

Pharmacognosy II

First semester

Lecture 2/ 2022~2023

Biosynthesis is a process of forming larger organic compounds from small subunits within a living organism, biosynthesis is mainly done by enzymes.

Biosynthesis is also known as anabolism since simple compounds are joined together to form macromolecules by enzymes.

Biosynthesis Pathway of Secondary Metabolites

According to the biosynthetic pathway the natural compounds classified into:

- 1- **Active compounds derived from shikimic acid pathway** (most of aromatic compounds derived from this pathway).
- 2- **Active compounds derived from acetate-mevalonic acid pathway** (most of non-aromatic compounds derived from this pathway).
- 3- Mixed pathway derived from both shikimate and mevalonate.

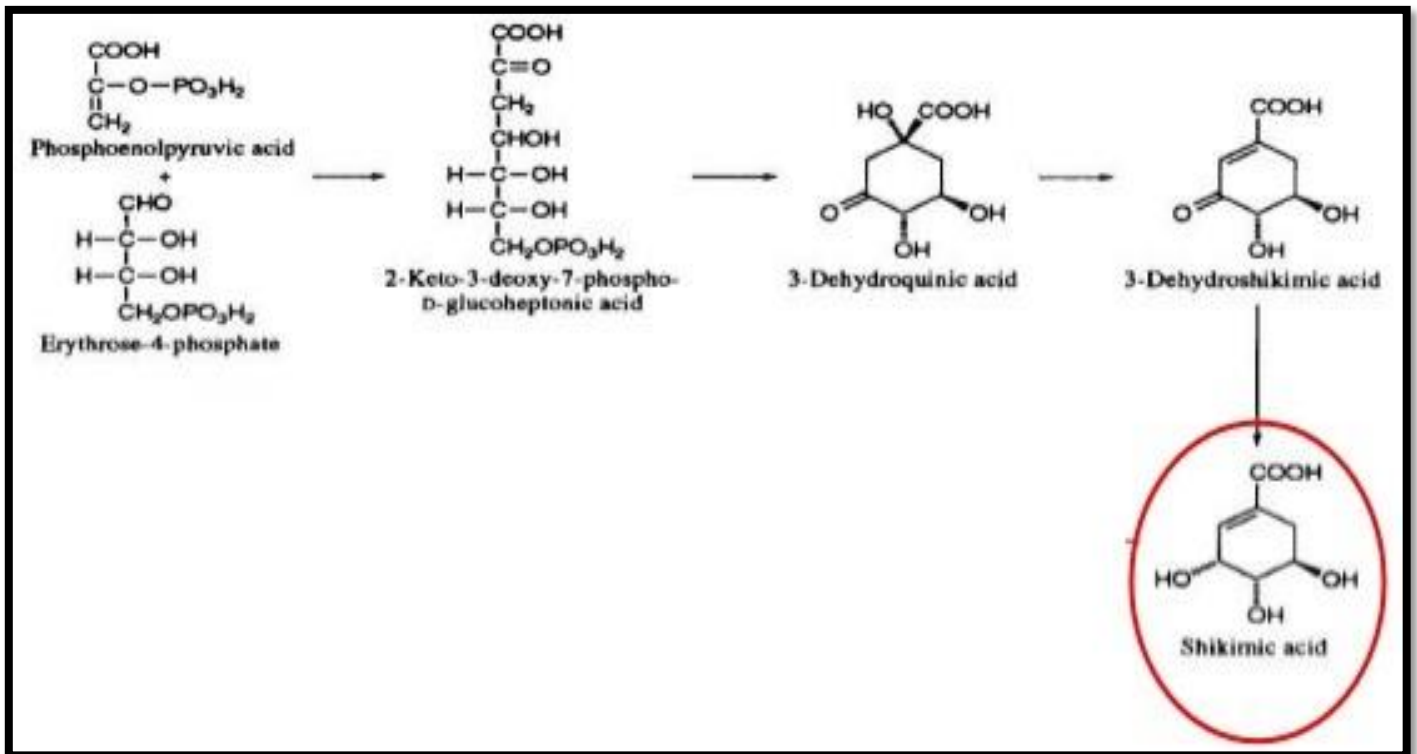
Shikimic acid

- Its name comes from the **Japanese flower shikimi** the Japanese star anise, (*Illicium anisatum*), from which it was first isolated in 1885.
- The shikimate pathway, also known as the **chorismate biosynthesis pathway**.
- Shikimic acid is also the glycoside part of some hydrolysable tannins.
- The Shikimic acid pathway converts simple carbohydrate precursors derived from glycolysis and the pentose phosphate pathway to the aromatic amino acids.
- The shikimic acid pathway is present in plants, fungi, and bacteria but not found in animals. Animals have no way to synthesize the three aromatic amino acids: phenylalanine, tyrosine, and tryptophan, which are therefore essential nutrients in animal diets.
- The shikimic acid pathway is a key intermediate from carbohydrate for the biosynthesis of C₆-C₃ unites (phenyl propane derivative).

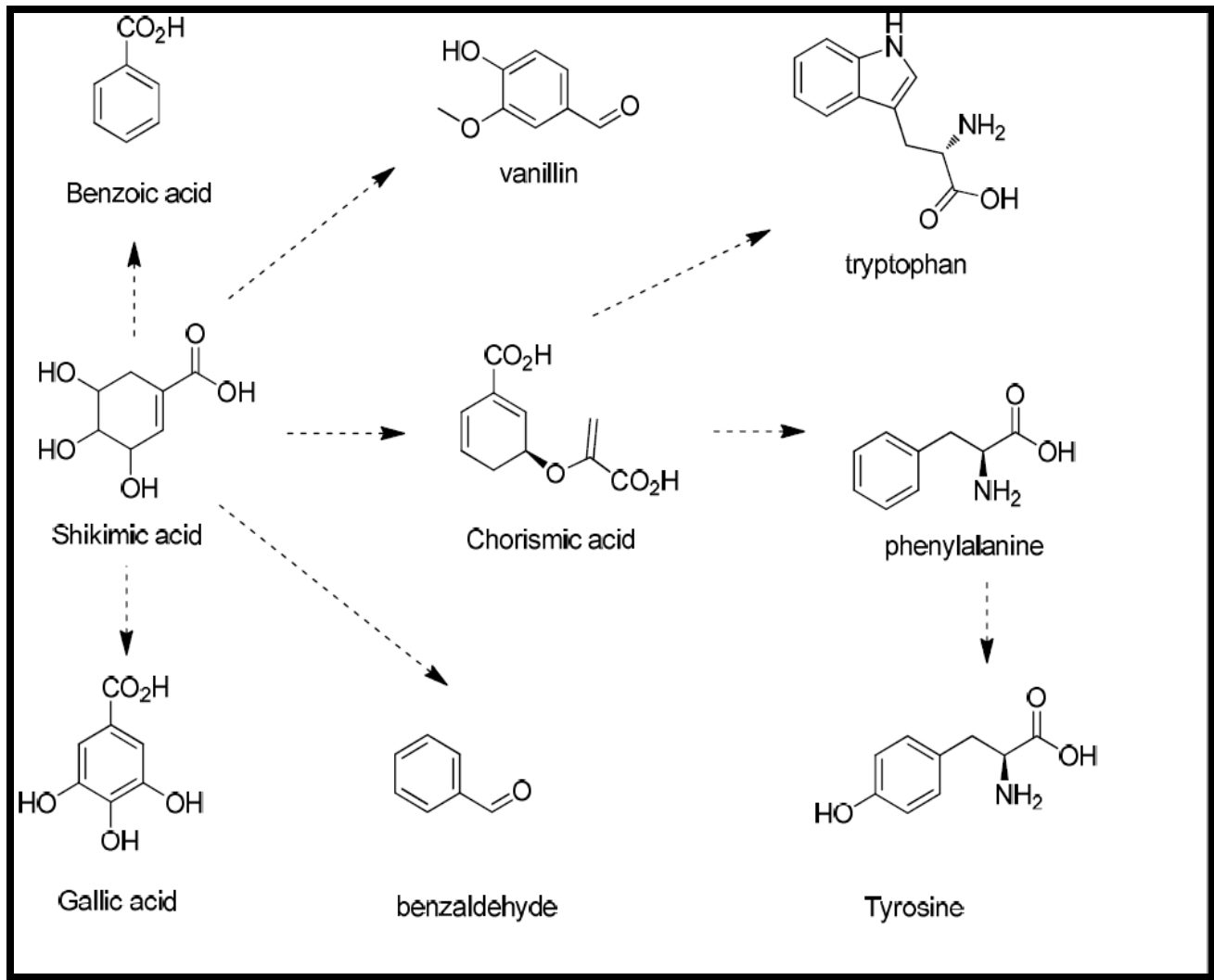
- Shikimic acid is also an intermediate in production of tannins, flavones, coumarins and vanillin.

Formation of Shikimic acid:

phosphoenolpyruvate (PEP) and erythrose 4-phosphate (E4-P) react to form **2-keto-3-deoxy-7-phospho-D-glucoheptonic acid**. Then it while transformed to **3-dyhydroquinic acid**, after that this compound dehydrated to **3-dehydroshikimic acid** which reduced to **shikimic acid**.



Formation of Shikimic acid

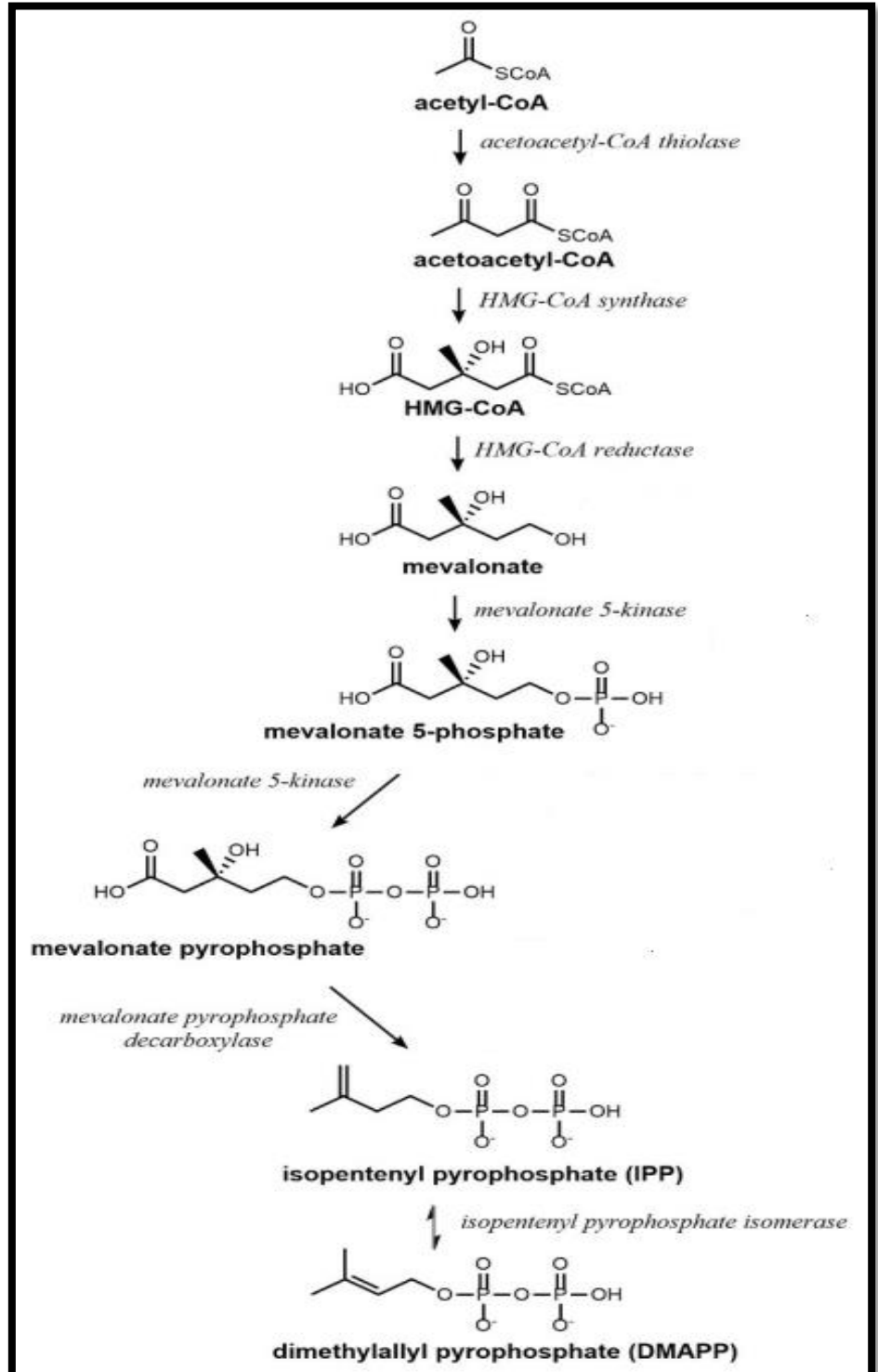


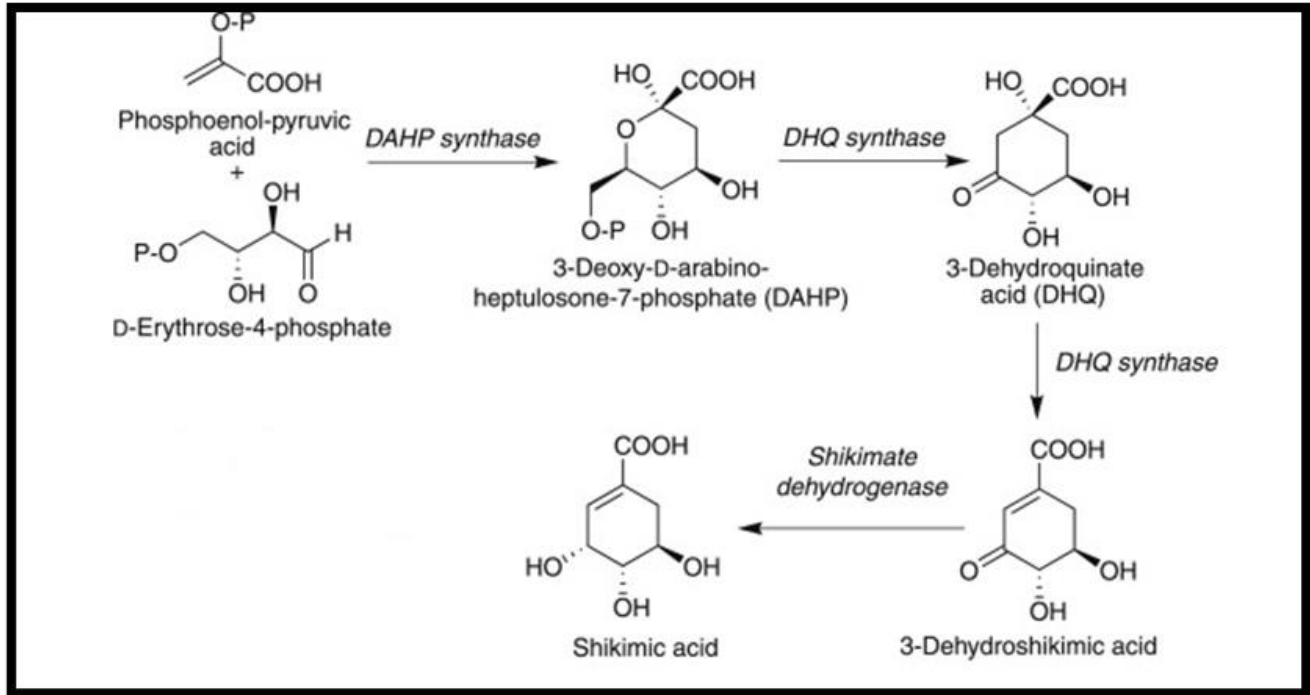
Shikimic acid pathway

1- Acetate-Mevalonic acid pathway

The acetate-mevalonic acid pathway, also known as isoprenoid pathway or HMG-CoA reductase pathway. Isoprenoids, namely terpenoids, are the largest and the most structurally varied groups of natural products, which contain more than 30,000 known compounds. All the isoprenoids are biosynthesized from only two C₅ precursors in plants, isopentenyl diphosphate and its isomer, dimethylallyl diphosphate.

The mevalonate pathway begins with [acetyl-CoA](#) and ends with the production of IPP and DMAPP.





*For reference only