Transient production of H_2O_2 and NO induced by ascorbic acid coincides with promotion of antioxidant enzyme activity and reduction of pericarp browning of harvested longan fruit

Sitthisak Intarasit and Kobkiat Saengnil

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Abstract

Ascorbic acid (AsA) plays an important role in the protection against oxidative stress in plants. Although the underlining mechanism is yet to be fully elucidated, it is believed that hydrogen peroxide (H_2O_2) and nitric oxide (NO) play a key role as a signaling agent. This study investigated the relationship between exogenously applied AsA and the activation of antioxidant defense through these signaling molecules, which coincided with reduced pericarp browning of harvested longan (*Dimocarpus longan* Lour. cv. Daw). It was found that the level of H_2O_2 in longan pericarp increased immediately after treatment with 2.5 mM AsA, reaching maximum 9 h afterward. The expression of nicotinamide adenine dinucleotide phosphate oxidase (*NOX*) and the activity of NOX simultaneously peaked after the AsA treatment and remained so for the next 9 h. NO content, on the other hand, did not rise until H_2O_2 peak was reached, attaining the highest level 3 h later. The change in NO content correlated well with the increase in nitric oxide synthase (NOS) gene expression and enzyme activity. Interestingly, the AsA treatment differently altered gene expression and activities of some vital antioxidant enzymes including superoxide dismutase, catalase, ascorbate peroxidase and glutathione peroxidase during the first 4 d of storage. With the exception of catalase, the treatment positively affected both the expression and the activity. Catalase activity remained constant for the first 9 h before rising afterward. These changes in the activity of the antioxidant enzymes were closely associated with the reduction in pericarp browning. These results suggested that H_2O_2 and NO generation triggered by AsA may activate the antioxidant defense mechanism in longan pericarp. This, in turn, helps overcome subsequent stressed-induced H_2O_2 and NO production, thereby reducing the pericarp browning.