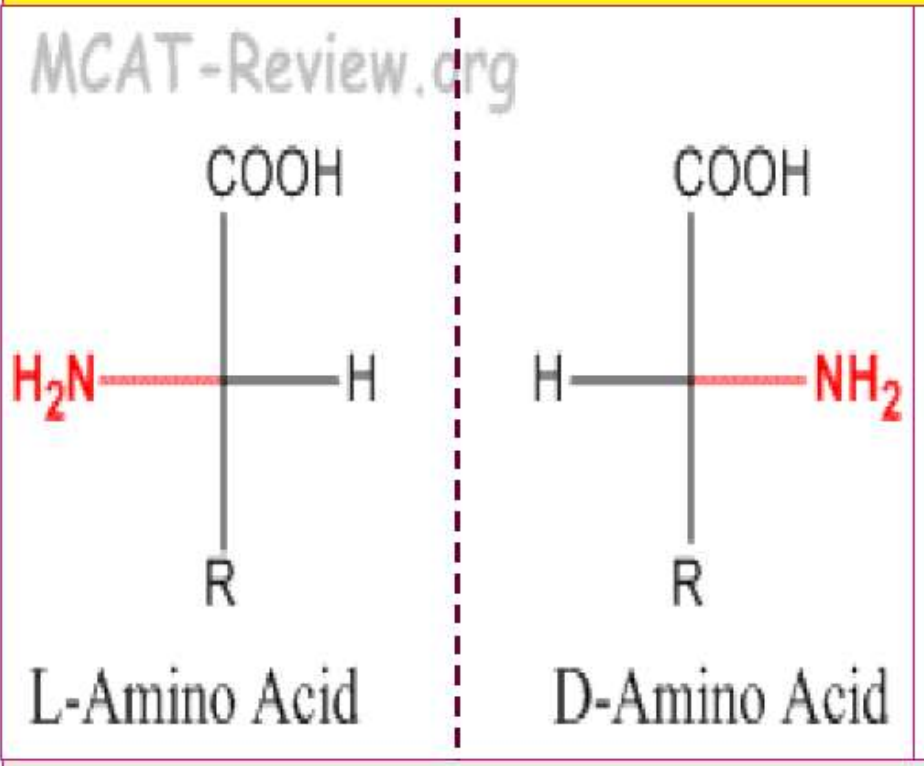
Comparison of the secondary amino group found in proline with the primary amino group found in other amino acids such as alanine.

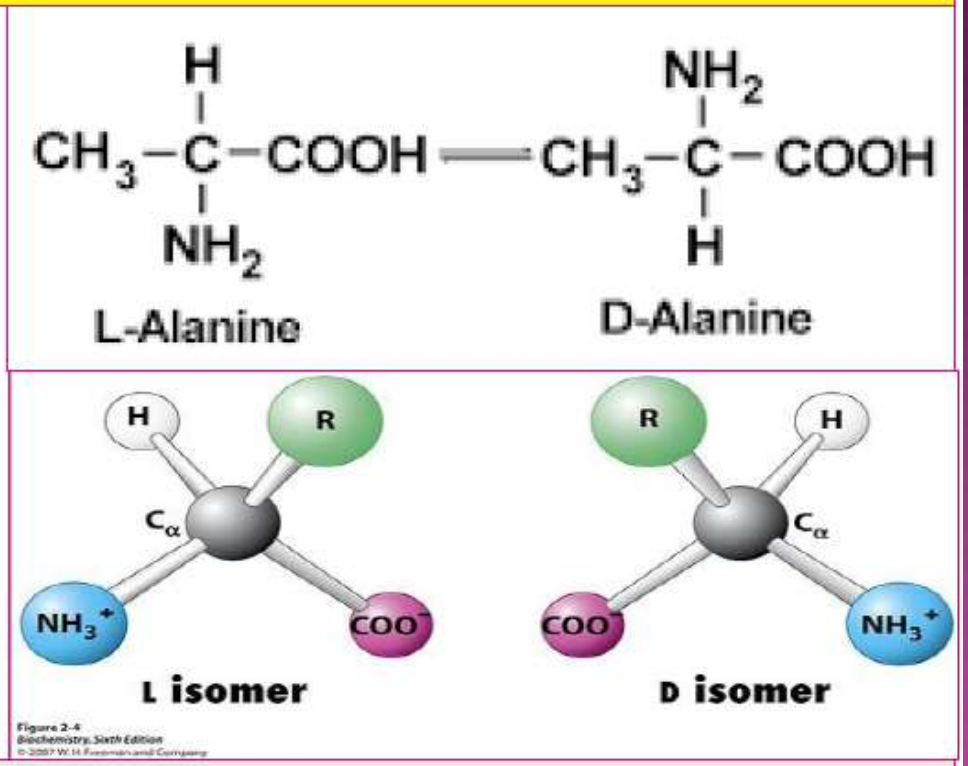
Most α-Amino Acids are Chiral

- The α-carbon has always four different substituents and is tetrahedral therefore exhibits optical isomerism
- Each amino acid has an unique fourth R-substituent
- Except In glycine, the R-substituent is also a hydrogen so it is non-chiral



L and D Isomers of amino acids

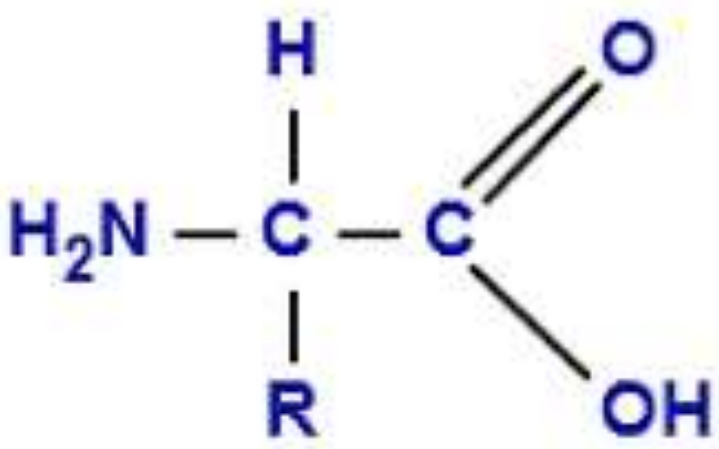




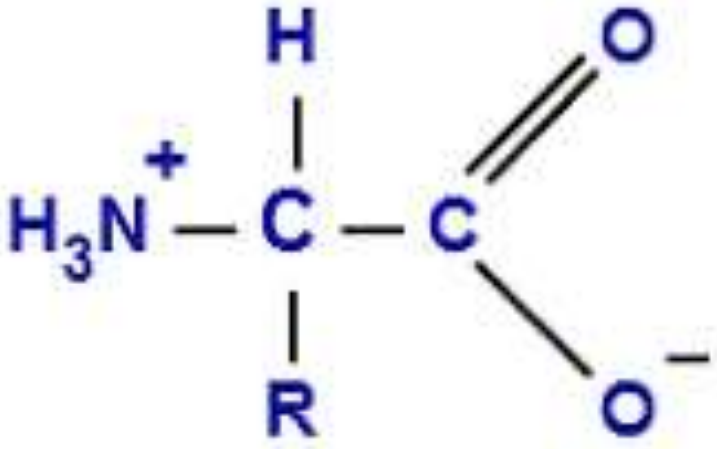
The proteins are composed of L-amino acids .

L and D Isomers of amino acids are mirror images and also called enantiomers.

STRUCTURE



Amino acid



Zwitterion

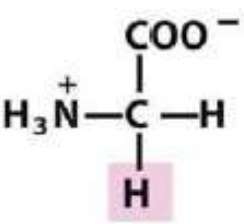
CLASSIFICATION

A. Amino acids classification based on their structure

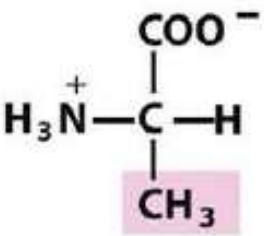
Common amino acids can be placed in seven basic groups depending on their R substituent

1. Aliphatic amino acids

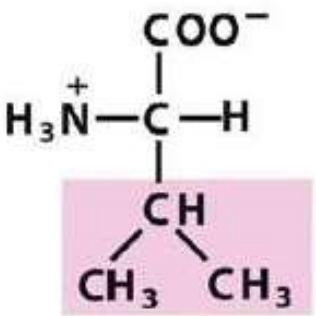
- Contains aliphatic R- chain
- these are hydrophobic and non-polar in nature
- these shows presence of simple or branched chain in R-group



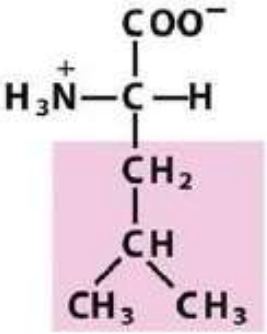
Glycine



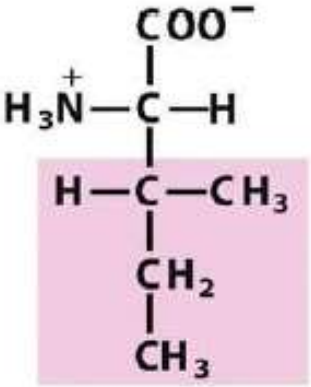
Alanine



Valine

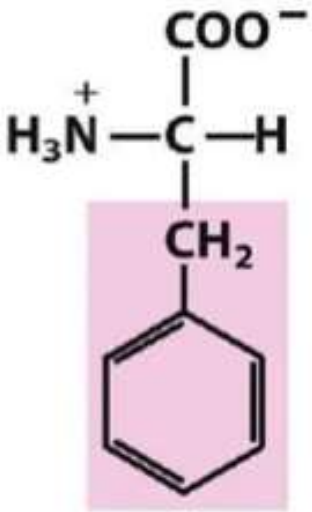


Leucine

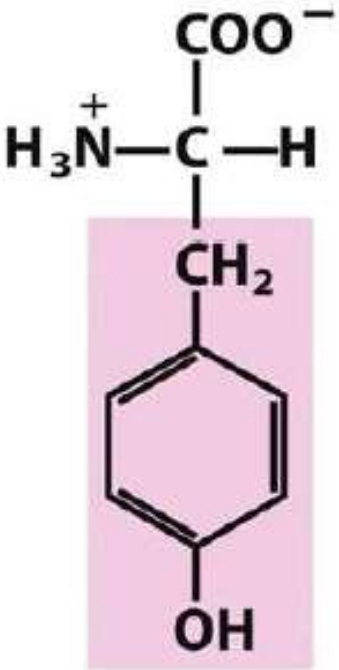


Isoleucine

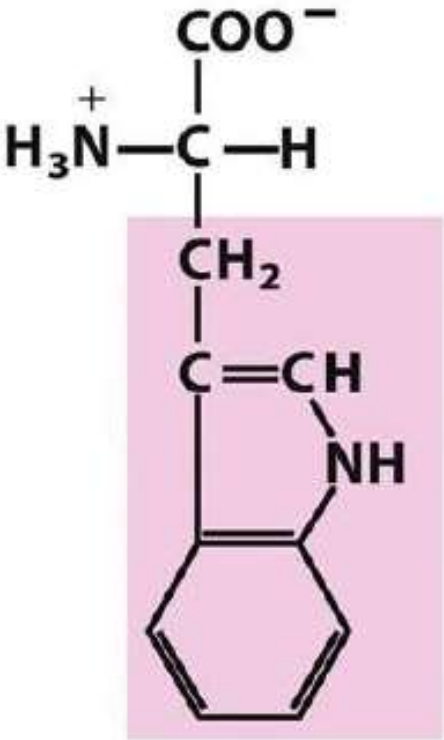
2. Aromatic amino acids
-Contains aromatic R- chain



Phenylalanine



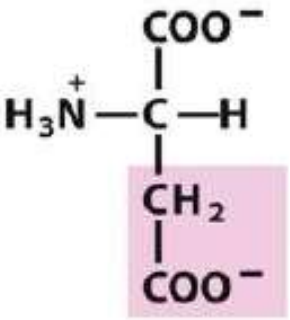
Tyrosine



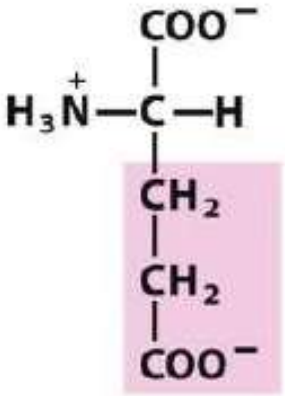
Tryptophan

3. Acidic amino acids

i) Dicarboxylic monoamino acids– Aspartic acid and Glutamic acid

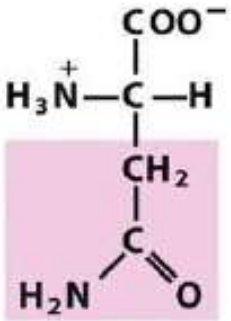


Aspartate

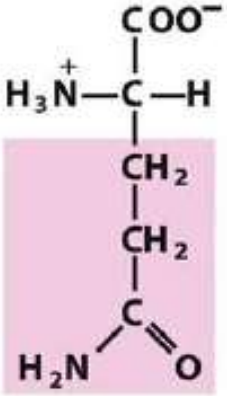


Glutamate

ii) Amides form of above acids



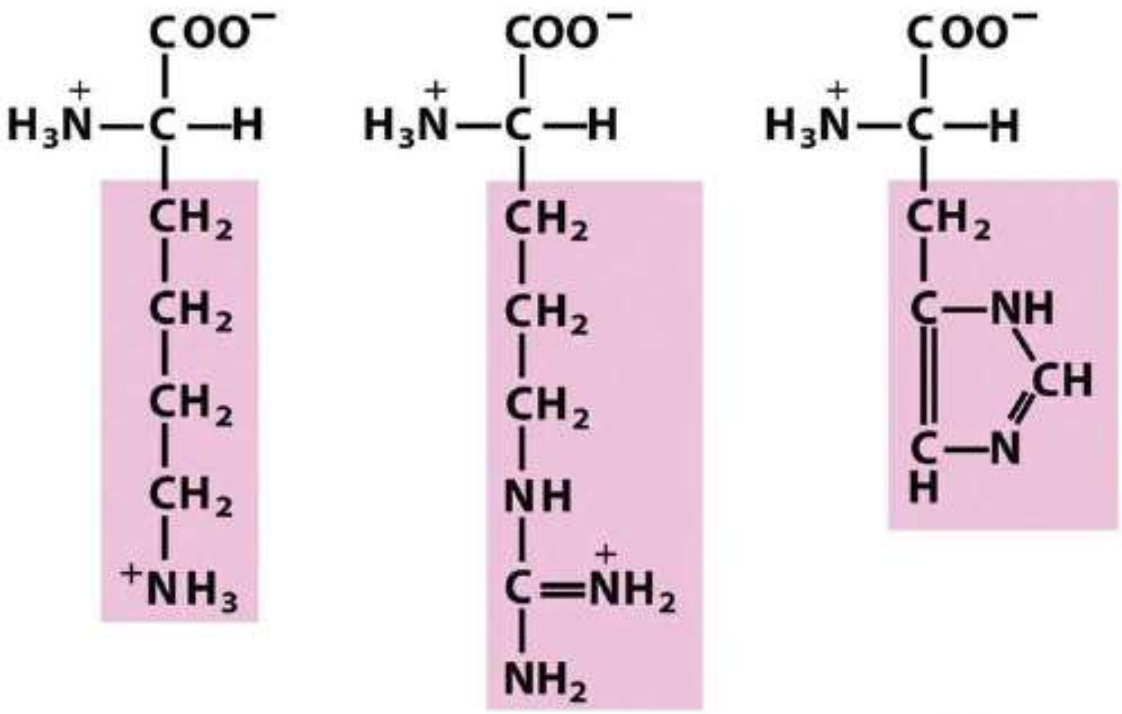
Asparagine



Glutamine

4. Basic amino acids

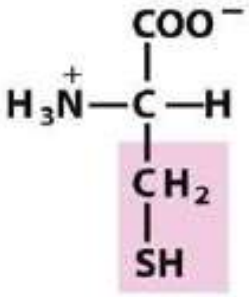
– These amino acids are basic in nature



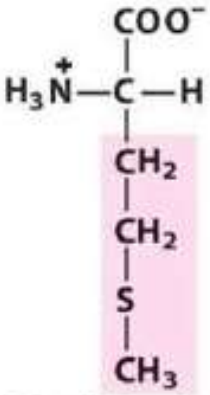
Lysine **Arginine** **Histidine**

5. Sulphur containing amino acids

– These amino acids contain sulphur atom in the structure



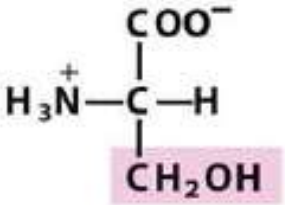
Cysteine



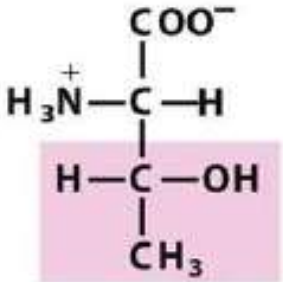
Methionine

6. Hydroxyl group containing amino acids

– These amino acids contain hydroxyl group in the structure



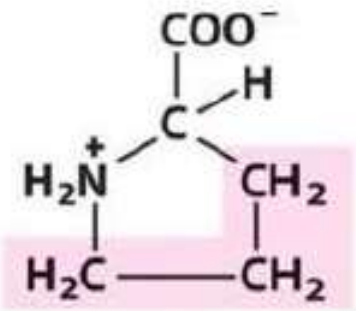
Serine



Threonine

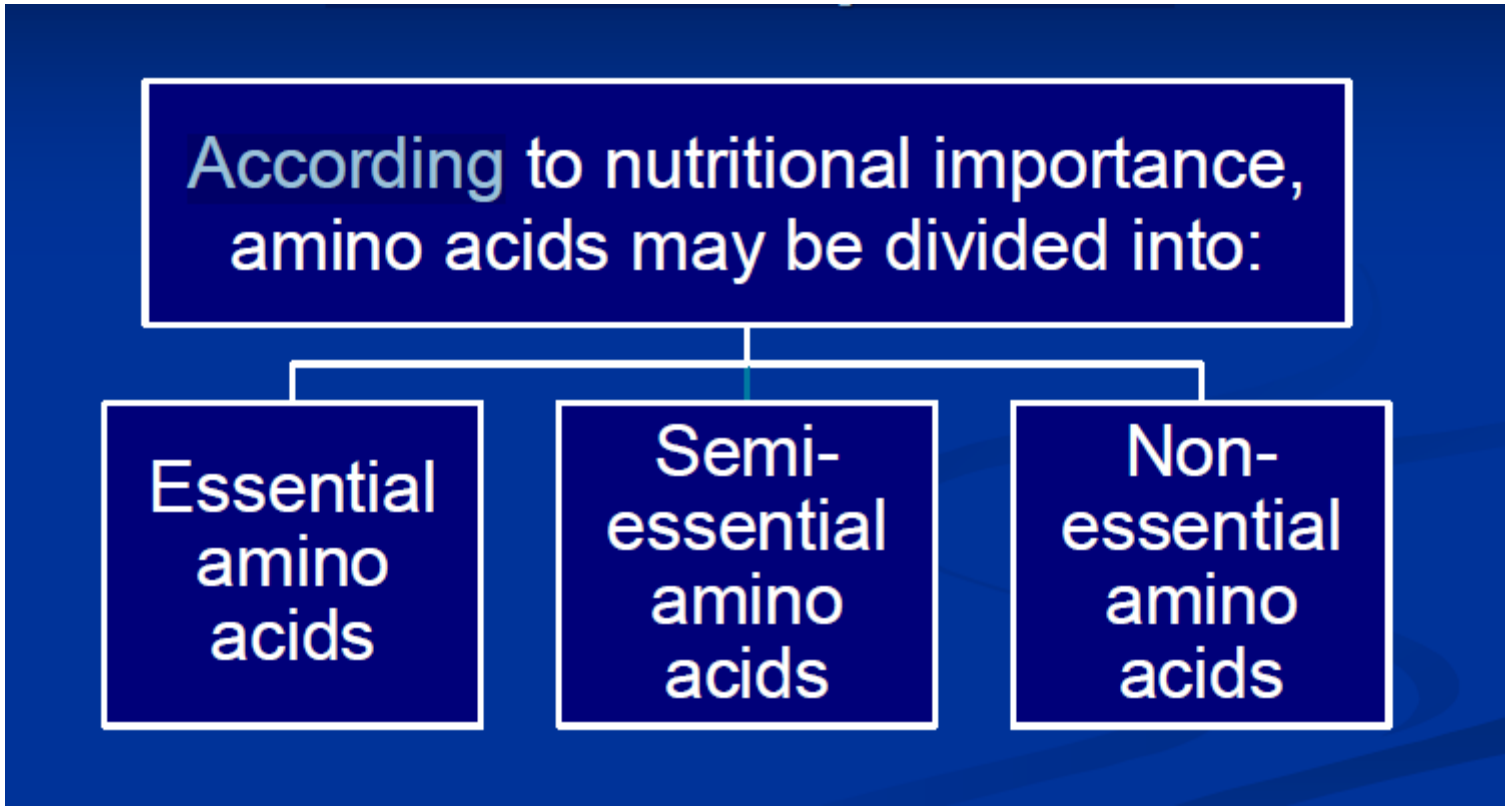
7. Imino acids

– These amino acids contain imino group(=NH) in place of amino group (–NH2) i.e. α– amino nitrogen is part of the structure



Proline

CLASSIFICATION ACCORDING TO NUTRITIONAL IMPORTANCE ACCORDING



ESSENTIAL AMINO ACIDS

- Proteins are synthesized from 20 standard amino acids
- All the standard amino acids are equally important for protein synthesis
- However, some of these amino acids can be synthesized in our body
- Some of the standard amino acids cannot be synthesized by human beings
- These amino acids are known as essential amino acids

Essential
Histidine
Isoleucine
Leucine
Lysine
Methionine
Phenylalanine
Threonine
Tryptophan
Valine

SEMI-ESSENTIAL AMINO ACIDS

- Synthesis of semi-essential amino acids is below their requirement in childhood
- Hence, they must be provided in the diet of children
- Arginine and histidine are semi-essential amino acids

Conditionally Non-Essential
Arginine
Cystine
Glutamine
Glycine
Proline
Tyrosine

NON-ESSENTIAL AMINO ACIDS

- Endogenous synthesis of non-essential amino acids can meet our requirement
- Hence, their presence in the diet is not essential

Non-Essential
Alanine
Asparagine
Aspartate
Glutamate
Serine

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