



# NEET-PG

**PART-A**

VOLUME-III  
**BIOCHEMISTRY**





# **BIOCHEMISTRY**

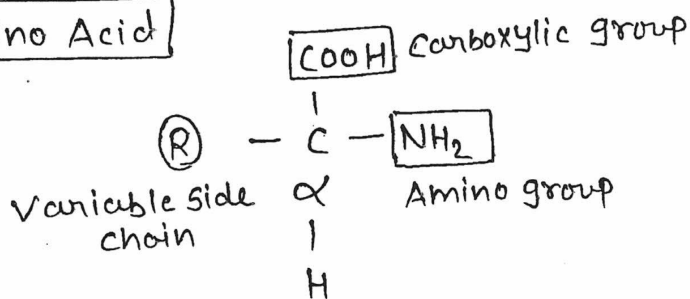
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## Amino Acid

- Building blocks of Proteins
- How AA will Join together? → By "Peptide bond"★
- Peculiarity of Peptide bond → Covalent bond★ = Strongest bond.
- Work Horses of genes.

### α-Amino Acid



- Most of AA are α AA.
- ★ Non α AA :- β Alanine
  - :- β Amino Isobutyrate
  - :- γ Amino Isobutyrate
- There are > 300 AA but only 20 AA Utilised in Human body b'coz genetic code excess for only 20 AA.
- only 20 AA transporter Present in Intestine.

### 20 Classification of AA

Based on Variable Side chain

 - divided into two

- I - Aliphatic AA
- II - Aromatic AA
- III - Imino Acid

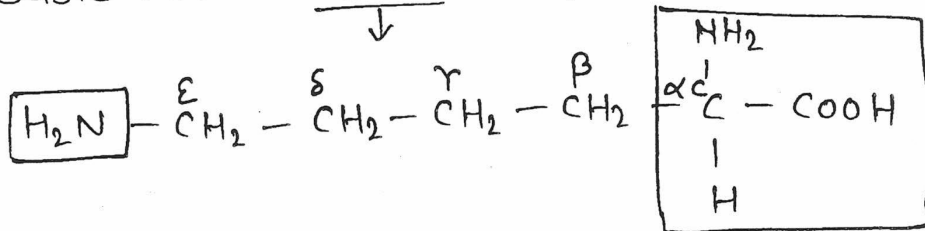
## I Aliphatic AA

- Simple AA :- Glycine, Alanine
- Branched chained AA :- "L I V" <sup>⊕</sup> Leucine, Isoleucine & Valine.
- Acidic AA (b'coz of extra carboxylic acid group (COOH) makes certain AA acidic)
  - :- Aspartic Acid (Aspartate)
  - :- Glutamic Acid (Glutamate)
- Amides - <sup>⊕</sup> JF <sup>⊕</sup> group having COOH in Acidic AA

$\downarrow$   
 $\text{CONH}_2$  is Amide

:- Aspartic Acid  $\longrightarrow$  Asparagine  
 Glutamic Acid  $\longrightarrow$  Glutamine

- Basic AA :- Lysine, Arginine. <sup>⊕</sup> ALH

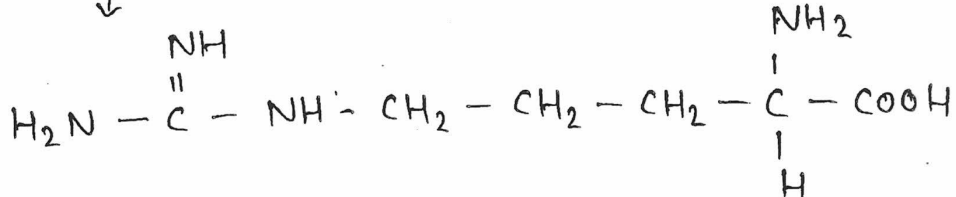


\* Histidine is also basic but it includes in Aromatic

Straight chain

$\epsilon \longrightarrow \text{NH}_2$

Arginine



★ NEET Arginine has special group called  $\longrightarrow$  Guanidinium Group

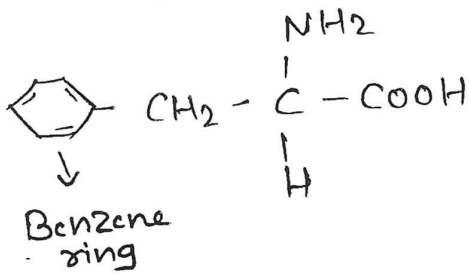


\* ∴ Methionine → Do not Answer Sulphur test 6

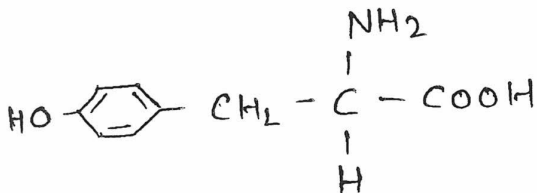
## II Aromatic Amino Acid

Identifying feature = Ring

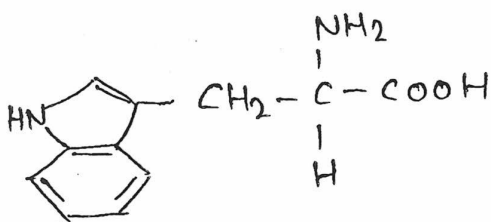
Phenyl Alanine



Phenol group → Containing AA = Tyrosine



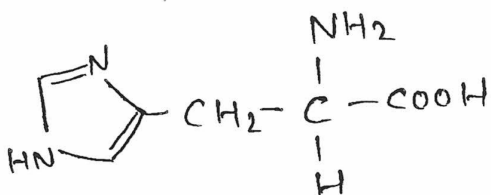
Indole ring → Containing AA = Tryptophan



"2 rings"

↳ Benzene ring } Indole ring  
 ↳ pyrrole ring }

Imidazole ring → Containing AA = Histidine



1 ring

↳ 5 membered ring  
 ↳ 2 Nitrogen

→ Basic Amino Acid

Q) Most basic AA = Arginine.

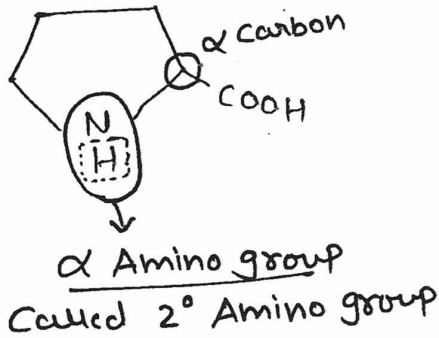
Q) AA with Max number of Amino group = Arginine

Q) Most Acidic AA = Aspartic Acid



III Imino Acid  $\longrightarrow$  Proline


L) Identificat<sup>n</sup>



- Single ring (5 membered)
  - $\alpha$  carbon atom is part of ring
  - $\alpha$  Amino group is also part of ring
- $\therefore$  Ring called as "Pyrrolidine Ring"

H  $\rightarrow$  can form peptide bond

\* \* Proline disrupt the stability of  $\alpha$  helix  $\rightarrow$  why??

- $\alpha\alpha_1 \rightarrow \alpha\alpha_2 \rightarrow \alpha\alpha_3 \}$   $\rightarrow$  called 1<sup>o</sup> structure
- when  $\alpha\alpha$  formed coiled  called 2<sup>o</sup> structure called  $\alpha$  helix, stabilised by H bond \*





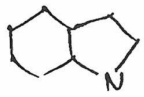

Q)  $\alpha$  helix &  $\beta$  pleated sheet are example of  $\alpha$  and  $\beta$   $\rightarrow$  Secondary structure

bond stabilise  $\alpha$  helix is "Hydrogen bond"

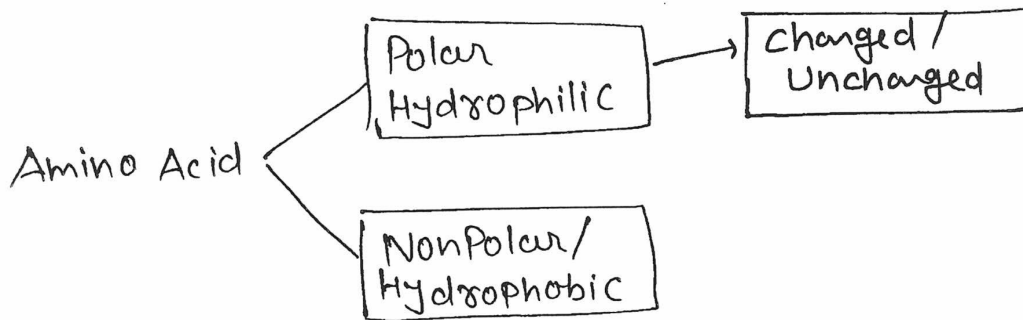
In Proline  $\rightarrow$  NO 'H' for provide. (In Proline H  $\rightarrow$  Peptide bond)  
 $\therefore$  Proline disrupt the stability of  $\alpha$  helix.

Revision

AA		Special group
Glycine	$\longrightarrow$	(H)
Arginine	$\longrightarrow$	Guanidinium $N-C^+N$
Phenyl Alanine	$\longrightarrow$	 Benzene
Tyrosine	$\longrightarrow$	 phenol ring

Tryptophen  $\longrightarrow$  Indole   
 Histidine  $\longrightarrow$  5 Membrane  $\epsilon$  2 Nitrogen   
 Aspartic Acid  $\longrightarrow$  COOH in R  
 Glutamic Acid  $\longrightarrow$  COOH in R  
 Asparagine / glutamine  $\longrightarrow$  CONH<sub>2</sub> in R

Based on side chain characteristic ★★



Polur changed Amino Acid

I - "ABC"  $\neq$  O

II - Acidic & Basic AA are changed

III - changed AA are polur

- Aspartic Acid
  - Glutamic Acid
  - Histidine
  - Arginine
  - & Lysine
- $\neq$  OALH

Polur Unchanged AA

- 1) Aliphatic Hydroxyl group containing AA 
 Serine  
 Threonine
- 2) Amides 
 Asparagine  
 Glutamine
- 3) Glycine
- 4) Cysteine

4) Cysteine

### Non Polar AA

- All Aromatic AA Except Histidine
- Branched AA (LIV)
- Imino Acid  $\rightarrow$  Proline
- Alanine
- Methionine

Phenylalanine  
Tyrosine  
Tryptophan

### One liners \*\*\*

- 1) Aromatic AA that is not non polar  $\rightarrow$  Histidine
- ✓ 2) Among Aromatic non Polar AA the least nonpolar  $\rightarrow$  Tyrosine
- 3) Simplest AA  $\rightarrow$  Glycine
- 4) Most Abundant AA in Protein  $\rightarrow$  Alanine
- 5) Most Abundant AA in Plasma  $\rightarrow$  Glutamine
- 6) Brain  $\rightarrow$  Glutamine
- ✓ 7) Most non polar AA  $\rightarrow$  Isoleucine
- ✓ 8) Least non polar Among the nonpolar AA is  $\rightarrow$  Proline
- ✓ 2<sup>nd</sup> least  $\rightarrow$  Tyrosine
- 9) Most polar AA  $\rightarrow$  Arginine
- 10) Least polar Among the polar  $\rightarrow$  Glycine

### Questions

1)  $\in$  of the following is polar

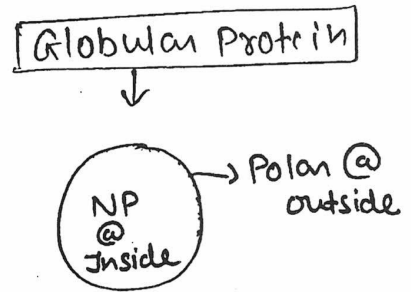
Ans  $\rightarrow$  Lysine ~~Glycine~~

\* Two AA with ambiguity in its polarity /  
 \*\* non polarity

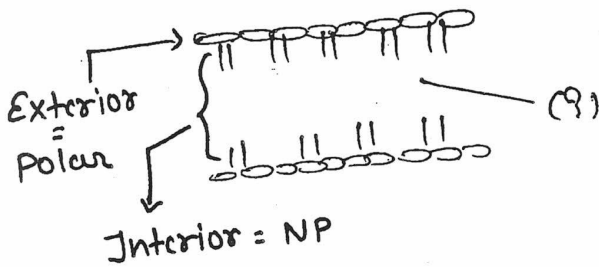
- ① Glycine
- ② Tyrosine

\*\* \* In a globular protein which AA is Present in the Interior ?

- ✓ a) Leucine → Non Polan
- b) Serine → P
- c) Lysine → P
- ✗ d) Arginine → P (Most Polan)



\*\* \* In a biological Membrane which AA is Present in the marked position ?



- ✓ a) Tryptophan
- b) Lysine
- c) Serine
- d) Aspartate

\* Which of the following is a conservative mutation of Leucine in Polypeptide (P) :

- ✓ NP a) Isoleucine
- NP b) Proline
- P c) Aspartate
- P d) Lysine

↳ NP  
 ↳ Branched  
 [Conservative Mutat<sup>n</sup> / Substitut<sup>n</sup> Means → One AA is replaced by another AA with similar characteristic]

\* In Hemoglobin-S Mutat<sup>n</sup> is → Non conservative Mutat<sup>n</sup>

Classification based on Metabolic fate 11

Purely ketogenic

AA that are catabolised to Acetoacetyl CoA and/or Acetyl CoA

Both ketogenic & Glycogenic

Purely glycogenic

AA that are catabolised to Intermediate of TCA cycle / Pyruvate to carbohydrate

Purely ketogenic

- Leucine
- Lysine ← Newly Added

Both ketogenic & glycogenic

- P - Phenyl Alanine
- I - Isoleucine
- T - Tyrosine
- T - Tryptophan

"all are Aromatic Except Isoleucine"

Purely glycogenic

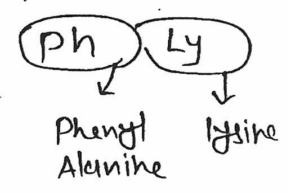
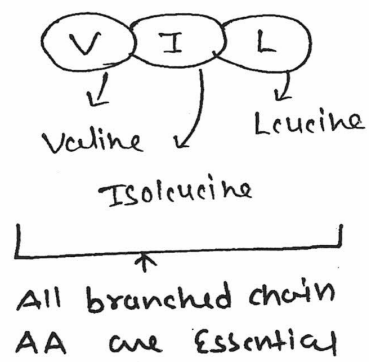
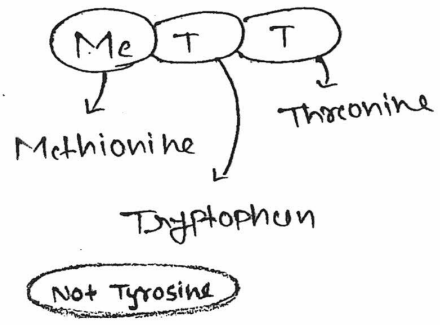
- Rest all are glycogenic

👤 Most glycogenic = Alanine

Classification based on Nutritional Requirement

Essential Amino Acids

Are 10 Met will fly + H




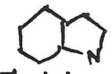
\* Histidine (Essential / SemiEssential)

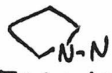
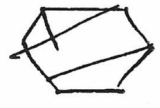
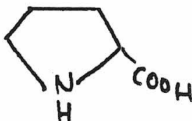
Semiessential AA → Arginine

Most Semi essential  
 ∴ Can be synthesized or can't be synthesized

Nonessential AA → Rest are

Quick revision chart

AA	Side chain	P/NP	Essential/ Semi/Non	Metabolic fate	Special group	
Glycine	R = H	Polar	Non Essential	Glycogenic	-	
Arginine	$\begin{matrix} N & & N \\ & \diagdown & / \\ & C & \\ &   & \\ & NH & \end{matrix}$	Polar	Semi	Glycogenic	Guanidinium	
Cysteine	R = CH <sub>2</sub> -SH	Polar	NE		Sulphur	
Methionine	C-S-CH <sub>3</sub>	NonPolar	Essential		Sulphur	
Lysine	E → NH <sub>2</sub>	Polar	E		-	
Leucine Isoleucine Valine	} Branched chain }	NonPolar	E		-	
Phenylalanine			NonPolar	E		-
Tyrosine		$\begin{matrix} OH \\   \\ \text{Benzene ring} \end{matrix}$ Phenol ring	NonPolar	NE		Phenol ring
Tryptophan	 Indole ring	NonPolar	E		Indole ring	

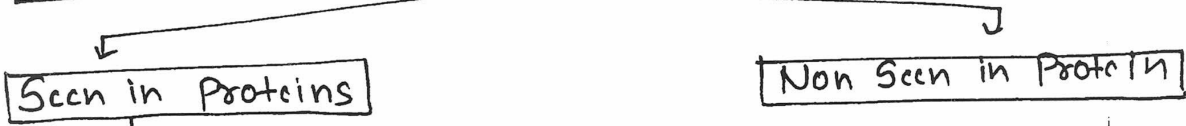
Histidine	 5 Membered & 2 Nitrogen	Polar	NE	Imidazole ring
Aspartic Acid Glutamic	$R = COOH$	Polar	NE	-
Asparagine Glutamine	$R = CONH_2$	Polar	NE	-
Serine	$R = OH$	Polar	NE	-
Threonine	$R = OH$	Polar	E	-
<del>Proline</del>				
Proline	 Pyrrolidine ring	Nonpolar	NE	Imino Acid
Alanine	$R = H$	Nonpolar	NE	-

**Derived Amino Acids**

What all ways quest<sup>n</sup> will formed 
Direct  
Indirect

- Q) AA with NO codon(s)
- Q) AA formed by Post translat<sup>n</sup> Modificat<sup>n</sup>
- Q) AA with no Aminoacyl tRNA

**Classificat<sup>n</sup> of Derived AA**



1. HydroxyProline  
 2. Hydroxylysine } → Present in Protein Collagen  
 → "Hydroxylat<sup>n</sup>" ⊕ α ketoglutarate ⊕  
 → \*vit-c is required ↓  
is required  
Fe<sup>2+</sup>\*

\* 3. γ Carboxyglutamate } → Present in clotting factor  
 II, VII, IX, X  
 → Protein C & S  
 → Present in Nephrocalcin & osteocalcin  
 → vit-k is required  
 → Usually carboxylat<sup>n</sup> required biotin but γ carboxylat<sup>n</sup> is biotin Independent carboxylat<sup>n</sup>

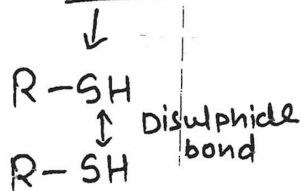
\* 4. Desmosine } → Present in "Elastin" AIIMS  
 → Derived from Lysine

\* 5. Cystine } → Present in protein  $\bar{c}$  Disulphide bond  
 i.e. Insulin  
 Immunoglobulin



Diff b/w cystine & Cysteine

15



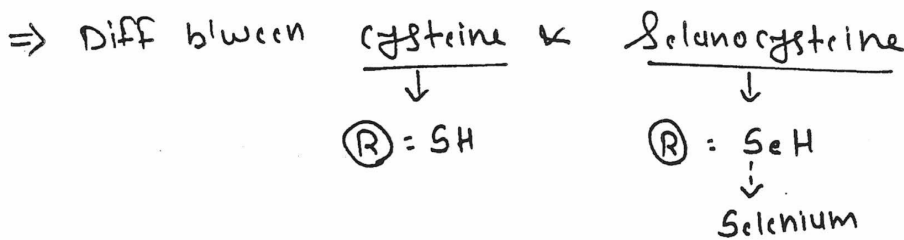
∴ 2 cysteine joined by disulphide bond = cystine

6. Methyl Lysine } → Present in Myosin.

**Not Seen in Protein**

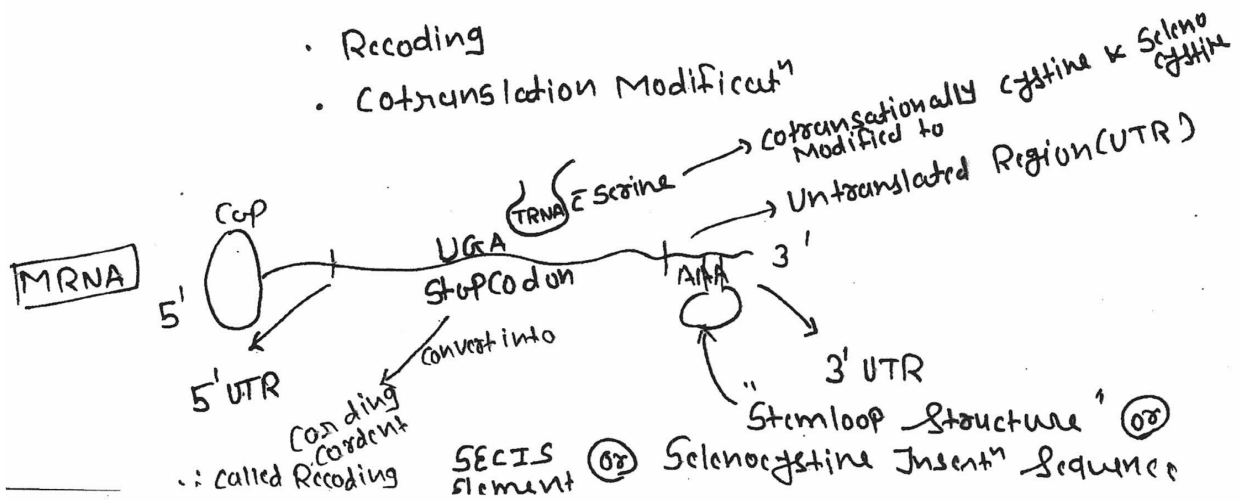
- |                      |                                   |
|----------------------|-----------------------------------|
| 1. Ornithine         | } → + <sup>nt</sup> in Urea cycle |
| 2. Argininosuccinate |                                   |
| 3. Citrulline        |                                   |
| 4. Homocysteine      | } → Seen in Methionine Metabolism |
| 5. Homoserine        |                                   |

**Selenocysteine**



\* ⇒ Synthesis → 100 words

- STOP Codon UGA
- Recoding
- Cotranslation Modification



★  $\Rightarrow$  Serena's Sister Selena Coming from UGA and.

$\Rightarrow$  Selenocysteine Presents in Protein / Enzyme = > 20 Proteins

"Reductases and Peroxidases" has Selenocysteine

★ Name of Enzymes  $\rightarrow$  Thioredoxin Reductase  $\checkmark$   
 $\subseteq$  Contains  $\rightarrow$  Deiodinase  
 Selenocysteine /  $\rightarrow$  Glutathione Peroxidase  
 Selenium  $\rightarrow$  Selenoprotein P  
 $\rightarrow$  Glycine reductase  $\checkmark$

Pyrrolysine  $\rightarrow$  22<sup>nd</sup> Protein forming AA

$\Rightarrow$  UAG

$\Rightarrow$  Present in bacteria

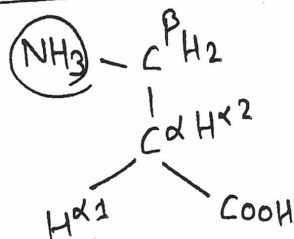
$\Rightarrow$  Recoding

$\Rightarrow$  Pylis = Pyloridin Insert<sup>n</sup> Sequence

$\Rightarrow$  Modified from "lysine"

It is not derived as it is cotranslat<sup>n</sup>

Beta Alanine



Amino group is present of  $\beta$  carbon atom

★  $\Rightarrow$  derived from  $\rightarrow$  cytosine & Uracil (no CUT)

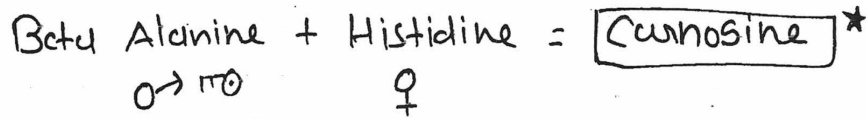
★  $\Rightarrow$  Present in Vitamine like  $\rightarrow$  Pantothenic Acid

★  $\Rightarrow$  Pantothenic Acid Present in Coenzyme A &

Acyl carrier protein

$\rightarrow$  Present in Fatty Acid Synthase Complex

→ **Dipeptide Containing  $\beta$ -Alanine**



$\therefore$  **Anserine**

\* both Carnosine & Anserine Present in Muscle

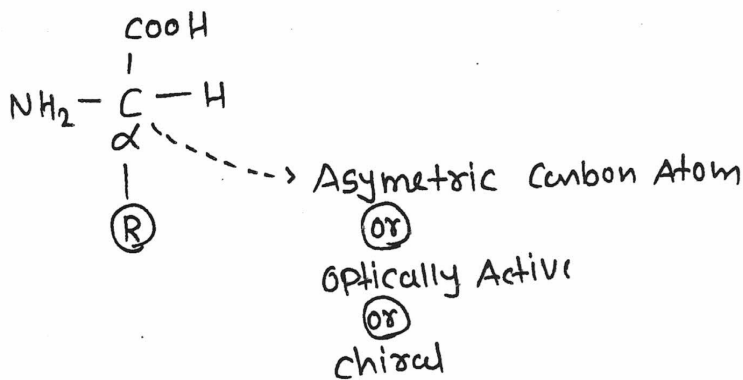
→ **Homocarnosine** = GABA + Histidine \*

- Present in brain.
- NO  $\beta$  Alanine.

**Properties of AA**

- 1) Exhibit Isomerism
- 2) Exist in different charged state
- 3) Exhibit buffering Action
- 4) Absorbed UV light.

**Amino Acid Exhibit Isomerism**



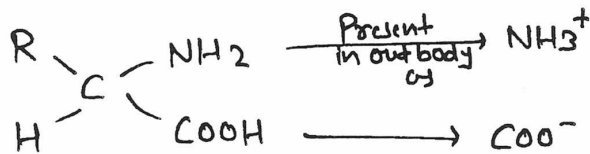
- Called D and L Isomerism
  - \* Most of AA → L Isomers
  - Most Carbohydrates → D Isomers
  - Amino Acid  $\bar{c}$  NO Asymmetric Carbon Atom  
 = Glycine b'coz  $\begin{array}{c} \text{NH}_2 \\ \diagup \\ \text{C} \\ \diagdown \\ \text{COOH} \end{array} \begin{array}{c} \text{H} \\ \diagdown \\ \text{H} \end{array}$  2 valency occupied by 2 Hydrogen  $\therefore$  NO D or L isomerism
- $\therefore$  Simple Glycine  $\uparrow$

- Enzymes act on L-Isomers
- ★ - 'D' AA is free form in body (✓) (Yes / No)<sup>18</sup>  
 Yes ∴ D Serine } Seen in brain.  
                   D. Aspartate }
- ★ - Major source of D AA is → Exogenous/Dietary

Exists in different charged state

- At pH = Isoelectric pH (pI)
- At pH > Iso

At pH = Isoelectric pH (pI)



At Isoelectric point, the number of positive charge = Neg charge

$$\therefore [\text{NH}_3^+] = [\text{COO}^-]$$

$$\therefore \text{Positive charge} = \text{Neg charge} \quad \therefore \text{No net charge.}$$

\* If In Media drawn below → AA is Present &  
 pH = pI  
 ∴ No Net charge (or) It is neutral



⇒ Properties of Amino Acid / Proteins at pH = pI

- Max Precipitability } Heat and Acetic Acid tube Test
- Max Solubility }
- No net Mobility in Electric field
- Least buffering Action