Title Dynamic controlled atmosphere (DCA): Does fluorescence reflect physiology in storage?

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Abstract

A link between the minimum fluorescence (F_o) and a metabolic shift from predominantly aerobic to fermentative metabolism [i.e. the lower oxygen limit (LOL)] is the foundation of dynamic controlled atmosphere (DCA). Current DCA technology uses pulse frequency modulated (PFM) sensors and employs a range of light intensities and extrapolation to measure F_α, an approximation of F_o. Like fruit mass, colour, sugar or acid levels, the LOL is inherently variable, even between apples (*Malus domestica*) (for example) from a given cultivar and tree or between the sun-exposed and shaded regions of a single fruit. The physiological link between metabolism and fluorescence has not been extensively studied. However, recent work suggests the low-O_2-induced rise in F_α results from a shut down of mitochondrial function and a buildup of reductant that leads to an over-reduction of the plastoquinone (PQ) pool and a decrease in photochemical quenching. Hypoxic conditions above the LOL can decrease F_α slightly in some species, possibly as a result of zeaxanthin formation and increased non-photochemical quenching. Low-intensity light differentially affects F_α depending on the O_2 level: light increases F_α when O_2 levels are above the LOL due to light-induced reduction of the oxidized PQ pool, but decreases the elevated F_α signal below the LOL as a result of a PSI-driven oxidation of the over-reduced PQ pool. Temperature has a negative, primarily non-physiological correlation with the F_α baseline which seems unrelated to the PQ pool redox state. Understanding how O_2 and other factors affect F_α may improve the utility and commercial application of DCA.