Short Communication

Regulation of Auxin-induced Ethylene Production in Mung Bean Hypocotyls

ROLE OF 1-AMINOCYCLOPROPANE-1-CARBOXYRIC ACID

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ABSTRACT

Ethylene production in mung bean hypocotyls was greatly increased by treatment with 1-aminocyclopropane-1-carboxylic acid (ACC), which was utilized as the ethylene precursor. Unlike auxin-stimulated ethylene production, ACC-dependent ethylene production was not inhibited by aminoethoxyvinlylglycine, which is known to inhibit the conversion of S-adenosylmethionine to ACC. While the conversion of methionine to ethylene requires induction by auxin, the conversion of methionine to S-adenosylmethionine and the conversion of ACC to ethylene do not. It is proposed that the conversion of S-adenosylmethionine to ACC is the rate-limiting step in the biosynthesis of ethylene, and that auxin stimulates ethylene production by inducing the synthesis of the enzyme involved in this reaction.

RESULTS AND DISCUSSION

In vegetative tissues, the conversion of labeled methionine to ethylene as well as endogenous ethylene production is greatly increased by auxin treatment. In controls without added auxin, little conversion of labeled methionine occurs and little ethylene is produced (3, 12). The results are interpreted to indicate that methionine is a precursor of ethylene and that the induction of ethylene biosynthesis by auxin occurs at a step following the synthesis of methionine. In order to determine at which step ethylene production is activated by auxin, we compared the influence of ACC with that of IAA plus zeatin on ethylene production in mung bean hypocotyl segments. The synergetic stimulation of auxin-induced ethylene production by cytokinin has been well documented (8). Surprisingly ACC caused a re-

MATERIALS AND METHODS

Dry seed of mung bean (Vigna radiata [L.] Wilczek) were grown in Vermiculite for 3 days in darkness at 25 C. Two-cm-long hypocotyl segments were cut at 1 and 3 cm below the hook. Twenty segments weighing 1 g were incubated in 5 ml of medium containing 2% sucrose, 50 μg/ml chloramphenicol, 50 mm Mes buffer (pH 6.1), 10 μM IAA, and 10 μM zeatin in an Erlenmeyer flask. Where indicated, ACC at various concentrations, 20 μM CHI, and 10 μM AVG were included. The flasks were flushed with air, sealed with rubber serum caps, and incubated at 27 C. At indicated time intervals, 1-ml gas samples were withdrawn from the headspace of the flasks and ethylene content determined by GC (9). Each determination the flasks were flushed with air and resealed for the next ethylene determination. All experiments were conducted in duplicates and the data represent mean values.

ACC was obtained from Calbiochem. [2-14C]ACC was prepared by feeding [2-14C]methionine to apple tissue under a N2 atmosphere as described previously (2). [3-14C]Methionine was purchased from Research Products International Corporation.

FIG. 1. Comparison of ethylene production by mung bean hypocotyls stimulated by ACC or auxin plus zeatin.
The induction of ethylene biosynthesis by auxin is exerted at a step following the synthesis of methionine, but the conversion of methionine to SAM (5; H. Imaseki, personal communication) and the conversion of ACC to ethylene are not dependent upon auxin. IAA must therefore exert its hormonal effect by inducing the synthesis of the enzyme responsible for the conversion of SAM to ACC. These conclusions are summarized in Figure 3. Recent work from this laboratory (4) has shown that application of ACC causes marked increase in ethylene production in various leaf, flower, fruit, stem, and root tissues, which normally produce little ethylene. These results are in agreement with the view that the rate-limiting reaction in ethylene biosynthesis occurs at a step prior to the formation of ACC.

LITERATURE CITED

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