

Molecular and metabolic responses of fruits to low oxygen postharvest stress

D. Cukrov, S. Brizzolara and P. Tonutti

Acta Horticulturae 1071: 37-43. 2015.

Abstract

The modulation of gas composition is widely used in storage rooms and/or packaging to delay ripening/senescence, to limit the incidence of postharvest physiological disorders, and, in some cases, to confine insect infestations. Hypoxic/high CO₂ conditions characterize the storage under MA and CA and fruit react to this stress by activating molecular and physiological mechanisms resulting in beneficial or detrimental effects depending on a number of endogenous (e.g., genotype, ripening stage) or exogenous (e.g., concentrations of the specific gas, duration of exposure) factors. Since the establishment of the first commercial CA rooms, the oxygen concentration showed a constant decrease throughout decades, reaching the low (<1 kPa) levels currently used in ULO (Ultra Low Oxygen), ILOS (Initial Low Oxygen Stress), and DCA (Dynamic Controlled Atmosphere) applications. The metabolic responses of fruit tissues to such extreme conditions are mainly related to dramatic changes in mitochondrial respiration and the activation of the fermentative metabolism. Several hypoxia-induced genes (e.g., alcohol dehydrogenase, ADH) have been identified in fruit tissues and anaerobic metabolites (e.g., alanine, succinate, malate, shikimate) are reported to differentially accumulate under low oxygen availability with marked consequences on the physiology of the fruit. The use and the integration of “omics” technologies represent key steps to better characterize the responses of fruit to low oxygen through the identification of specific metabolites, and to elucidate the mechanisms by which oxygen is perceived, the role of specific transcriptional regulatory elements, such as those belonging to the Ethylene Response Factors (ERF), and the involvement of ROS-related genes involved in both signaling and attenuation of oxidative-stress.