

Title Combined effect of volatile antimicrobial agents on the growth of *Penicillium notatum*
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Abstract

Widely used antimicrobial volatile organic compounds, such as sulphur dioxide and ethanol but also selected aroma compounds such as carvacrol, allyl isothiocyanate (AITC) and cinnamaldehyde, were tested single and in binary combination for their effect on *Penicillium notatum* growth in vapour phase at 30 °C. Aroma compounds were more efficient compared to sulphur dioxide and ethanol. AITC and cinnamaldehyde had the highest inhibition activity on the growth of *P. notatum* with minimum inhibitory concentration (MIC) of 3.8 and 3.9 µmol/L of air, respectively. The impact of agents combined two by two was assessed using two criteria, the increase of growth delay and the reduction of growth rate. A synergistic activity was identified for six combinations; ethanol/carvacrol, sulphur dioxide/carvacrol, sulphur dioxide/AITC, sulphur dioxide/cinnamaldehyde, AITC/cinnamaldehyde and cinnamaldehyde/carvacrol. The advantage of these combinations is to reduce the concentration of each agent and their relative impact in organoleptic properties.