Title Effect of high temperature on color, chlorophyll fluorescence and volatile biosynthesis in green-ripe banana fruit

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Abstract

Banana (Musa AAA group) is one of the most consumed fruits in the world. It has been reported that chlorophyll breakdown and color formation in banana is inhibited by ripening temperatures above 24 °C. At this temperature thylakoid membranes are retained resulting in reduced chlorophyll degradation. In this study, green mature, untreated banana fruit were obtained from a local wholesale market and half of the fruit were subjected to ethylene treatment at 10 $\mu L\ L^{-1}$ for 24 d. After ethylene treatment, both treated and untreated fruit were stored at 20 °C or 30 °C for 7 d. Fruit were sampled after 0, 1, 4 and 7 d of storage and evaluated for color, chlorophyll fluorescence, volatile production and expression of genes related to volatile biosynthesis. Storage at 30 °C reduced yellow color development in the peel, decreased chlorophyll fluorescence (Fv/Fm), but increased Fo, indicating possible heat stress of the fruit. A total of 19 volatile compounds were identified using SPME/GC/MS. Both ethylene treatment and high temperature enhanced volatile production. The increase of Fo and hexanoate and acetate esters are coincided with the stress of high temperature. Using real time PCR (qPCR), expression of genes related to volatile biosynthesis including *branched-chain amino acid transaminase* (*BCAT*), *lipoxygenase* (LOX), *hydroperoxide lyase* (*HPL*), *pyruvate decarbolxylase* (*PDC*), *alcohol dehydrogenases* (*ADH*, short and medium chains), and *alcohol acetyl transferase* (*AAT*) were investigated in both peel and pulp tissues. Among the tested genes, *BCAT*, *HPL*, *ADH* and *AAT* in peel and pulp tissues increased significantly in response to ethylene and storage at 30 °C. *PDC*, *ADH* and *BCAT* (in pulp tissue) were induced by storage at 30 °C in ethylene-treated fruit. *LOX* decreased during ripening and storage at 30 °C in the peel, but increased in the pulp tissue of ethylene-treated fruit. This study demonstrates that both ethylene and high temperature influence volatile biosynthesis in banana fruit at the transcriptional level and confirms findings that high temperature causes stress in banana fruit during ripening.