

Discovery:- Cytokinins

- The cytokinins were discovered in the course of studies aimed at identifying factors that stimulate plant cells to divide
- Haberlandt, a German plant physiologist noted certain diffusible factors from phloem tissue eg; Phloem exudate, could cause cell division in potato tubers.
- Later in 1921 he discovered that healing of cut plant tissues by cell division was prevented if the cut surfaces were washed with water. These observations suggested the presence of a soluble factor in plant tissues that promoted cell division
- In 1940s and 1950s, it was found that callus cultures from tobacco pith explants or carrot roots placed on agar blocks soaked with nutrients & auxin still showed very little cell division. They required other substances eg: Coconut milk (liquid endosperm from coconut) or extracts from vascular tissues, yeast extracts, autoclaved DNA or even adenine
- In 1956, Carl Miller in Folke Broog's laboratory at Wisconsin University, Madison, discovered that a substituted adenine, 6-ferfuryl amino purine, obtained from autoclaved herring sperm DNA was far more potent than adenine in promoting cell division in tobacco pith explants. This substance was given the name kinetin
- Kinetin does not occur naturally in plants

→ In 1963, D.S. Letham, isolated a substance from kernels of sweet corn that had a high cell - on promoting capacity in cell cultures. The material was N⁶-substituted adenine [6-(4-hydroxy-3-methyl-trans-2-enylamino) purine] and was given name

Zeatin

Since, the discovery of Zeatin, several naturally occurring Cytokinins & some synthetic substances with similar biological activities have been discovered.

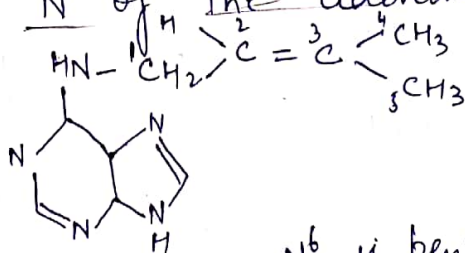
Properties:-/ Biological Functions

- Cytokinins are defined as compounds that promote cell division in callus and tissue culture
- In combination with Auxin, they regulate the ratio of shoot bud vs root growth in tissue culture and in stem cuttings
- In intact plants, they regulate apical dominance and lateral root initiation
- They also retard senescence and chlorophyll degradation in aging leaf tissues
- Cytokinins like auxins and Gibberellins, have a wide occurrence in plants and are known besides vascular plants from mosses and algae.
- They are also produced by several strains of soil living bacteria such as Agrobacterium and Pseudomonas, which cause crown galls or tumors in plants, and by certain phytopathogenic fungi such as

An example of the inhibition of senescence by cytokinins is provided by these fungi: they cause the formation of "green islands" on the leaves of plants, which they infect.

STRUCTURE OF CYTOKININS

→ All naturally occurring cytokinins have an adenine ring structure with a 5 carbon isopentenyl side chain from N⁶ of the adenine molecule

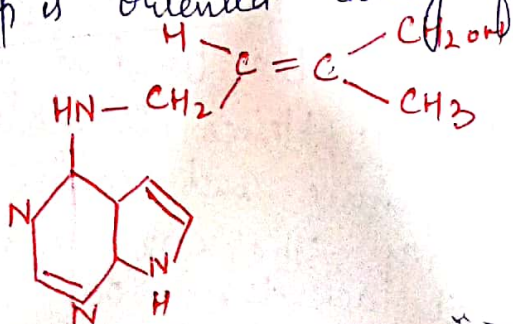


N⁶-isopentenyl adenine

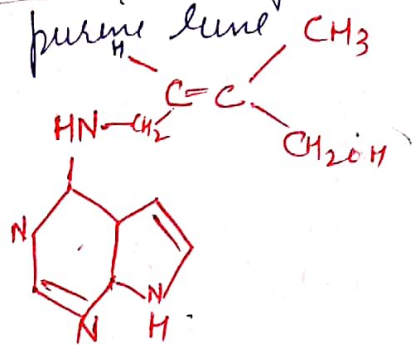
In addition to Zeatin, they include isopentenyl adenine and the reduced form of Zeatin, the dihydrozeatin.

As the side chain in Zeatin possesses a double bond geometric isomers are possible. These occur either as trans Zeatin or cis-Zeatin:

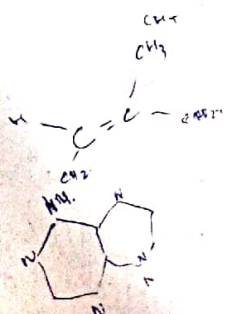
→ In cis isomer, the hydroxyl group of isopentenyl side chain is oriented towards the N⁷ position of the purine ring, whereas in trans isomer the hydroxyl group is oriented away from the purine ring.



trans-Zeatin

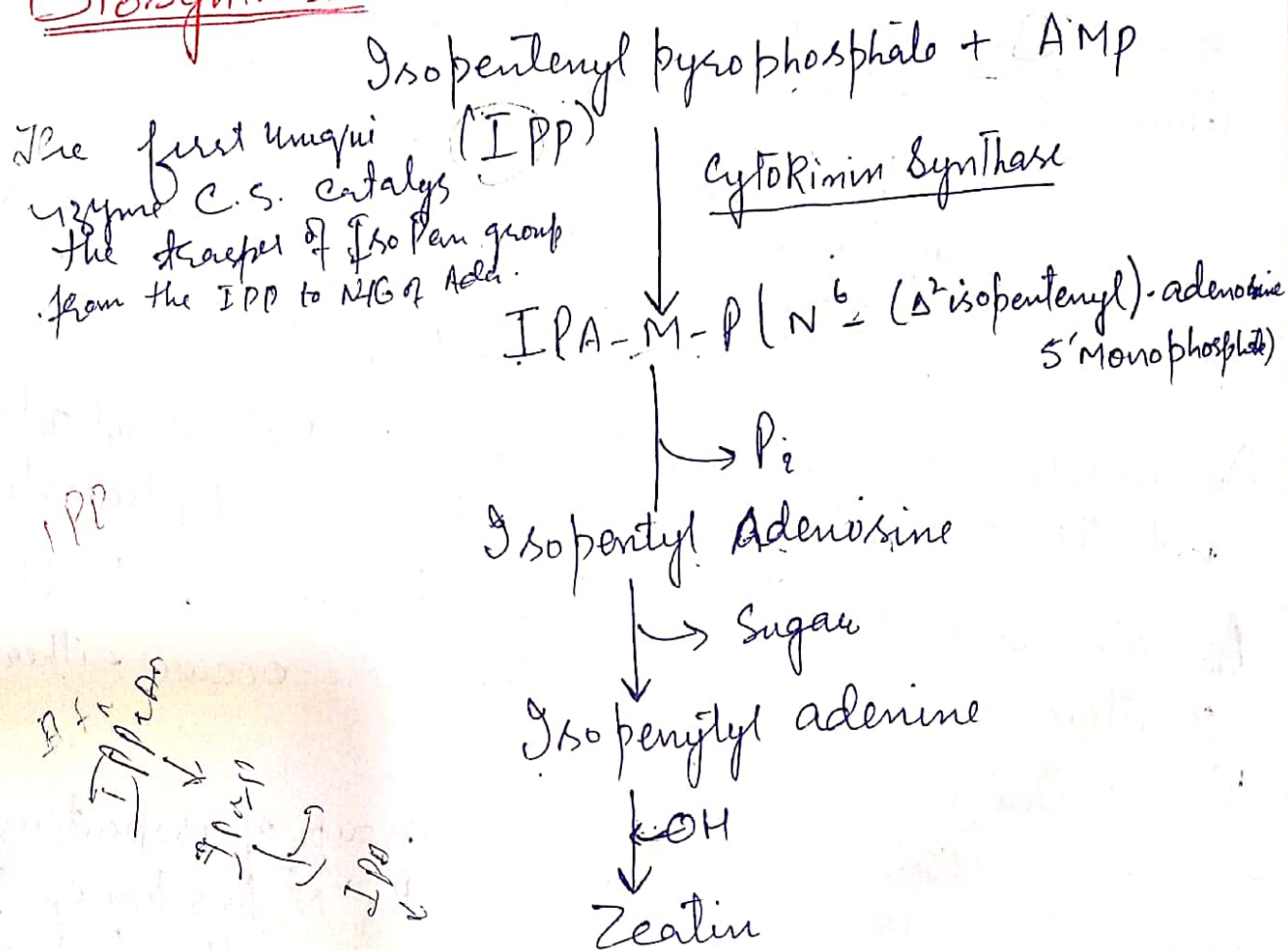


cis-Zeatin



- The natural cytokinins ~~also~~ occur as their sugar derivatives, N⁹ ribosides and ribotides
- In addition to ribosides and ribotides, conjugates of cytokinins with glucose, xylose and amino acids are also known

↳ Biosynthesis



Cytokinin Oxidase :- is the enzyme that catalyzes the cleavage of N⁶ side chain from adenosine. The enzyme requires the double bond in the side chain for its activity. Hence its natural substrates are isopentenyl adenine and Zeatin and their ribosylated derivatives. The enzyme is unable to cleave side chains that lack the double bond as in dihydrozeatin & its derivatives. It is also inactive against O-glycosylated conjugates, where the side chains have a glucosyl or xylosyl residues and against synthetic cytokinins where the side chain have an aromatic