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Plant Secondary Metabolites

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PART ONE

Primary Metabolite





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Role of Biochemistry in Survival of an Organism

The typical characteristics of life are growth, metabolism, reproduction, self-organize, self-replicate, interact, ability to sense and react are some very essential features of living things/organisms. For these activities an organism has to interconvert a vast number of organic compounds

Primary Metabolism

The pathways for generally modifying and synthesizing carbohydrates, proteins, fats, and nucleic acids are found to be essentially the same in all organisms. collectively described as 'primary metabolism'. Compounds involved in the pathways being termed 'primary metabolites'.

Examples

Carbohydrates: glycolysis and the Krebs/citric acid/tricarboxylic acid cycle; Energy generation (ATP).

Lipids/Fats: β -oxidation



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PART TWO

Secondary Metabolite





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Secondary Metabolism

Secondary metabolism is concerned with compounds which have a much more limited distribution in nature. Such compounds, called 'secondary metabolites', are found in only specific organisms, or groups of organisms, and are an expression of the individuality of species.

Pathways Involved in Secondary Metabolite Production

There are several pathways involved in production of intermediates or basic building block of secondary metabolites. Some of the examples are Ornithine Cycle, Shikmic acid pathway, Pentose-phosphate pathway

Examples of Secondary Metabolites

Alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.



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PART THREE

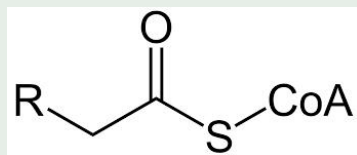
Building Blocks



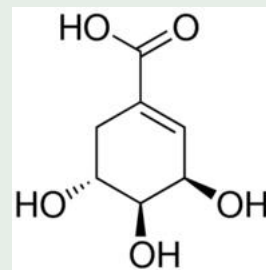


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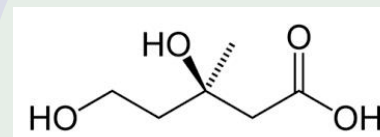
Acetyl-CoA



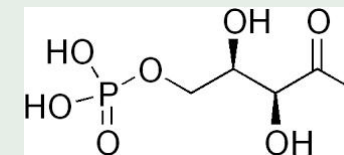
Shikimic acid



Mevalonic acid



1-deoxyxylulose 5-PO4



The most important building blocks employed in the biosynthesis of secondary metabolites are derived from the intermediates acetyl coenzyme A (acetyl-CoA), shikimic acid, mevalonic acid, and 1-deoxyxylulose 5-phosphate. These are utilized respectively in the acetate, shikimate, mevalonate, and deoxyxylulose phosphate pathways.



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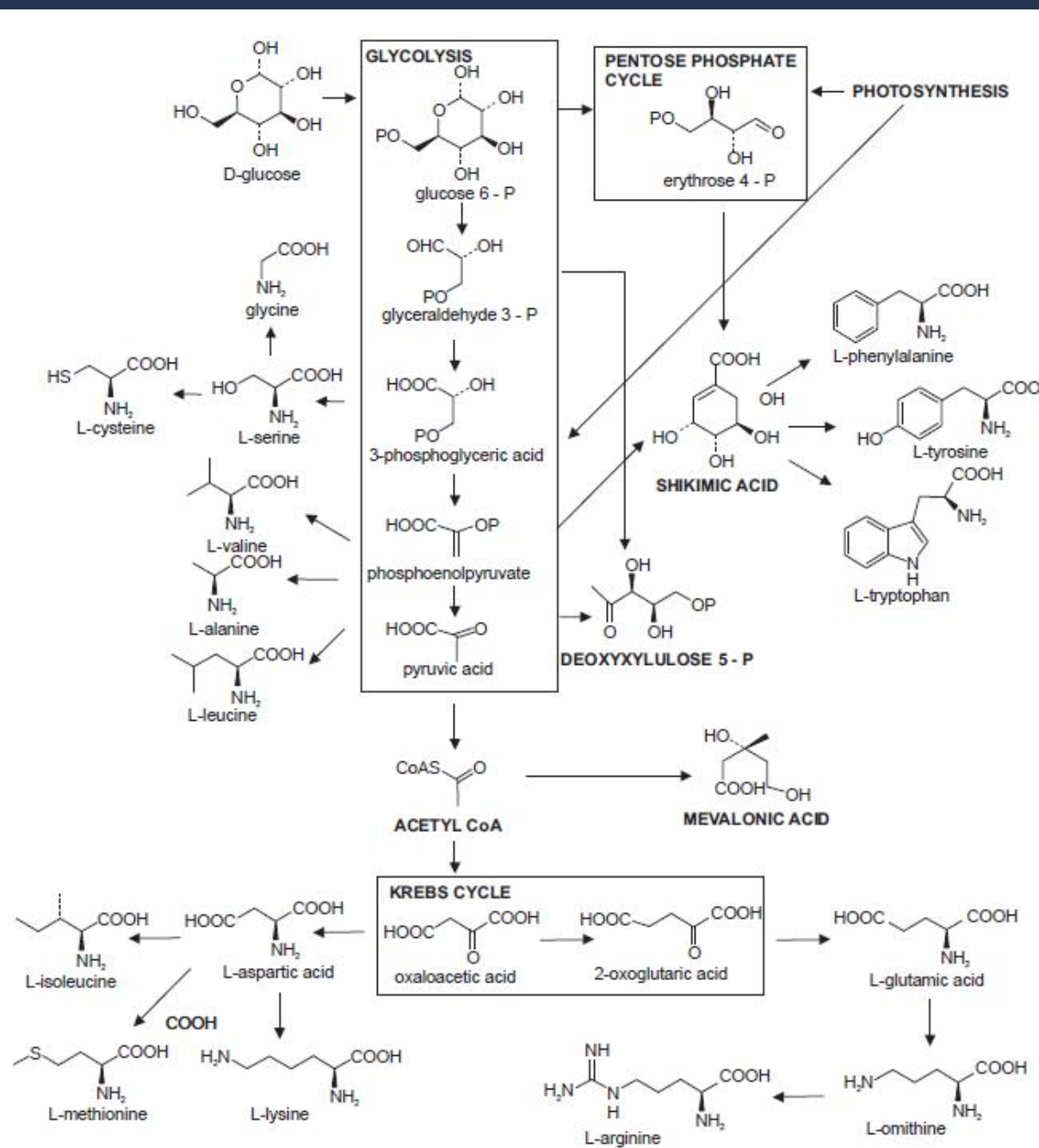


Fig. 13.1 Primary metabolic pathways



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PART FOUR

Pathways for Secondary Metabolite Synthesis





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Shikimic Acid Pathway

- Starting point for biosynthesis of Phenolics. Such as Phenyl alanine and tyrosine, which are precursors for biosynthesis of phenylpropanoids. The ploypropanoids are then used for production of flavonoids, coumarins, tannins and lignin.
- Shikimic acid pathway is also utilized for gallic acid synthesis, which is formed by the action of shikimate dehydrogenase on 3- dehydroshikimate, resulting in 3,5- didehydroshikimate. Then the didehydroshikimate undergoes spontanuou rearrangement to form gallic acid
- Shikimic acid is also precursor for synthesis of indole derivatives, and many other alkaloids and aromatic metabolites.





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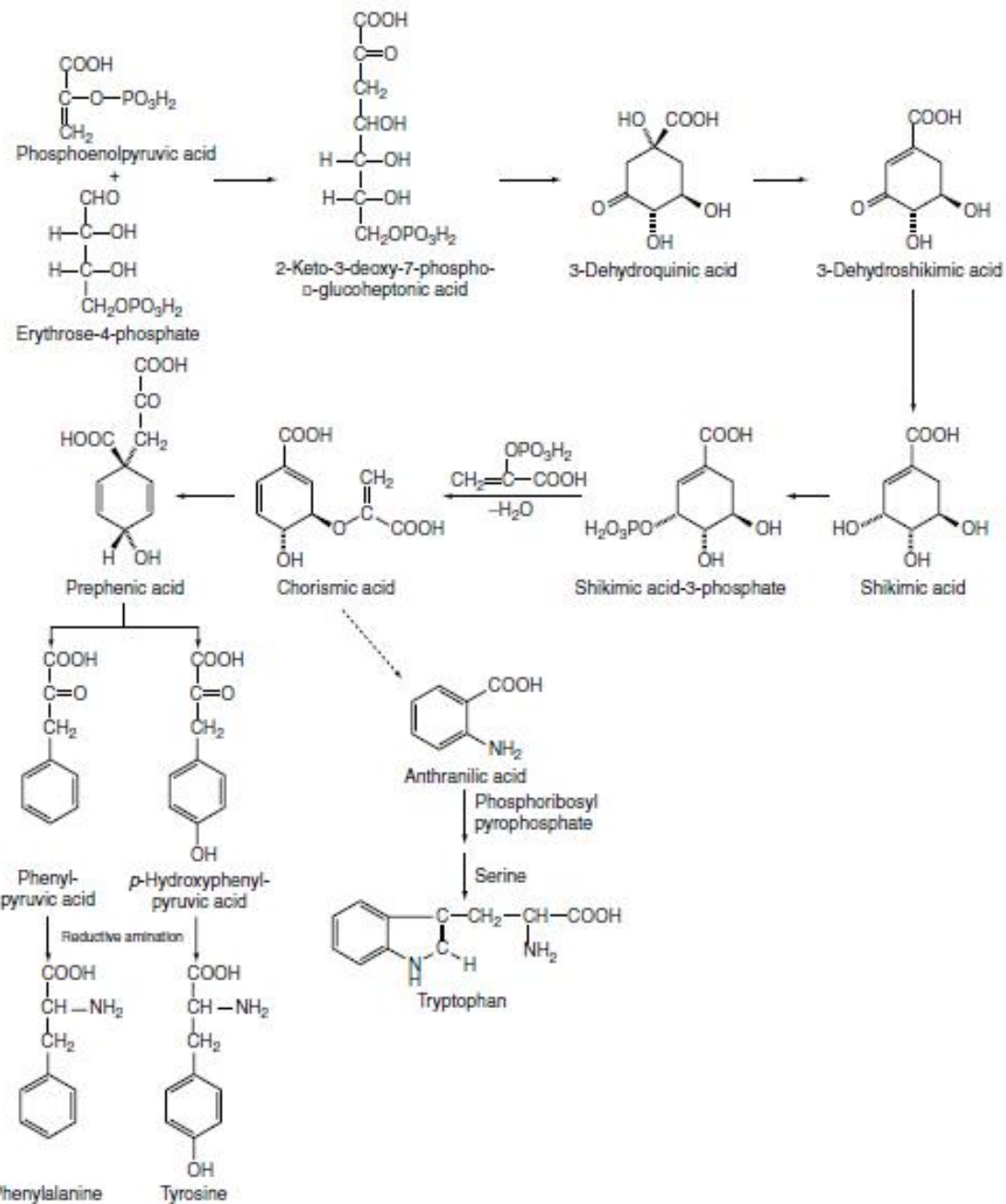


Fig. 18.8 Biosynthesis of aromatic compounds via the shikimic acid pathway.



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REFERENCES & FURTHER READINGS

- ✘ Kokate, C. K., A. P. Purohit, and S. B. Gokhale. "Book of Pharmacognosy." *Nirali prakashan 36th edition* (2005).
- ✘ Evans, William Charles. *Trease and Evans Pharmacognosy, International Edition E-Book*. Elsevier Health Sciences, 2009.
- ✘ Shah, B., and A. Seth. *Textbook of Pharmacognosy and Phytochemistry - E-Book*. Elsevier Health Sciences, 2012. Print



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THANK YOU

We Will continue further in next class