Metabolic snapshot of grapevine-pathogen interactions through mass spectrometry imaging

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Abstract

Every year, viticulture is facing several outbreaks of established diseases, such as downy and powdery mildews and gray mold, which possess different life cycles and modes of infection. To cope with these different aggressors, grapevine must recognize them and arm itself with an arsenal of defence strategies, including the accumulation of antimicrobial metabolites.

Plant metabolites are the first to be affected by changing conditions. Their rapid reactions activate and induce a series of defense mechanisms allowing the plant to adapt, defend and survive.

Despite the scientific community's efforts to characterize grapevine defence responses to pathogens, the molecules involved in pathogen recognition and their specific location upon pathogen interaction are still unknown.

Hence, to fully understand grapevine-pathogen interactions and to clarify metabolite specific roles in plants resistance/susceptibility to pathogens, it is not only important to identify the compounds involved in the first moments of the infection process but also to localise them *in vivo* and correlate their localisation with pathogens' recognition and development.

In our work, we investigate the metabolic responses during grapevine-pathogen interactions. We have been studying the metabolic events occurring in leaves, from different *Vitis* cultivars, infected with *Botrytis cinerea*, the causal agent for gray mold*,* through a time course infection using Matrix Assisted Laser Desorption Ionization-Mass Spectrometry Imaging (MALDI-MSI).

MALDI-MSI is a powerful technique that has the unique ability to analyse the sample surface directly by combining raster-scans of the sample surface with laser shots with high-mass resolution. This technique can reveal the molecules involved in the first stages of pathogen contact with the host leaf surface as well as their localisation, bringing new information and allowing a better understanding of pathogen recognition by grapevine and defense mechanism induction. In this work, we focus on the accumulation and spatial distribution of different phytoalexins (small compounds with antimicrobial activity synthesized *de novo* by plants in response to stresses) such as resveratrol and viniferins. Our results show that these compounds accumulate in areas close to the pathogen infection sites. Different genotypes are being compared and other phytoalexins as well as other compounds (involved in grapevine defence) are being investigated.

Keywords: mass spectrometry imaging, metabolomics, plant-pathogen interaction, phytoalexins