SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr M.G.R Medical University, Chennai

DEPARTMENT OF PHYSICIAN ASSISTANT

COURSE NAME: BIOCHEMISTRY

UNIT : 1

TOPIC : AMINO ACIDS

FACULTY NAME: MITHRA V

AMINO ACIDS (DEFINE)

- Organic compounds - combine to form proteins, building components of proteins.
- Proteins - structural support inside the cell
- Each protein - made up of different combinations of 20 types of simpler amino acids.
- Amino acids - involved in growth and development of human beings.
- Important role in building and repairing tissues, formation and function of enzymes, food digestion, transportation of molecules, etc.

SOURCES

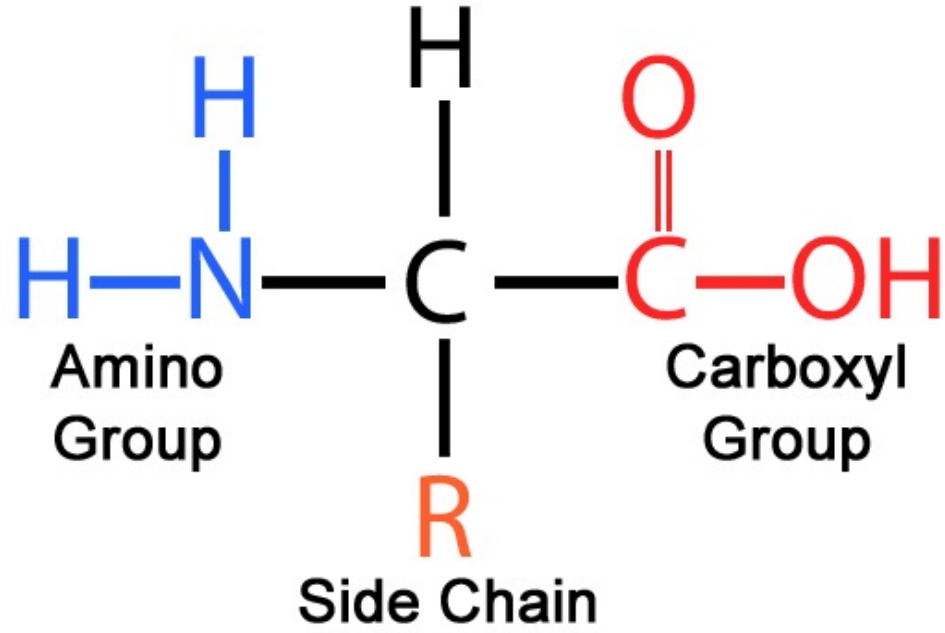
•**Plant-based**: Broccoli, beans, nuts, chia seeds, oats, soybeans.

•Fruits (apples, bananas, berries, etc.).

•**Animal-based**: Dairy, eggs, seafood, chicken, pork.

STRUCTURE OF AMINO ACIDS

- All amino acids have a central **α-carbon** attached to:
- Amino group ($-NH_2$)
- Carboxyl group (–COOH)
- Hydrogen atom (H)
- Variable **R-side chain**



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, Valine Tryptophan PVT.
Threonine Isoleucine Methionine TIM
Histidine Arginine Leucine Lysine HALL

BASED ON R-GROUP

Category	Description	Examples
Aliphatic side chain	Amino acids with aliphatic side-chains (linear, branched, or cyclic)	Leucine, Isoleucine, Valine
Hydroxy amino acids	Contain a hydroxyl (-OH) group in side chain	Serine, Threonine
Sulfur-containing	Have sulfur atom in the side chain	Cysteine, Methionine
Acidic amino acids	Have more carboxyl (-COOH) group in side chain	Aspartic acid, Glutamic acid
Basic amino acids	Contain more amino ($-NH_2$) group in side chain	Lysine, Arginine
Aromatic amino acids	Have a benzene ring in the side chain	Phenylalanine, Tyrosine
Imino acid	Contains a secondary amine group	Proline

BASED ON POLARITY AND R GROUP

Category	Description	Examples
Polar (Hydrophilic)	Side chains interact with water - uncharged and charged groups.	Uncharged: Gly, Ser, Thr, Cys, Charged: Asp, Glu (-ve); Lys, Arg (-ve)
Non-polar (Hydrophobic)	Side chains do not interact with water; aliphatic or aromatic.	Aliphatic: Ala, Val, Leu, Ile, Pro Aromatic: Phe, Trp, Met
Polar Uncharged	Interact with water; neutral at physiological pH.	Gly, Ser, Thr, Cys, Tyr, Gln, Asn
Negatively Charged	Acidic side chains with –COOH; lose H^+	Asp, Glu
Positively Charged	Basic N-containing side chains; gain H^+	Lys, Arg, His

BASED ON METABOLIC FATE

Type	Definition	Metabolic Role
Glucogenic	Amino acids that break down into carbohydrate precursors.	Can be used to generate glucose when necessary (via gluconeogenesis).
Ketogenic	Amino acids that break down into acetyl-CoA and acetoacetate.	Undergo ketogenesis to produce ketone bodies: acetoacetate, beta-hydroxybutyrate, and acetone.

BASED ON NUTRITIONAL REQUIREMENTS

Type	Definition	Examples
Essential Amino Acids	Cannot be synthesized by the body; must be obtained from food.	Arginine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, Valine
Non-Essential Amino Acids	Can be synthesized by the human body; not required from diet.	Alanine, Asparagine, Aspartic acid, Cysteine, Glutamic acid, Glutamine, Glycine, Proline, Serine, Tyrosine

FUNCTIONS OF ESSENTIAL AMINO ACIDS

Amino Acid	Role
Phenylalanine	Keeps nerves healthy, improves memory
Valine	Helps muscles grow
Threonine	Boosts immune system
Tryptophan	Makes vitamin B3 & serotonin; controls hunger, sleep, mood
Isoleucine	Makes hemoglobin, insulin; carries oxygen in body
Leucine	Builds proteins, helps growth hormones
Lysine	Makes antibodies, hormones, enzymes; fixes calcium in bones
Histidine	Makes red & white blood cells

FUNCTIONS OF NON-ESSENTIAL AMINO ACIDS

Amino Acid	Role
Alanine	Removes toxins, makes glucose
Cysteine	Acts as antioxidant, builds collagen for skin
Glutamine	Supports brain, helps make DNA & RNA
Glycine	Helps cell growth, heals wounds, calms brain
Glutamic acid	Brain messenger, helps brain work
Arginine	Makes proteins/hormones, cleans kidneys, boosts immunity
Tyrosine	Makes thyroid hormones (T3 & T4)
Serine	Builds muscles, makes immune proteins

REFERENCES

- Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry* (7th ed.). Satyanarayana, U., & Chakrapani, U. (2018). *Biochemistry* (5th ed.).
- https://www.ncbi.nlm.nih.gov/books/NBK557845/
- https://www.khanacademy.org/science/biology/macromolecules/proteins-and-amino-acids
- https://www.hsph.harvard.edu/nutritionsource/what-should-you-eat/protein/

THANK YOU