Inhibitory effect of gamma irradiation on *Penicillium digitatum* and its application in the preservation of Ponkan fruit

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Abstract

Penicillium digitatum is a fungal pathogen, mainly responsible for postharvest decay of citrus fruits. Herein, we investigated the effect of gamma irradiation on fungal growth and postharvest physiology of Ponkan mandarin (*Citrus reticulata* Blanco). Preliminary results revealed that high dose gamma irradiation (> 1 kGy) severely damaged the fruit. Thus, we evaluated the effect of lower doses of gamma radiation (0, 0.25, 0.50, 0.75, 1.0 kGy) on disrupting the growth of *P. digitatum*, as well as on the postharvest quality of the Ponkan fruit. We found that there was an inverse dose-dependence to gamma irradiation-mediated inhibition of *P. digitatum* growth. Next, we examined the membrane integrity in the fungi that were exposed to gamma radiation to understand the underlying mechanism of the observed growth inhibition. The gamma irradiation disrupted the fungal membrane, resulting in the leakage of intracellular contents, such as sugars and proteins out of the damaged cells. Moreover, the irradiation impaired the metabolic functioning of malate dehydrogenase (MDH) and succinate dehydrogenase (SDH) within the tricarboxylic acid cycle (TCA) cycle. The overall results showed that at room temperature, the preservative effects of 0.25 and 0.75 kGy radiation were not evident, whereas 1.0 kGy resulted in rapid aging of the Ponkan fruit; 0.5 kGy was the optimal radiation dose to slow down the rate of fruit decay whilst decreasing the nutrient and weight loss in storage. Additionally, 0.5 kGy irradiation reduced the content of malondialdehyde (MDA), resulting in the improved activity of superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD). Thus, these findings suggest that the optimal dosage of gamma radiation had the potential to extend the room temperature storage life of Ponkan fruit.