Title Ethylene-induced tolerance to non-chilling peel pitting as related to phenolic metabolism and lignin content in 'Navelate' fruit

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Citation Postharvest Biology and Technology, Volume 45, Issue 2, August 2007, Pages 193-203

Keywords Albedo; Citrus; Ethylene; Flavedo; Lignin; Phenylalanine ammonia-lyase (PAL); Rindstaining; Soluble and ionically bound peroxidase (POD); Total phenolics

Abstract

The involvement of phenylpropanoid metabolism in the beneficial effect of ethylene conditioning in reducing postharvest non-chilling peel pitting occurring in 'Navelate' orange fruit has been investigated. We examined changes in the activities of the enzymes phenylalanine ammonia-lyase (PAL; EC 4.3.1.5), soluble and ionically bound peroxidase (POD, EC 1.11.1.7) and on phenolic and lignin contents in the flavedo and albedo tissues of fruit stored in air at 22 °C and constant high (90–95%) RH (control fruit), and in fruit conditioned for 4 days with 2 or 10 μL L^{-1} ethylene at 22 °C and 90–95% RH, and then transferred to air at the same temperature and RH. Non-chilling peel pitting was visible in control fruit after 7 days and sharply increased for up to 14 days, to remain nearly constant thereafter; while conditioning the fruit with both ethylene concentrations considerably reduced it. Soluble and cell wall-related POD activities decreased, and PAL transiently increased, in the albedo and flavedo of control fruit with the appearance of damage. Phenolic and lignin contents slightly increased in the flavedo, while in the albedo, which had a lower PAL activity than the flavedo, phenolic contents barely changed and lignin decreased. Thus, the activation of PAL in both tissues and the slight rise in lignin and phenols in the flavedo may reflect a demand for phenylpropanoid products to reduce non-chilling peel pitting. Furthermore, the decline in POD in both tissues and also the lack of the ability of the albedo to increase phenolic and lignin contents might be related to the low ability of air-treated 'Navelate' fruit to overcome this physiological disorder. Fruit conditioned with 10 μL L^{-1} ethylene maintained higher phenol and lignin levels up to 14 days and higher soluble and ionically bound POD levels up to 21 days in the flavedo, while applying 2 μL L^{-1} ethylene was less effective. In the albedo, both ethylene concentrations activated soluble POD after transfer of fruit to air and PAL also, though to a lower extent than in the flavedo. Such an increase had a low impact on the phenolic content. Likewise, both ethylene treatments delayed the decline in lignin in the albedo, but the most important differences between control and ethylene-treated fruit occurred when peel damage was very evident in control fruit. The overall results indicate, therefore, that phenolic metabolism may be required for building protecting barriers that would help 'Navelate' fruit to reduce non-chilling peel pitting, although additional defense mechanisms which would assist in reducing non-chilling peel pitting in 'Navelate' fruit appear to be induced by ethylene pretreatment.