

# **BIOCHEMISTRY OF BIOLOGICAL NITROGEN FIXATION.**

# INTRODUCTION

- ▶ Apart from atmospheric and industrial nitrogen fixation, Biological nitrogen fixation still remains responsible for 65% of total NITROGEN USED BY MAAN MAINLY THROUGH FOOD INTACT.
- ▶ THE REASON FOR THE NAME BIOLOGICAL IS BECAUSE IT REQUIRES A LIVING ORGANISM/HOST/SITE FOR THIS PROCESS TO OCCUR AND IN MOSTT CASES IT IS THE ROOTS OF LEGUMEIOUS PLANTS.
- ▶ NITROGEN GAS IS METABOLISED INTO AMMONIA AND INCOOPERATED INTO BIOMOLECULES THROUGH THE AID OF NITROGEN FIXING BACTERIA WHICH COULD BE FREE LIUVING BACTERIA OR SYMBIOTIC BACTERIA (WHEN ANOTHER LIVING ORGANISM IS REQUIRES).
- ▶

# EXAMPLES OF NITROGEN FIXING BACTERIA

FREE LIVING BACTERIA	SYMBIOTIC BACTERIA
AZOTOBACTER	RHIZOBIUM
RHIZODOSPILUM	ANABAERA
Bacillus	

First we are going to discuss symbiotic nitrogen fixation which is only different from non-symbiotic or free living in the sense that it requires a living host/site/organism like the root hair of legumes to take place.

# SYMBIOTIC NITROGEN FIXATION; RHIZOBIUM, ETC.

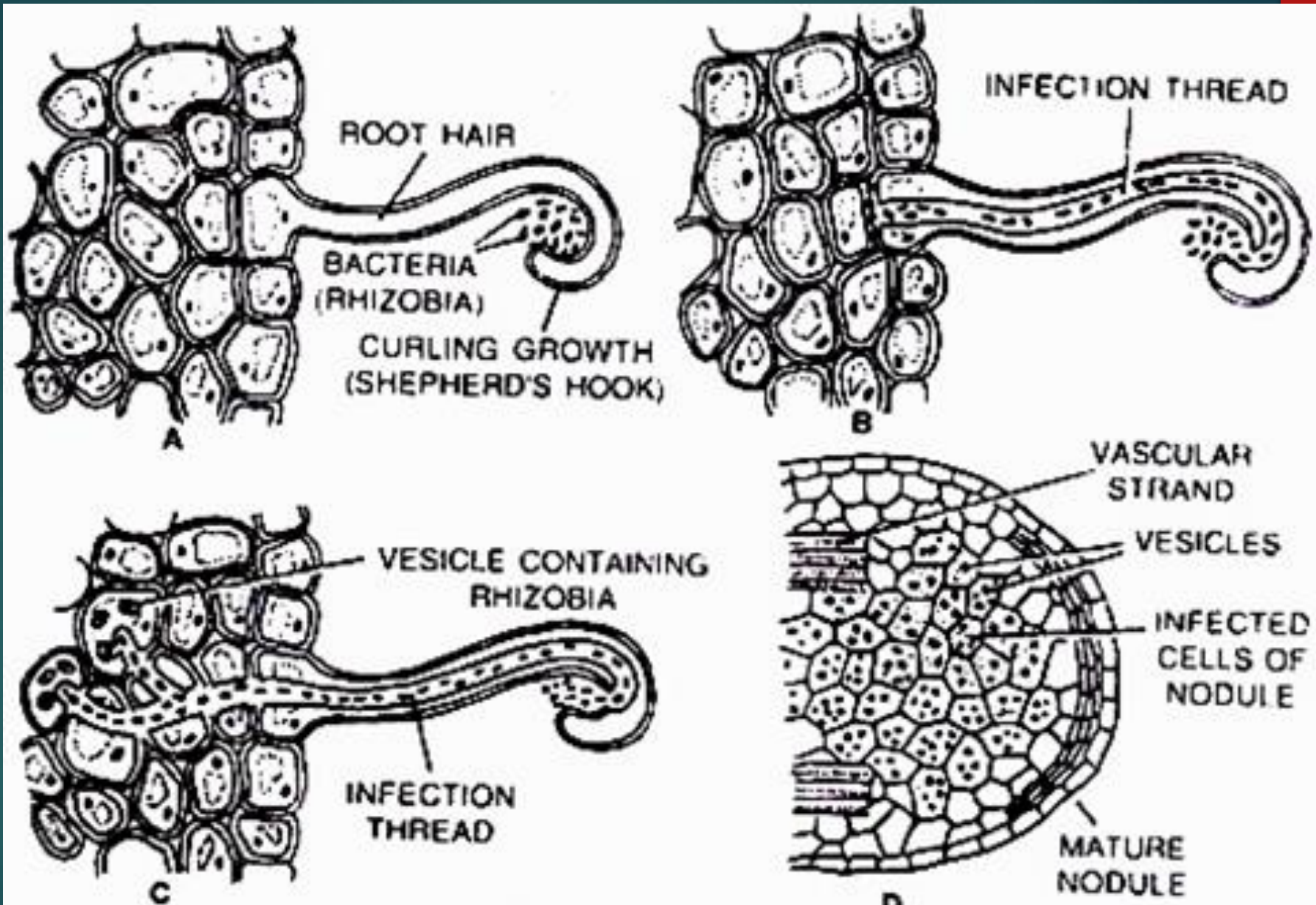
- ▶ THIS IS A SYMBIOTIC LEGUMINOSERUM, IT HELPS IN NITROGEN FIXATION IN AN ANEROBIC CONDITION. THOUGH THIS BACTERIA IS AROBIC IN NATURE, THE ENZYME NITROGENASE ONLY BECCOMESS ACTIVE IN AN ANEROBIC CONDTION. THIS ENZYME NITROGENASE IS AN FE-PROTEIN AND MO/FE-PROTTEIN COMPEX CONTAINING ENZYME OCCURING TOGETHER IN A COMPLEX.

# STEPS INVOLVED IN SYMBIOTIC NITROGEN FIXATION.

## ▶ 1. FORMATION OF NODULES;

a. A CHAIN OF BACTERIA (Rhizobium) gain access into the root hair forming an infection thread. This thread on getting to the cuticle causes the coiling off the root hair.

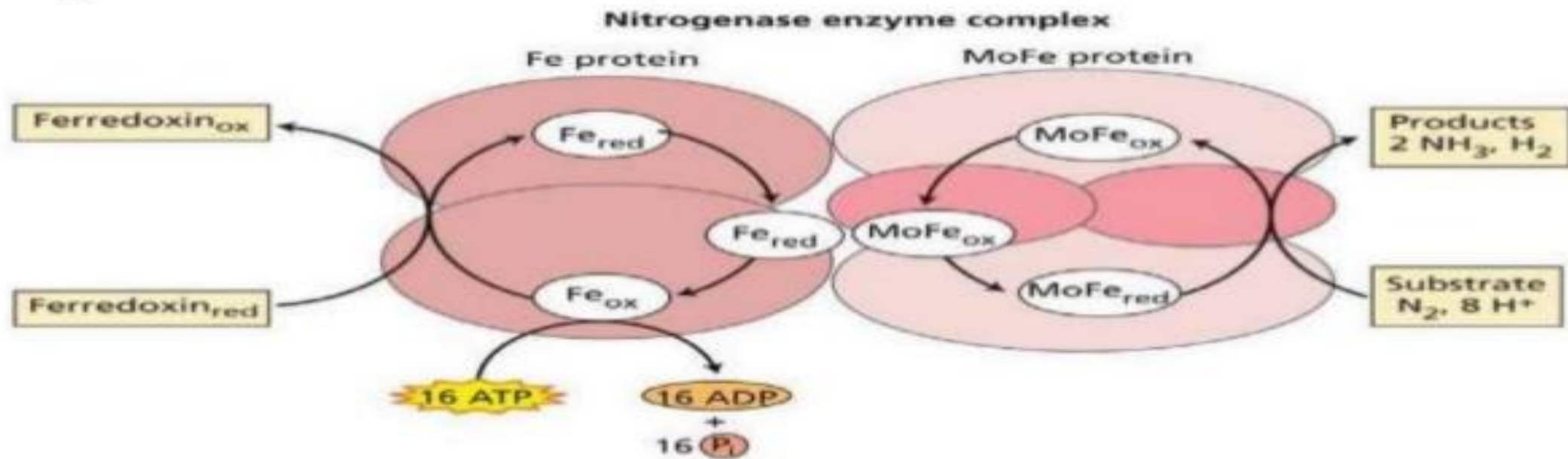
b. In the cuticle these bacteria cells differentiates into either bacteroids (which causes multiple cell division in the cortex resulting in a lump of cells called the NODULES) or forms Nitrogen fixing cells (which forms a thick wall limiting oxygen access thereby making the area anaerobic for further process).



## 2. NITROGEN FIXATION; factors required

- ▶ FOR THIS PROCESS TO OCCUR SOME FACTORS MUST BE MADE AVAILABLE;
- ▶ A. NITROGENASE
- ▶ B. LEG Hemoglobin; this is a pink pigment which acts an oxygen scavenger.
- ▶ C. Hydrogen donor e.g; Pyruvic acid, sucrose, glucose...
- ▶ D. Mg-ATP
- ▶ Carbon compound to receive ammonia

# Nitrogenase Complex

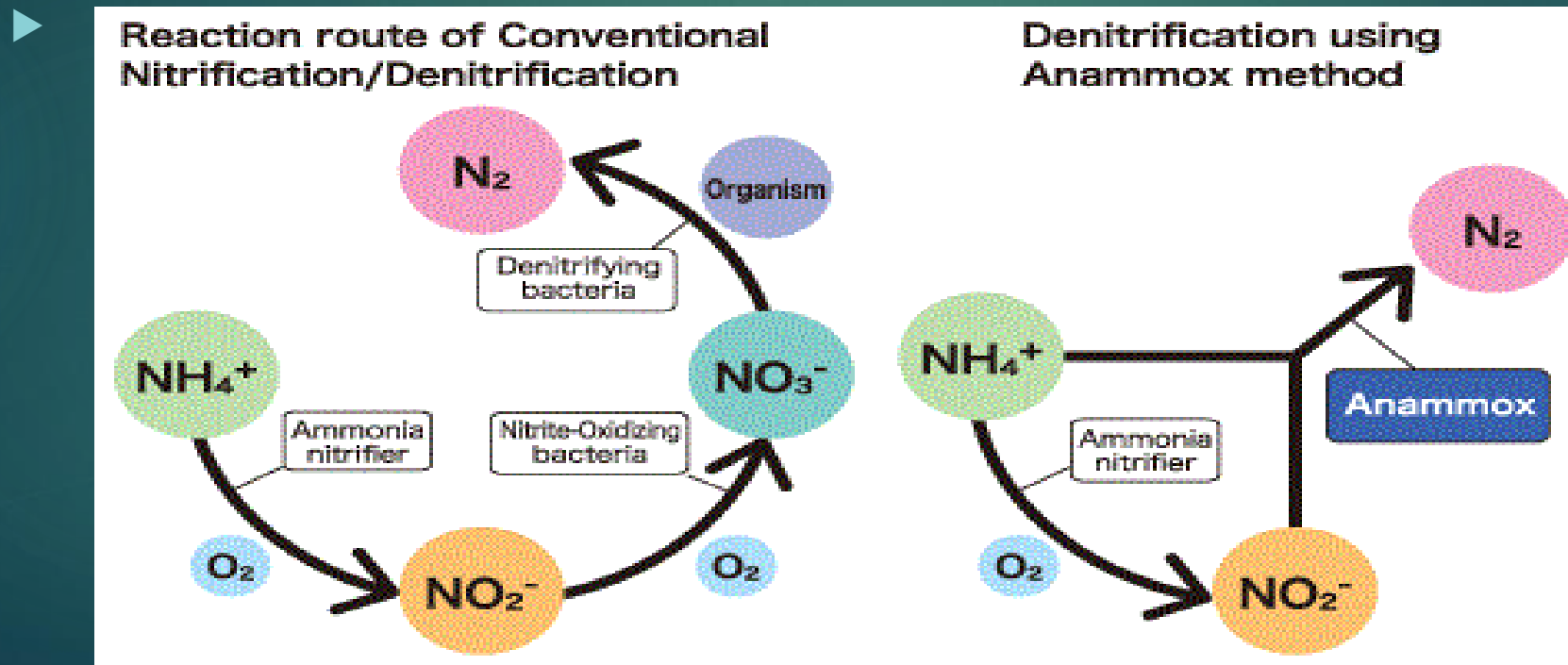


Schematic representation of the electron flow in nitrogen fixation



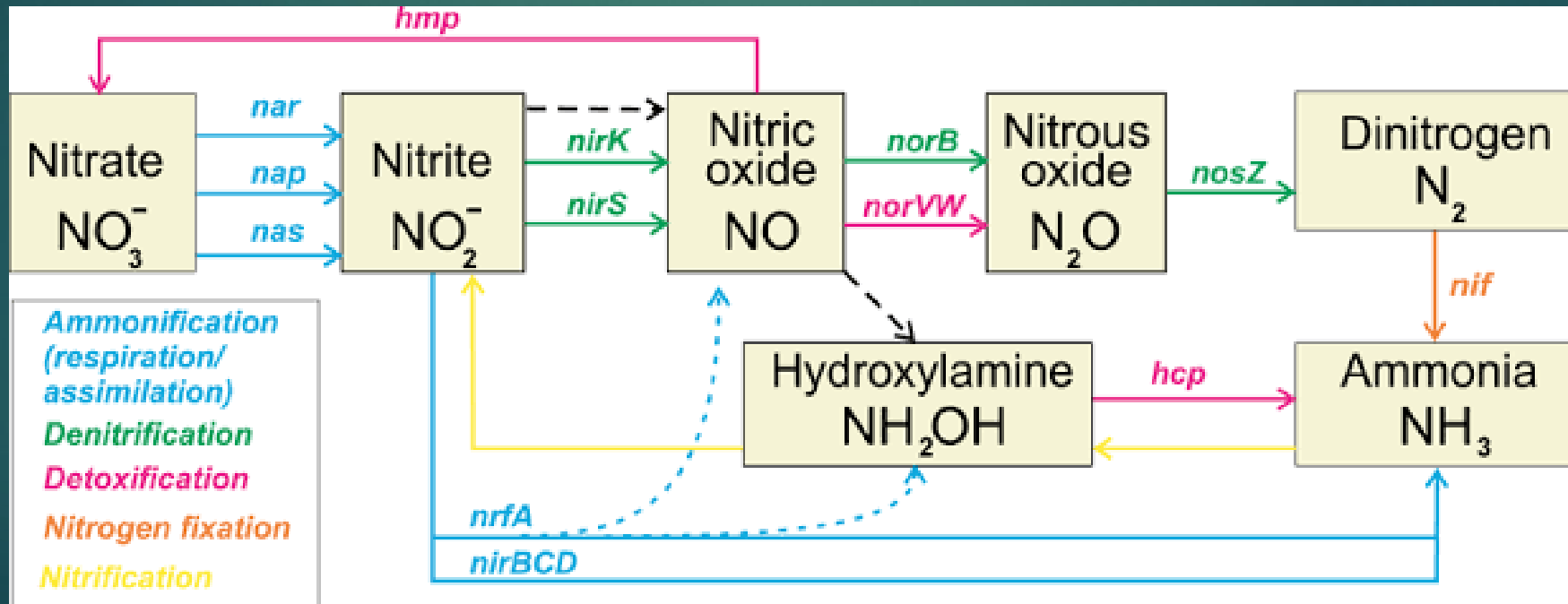
# 3. NITRIFICATION

- ▶ Ammonia synthesized are Oxidized by some bacteria like Nitrosomonas and Nitro-coccus to Nitrate and Nitrite utilizing Nitrate reductase and Nitrite reductase respectively.



# 4. Ammonification

- ▶ Organic matters are also converted into ammonia. These organic matters are gotten from dead and decayed plant and animals as well as an excret of some animals like rabbits and ruminants.

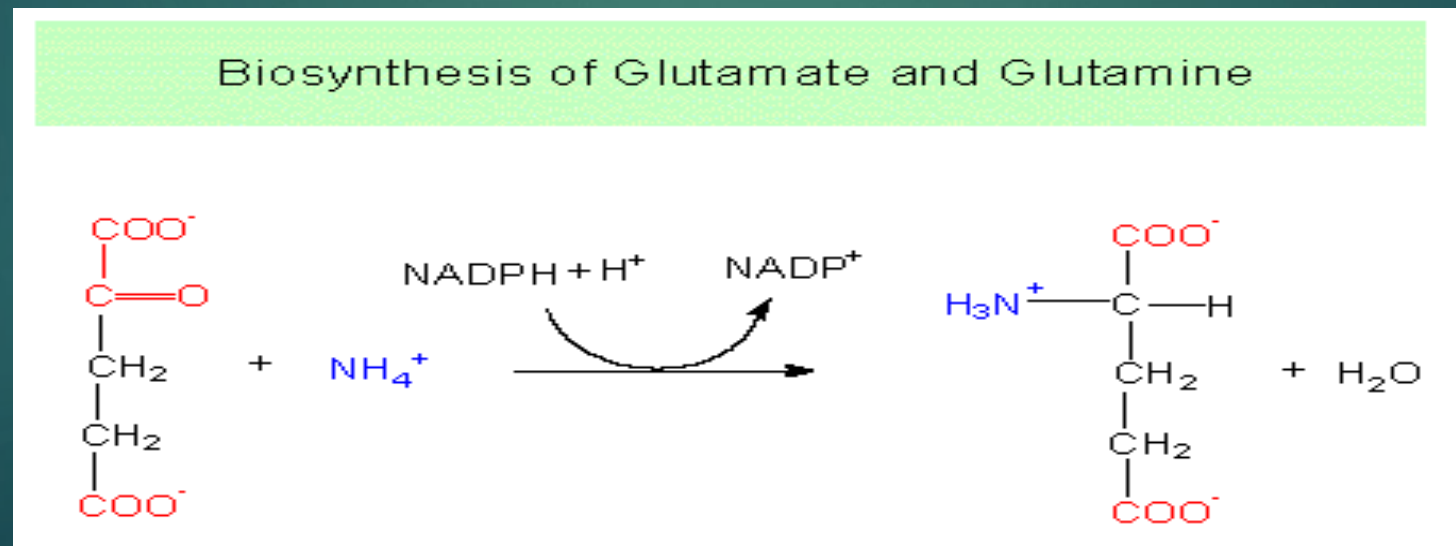


# 5. ASSIMILATION OF NITROGEN.

- ▶ This seems to be the most important stage of nitrogen fixation as all synthesized ammonia must be incorporated into a biomolecule which usually results in amino acid or amide formation. This occurs in two stages namely;
- ▶ **1. NITRATE ASSIMILATION.**
- ▶ A. nitrate reductase reaction; here the nitrate obtained from the soil is reduced by the action of Nitrate reductase forming Nitrite in the process.
- ▶ B. Nitrite reductase reaction; Here the nitrite obtained from the soil is reduced by an immediate action of nitrite reductase forming Ammonia which undergoes reduction to ammonia before it is incorporated into an substrate e.g; alpha-Ketoglutarate to form glutamic acid.

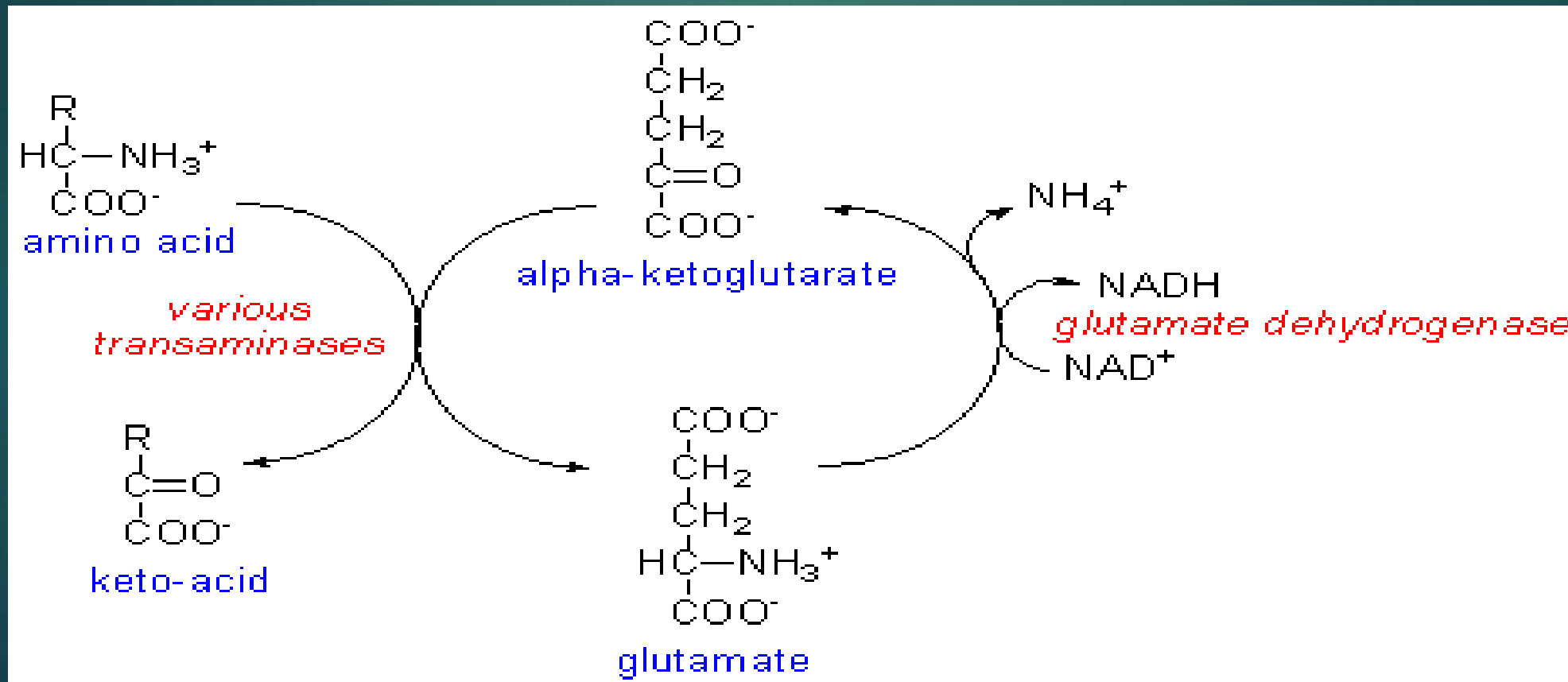
# Continues;

- ▶ **2. SYNTHESIS OF AMINO ACIDS;**
- ▶ On incorporation the ammonium formed is utilized through amination and transamination process to form amino acids and amides.
- ▶ **A. AMINATION OF ALPHA-KETOGLUTARATE TO GLUTAMATE.**



# B. TRANSAMINATION

This is simply the transfer of amino functional group from a substrate donor to a substrate acceptor. This process does not require energy equivalents and is catalyzed by an enzyme called transaminase.



# HETEROTROPHIC MODE OF NITROGEN FIXATION.

Some plants do not require Nitrogen fixation to obtain their Nitrogen they require for metabolic processes, growth and development, these plants could either be;

1. PARASITIC PLANTS; these plants derive their all their nutrients from a living host plant/organism including nitrogen.
2. SAPROPHYTIC PLANTS: these plants derive their Nitrogenous need from Dead and decayed organic matter.
3. INSECTIVOROUS PLANTS; these plants feed on smaller organisms like insects and obtain their nitrogen need from lysis of their protein contents. These plants can survive on nitrogen free soil since they are totally dependent on soil nitrogen.

**THANKS FOR READING.**

