# Boosting antifungal effect of essential oils using combination approach as an efficient strategy to control postharvest spoilage and preserving the jujube fruit quality

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## Abstract

Antifungal activity and biochemical changes in jujube fruit treated with the synergistic combinations of some essential oils were investigated to extend the postharvest shelf-life. The combinations of thyme-rosemary and thyme-cinnamon showed synergistic effects (fractional inhibitory concentration index (FICI) ≤0.5) against *Alternaria alternata*. The same interaction was also observed in the dual combinations of cinnamon-marjoram, and thyme-cinnamon in inhibiting the *Penicillium expansum*, and a triple combination of cinnamon-rosemary-thyme. Also, the synergistic effects of the dual treatment of thyme (0.312 g $L^{-1}$)-cinnamon (0.312 g $L^{-1}$) and triple treatment of cinnamon (0.156 g $L^{-1}$)-rosemary (0.625 g $L^{-1}$)-thyme (0.078 g $L^{-1}$) in inhibiting both spoilage fungi in jujube fruit were confirmed. Furthermore, the treatment of jujube fruit with dual or triple EOs has been effective on the phenolic compounds, flavonoids, polyphenol oxidase (POD) and phenylalanine ammonia-lyase (PAL) activities. Moreover, controlled respiratory activity and weight loss as well as ascorbic acid stability during the storage period were recorded for jujube fruit treated with EOs.