^{60}Coγ-ray irradiation inhibits germination of fresh walnuts by modulating respiratory metabolism and reducing energy status during storage

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Abstract

Postharvest germination negatively affects the development of fresh walnut industry. Our previous research showed that ^{60}Coγ-ray irradiation with 0.3 kGy effectively inhibited the germination of fresh walnuts during storage, but the underlying mechanism in respiratory metabolism remains still unclear. The untreated and 0.3 kGy-irradiated fresh walnuts were stored at 25 °C for 24 d, and then the indicators related to respiratory metabolism in kernels and embryos were determined. The results found that the 0.3 kGy irradiation decreased the respiration intensity after 15d and completely inhibited the germination of fresh walnuts with the declined adenosine triphosphate (ATP) content and energy charge (EC) levels in kernels except from 12 to 15 d and polyphenol oxidase (PPO), cytochrome C oxidase (CCO) and ascorbic acid oxidase (AAO) activities in both tissues except the stimulated PPO activity in embryos during storage. Moreover, the irradiation promoted the glucose-6-phosphate dehydrogenase (G6PDH) and 6-phosphogluconate dehydrogenase (6PGDH) activities but reduced the isocitrate lyase (ICL) activity in both tissues, and decreased the nicotinamide adenine dinucleotide reduced form (NADH) content but increased the nicotinamide adenine dinucleotide phosphate reduced form (NADPH) content in kernels of fresh walnuts during storage. The irradiation induced the *JRG6PDH* and *JR6PGDH* expression levels in both tissues, as well as the *JRICL* and *JRMS* expression levels in kernels before 12 d but suppressed those after 12 d of storage. In conclusion, the germination inhibition of fresh walnuts by gamma irradiation is attributed to suppressed terminal oxidases activities, decreased ratio of Embden–Meyerhof–Parnas pathway-tricarboxylic acid cycle (EMP-TCA) and glyoxylate cycle (GAC), increased level of pentose phosphate pathway (PPP) and reduced energy status.