Title The kinetics of acetaldehyde and ethanol accumulation in 'Hass' avocado fruit during induction and recovery from low oxygen and high carbon dioxide conditions

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Citation Postharvest Biology and Technology, Volume 43, Issue 2, February 2007, Pages 207-214

Keywords Avocado; *Persea americana* Mill.; Fruit; Oxygen; Carbon dioxide; Acetaldehyde; Ethanol; Anaerobic; Kinetics

Abstract

The kinetics of acetaldehyde (AA) and ethanol (EtOH) accumulation and pyruvate decarboxylase (PDC) and alcohol dehydrogenase (ADH) activities were studied in pre-climacteric 'Hass' avocado fruit flesh during induction and recovery from hypoxic conditions at 6 °C. Oxygen levels <0.5% resulted in a rapid accumulation of AA and EtOH. The pattern of AA and EtOH accumulation could be described by a hyperbolic model, although the initial 96 h of EtOH accumulation was linear. The accumulation of EtOH and AA was coincident with a doubling of the extractable ADH and PDC activities after 120 h exposure. Exposure of the fruit to up to 20% CO_2 concentrations resulted in an increase in tissue levels of AA, but not EtOH. The pattern of AA accumulation under high CO_2 was similar to that under low O_2, with the level of AA being higher at higher CO_2 concentrations.

The AA and EtOH induced by low O_2 declined to basal levels in an exponential manner when O_2 was increased from ≤0.5 to ≥2%. The longer the duration of hypoxic induction, the longer the time required for AA and EtOH to decline to basal levels. When low O_2 induction was 48 h or less, the time required for AA and EtOH to decline to basal levels was not affected by O_2 concentrations >2%. However, after 96 h induction, the initial rate of decline in AA or EtOH was slower at lower O_2 concentrations. Including 20% CO_2 in the recovery atmosphere decreased the initial rapid rate of AA and EtOH decline, affecting EtOH levels more than AA, although both compounds reached pre-induction levels at approximately the same time. The rate of decline of ADH and PDC activity following low O_2 induction was accelerated by the presence of CO_2 in the atmosphere.

Based on the rapid induction of AA and EtOH in response to low O_2 stress, and the comparable rapid recovery to basal levels after removal of the stress atmosphere, together with a seemingly high tolerance to O_2 atmospheres <2% and the similar but relatively smaller effect of CO_2 compared with O_2, it is concluded that preclimacteric 'Hass' avocados are physiologically well suited to dynamic CA storage.