

Title Effects of hypoxic and anoxic controlled atmospheres on carbohydrates, organic acids, and fermentation products in Asiatic hybrid lily bulbs

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Citation Postharvest Biology and Technology, Volume 56, Issue 1, April 2010, Pages 85-94

Keywords *Lilium* bulbs; Hypoxia; Anoxia; Carbohydrates; Organic acids; Ethanol; Pyruvate kinase; Phosphoenolpyruvate carboxylase

Abstract

The effects of long-term storage of *Lilium* bulbs in humidified hypoxic and anoxic controlled atmospheres on the metabolism of carbohydrates, organic acids, and fermentation products in source and sink tissues were investigated. Shoot tissue of intact bulbs exposed to hypoxia accumulated carbohydrates (sucrose and reducing sugars), malate, and lactate, while ethanol accumulated and then gradually declined, compared with those stored in air. Under hypoxia, shoot tissues had lower invertase (Inv) to sucrose synthase (SuSy) and greater pyruvate kinase (PK) to phosphoenolpyruvate carboxylase (PEPC) activity ratios than in shoots held in air. Shoot tissues exposed to anoxia were rapidly depleted of carbohydrates, and accumulated succinate and lactate compared with shoots held in air. In anoxia, ethanol rapidly accumulated and stabilized, but did not decline as observed in shoots kept in hypoxia. Shoot tissues under anoxia also had lower Inv to SuSy activity ratios than those in air, but they were not as low as those in hypoxia. PK to PEPC activity ratios initially increased compared with air but then rapidly declined. Scales of intact bulbs accumulated sucrose under hypoxia and showed a decrease in sucrose under anoxia when compared with air storage; however, sucrose stores were not exhausted under anoxia as they were in shoot tissues. Subsequently, scale tissue viability was maintained under anoxia. Scale tissues under hypoxia did not accumulate malate, lactate, and ethanol as did shoot tissues, but accumulated succinate, lactate, and ethanol under anoxia as did shoot tissues. The accumulation of lactate in anoxic scale tissues was lower than in anoxic shoot tissues, and subsequently resulted in a higher succinate to lactate ratio. Differential responses of source and sink tissues to sub-ambient O₂ levels are discussed.