1 AminoAcids

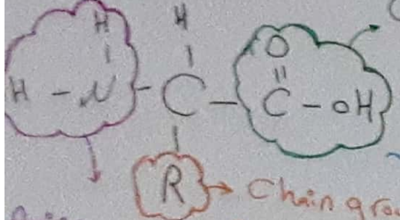
The Simplest Amino Acid is Glycin (R group → H)

(300 Amino Acids)

Key elements of amino acids ← (C, N, O, H, S) founded in chain group (R)

Amino Acids : are biologically important organic molecules that contain both Carboxylic Acid (-COOH) and Amine groups (NH₂-).
→ The basic structural building units of proteins.
+ Energy Source.

→ Main Formula :



Carboxylic Acid (-COOH) ← موجودة بشكل أساسي في كل الأحماض الأمينية

Amine Group (NH_2-)

R → Chain group — يميز الأحماض الأمينية عن بعضها البعض

Amino acids are Amphoteric molecules (Ampholytes) (have (COOH) + (NH_2))

(Acidic Group) تعتبر → Proton Donor
COOH − H^+ → COO^- (Anionic) → Net charge (-1) → (High pH)

*Disulfide bond
- Intramolecular → same Polypeptides
- Intermolecular → Different Polypeptides.

*Amine Group (NH_2)
تميز الأحماض الأمينية وتقسمها إلى (α-β-γ-δ) :
وذلك حسب موقع ارتباطها
1. Carbon (2) → α-Amino Acids
2. Carbon (3) → β-Amino Acids
3. Carbon (4) → γ-Amino Acids
4. Carbon (5) → δ-Amino Acids

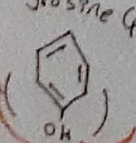
Amine Group is Basic (Proton Acceptor)
$NH_2 + H^+ \rightarrow NH_3^+$ → Net Charge (+1) → Cationic (Low pH)

(COO^- ⊕ NH_3^+) we will have Zwitterions (Non-charged polar)
→ It's Neutral (+ ⊖ -) (Net charge = Zero)
→ Non-Ionized (NH_3^+ - CH_2 - COO^-) (ph: 7)
→ Isoelectric point
$PI = \frac{1}{2}(pKa_1 + pKa_2)$

→ Primary Amino Acid (NH_2)
→ Secondary Amino Acid (NH)

Called (R) Group:

- **Non-polar** → Nine Amino Acids (9):
  - (6) → Aliphatic
  - (2) → Aromatic
  - (1) → Cyclic side
  - Glycine, Alanine, Valine, Leucine, Isoleucine, Methionine, Proline, Phenylalanine, Tryptophan
  - (Hydrophobic)
- **Charged Polar** → Five Amino Acids (5):
  - (3) → positively (+) Basic → Lysine, Histidine, Arginine.
  - (2) → Negatively (-) Acidic → Aspartate, Glutamate (~~Glutamine~~)
  - (Hydrophilic)
- **Non-charged Polar** → Six Amino Acids (6): "with hydroxyl, Amide and Thiol groups"
  - Serine, Threonine, Cysteine (SH group), Asparagine, Glutamine (-S-S bond)
  - Thyrosine (phenolic group)



*Standard Amino Acids (Divided according to Nutrition and Body requirement) :

- **Essential** → Not produced (by the body) → Through Diet (8 Amino Acids)
  - Leucine, Lysine, Methionine, Tryptophan, Valine, Isoleucine, Phenylalanine, Threonine.
- **Non-Essential** → Synthesized by body (9 Amino Acids).
  - Glycine, Alanine, Serine, Cysteine, Aspartic Acid, Glutamic Acid, Asparagine, Glutamine, proline.
- **Conditionally essential** → Synthesized by body → Through Diet
  - Its Essential in Cases: Children, Pregnant and Lactating women
  - (3) Amino Acids: Histidine, Arginine, Tyrosine
  - Growth promoting factors, essential in growing child + Pregnancy + Lactation
  - Tyrosine: produced from Phenylalanine → ينتج خطأ في التحويل إلى (PKU) أي يؤدي إلى ظهور مرض

Both

→ Amino Acid Derivatives :
1. Tryptophan —precursor→ Serotonin (Neurotransmitter)
2. Tyrosin —precursor→ Thyroxin (Thyroid Hormone); → Dopamine, → Adrenaline, → Noradrenaline (Catecholamine Neurotransmitter)
3. Histamine during Allergy ← Histidine (Decarboxylation)
4. Glutamate —precursor→ γ-Amino butyric acid (GABA) [Inhibitor of NT] Neurotransmitter in brain].

2 Amino Acids

Non-Standard (non-canonical), sometimes (Nonproteinogenic) except (3) Amino Acids. (post-translation modification) and They are derivative from Standard Amino Acids

Standard (20) (canonical, natural, protein role, proteinogenic always) Adding in vivo protein synthesis (m-RNA translation) All known as (α-Amino Acid) + primary Amino Acid

exception (proline → secondary) Cyclic Pyrrolidine (side chain)

All of them Chirals + not superimposed

exception (Glycine → Achiral - superimposed) (Optical Activity) X

Enantiomers: Two stereoisomeres that are mirror images but not superimosable.

If the (Amino Group) on → Right hand side → D (dexter); → Left hand side → L (laevus)

Fisher projection: way commonly used to represent the structure of chiral molecules → Amino Acids; → Carbohydrate.

L-Amino Acides → Naturally Biologically isomer. (Bacterial Cell walls) → D-Amino Acides.

Optical Activity (Polarimeter) → used to Chirals → Clockwise (+); → Counterclockwise (-)

Clockwise (+)/(d) ⇒ (9) L-Amino Acids are (+)/dextrorotary

Racemic Mixture: equal amounts of each enantiomers (Net = Zero).

→ Tyrosine (Phynolic group) → Cysteine (-S-S) disulfied bond *Covalent linkage

* We have (20) Standard (α-Amino Acids)

* And, (23) proteinogenic * Amino Acids → 20 standard; 3 Non-standard

* Natural Amino Acids (21) → (20) standard α-Amino Acid; (1) Non standard β-Amino Acid (β-Alanine) (Pantothenic Acid (Vitamin B5))

* Chiral Amino Acid (19) standard (- Glycine)

* Primary α-Amino Acid (standard) (19) → standard (- proline).

* protein role (21) → (20) standard; (1) Non standard (Hydroxyproline)

→ Glycine (side chain H)

→ Methionine → (Thio ether group + Sulfur atom (S))

→ Phenylalanine (Phenyl moiety) → Tryptophan (NH)

* Isomers = molecules with same molecular formula but different chemical structure:
① Constitutional (structural) isomers (atoms + functional group)
② Stereoisomers (Spatial isomers): Atomic connectivity

Like (Ornithine) + (Citrulline) in the Urea cycle "part of Catabolism"

(1) As intermediates during Metabolism.
(2) Post translational modification process.
(3) Other enzymatic reactions.

* Post-Translational Modification (essential function → protein):
① Carboxylation → Glutamate (Blood Clotting Cascade)
② Hydroxlation → proline (in Collagen protein in Conn ective tissue).
③ Phosphorylation (of OH group) (Serine, Threonine + Tyrosine) negative charge → protein and Enzyme.
④ Glycosylation (add sugar) stabilizes protein + Direct selected protein → Intracellular organelles

* α-Amino Acids Are Standard.

* β-Amino Acids are Non standard

* β-peptides Used t. synthesis (Antibiotics)

→ Non proteinogenic + Non standard Amino Acids are derivative from (Standard Amino Acids).

[may → protein role; → Nonprotein role] → They are active by themselves and Have a function.

* [Nonproteinogenic / Proteinogenic] + Non standard (derivatives by Standard Amino Acid)

Carnitine and GABA → Non-standard, Non-proteinogenic, Non protein role, Not found in proteins

* (Hydroxyproline) → Non standard, Non proteinogenic. not produced directly by standard cellular machinery.

* Hydroxyproline → Non standard, Non proteinogenic → Protein role

→ Non proteinogenic + Non standard Amino Acids