



Shri Shivaji Science College, Amravati

P. G. Department of Chemistry

Seminar on

Amino acids

Academic Year : 2022-23

M.Sc. II Semester III

- Presented by -

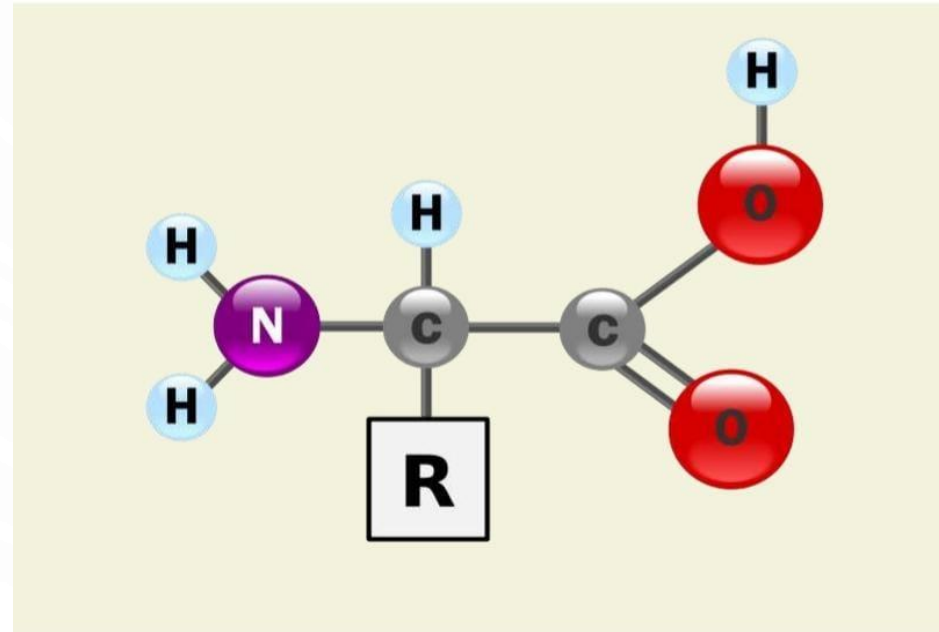
Miss. Gauri Anantrao Gawande

Content :

- Introduction of Amino acids
- History
- Classification of Amino acids
- Stereochemistry of Amino acids
- Reactions of Amino acids
- Strecker Synthesis
- General properties

Introduction :

- Proteins are polymers of simple units known as amino acids.
- Amino acids are organic compound containing Amine and Carboxyl functional group along with a side chain specific to each amino acids.
- Amino acid is methane derivative.



- Neutral amino acid - glycine → when Amine group = Carboxyl group
 - Basic Amino acid - Alanine → when Amine group = Carboxyl group
 - Acidic amino acid - Aspartic acid → when amine group = α Carboxyl group
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- Apart from being building blocks of proteins many amino acids are used to synthesize other molecules e.g. Serotonin and Tryptan
 - Catecholamine dopamine, epinephrine & norepinephrine from trrosine.

History :

- The first amino acid which was discovered in asparagine in 1806. Threonine was the last amino acid to be found in the year 1938.
- All the amino acids have trivial or common name from which they were first isolated.
- Asparagine was found in asparagus and glutamine was found in Wheat gluten : tyrosine was first isolated from cheese and glycine (Greek glycan means sweet) was so named because of the sweet taste.

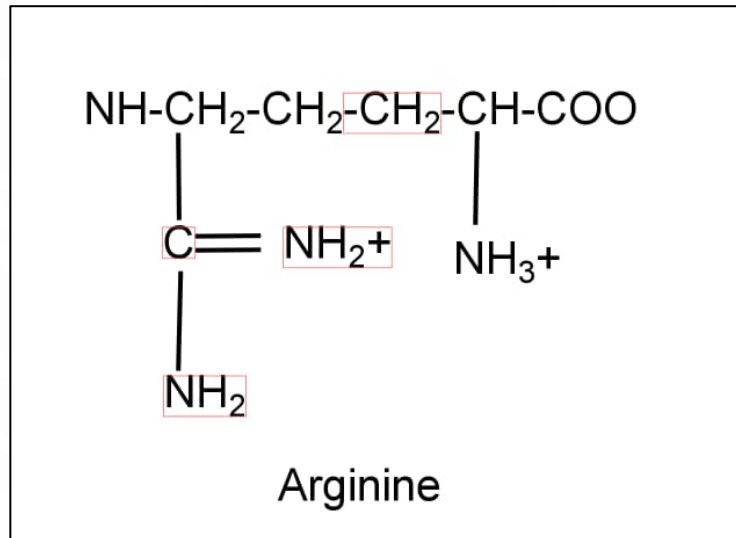
Classification of Amino acid :

1. Nutritional classification of Amino acid.
2. Classification of amino acid based on polarity.
3. On the basis of two main group of Amino acids.

Nutritional classification of Amino acid :

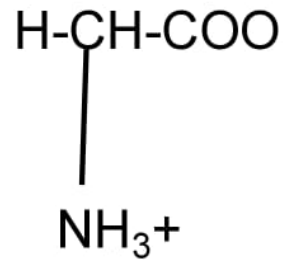
1. Essential Amino Acids : -

- The amino acid which cannot be synthesized by the body and therefore need to be supplied through the diet is called essential amino acids.
- Some essential amino acids are – e.g. Arginine, Valine, Histidine, Isoleucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan.

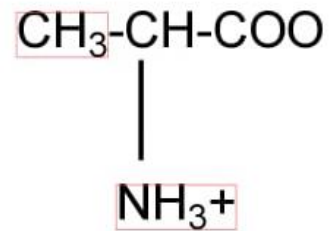


2. Non – Essential Amino Acids :-

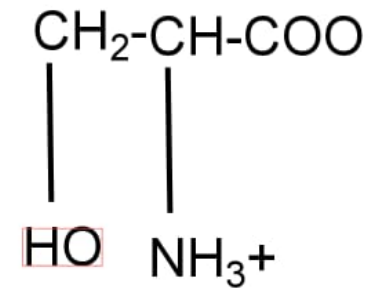
- The body can synthesize amino acids to meet the biological need hence they need not be consumed in the diet.
- Non essential amino acids are glycine, Alanine, Serine, Cysteine, Aspartate, Glutamate, Glutamine, Tyrosine & Proline.



Glycine



Alanine



Serine

Classification of Amino acids based on Polarity :

1. Non polar amino acids with Aliphatic ' R ' group : -

- These amino acid are non-polar and also referred to as hydrophobic. They have no charge on the ' R ' group. The amino acids included in the group of glycine, Alanine, leucine, isoleucine, valine and methionine.

2. Non polar amino acids with aromatic ' r ' group : -

- Their aromatic side chain are relatively non-polar. All can participate in hydrophobic interactions, the amino acids included in these groups are phenylalanine. Tryptophan and tyrosine.

3. Polar amino acids with no charge on ' R ' group : -

- These amino acid carry no charge on 'R' group and soluble in water or more hydrophilic. They passes group such as hydroxy, Sulfhydryl and amide group. E.g. Proline, serine, threonine .

4. Polar amino acids with negative ' R ' group : -

- The dicarboxylic monoacid, aspartic acid, glutamic acid are included in the group.

5. Polar amino acids with positive ' R ' group :-

- These amino acid carry positive charge on the 'R' group and are dibasic monocarboxylic acid. They are highly basic in nature the three amino acid Lysine, Arginine and Histidine are included in this group.

Two main groups of Amino acid :

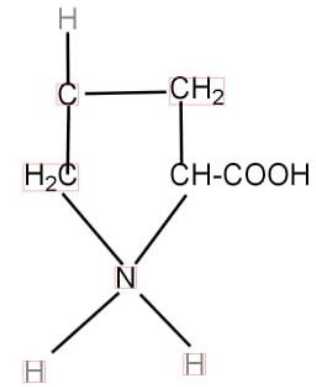
1. **Standard Amino acids :-**

- Amino acids are building blocks of protein. The 20 standard amino acids also takes part in formation of protein structure.
- Arginine, Valine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, Glycine, Alanine, Serine, Cysteine, Aspartate, Asparagine, Glutamate, Glutamine, Tyrosine and Proline.

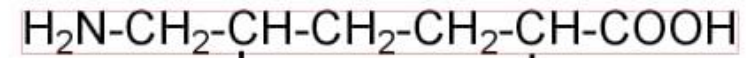
2. Non – Standard Amino acids :-

- In addition to 20 standard amino acids, proteins may contain non – standard residues created by modification of standard residues already incorporated into a polypeptide.
- 4-Hydroxyproline- derivative of Proline
- 5-Hydroxylysine- derivative of Lysine
- 6-N-Methyllysine
- γ -carboxyglutamate
- Desmosine
- Selenocysteine

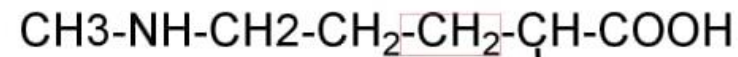
Structure of Non – Standard Amino acid :



4-Hydroxyproline



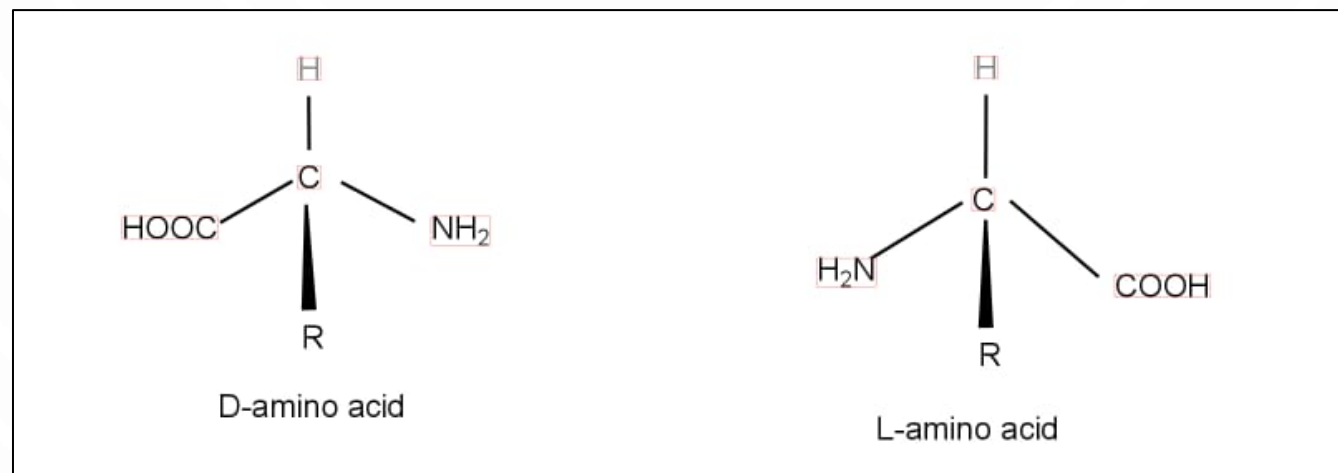
5-Hydroxylysine



6-N methyllysine

Stereochemistry of amino acids :

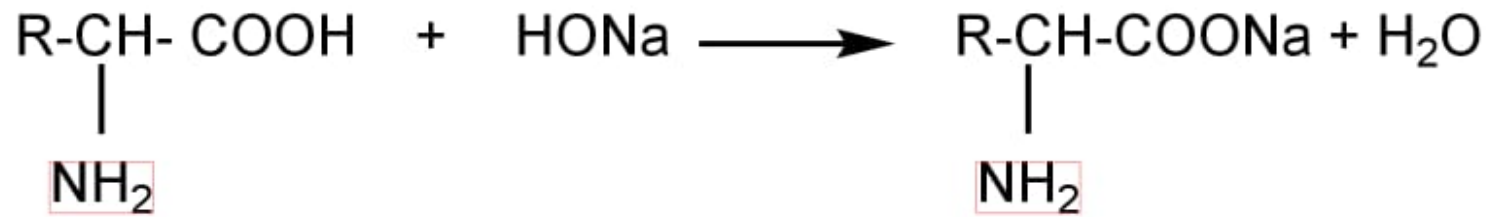
- With exception of glycine, all α - amino acids have four different group attached to the α - carbon atom and serves as the center.
- Since, they have chiral carbon, they are optically active & must have two unsymmetric form (mirror images).



- However, all naturally occurring amino acids belongs to the L - series which has NH₂ on left side.

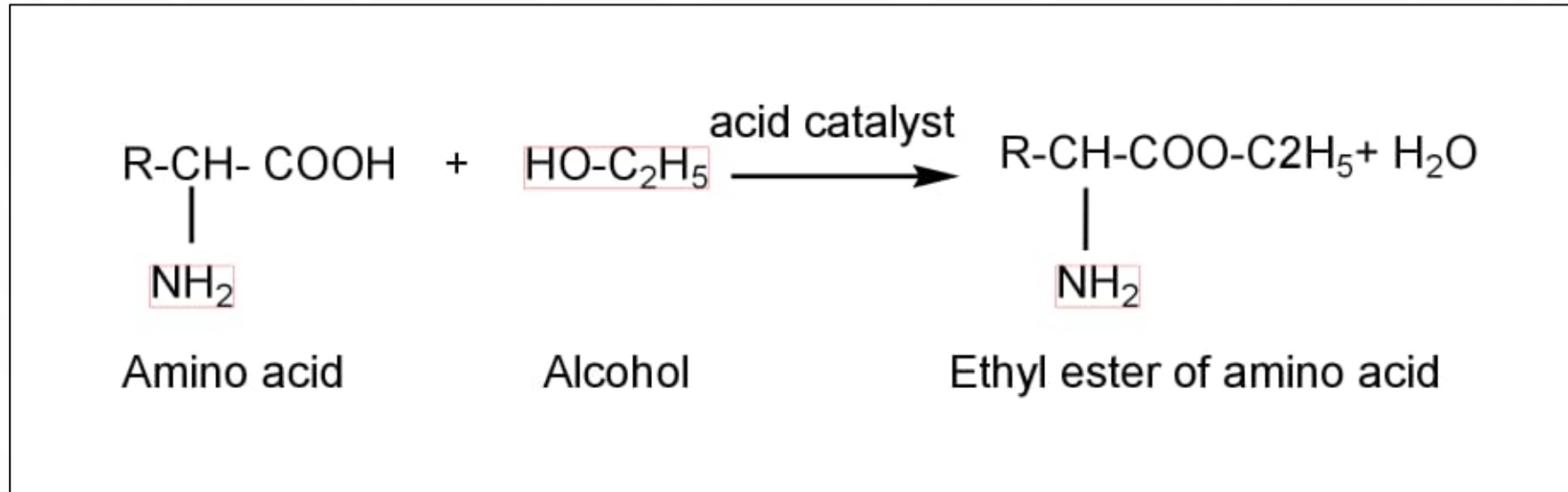
Reactions of amino acids :

- Reaction with Alkalis (salt formation)
 - The carboxyl group of amino acids can release a H^+ ion's with the formation of Carboxylate (coo^-) ion's.



■ Reaction with Alcohols (Esterification)

- The amino acids are reacted with alcohol to form, “Ester” the esters are volatile in contrast to amino acid.

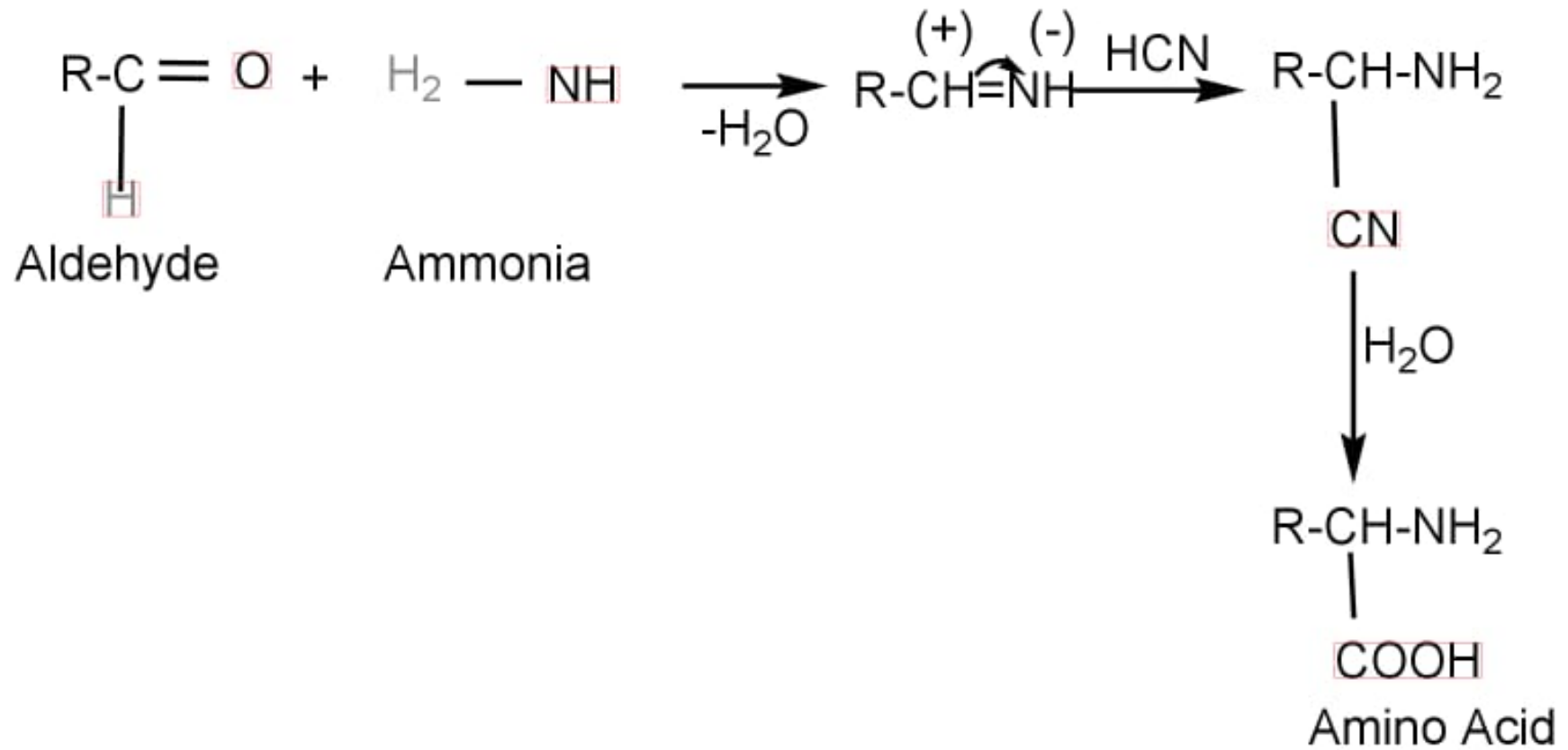


Strecker Synthesis :

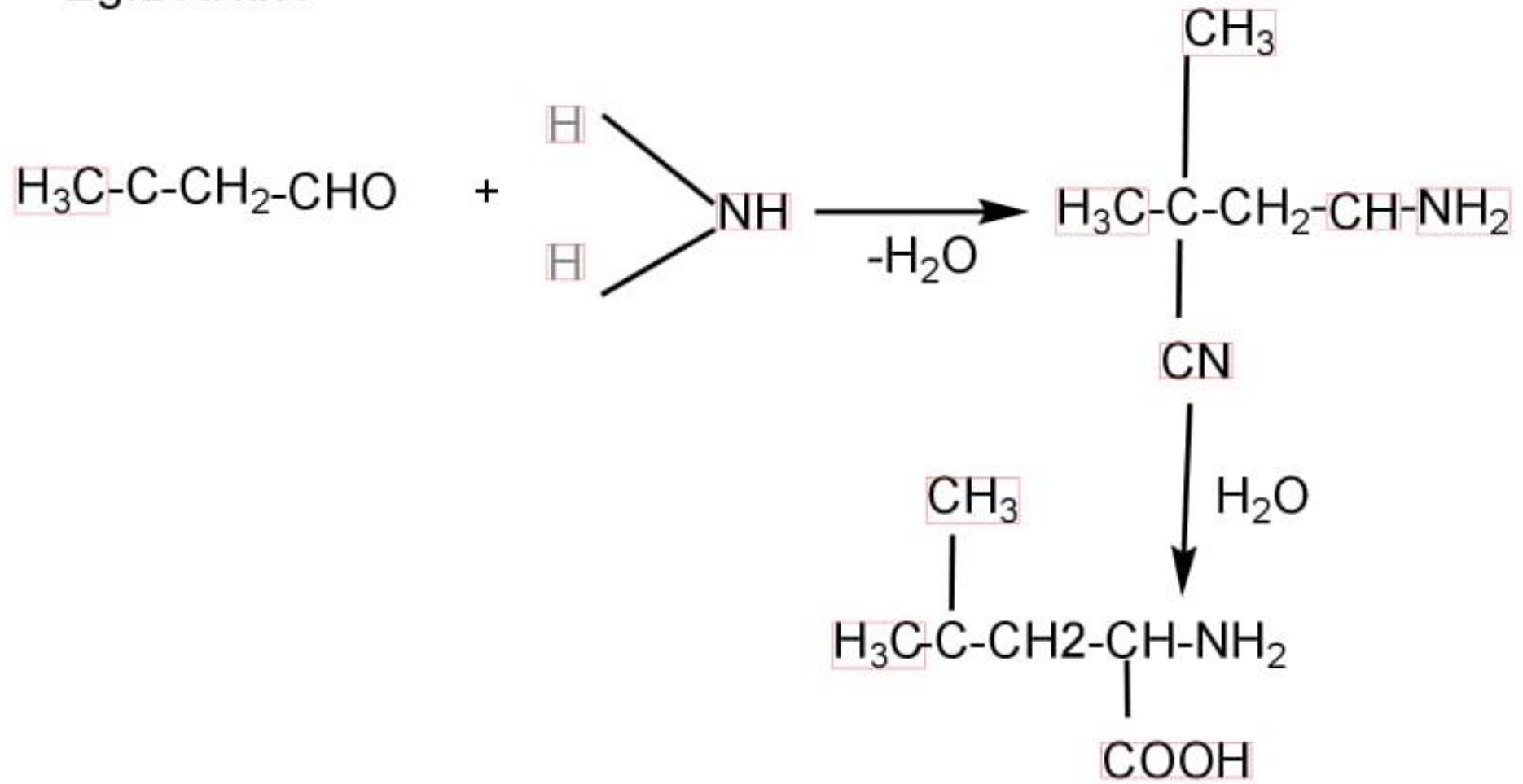
- Economical Synthesis of α - amino acids are possible if an appropriate aldehyde, bearing one less Carbon than desired product is available. In the Strecker's synthesis, an aldehyde is converted into an amino-nitrile by action of hydrogen cyanide and ammonia. Then, the resulting amino-nitrile is hydrolyzed with an acid. The inconvenience of using hydrogen cyanide as a reagent is avoided, and the yields are frequently improved by use of ammonium salts and alkali cyanides instead of NH_3 and HCN , respectively by preceding conversion of the aldehyde into its bisulfite addition compound.

- *Mechanism* – The reaction is initiated by Nucleophilic addition of ammonia to the aldehyde. Elimination of water, followed by the addition of cyanide to the aldimine. 1. Yields α - amino nitrile. 2. Subsequent hydrolysis. 3. Gives the desired amino acid.
- *Reaction Mechanism* – Practical large scale synthesis of glycine, alanine, serine, valine, methionine, glutamic acid, leucine, isoleucine, nor leucine & phenylalanine have been based on Strecker synthesis.

Mechanism :

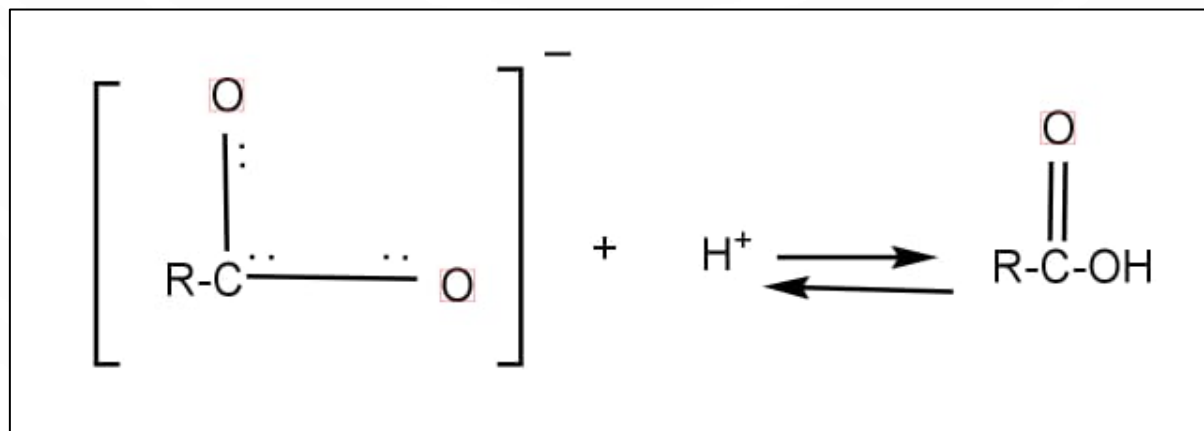


Eg. Leucine



General properties of amino acids :


- *Physical properties* – The natural α - amino acids are colorless, stable, high melting solids, most are soluble in common organic solvent.
- *Infra-red spectra* – Amino acids, in the solid state or in neutral solution, do not exhibit any infrared band at 1720 CM^{-1} a characteristic frequency of non ionized carboxylic group. They exhibit absorption near 1400 to 1600 CM^{-1} .



- *Chemical properties* – The amino acids will undergo decarboxylation to form the corresponding “amines” thus Amines are produced.
 - Histidine \rightarrow Histamine + CO₂
 - Tyrosine \rightarrow Tyramine + CO₂
 - Lysine \rightarrow Cadaverine + CO₂

Reference :

- Organic chemistry of natural product – **O. P. Agrawal**
- Organic chemistry of natural product – **Gurdeep R. Chatwal**

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Thank you...!