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RESEARCH ARTICLE

Carbon dioxide sensitization delays the postharvest ripening and fatty acids composition of *Capsicum* fruit by regulating ethylene biosynthesis, malic acid and reactive oxygen species metabolism

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Abstract

Present study would be significant in the sustenance of quality characters for postharvest storage of *Capsicum* fruit with CO_2-sensitization in biocompatible manner**.** The present experiment describes effects of CO_2 sensitization on delaying postharvest ripening through physiological attributes in *Capsicum* fruit**.** The experiment was conducted with acidified bicarbonate-derived CO_2 exposure for 2 h on *Capsicum* fruit, kept under white light at 25 °C through 7 days postharvest storage. Initially, fruits responded well to CO_2 as recorded sustenance of greenness and integrity of fruit coat resolved through scanning electron micrograph. Loss of water and accumulation of total soluble solids were marginally increased on CO_2-sensitized fruit as compared to non-sensitized (control) fruit. The ethylene metabolism biosynthetic genes like *CaACC synthase*, *CaACC oxidase* were downregulated on CO_2-sensitization. Accompanying ethylene metabolism cellular respiration was downregulated on CO_2 induction as compared to control through 7 days of storage. Fruit coat photosynthesis decarboxylating reaction by NADP malic enzyme was upregulated to maintain the reduced carbon accumulation as recorded on 7 days of storage under the same condition. CO_2-sensitization effectively reduced the lipid peroxides as oxidative stress products on ripening throughout the storage. Anti-oxidation reaction essentially downregulates the ROS-induced damages of biomolecules that otherwise are highly required for food preservation during postharvest storage. Thus, the major finding is that CO_2-sensitization maintains a higher ratio of unsaturated to saturated fatty acids in fruit coat during storage. Tissue-specific downregulation of ROS also maintained the nuclear stability under CO_2 exposure. These findings provide basic as well as applied insights for sustaining *Capsicum* fruit quality with CO_2 exposure under postharvest storage.

Keywords Antioxidant defense · Fatty acid · NADP malic enzyme · DNA damage · Ethylene signaling · Cell wall residues

Introduction

Fruit ripening in general is based on a series of developmental changes that include physiological, biochemical, and cellular activities altering sensory and quality characters like color, flavor, aroma, texture, and nutritional quality. In fruit ripening, catabolic reactions include hydrolysis of polysaccharides into simple sugars, inter-conversion of organic acids-sugars, turnover of proteins, breakdown of higher molecular residues into simpler ones etc. (Pott et al. 2022). The ripening occurs on shoots naturally, however, during postharvest storage the ripening also occurs preferentially for the fruits depending on ethylene metabolism. These fruits are characteristically regarded climacteric fruits as exampled by apple, tomato, mango, pear etc. On the other hand, non-climacteric fruits ripening is quite uncertain with regards to ethylene metabolism but a few growth regulators

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