AMINO ACIDS, PEPTIDES AND PROTEINS

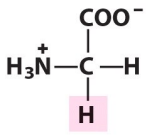
المرحلة الثالثة /قسم الكيمياء/الفصل الثاني

أ.د.فيحاء مقداد خليل

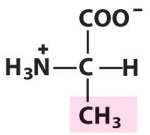
Syllabus of proteins , DNA& RNA :

1.Types of amino acids.
2.Types of identification proteins .
3. Stereochemistry of Amino Acids
4. Classification of α-Amino acids.
5. Acid-Base Behavior of Amino Acids.
6. *Electrophoresis.*
7. properties of their side chains .
8. Proteins and peptides .
9. Protein Structure.
10. Hemoglobin(H) and Myoglobin (M).
11. Classification of Proteins on the Basis of Biological Role.
12. Denaturation of Proteins.
13. Cleavage of proteins .
14. DNA Structure.
15. RNA Structure.
16. DNA& RNA functions.

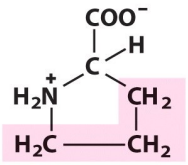
Nonpolar, aliphatic R groups



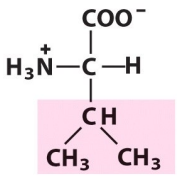
Glycine



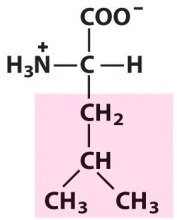
Alanine



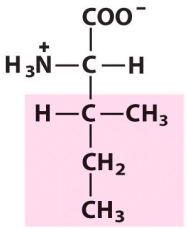
Proline



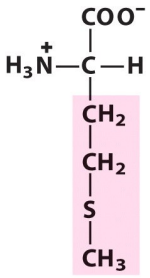
Valine



Leucine

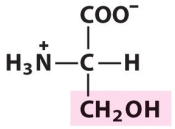


Isoleucine

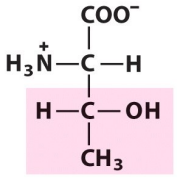


Methionine

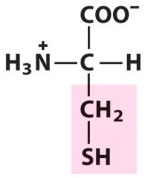
Polar, uncharged R groups



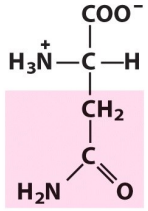
Serine



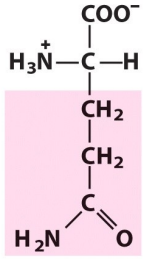
Threonine



Cysteine

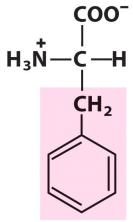


Asparagine

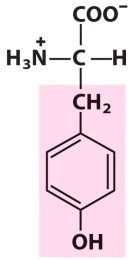


Glutamine

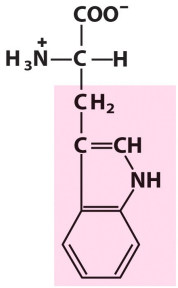
Aromatic R groups



Phenylalanine

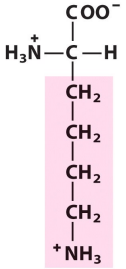


Tyrosine

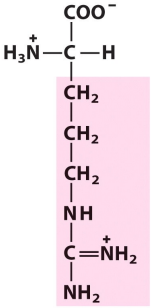


Tryptophan

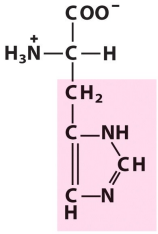
Positively charged R groups



Lysine

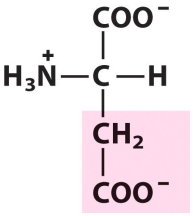


Arginine

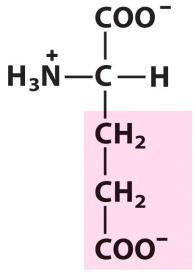


Histidine

Negatively charged R groups



Aspartate



Glutamate

- Ninhydrin's test (specific to all Proteins & Amino acids
- Biuret's test (specific to Proteins)
- Sakaguchi's test (specific to Arginine)
- Nitropruside's test (specific to Cysteine)
- Millon's test (specific to Tyrosine)
- Hopkins-Cole's test (specific to Tryptophan)

Stereochemistry of Amino Acids: The natural configuration of the α-carbon is L. D-Amino acids are found in the cell walls of bacteria. The D-amino acids are not genetically encoded, but derived from the epimerization of L-isomers

α- Amino Acid

R = sidechain

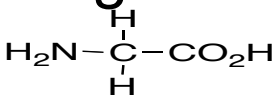
monomer unit:
α-amino acids

peptide (< 50 amino acids)
protein (> 50 amino acids, Peptide or protein (polypeptide)

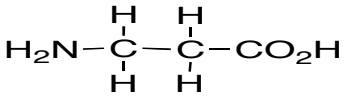
» **Proteins / polypeptides - chains formed by the condensation/combination of 20 different α - amino acids. Polypeptides - may be di-, tri -, etc; up to 10 a.a.**

- **Proteins - longer than 10 a.a. units; ie. MW>10,000**

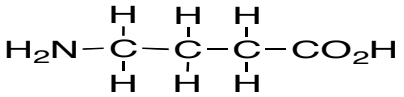
Classification of Amino Acids. AA's are classified according to the location of the amino group.



α-amino acid
(2-amino carboxylic acid)



β-amino acid
(3-amino carboxylic acid)



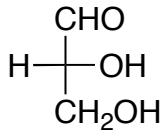
γ-amino acid
(4-amino carboxylic acid)

There are 20 genetically encoded α-amino acids found in peptides and proteins. The R configuration denotes a clockwise rotation, while the S configuration denotes an anticlockwise rotation.

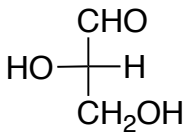
Isoleucine and threonine are the only two amino acids with two chirality centers

Assign R or S configuration to the methyl-bearing carbon atom of isoleucine.

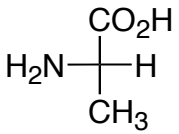
19 are primary amines, 1 (proline) is a secondary amine19 are "chiral", 1 (glycine) is achiral; the natural configuration of the α-carbon is L.



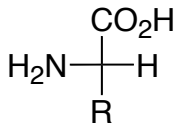
D-glyceraldehyde

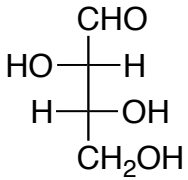


L-glyceraldehyde

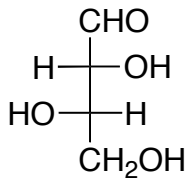


L-alanine

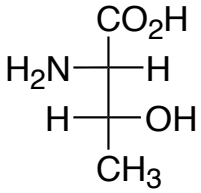




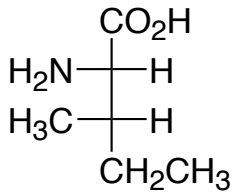
D-erythrose



L-erythrose

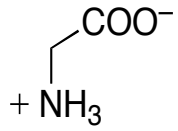


L-theronine
(2S,3R)

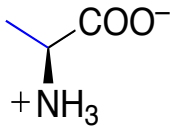


L-isoleucine
(2S,3S)

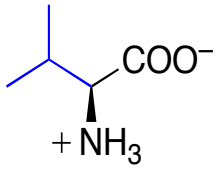
α-Amino acids are classified by the properties of their side chains *Nonpolar:* **using the designations '*R*' (from the Latin *rectus*, meaning right-handed) or '*S*' (from the Latin *sinister*, meaning left-handed)**



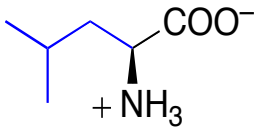
Glycine *(Gly, G)*



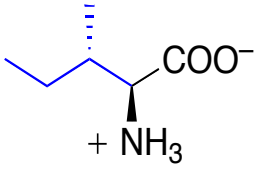
(S)-(+)-Alanine *(Ala, A)*



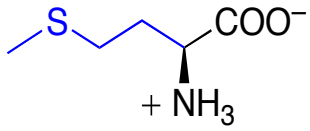
(S)-(+)-Valine *(Val, V)*



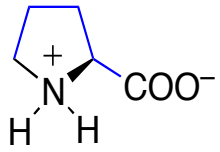
(S)-(–)-Leucine *(Leu, L)*



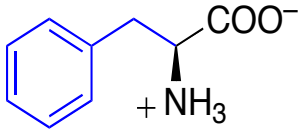
(2S,3S)-(+)-Isoleucine *(Ile, I)*



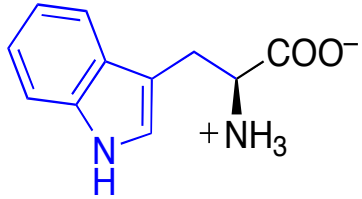
(S)-(–)-Methionine *(Met, M)*



(S)-(–)-Proline *(Pro, P)*

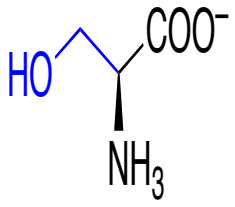


(S)-(–)-Phenylalanine *(Phe, F)*



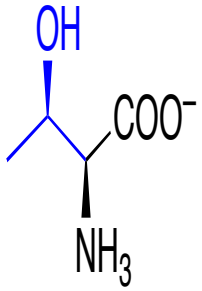
(S)-(–)-Tryptophan *(Trp, W)*

Polar but non-ionizable:



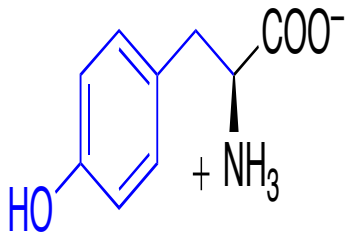
(S)-(–)-Serine *(Ser, S)*

pKa ~ 13



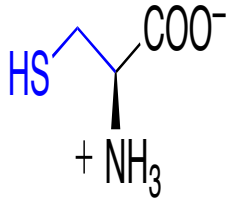
(2S,3R)-(–)-Threonine *(Thr, T)*

pKa ~ 13



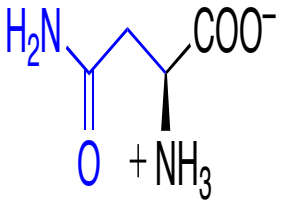
(S)-(–)-Tyrosine *(Tyr, Y)*

pKa ~ 10.1

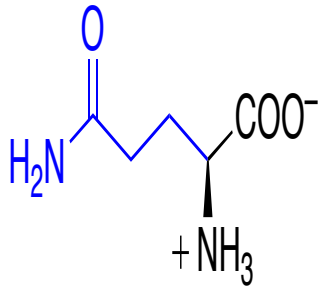


(R)-(–)-Cysteine *(Cys, C)*

pKa ~ 8.2

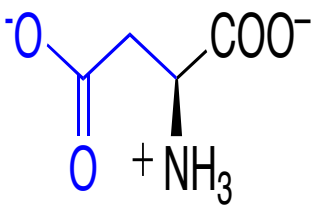


(S)-(–)-Asparagine *(Asn, N)*



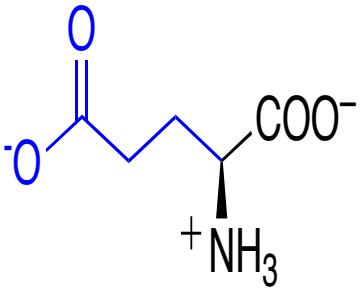
(S)-(+)-Glutamine *(Gln, Q)*

Acidic:



(S)-(+)-Aspartic Acid *(Asp, D)*

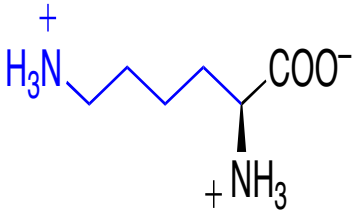
pKa ~ 3.6



(S)-(+)-Glutamic Acid *(Glu, E)*

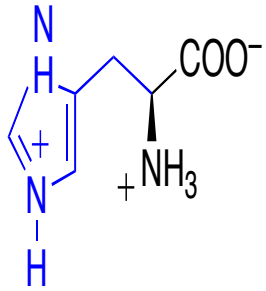
pKa ~ 4.2

Basic:



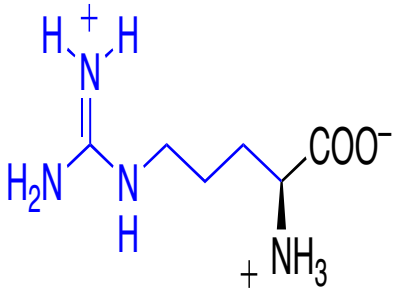
(S)-(+)-Lysine *(Lys, K)*

pKa ~ 10.5



(S)-(–)-Histidine *(His, H)*

pKa ~ 6.0



(S)-(+)-Arginine *(Arg, R)*

pKa ~ 12.5