N₂ metabolism completes through 4 stages.

1. The assimilation of N_2
2. The formation and interconversion of Amino Acids.
3. The synthesis of Amides, peptides and other Nitrogenous compounds.
4. The synthesis and degradation of proteins and Nucleic Acids.

① Assimilation of N_2 :

Source of N_2 :

① Atmospheric N_2 & Molecular N_2

② soil N_2 —— ⓐ organic N_2 – humus, urea etc.
ⓑ Inorganic N_2 = NH_4^+, NO_3^-, NO_2^- etc.

Biological agents that fix N_2 :

A. Symbiotic N_2-fixing agents –
① Leguminous plants plus root nodule bacteria
2. Non-Leguminous plants – Gymnosperm and Angiosperm (Alder, Myrica etc.)

B. Non symbiotic N_2 fixing agents (free fixers)

1. Blue-green algae (Aulosira, Nostoc, Anabaena etc)

2. Yeast (Rhodotorula sps)

3. Bacteria :

(a) Aerobic – Azobacter
Azotomonas etc.

(b) Anaerobic :–

(i) Non-photosynthetic :– { Clostridium
Desulforibrio etc.

(ii) Photosynthetic :– { Rhodospirillum
Rhodomicrobium etc
Bacillus
Rhizobium

(c) Facultative :– { Aerobacter, Aerogens,
Klebsiella etc.

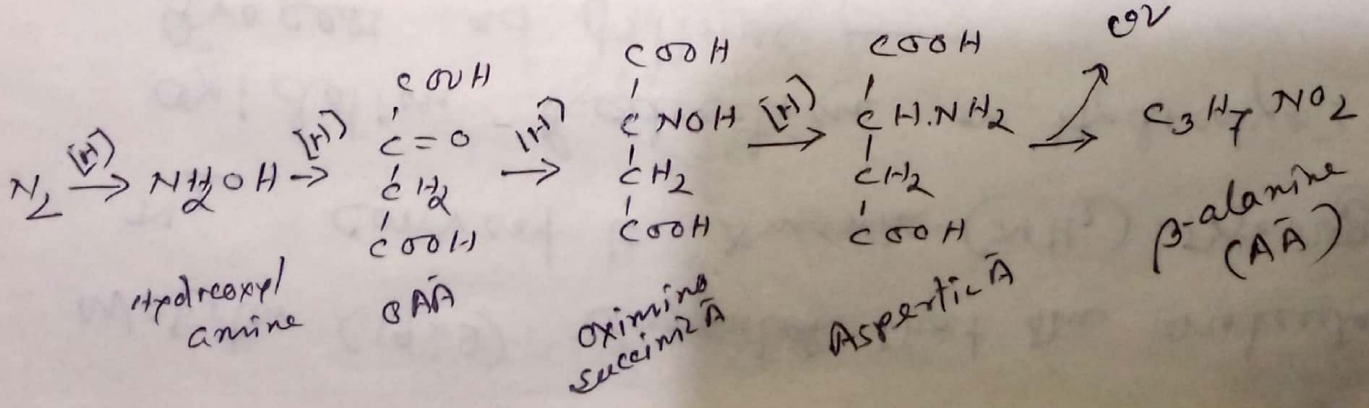
Virtanen & Laine (1936) proposed the 'Hydroxylamine theory' for N_2 fixation —— They suggested that the reduction of molecular N_2 proceeds the following stages ——

(a) Reduction of molecular N_2 yields (NH_2OH) Hydroxylamine

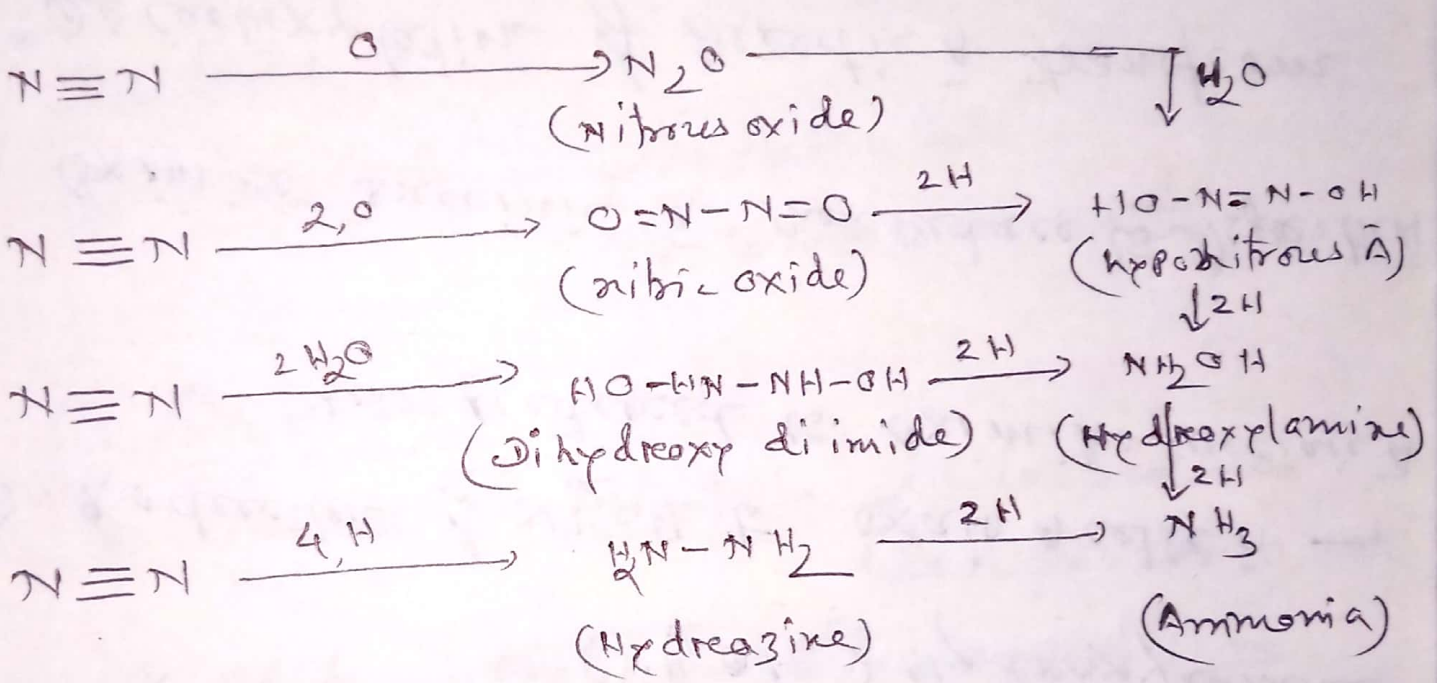
(b) Reduction of NH_2OH to oxaloacetic Ā — then reduced to oximino succinic Ā

(c) Oximino succinic Ā then reduce to Aspertic Ā

(d) Decarboxylation of Aspertic Ā transform in to β (Beta) Alanine (Amino Ā)



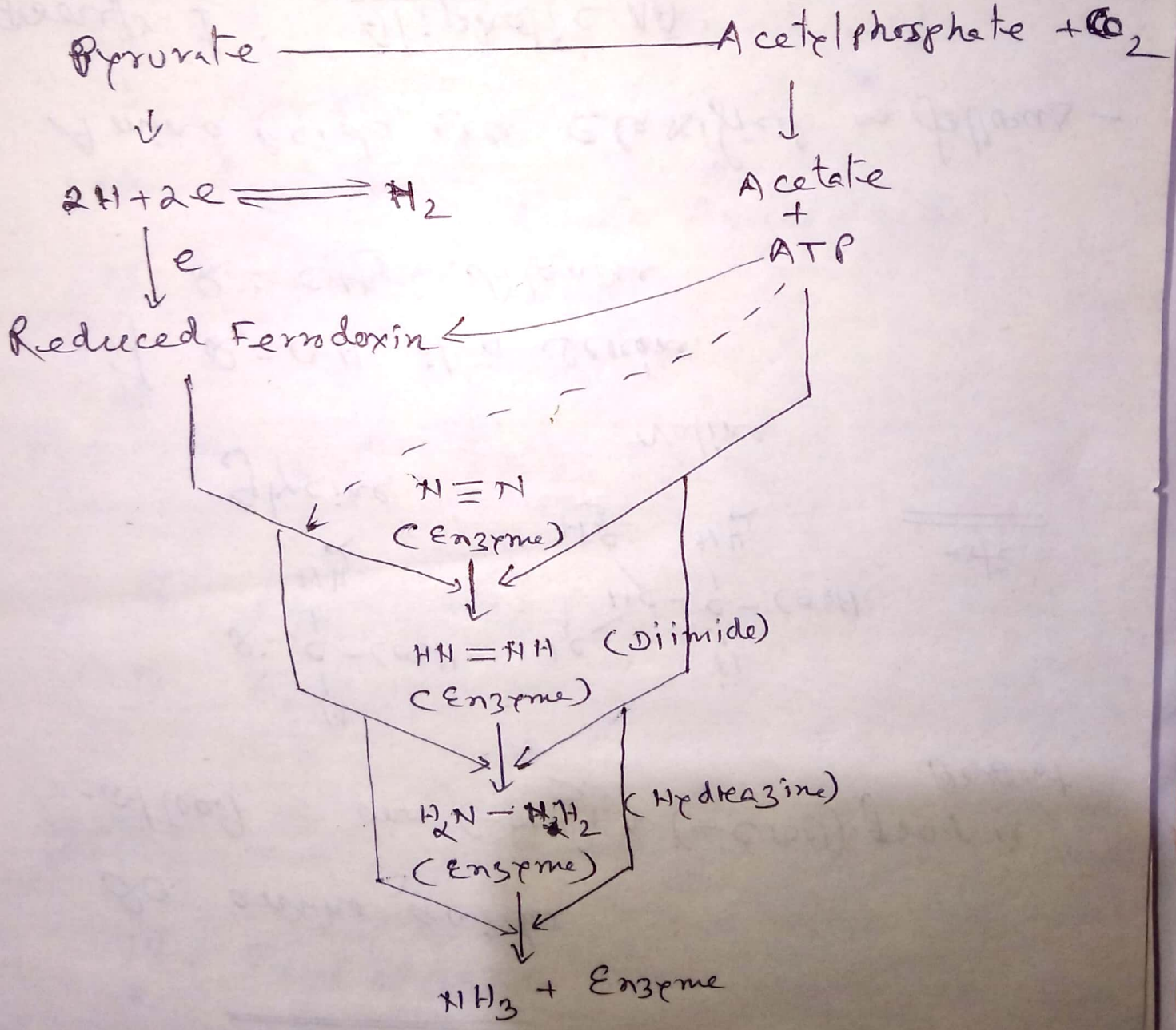
Webster (1959) suggested that the molecular N_2 convert to Ammonia (NH_3) through oxidation, Reduction or hydrolysis process as follows —



Working Hypothesis :

Hoch et al (1960) and Burris (1966) Prepared a working Hypothesis to explain the intermediate N_2 fixation between NH_3 and N_2, which has a little experimental evidances in support of them.

They proposed that the N_2 found in the environment is reduced stepwise with reuptake of N_2 bond ($N \equiv N$) until the final stage which yield NH_3 and releases Enzyme. The Figure as follows—



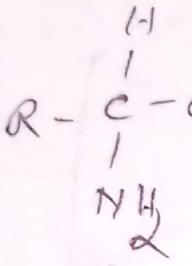
Working Hypothesis

continued-

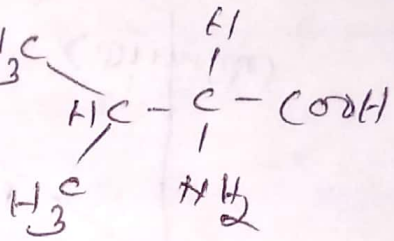
Amino Acids

20 amino acids

atleast one ($-NH_2$) & ($-COOH$) group is present



Glycine



Valine

etc

If R = OH, it is Serine

R = CH_3 - Alanine

Amino Acids are classified as follows -

group-1 : Aliphatic AA

1. Glycine
2. Alanine
3. Valine
4. Leucine
5. Isoleucine

} Monoamino monocarboxylic Acids

6. Serine
7. Theonine

} Hydroxy Amino Acids

8. Methionine
9. Cystine
10. Cysteine

} S containing Amino Acids.

11. Aspertic Acid
12. Glulamic Acid

} Di Carboxylic Amino acids (Acidic AA)

13. Lysine
14. Arginine
15. Histidine

} Basic Amino Acids

16.

Group - 2 : Aromatic AA

16. Phenylalanine
17. Tyrosine

Group - 3 : Heterocyclic AA

18. Tryptophane

19. Proline
20. Hydroxyproline } Secondary Amino acids

Non-Protein Amino acids:

1. L-amino aliphatic acid
2. Homo Serine
3. Homo Systeine
4. Diaminopimelic acid
5. Citrulline

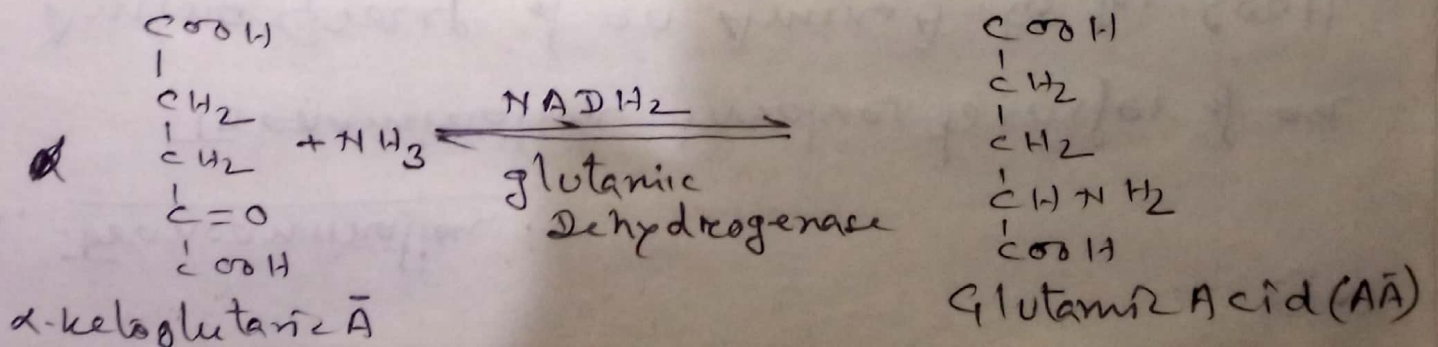
Biosynthesis of Amino Acids:

It takes place through the following stages-

1. ~~Transamination~~
2. Reductive amination
2. Transamination
3. Modification or change in Carbon-skeleton

Reductive amination:

Inorganic Nitrogen in the form of NH_3 react with α-ketoglutaric acid in presence of glutamic dehydrogenase enzyme and $NADPH_2$ & form the Amino acid (ie. Glutamic Acid)

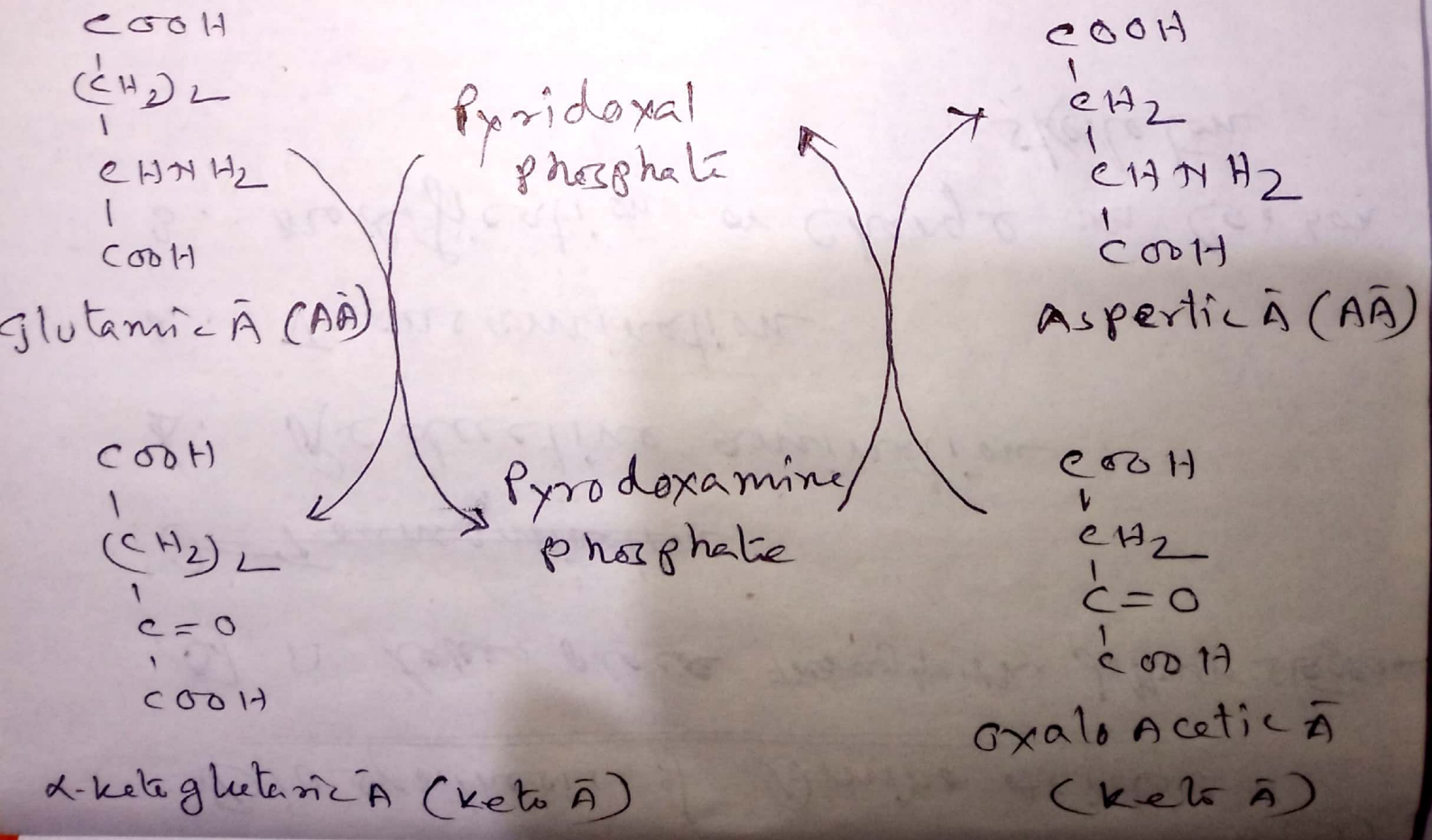


α-ketoglutaric Ā

Glutamic Acid (AĀ)

2. Transamination :

Tranamination involves transfer of an Amino Group of an Amino Ā to the COOH group of a keto Ā. Wilson (1969) described 17 different AĀs ~~formation~~ are formed through Tranamination reaction. This process is catalysed by enzyme Transaminase which requires Pyrodoxal phosphate as coenzyme.

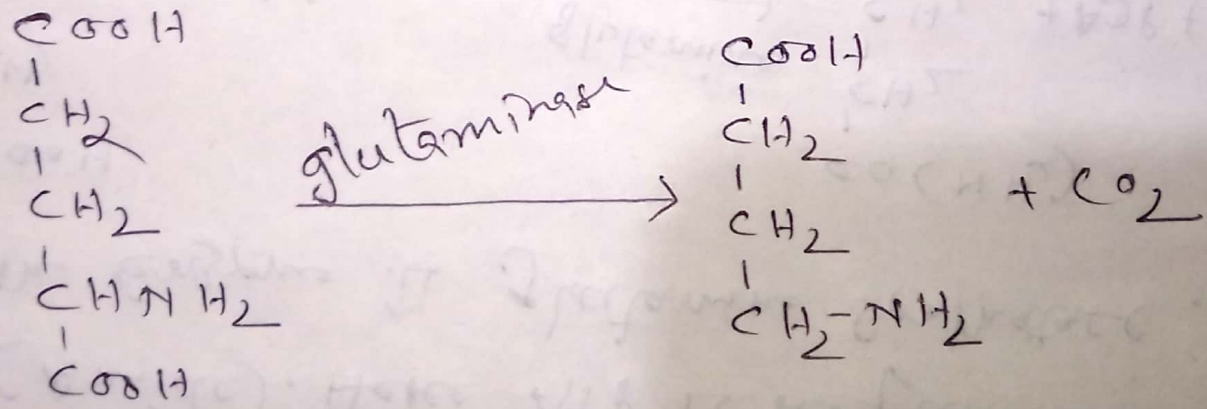


3. Carbon transformation :

Decarboxylation :—

Amino Acids are formed by the release of CO_2 from another AA.

2) γ aminobutyric Ā (GABA) an amino acid is formed from Glutamic Ā (AĀ) which is catalysed by enzyme glutaminase.

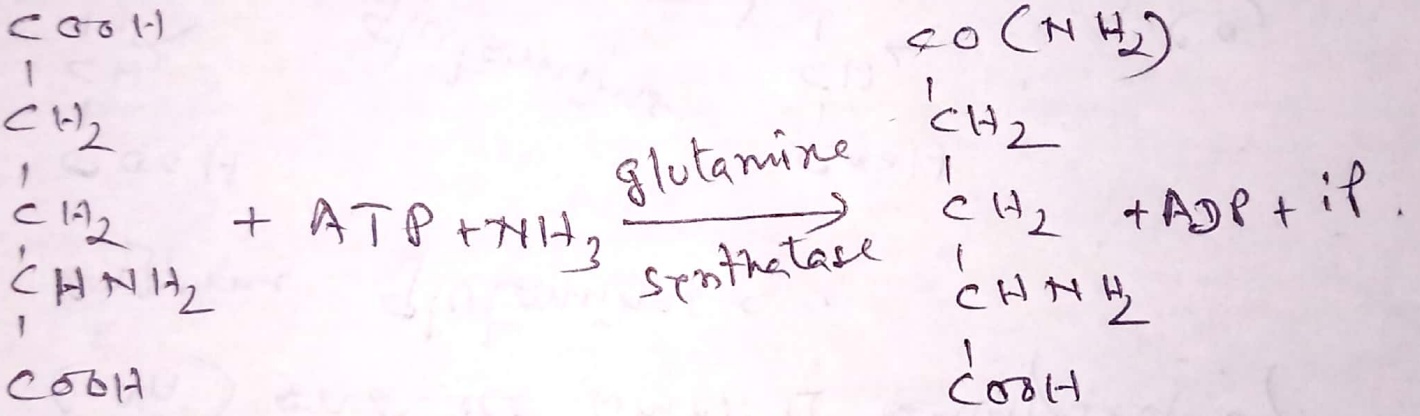


glutamic Ā (AĀ)

γ Aminobutyric Ā (AĀ) (GABA)

Synthesis of Amides.

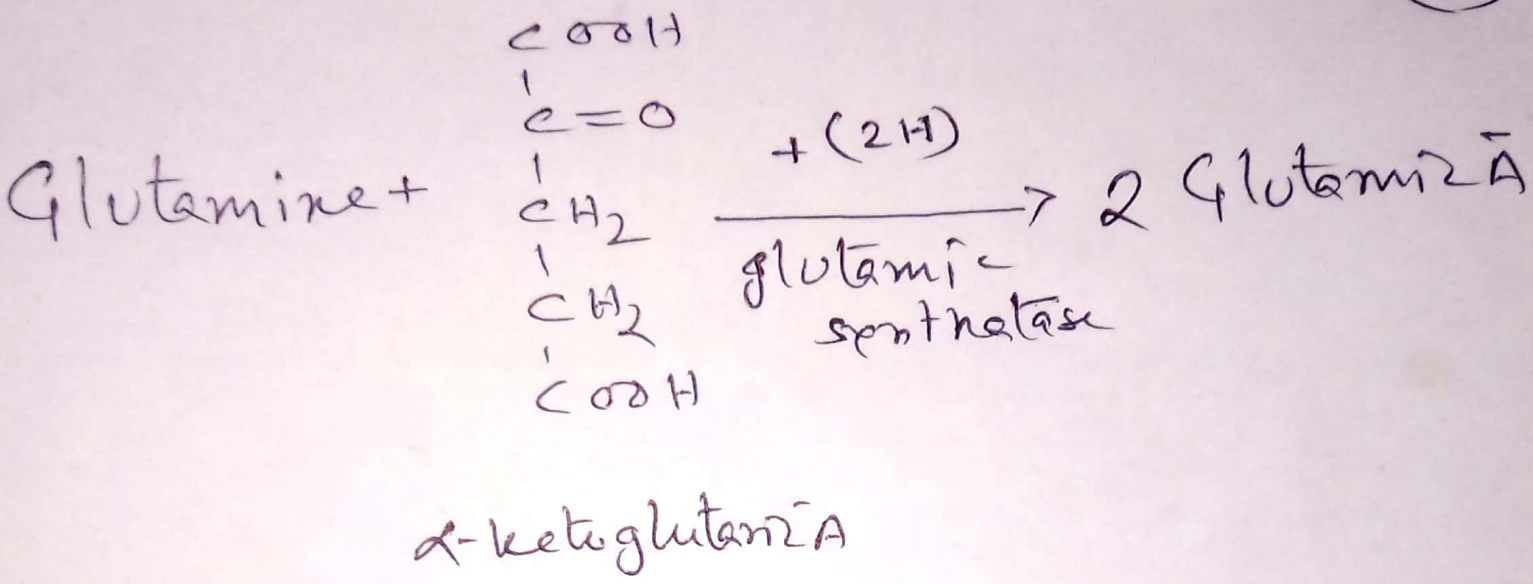
In higher plants assimilation of NH_3 is important. First Glutamic Acid react with NH_3, Produces Glutamine (Amide). Here ATP is required and the Enzyme is glutamine Synthatase.



Glutamic Ā

Glutamine

The Glutamine again react with a keto Ā (α-ketoglutaric Ā) Produces An Amino Ā. Here reduced Ferredoxin (FD) act as Reducing agent and the enzyme is glutamic synthatase.



α-ketoglutaric Acid

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