PHARMACOGNOSY AND PHYTOCHEMISTRY 2

UNIT – 1

a) Metabolic Pathways in Higher Plants and Formation of Secondary Metabolites:

1. **Shikimic Acid Pathway:**

- **Overview:** The Shikimic Acid Pathway is crucial for the biosynthesis of aromatic amino acids (phenylalanine, tyrosine, and tryptophan).
- **Key Steps:**
    - **Phosphoenolpyruvate (PEP) and Erythrose-4-phosphate Formation:** These precursor molecules are generated from glycolysis and the pentose phosphate pathway.
    - **Chorismate Formation:** A series of enzymatic reactions convert PEP and erythrose-4-phosphate into chorismate.
    - **Aromatic Amino Acid Formation:** Chorismate is further converted into phenylalanine, tyrosine, and tryptophan.

2. **Acetate Pathway:**

- **Overview:** The Acetate Pathway involves the synthesis of various compounds from acetyl-CoA, including fatty acids, isoprenoids, and polyketides.
- **Key Steps:**
    - **Acetyl-CoA Formation:** Acetyl-CoA is derived from pyruvate through the pyruvate dehydrogenase complex.
    - **Fatty Acid Synthesis:** Acetyl-CoA is used in the synthesis of fatty acids.
    - **Isoprenoid Biosynthesis:** Acetate is a precursor for the formation of isoprenoids, essential in plant metabolism.
    - **Polyketide Synthesis:** Polyketides, such as various secondary metabolites, are formed through the condensation of acetyl-CoA units.

3. **Amino Acid Pathway:**

- **Overview:** The Amino Acid Pathway involves the biosynthesis of amino acids essential for protein synthesis and various metabolic processes.
- **Key Steps:**
    - **Nitrogen Assimilation:** Ammonium ions are incorporated into organic molecules during nitrogen assimilation.
    - **Glutamate Formation:** Glutamate is a central molecule in amino acid metabolism.
    - **Branching Pathways:** From glutamate, various amino acids like proline, arginine, and histidine are synthesized through branching pathways.

b) Utilization of Radioactive Isotopes in Biogenetic Studies:

1. **Introduction:**

- **Radioactive Isotopes:** Isotopes with unstable nuclei that decay over time, emitting radiation.
- **Biogenetic Studies:** Investigation of the origin and formation of biological molecules.

2. **Applications in Metabolic Pathways:**

- **Tracer Studies:** Radioactive isotopes, such as 14C or 3H, are used as tracers to follow the movement of atoms within metabolic pathways.
- **Determining Reaction Rates:** Incorporation of radioactive precursors allows the measurement of reaction rates in various metabolic processes.

3. **Example Studies:**

- **Photosynthesis:** 14CO2 is used to trace the incorporation of carbon dioxide into organic compounds during photosynthesis.
- **DNA Replication:** Incorporation of radioactive thymidine (3H-thymidine) is used to study DNA synthesis.
- **Protein Synthesis:** Radioactive amino acids, like 35S-methionine, can be used to track protein synthesis.

4. **Limitations and Considerations:**

- **Safety:** Radioactive materials require careful handling and disposal.
- **Short Half-life:** Some isotopes have short half-lives, limiting the duration of experiments.

5. **Advantages:**

- **Precision:** Provides precise information on the fate of specific atoms within molecules.
- **Quantitative Analysis:** Allows for the quantitative measurement of metabolic rates.

In conclusion, understanding metabolic pathways in plants and utilizing radioactive isotopes in biogenetic studies are powerful tools for unraveling the intricate processes governing plant metabolism and the formation of secondary metabolites.