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Editorial on Isoprenoids

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Editorial

Isoprene is produced and released by a wide range of tree species (majorproducers are oaks, poplars, eucalyptus, and some legumes). Isoprene emissions by plants are estimated to be about 600 million metric tons per year, with half coming from tropical broadleaf trees and the rest mainly from shrubs.

The methyl-erythritol 4-phosphate pathway (MEP pathway, also known as the non-mevalonate pathway) in plant chloroplasts produces isoprene. Isoprene synthase cleaves dimethylallyl pyrophosphate (DMAPP), one of the two MEP pathway end products, to form isoprene and diphosphate.

Regulation

Isoprene emission in plants is controlled by the availability of the substrate (DMAPP) as well as the activity of the enzyme (isoprene synthase). The dependence of isoprene emission on light, CO_2, and O_2 is controlled by substrate availability, while the temperature dependence of isoprene emission is regulated by both substrate level and enzyme activity.

Isoprenoids

Terpenes (also known as isoprenoids) are naturally occurring compounds thatcontain the isoprene backbone, but these compounds do not come from isoprene. Dimethylallyl pyrophosphate (DMAPP) and its isomer isopentenyl pyrophosphate are the precursors to isoprene units in biological systems Isoprenes, as a plural, is often used to refer to all terpenes. Carotene, phytol, retinol (Vitamin A), tocopherol (Vitamin E), dolichols, and squalene are all isoprenoids. Heme A has an isoprenoid tail, and lanosterol, the sterol precursor in animals, is made up of squalene and hence isoprene.

Industrial production

Short-lived free radicals (such as the hydroxyl radical) and, to a lesser degree, ozone transform isoprene into a number of species, including aldehydes, hydro peroxides, organic nitrates, and epoxides, which combine into water droplets and contribute to the formation of aerosols and haze.

Industrial production

Isoprene is most commonly used in industry as a byproduct of naphtha or oilthermal cracking, or as a byproduct of ethylene processing. Annually, about 800,000 metric tons are made. Cis-1,4-polyisoprene, a synthetic form of natural rubber, accounts for about 95 percent of isoprene production.

Natural rubber is mostly composed of poly-cis-isoprene, with a limited proportion of proteins, fatty acids, resins, and inorganic materials. Gutta percha, a type of natural rubber, is made up of trans-1,4-polyisoprene, a structural isomer with similar but not identical properties.

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