Antifungal effect of nerol via transcriptome analysis and cell growth repression in sweet potato spoilage fungi *Ceratocystis fimbriata*

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Abstract

Ceratocystis fimbriata is the most devastating phytopathogen causing significant losses in post-harvest sweet potato. In this study, monoterpene nerol (NEL), the active compound in neroli essential oil, was found to dose-dependently inhibit the mycelial growth and spore germination of *C. fimbriata* at a minimum inhibitory concentration (MIC) of 0.25 mL L^{-1}. NEL vapor treatments significantly reduced the incidence and lesion diameter of black rot in sweet potato infected by the fungus and regulated the defense-related enzyme activity of phenylalanine ammonia lyase (PAL). Using RNA sequencing (RNA-seq) and biochemical assays, it was demonstrated that NEL treatment impaired cell membrane integrity via down-regulating the expression of ergosterol synthesis genes and reduced the ergosterol content. Moreover, an analysis of a series of apoptotic events revealed that NEL treatment caused mitochondrial membrane damage by reducing the mitochondrial membrane potential (MMP, $\Delta\psi m$), which led to down-regulation of genes involved in ATP production, then induced accumulation of intracellular reactive oxygen species (ROS) generation. Simultaneously, NEL caused nuclear chromatin condensation and concomitant DNA cleavage, which led to the up-regulation of DNA repair genes expression, and the cell-cycle arrest principally occurred at the G2/M phase in *C. fimbriata*. Altogether, these findings provide information about the underlying antifungal mechanism of NEL against *C. fimbriata* and suggest that NEL could be a useful alternative for controlling *C. fimbriata* in post-harvest spoilage of sweet potato.