Pharmacognosy-(ii)

Unit-1st

Metabolic Pathways in Higher Plants And Their :- Determination :-

Basic Metabolic Pathways :- Angiosperm and Gymnosperm plants are the higher plants because they are fully developed into root, stem, lieves, flower, fruit.

→ They also produce endosperm and shows sexual reproduction

→ Higher plants produce diff. metabolite or biochemical substance by basic metabolic pathway

→ " Those chemical cycle in plant by which they produce chemical substance is called metabolic pathway.

→ photosynthesis produces the substrates for respiration and diff. building blocks as starting organic compounds for biosynthesis of primary and secondary metabolites metabolites are organic compound synthesized by plant using enzyme-mediated chemical reactions called metabolic pathway.

→ And the chemical subs. which is produced by metabolic pathway is called metabolite.

Types of Metabolite :-

(i) Primary Metabolite

(ii) Secondry Metabolite.

(i) - Primary Metabolites :- Primary metabolites are the organic compounds synthesized through primary metabolism.

→ These are essential for plant growth and development and thus primarily needed. These compounds are unanimously distributed in plant kingdom including, but are not limited to carbohydrates, lipids, proteins and nucleic Acid.

→ Most of primary metabolites are precursors (Starting Material) for the synthesis of secondry metabolites.

Ex:- Sucrose and starch as energy molecule cellulose as structural molecule DNA(deoxyribonucleic) Acid And RNA as informational molecule and pigments like chlorophyll.

(ii) Secondry Metabolite:- Those chemical metabolites which are synthesize by secondry metabolic pathway with the help of primary metabolites is called secondry metabolite.

→ Secondry Metabolites are more complex and less essential for the plant.

→ Secondry metabolite is not present in each and every part of the plant they are present in some specific plant and specific part. Ex:- Alkaloids (Quinine), Terpenoids (Citral, β-Amyrin) phenolics (Gallic Acid, tannin Acid) etc.

The building block

The first chemical molicule from which any metabolic pathway start is called precursure molecule.

→ And the building block molecule are actually the precursure molecule for the synthesis of secondry metabolite.

→ Building block molecule are produced from primary metabolites.

→ These are considered to be intermediates, few important are acetyl coenzyme A (Acetyl-CoA) Shikimic acid, Mevalonic Acid, and 1-deoxy xylulose 5-phosphate derived from Acetate mevalonate and deoxy xylulose phosphate pathways respective.

- Classification of building blocks :-

→ On the basis of number of carbon atom present in the building block molecule can be categorised to to five class.

(1) C_1 : The simplest of the building blocks are composed of a single carbon atoms it is derived from the S-Methyl of L-Methionine.

(2) C_2 : It includes simple esters, most frequent from is acetyl-CoA.

(3) C_5 It includs the branched chain c5 molecule such as isoprene unit.

(4) $C_6 - C_3$ These are known as phenylpropyl units includes l-phenylalanine or l-tyrosine aromatic amino Acid synthesized through shikimic acid pathway.

(5) CN- a) $C_6 - C_2$ N Synthesized from either l-phenylalanine or l-tyrosine, l-Tyrosine.

∴ Most Imp.

∴ Shikmic Acid Pathway ∴

Shikmic Acid pathway is one of the important biosynthetic pathways for production of different building blocks and secondry metabolites.

— The shikmic acid is k/a shikmate which firstly isolated from Japanese plant shikimi (Illicium species) as plant acid later its role as key intermediate has been ~~revealed~~ revealed (रहस्य को खुलासा)

⇒ The precursure molecule for the shikmic Acid pathway is phosphoenolpyruvate and Erythrose-4 Phosphate.

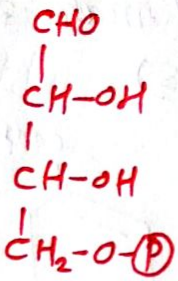
⇒ Phosphoenolpyruvate is the primary metabolite product of glycolysis cycle and erythrose-4 Phosphate is of pentose phosphate pathway.

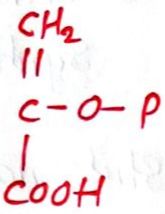
⇒ By the shikmic Acid pathway biosynthesis of Aromatic amino acid taks place such as.

(i) L-Phenylalanine
(ii) L- Tyrosine
(iii) L- Tryptophan.

(Shikmic Acid Pathway)

∴ Biosynthesis of Aromatic Amino Acid ∴

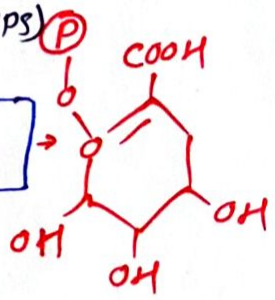




Erythrose 4-Phosphate + Phosphoenol Pyruvate

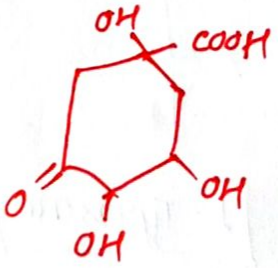
3-Deoxy Arabino Heptulosonate 7-Phosphate Synthase (DAHPS)

3-Deoxy-D-Arabino Heptulosonate 7-Phosphate



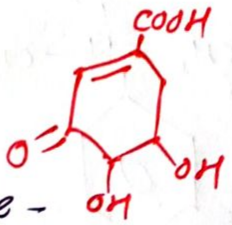
3-Dehydroquinate Synthase (DHQS)

3-Dehydro quinate



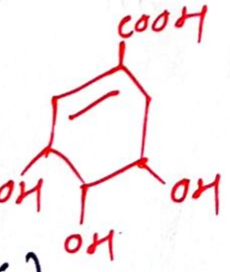
3-dehydroquinate dehydratase (DHQ) (DHQD)

3-Dehydroshikimate



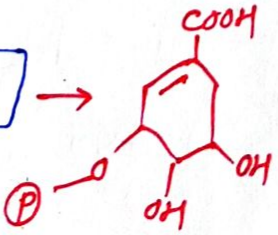
Shikimate-5-dehydrogenase

Shikimate



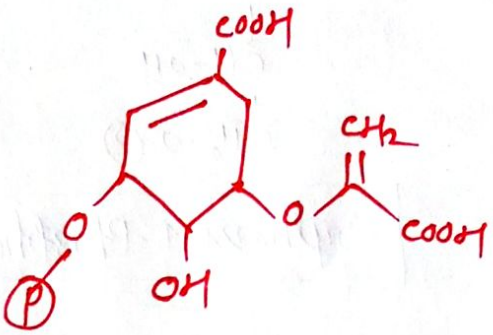
Shikimate Kinase (SK)

Shikimate 3-Phosphate



5-Enolpyruvyl shikimate-3 Phosphate Synthase (EPSPS)

5-Enolpyruvyl Shikimate 3-Phosphate

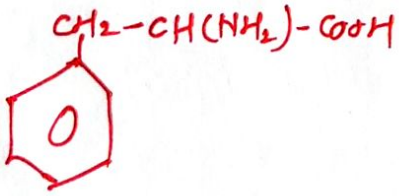


Chorismate Synthase (CS)

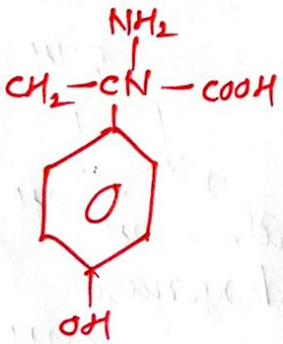
Chorismate

Aromatic Amino Acid

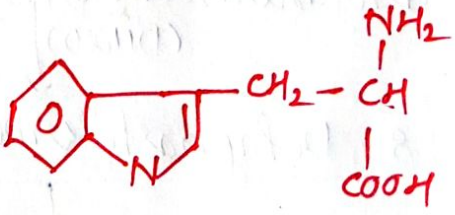
L-Phenyl Alanine



L-Tyrosine



L-Tryptophan



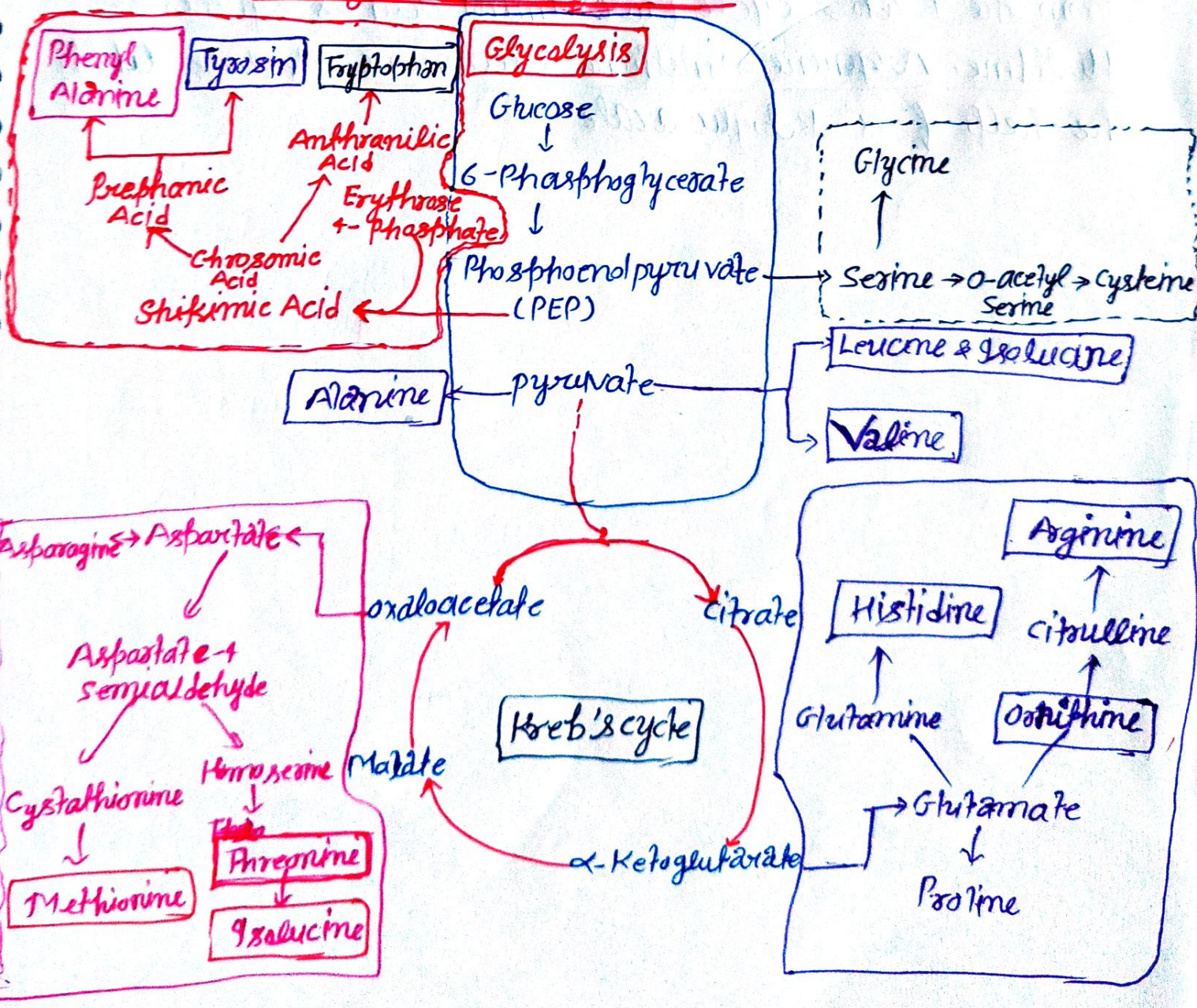
∴ Significance of Shikimic Acid Pathway ∴

→ Shikimic Acid pathway is the important pathway for the formation of various kinds of secondry metabolites.

⇒ By this shikimic Acid pathway basically three types of secondry metabolites are synthesize

→ (i) Biosynthesis of Glycoside.
(ii) Biosynthesis of Alkalaids.
(iii) Biosynthesis of Amino Acid.

(i) Biosynthesis of Amino Acid ∴



→ The four amino acid Leucine, Isoleucine, Valine, Alanine, is synthesize from the pyruvate.

→ From the 6-Phosphoglycerate three amino is synthesise Glycine, Serine, Cysteine.

→ From the Krebs cycle four Amino acid is synthesise Asparagine, Threonine, Methionine, Isoleucine with the help of Oxaloacetate.

→ In glycolysis pathways three Amino acid is synthesize Phenyl Alanine, Tyrosine, Tryptophan from the PEP Phosphoenolpyruvate.

→ From the Krebs cycle four amino acid is synthesize Histidine, Arginine, ornithine, Glutamine, Proline with the help of α-Ketoglutarate

L-4

Acetate Mevalonate Pathway :- The Acetate Mevalonate pathway is first discovered in 1950 after the knowledge of radioactive isotopes.

→ By the Acetate Mevalonate Pathway the biosynthesis of Terpenoid, and Steroid takes place.

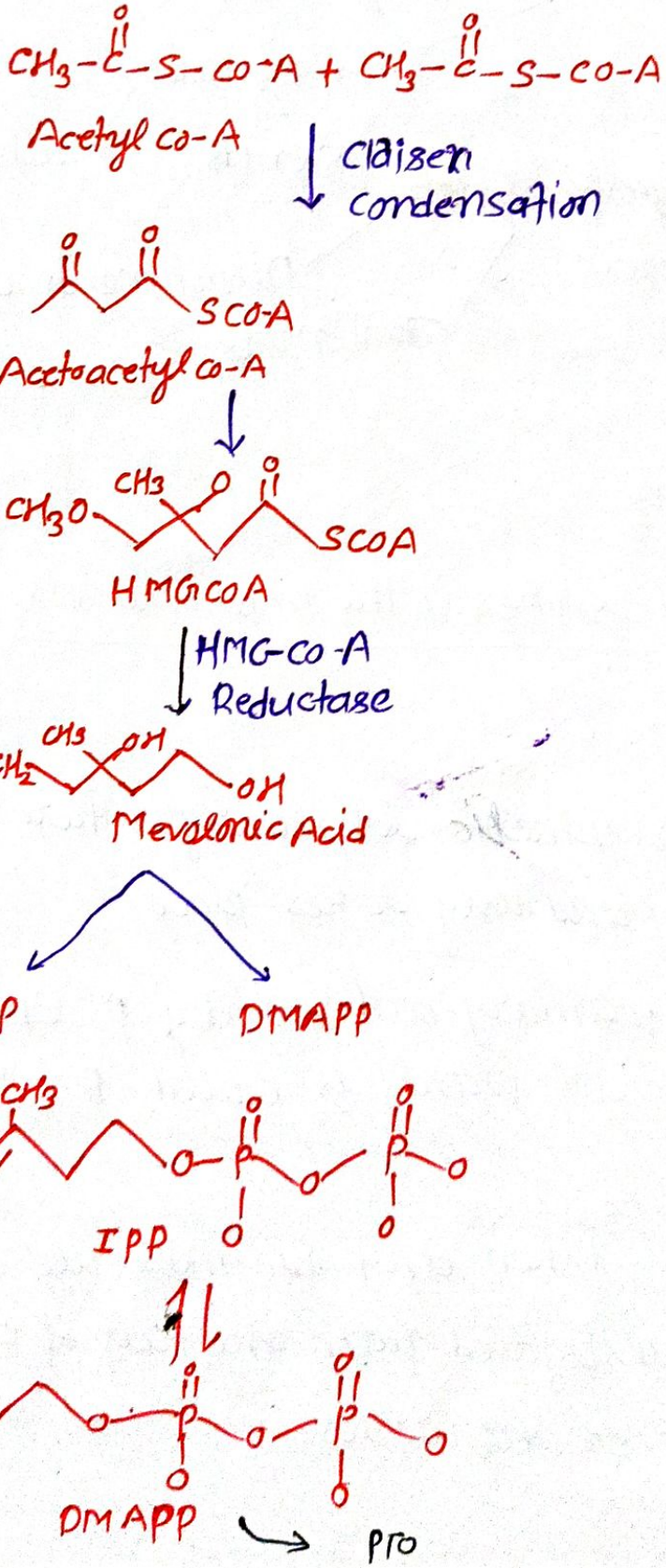
→ Terpenoid are basically produced from Acetate Mevalonate pathway and this single unit is also called Isoprene units.

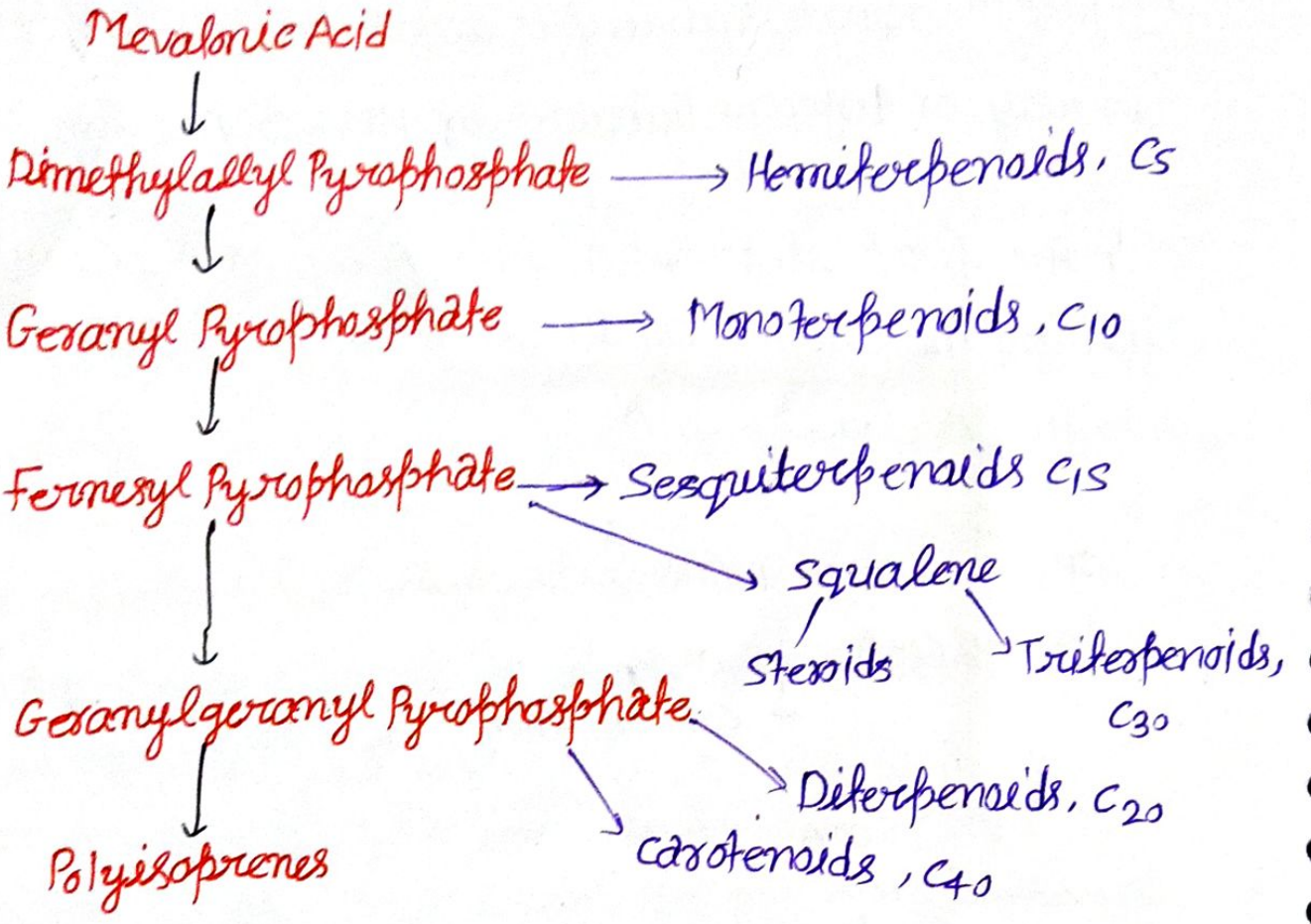
→ C_5 - Isoprene, C_{10} - Monoterpene, C_{15} - Sesquiterpene. C_{20} - Diterpene, C_{30} - triterpene, C_{40} - carotinoids.

→ Acetate Mevalonate Pathway is also known as Terpenoid Pathway, or Isoprene Pathway, of HMG Co-A Pathway.

→ In the first step. when two Acely-co-A is combine then by the Claisen condensation reaction. they convert into the Acetoacetyl co-A

→





L-5

Use of Radioactive isotopes in the Investigation of Biogenetic Study :-

⇒ The plants are biosynthetic labalatary where several biosynthetic ran continuously takes place.

⇒ To determination of primary and Secondry Metabolite and there pathway in plant is called Biogenetic investigation.

⇒ **Tracer Techniques :-** When any bio molecule and their biosynthesis is investigated with the help of Radio isotope is called Tracer techniques.

→ And the Radioactive Isotope which are used in tracer Techniques is called Radio tracer, Radioactive tracer or Radio active lavel.

⇒ **RadioActive Isotope:-** Those Atoms which have similer no of e^- but they have diff-2 Neutrons and Protons.

Ex - C — C^{7}, C^{8}
O — O^{17}, O^{18}
N — N^{15}
H — H^{2}, H^{3}

∴ Types of Tracer Techniques:-

(i) Use of Isolated organs
(ii) Grafting Method
(iii) Use of Mutant ~~organ~~ Stain

Steps in Tracer techniques:- In the process of tracer techniques basically three steps are involved.

(i) Radio lavelled compound Preparation.
(ii) Introduction of lavelled compound into a biological system.
(iii) Separation & Determination of lavelled compound in a varrious biochemical fraction at later time.

(1) Radiolevelled Compound Preparation:- Basically Radioactive C, & H are used for biogenetic Investigation.

⇒ The C^{14} isotope is prepared by Bombardment of N^{14} by using Al or Be Nucleus.

⇒ In Another techniques C^{14} isotope is produced from. Algae chlorella grow in Atmosphere containing $CO^{(14)}_2$

(2) Introduction of Radioactive levelled Compound:-

Before inverting the RAI following points considered.

⇒ Specific site and part

⇒ Introduction time.

⇒ Minimum dose.

⇒ The introduction of is perform by following method.

(A) Route feeding.
(B) Stem feeding.
(C) Direct Injection.
(D) In filtration.
(E) In floating Method
(F) Spray technique.

(3) Separation And determination of levelled compound in various bio chemical fraction at laterTime:-

- Inside the plant when the radiolabelled are biosynthesise it is measured by various scintillation techniques.

(a) Geiger - Muller Counter.
(b) Liquid Scintillation Counter.
(c) Gas Ionization Chamber.
(d) Bernstein - Bellentine Counter.
(e) Mass Spectroscopy.
(f) NMR Electrodemeter.
(g) Autoradiography.