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JASMONIC ACID

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IUPAC name: (1*R*,2*R*)-3-Oxo-2-(2*Z*)-2-pentenyl-cyclopentaneacetic

Jasmonic acid (JA) is an organic compound found in several plants including jasmine. The molecule is a member of the jasmonate class of plant hormones. It is biosynthesized from linolenic acid by the octadecanoid pathway. It was first isolated in 1957 as the methyl ester of jasmonic acid by the Swiss chemist Edouard Demole and his colleagues.

Biosynthesis:

Its biosynthesis starts from the fatty acid linolenic acid, which is oxygenated by Lipoxygenase (13-LOX), forming a peroxide. This peroxide then cyclizes in the presence of allene oxide synthase to form an allene oxide. This allene oxide rearranges as it gets catalyzed by the enzyme allene oxide cyclase to form 12-oxophytodienoic acid, and undergoes a series of β -oxidations to 7-iso-jasmonic acid. In the absence of enzyme, this iso-jasmonic acid isomerizes to jasmonic acid.

BOTANY: SEM – V, PAPER-C12T: PLANT PHYSIOLOGY, UNIT-5: PLANT GROWTH REGULATORS – JASMONIC ACID



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Function:

1. The major function of JA and its various metabolites is regulating plant responses to abiotic and biotic stresses as well as plant growth and development. —
2. Regulated plant growth and development processes include
 - a) growth inhibition,
 - b) senescence,
 - c) tendrils coiling, —
 - d) flower development and
 - e) leaf abscission.
3. JA is also responsible for tuber formation in potatoes and yams.
4. It has an important role in response to wounding of plants and systemic acquired resistance. The Dgl gene is responsible for maintaining levels of JA during usual conditions in *Zea mays* as well as the preliminary release of jasmonic acid shortly after being fed upon. When plants are attacked by insects, they respond by releasing JA, which activates the expression of protease inhibitors, among many other anti-herbivore defense compounds. These protease inhibitors prevent proteolytic activity of the insects' digestive proteases or "salivary proteins", thereby stopping them from acquiring the needed nitrogen in the protein for their own growth.
5. JA also activates the expression of Polyphenol oxidase which promotes the production of Quinolines. These can interfere with the insect's enzyme production and decrease the nutrition content of the ingested plant.
6. JA may have a role in pest control. —
7. JA has been considered as a seed treatment in order to stimulate the natural anti-pest defenses of



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the plants that germinate from the treated seeds. In this application jasmonates are sprayed onto plants that have already started growing. These applications stimulate the production of protease inhibitor in the plant. This production of protease inhibitor can protect the plant from insects, decreasing infestation rates and physical damage sustained due to herbivores.

8. However, due to its antagonistic relationship with salicylic acid (an important signal in pathogen defense) in some plant species, it may result in an increased susceptibility to viral agents and other pathogens. In *Zea mays*, salicylic acid and JA are mediated by NPR1 (nonexpressor of pathogenesis-related genes1), which is essential in preventing herbivores from exploiting this antagonistic system. Armyworms (*Spodoptera* spp.), through unknown mechanisms, are able to increase the activity of the salicylic acid pathway in maize, resulting in the depression of JA synthesis, but thanks to NPR1 mediation, JA levels aren't decreased by a significant amount.

Derivatives:

Main article: Jasmonate

Jasmonic acid is also converted to a variety of derivatives including the ester methyl jasmonate. This conversion is catalyzed by the jasmonic acid carboxyl methyltransferase enzyme. It can also be conjugated to amino acids in some biological contexts. Decarboxylation affords the related fragrance jasmone.



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