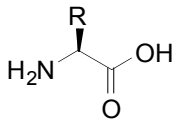
The Synthesis of Amino Acids

Introduction

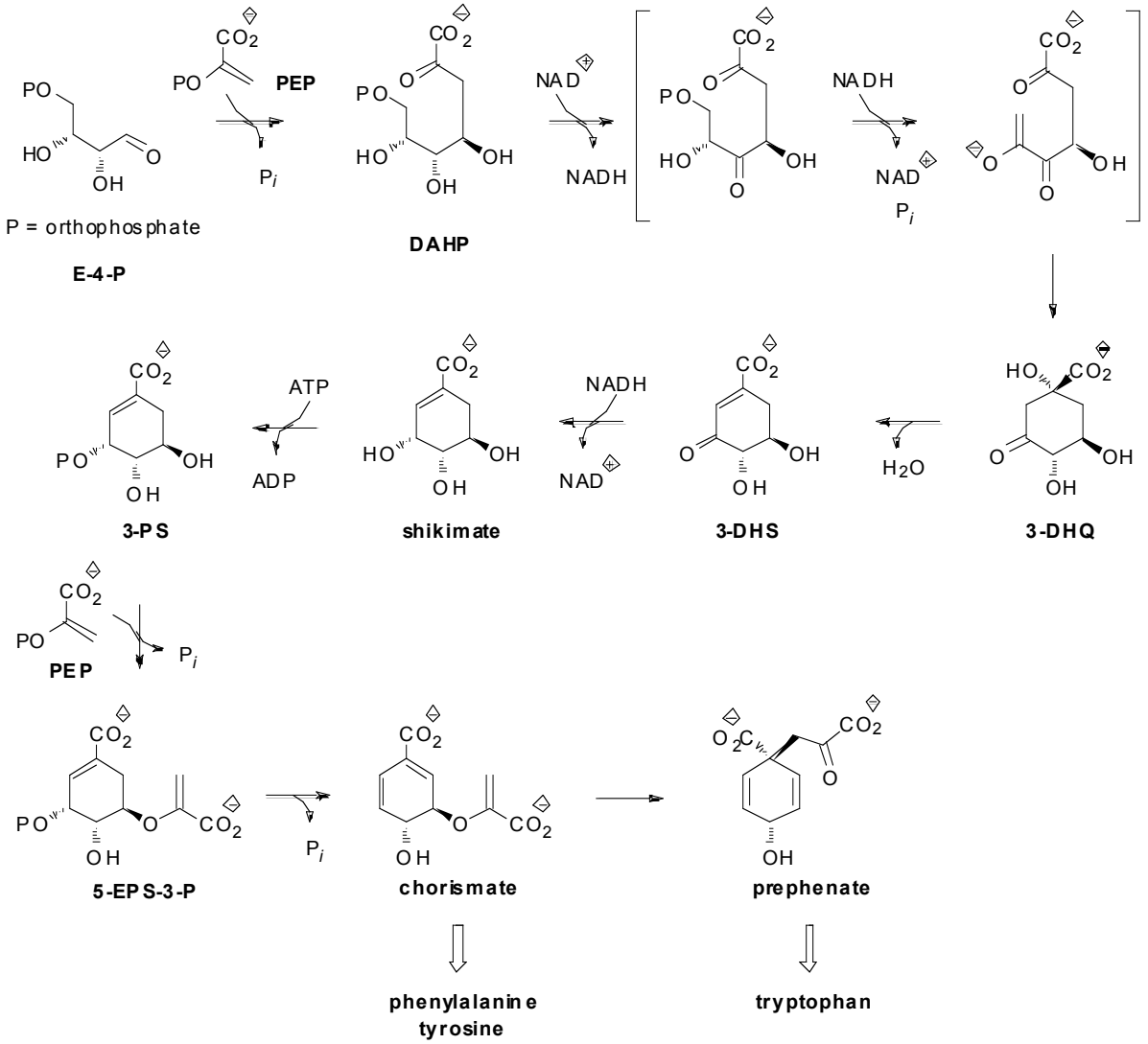
Amino acids are molecules containing an amine group, a carboxylic acid and a side chain that varies between different amino acids.



Part 1 -- Biochemical processes

Shikimic acid pathway: biosynthesis of the aromatic amino acids Phe (phenylalanine), Tyr (tyrosine), and Trp (tryptophan).

Please work through the key steps in the reaction scheme with questions below (Hints provided).



Q1: The first step in the above biosynthetic route is the formation of 3-deoxy-D-arabinoheptulosonate-7-phosphate (DAHP) from phosphoenol pyruvate (PEP) and erythrose-4-phosphate (E-4-P). **Please suggest the mechanism for this step.**

Hint 1: this step is an 'aldol reaction'.

Q2: The 2nd step is the formation of 3-dehydroquinate (3-DHQ). **Please suggest the mechanism for this step.**

Hint 2: this step involves alcohol → ketone → alcohol redox cycle, and cyclisation via aldol reaction.

Q3: The 3rd step is the formation of 3-dehydroshikimate (3-DHS). **Please suggest the mechanism for this step.**

Hint 3: an Enzyme-NH_2 is involved in the reaction to encourage the elimination of H_2O (1eq. in total).

Q4: The next two steps are formation of shikimate, followed by the formation of 3-phosphoshikimate (3-PS). **Please suggest the mechanism for this step.**

Hint 4: This is a stereoselective ketone reduction, followed by alcohol phosphorylation.

Q5: A 2nd eq. of PEP is used for the formation of 5-enolpyruvylshikimate-3-phosphate (5-EPS-3-P). **Please suggest the mechanism for this step.**

Q6: Formation of chorismate requires the use of FMN, a mediator of biological oxidations (e.g. dehydrogenations – *Hint: not a dehydrogenation in this step, but elimination*). **Please suggest the mechanism for this step.**

Q7: Please give the name of the last step and suggest the mechanism.

To be continued...