

Title RETRACTED ARTICLE: Effect of calcium chloride on the biocontrol efficacy of two antagonistic yeasts against *Penicillium expansum* on apple fruit

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Abstract

Two antagonistic yeasts, *Candida membranaefaciens* and *Pichia guilliermondii*, were evaluated for the control of the blue mold of apple caused by *Penicillium expansum*. Dual culture, cell-free metabolite and volatile tests were used for *in vitro* assay. Yeast strains of two genera inhibited growth of *P. expansum*; inhibition varied from 30.27% to 44.19% in dual culture, from 79.40% to 90.57% in the volatile metabolite test, and from 72.99% to 88.77% in the cell-free metabolite test. Calcium chloride (2% w/v) significantly inhibited the growth of the pathogen *P. expansum*, but did not affect the colony-forming units (CFU) of the yeasts *C. membranaefaciens* and *P. guilliermondii* in potato dextrose broth. The concentration of yeast suspension influenced spore germination and germ tube growth of *P. expansum in vitro*, as well as disease incidence and lesion development in fruits. There were significant negative relationships between the suspension concentrations of the yeasts and the growth as well as infectivity of the pathogen. The addition of calcium resulted in lower spore germination rates and slower growth of germ tubes *in vitro*, as well as in lower disease incidences and smaller lesion diameters compared with treatments with yeast antagonists alone. When yeast cell suspensions reached a concentration of 10^7 CFU ml⁻¹, growth of the pathogen was completely limited *in vitro*, and no infection was found in apple fruits treated with or without calcium.

<http://www.springerlink.com/content/402n6u5r742v1460/fulltext.pdf>