Dynamics of sugars, anaerobic metabolism enzymes and metabolites in apples stored under dynamic controlled atmosphere

Fabio Rodrigo Thewes, Auri Brackmann and Daniel Alexandre Neuwald

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Abstract

Apple storage under extremely low oxygen concentrations, as in dynamic controlled atmosphere, changes both aerobic and anaerobic metabolism. In this work we evaluated the effects of controlled atmosphere (CA) and dynamic controlled atmosphere based on respiratory quotient (DCA – RQ), with RQ 1.3 and RQ 1.5, on the dynamics of pyruvic acid, sugars, anaerobic metabolites and enzymes involved in anaerobic metabolism of 'Elstar' and 'Nicoter' apples after harvest, 6 and 9 months of storage plus 7 days of shelf life. We also investigated the induction of sorbitol and glycerol biosynthesis, as a response to low oxygen stress in apples stored under DCA – RQ, protecting the cell membrane from leakage. Storage under CA and DCA – RQ had different dynamics of sugars accumulation from harvest up to 9 months of storage, especially for sorbitol, which accumulated more over the storage period when fruit are stored under DCA - RQ. Glycerol was not detected in any of the cultivars or storage conditions. Storage under DCA reduces the membrane permeability even with the accumulation of anaerobic metabolism compounds, like acetaldehyde and ethanol. Perhaps, this is a result of the higher sorbitol accumulation, which acts as osmolyte. For both cultivars, the storage under DCA resulted in an increase of PDC enzyme activity from harvest to 9 months of storage. The dynamics of anaerobic metabolism compounds were different for both cultivars: 'Elstar' apples showed an increase from harvest to 9 months storage, but 'Nicoter' had an increase until 6 months of storage and a sharp reduction until 9 months of storage. The regulation of anaerobic metabolism is performed by PDC enzyme activity, with little influence of ADH enzyme activity, when apples are stored under DCA – RQ. 'Nicoter' apples are much more sensitive to low oxygen stress conditions as compared to 'Elstar'.