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Stilbenes as Sustainable Antimicrobial Compounds to Control Vitis Vinifera Diseases

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Abstract : Nowadays, there is a strong pressure to reduce the phytosanitary inputs of synthetic chemistry in vineyards. It is, therefore, necessary to find viable alternatives in order to protect the vine against its major diseases. For this purpose, we suggest the use of a plant extract enriched in antimicrobial compounds. Being produced from vine trunks and roots, which are co-products of wine production, the extract produced is part of a circular economy. The antimicrobial molecules present in this plant material are polyphenols and, more particularly, stilbenes, which are derived from a common base, the resveratrol unit, and that are well known vine phytoalexins. The stilbenoids were extracted from trunks and roots (30/70, w/w) by a double extraction with ethyl acetate followed by enrichment by liquid-liquid extraction. The produced extract was characterized by UHPLC-MS, then its antimicrobial activities were tested on Plasmopara viticola and Botrytis cinerea in the laboratory and/or in greenhouse and in vineyard. The major compounds were purified, and their antimicrobial activity was evaluated on B. cinerea. Moreover, after its spraying, the effect of the stilbene extract on the plant defence status was evaluated by analysis of defence gene expression. UHPLC-MS analysis revealed that the extract contains 50% stilbenes with resveratrol, ε-viniferin and r-viniferin as major compounds. The extract showed antimicrobial activities on P. viticola with IC_{50} and IC_{100} respectively of 90 and 300 mg/L in the laboratory. In addition, it inhibited 40% of downy mildew development in greenhouse. However, probably because of the sensitivity of stilbenes to the environment, such as UV degradation, no activity has been observed in vineyard towards P. viticola development. For B. cinerea, the extract IC50 was 123 mg/L, with resveratrol and ε-viniferin being the most active stilbenes (IC_{50} of 88 and 142 mg/L, respectively). The analysis of the expression of defence genes revealed that the extract can induce the expression of some defence genes 24, 48, and 72 hours after treatment, meaning that the extract has a defence-stimulating effect at least for the first three days after treatment. In conclusion, we produced a plant extract enriched in stilbenes with antimicrobial properties against two major grapevine pathogenic agents P. viticola and B. cinerea. In addition, we showed that this extract displayed eliciting activity of plant defences. This extract can therefore represent, after formulation development, a viable eco-friendly alternative for vineyard protection. Subsequently, the effect of the stilbenoid extract on primary metabolism will be evaluated by quantitative NMR.

Keywords : antimicrobial, bioprotection, grapevine, Plasmopara viticola, stilbene
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