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Essential oils and natural plant extracts as antifungal ingredients of pectin-based edible composite coatings to control green mold and maintain postharvest quality of 'Valencia' oranges

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Abstract

Pectin-beeswax edible coatings containing essential oils (EOs) and plant extracts as antifungal ingredients have been developed to reduce postharvest losses in 'Valencia' oranges. After *in vitro* evaluation of the antifungal activity of the ingredients against *Penicillium digitatum*, selected agents and concentrations (0.2-2%, w/w) were incorporated into the coating. The curative activity of antifungal edible coatings (AECs) to control green mold was tested on artificially inoculated oranges incubated 8 days at 20°C. The effects of selected AECs on green mold and fruit physicochemical and sensory quality were tested on oranges stored for up to 8 weeks at 5°C plus 1 week at 20°C. Commercial compounds evaluated *in vitro* were cinnamon (CN), lemongrass (LG), *Satureja montana* (SM), myrrh (MY), eugenol (EU), geraniol (GE), green tea extract (GT), propolis (PRO), and vanillin (VA). Mycelial growth inhibition of *P. digitatum* after 7-14 days of incubation at 25°C was evaluated in PDA media exposed to EOs volatiles or by direct contact with the extracts using the agar dilution method. CN, SM, EU and GE (at a dose of 20 µL) inhibited the fungus radial growth by 90-100%; whereas, VA, PRO and MY were effective at 0.125-0.5%. After 8 days of incubation at 20°C, AECs containing 0.2% GE, 0.8% EU or 1.5% MI reduced green mold incidence (infected fruit, %) on oranges by more than 40%, while the highest reduction in disease severity (lesion diameter, mm) was observed with 0.8% CN. After 4 weeks of cold storage, 0.2% GE and 0.8% EU-based coatings reduced disease incidence by more than 50%, and 0.8% EU-coating was the most effective to reduce severity. In addition, the 0.8% EU-based coating was the most effective to reduce weight loss and provided the highest gloss on coated oranges at the end of the storage, showing its potential to reduce citrus postharvest losses.

Keywords: Citrus, *Penicillium digitatum*, disease control, natural antifungal agents, postharvest quality