Title Induction of resistance in citrus fruit against *Penicillium digitatum* infection and phenylpropanoid metabolism

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Abstract

Penicillium spp. are among the major postharvest pathogens of citrus fruit in Mediterranean climate regions. The application of fungicides constitutes the most common method used to control postharvest diseases. However, due to the development of resistance to fungicides among fungal pathogens and the growing public concern on their effects on human health and environment, there is a trend to develop alternative methods to control postharvest diseases. Induction of natural resistance in fruits constitutes one of the most promising alternatives to chemical fungicides. We have recently used an infection+curing treatment that induces resistance in citrus fruit. Resistance coincided with the induction of PAL, soluble peroxidase, basic β-1,3-glucanase and chitinase at both gene expression and enzyme activity levels. Moreover, using a transcriptomic approach we have shown that secondary metabolism, mainly phenylpropanoid biosynthesis, and ethylene play important roles in the induction of resistance in citrus fruit and in the defense against pathogens.

In order to better understand the biological basis of induced resistance in citrus fruit and to gain deeper insight into the involvement of the phenylpropanoid pathway, we studied changes in the expression of genes coding for PAL and several O-methyltransferases. Most of these genes are up-regulated by the induction treatment, but to a higher level in the albedo. We have also determined the metabolic profile of phenolic compounds in elicited oranges using HPLC coupled to a PDA and a fluorescence detector. Further analyses by HPLC coupled to an accurate mass spectrometer allowed the identification of several compounds that may be relevant for induced resistance. In elicited fruits, a greater diversity of phenolic compounds was observed in the flavedo (outer coloured part of the peel) as compared to the albedo (inner white part of the peel). Only small changes were detected in the most abundant flavonoids, such as flavones, flavanones and polymethoxylated flavones. The coumarin scoparone was among the compounds with highest induction upon elicitation. Two other induced compounds were identified as citrusnin A and drupanin aldehyde. All three compounds are known to exert antimicrobial activity. Our results indicate that phenylpropanoids and flavonoids play an important role in the induction offesistance in citrus fruit.