

# Evaluation of yeast isolates from kimchi with antagonistic activity against green mold in citrus and elucidating the action mechanisms of three yeast: *P. kudriavzevii*, *K. marxianus*, and *Y. lipolytica*

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## Abstract

Many citrus farmers are deprived of their profits as a result of post-harvest losses in citrus production. Diverse microbial environments including fermented foods are necessary to be explored in the quest to get more novel biocontrol yeasts to control post-harvest pathogens in citrus. 90 yeasts were isolated from kimchi in this investigation. Inhibition tests *in vitro* showed that 10 of the 90 yeasts reduced the development of fungal mycelia by the formation of an inhibition zone. Molecular methods were used to identify the yeast isolates, and they were *Pichia* sp., *Kluyveromyces marxianus*, *Yarrowia lipolytica*, and *Issatchenkia orientalis*. Three isolates tested *in vivo* in citrus were able to reduce disease incidence within the range from 18 % to 57 %. The action mechanisms of the three yeasts were studied subsequently by determining the biofilm formation ability of the yeast isolates, screening of yeast isolates for extracellular lytic enzyme activity, evaluating the effect of yeast isolates' volatile organic compounds (VOCs) on *P. digitatum*, investigating the competition for nutrients between *P. digitatum* and yeast isolates, etc. For *Pichia kudriavzevii*, the most effective one, reduced the incidence of green mold caused by *Penicillium digitatum* (Pd1 / CECT 20795) by biofilm formation, competition for nutrients, and emitting volatile organic compounds. *K. marxianus* showed antifungal activity by inducing resistance, and colonization on wound sites. Whereas *Y. lipolytica* inhibited *P. digitatum* by adhesion to pathogen mycelia and production of extracellular lytic enzymes. Evidence from this study suggests that some yeast strains isolated from kimchi have the potentials to inhibit green mold in citrus.