

## Postharvest treatments with biocontrol agents and essential oils strongly modify the fruit microbiome

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Postharvest disease management of fruits is crucial for global food security amid a growing population. Innovative strategies utilizing natural compounds, such as essential oils and biocontrol agents, are promising alternatives to pesticides to control storage rots of fruit. Biofumigation with slow-release diffusers of essential oils (EOs) was effective in the control of grey mould of apples and of brown rot of nectarines. Metabarcoding analysis showed a significant impact of tissue, treatment, and sampling time on the fruit microbiome composition. Epiphytic microbiome had higher richness and evenness compared to their endophytic counterpart. On apples, treatments with thyme EO reduced *B. cinerea* abundance, while favouring a significant increase in *Penicillium* species. Similarly, on nectarines, basil EO was able to reduce the abundance of *Monilinia* spp. but it favoured a significant increase of *Penicillium* spp. Application of different biocontrol agents (BCAs) to control postharvest rots of apples, nectarines and grapes significantly affected both the epiphytic and endophytic microbiome. The BCAs were recovered as epiphytes and as endophytes, demonstrating an internalization in the fruit pulp. On nectarines, the microbiome analysis showed a good proliferation of the yeasts on the treated fruit, together with a reduction of *Monilinia* spp. On apples, the addition of *Aureobasidium pullulans* did not correlate with a decreased abundance of white haze genera, though the disorder occurrence was reduced on the fruit, which might suggest a more complex activity. On grapes, the species of BCAs applied were among the most abundant taxa recovered, with a consequent reduction of *Botrytis* spp. Fruit surfaces harbour resilient microbial communities, which make challenging the establishment of BCAs. Integrating microbial communities to create a conducive environment for biocontrol agents shows promise in real-world conditions. These findings provide new insights for the development of sustainable strategies for the management of postharvest diseases of fruit.

*Biofumigation, metabarcoding, apples, nectarines, grapes, biological control, microbiota, Botrytis, Penicillium, Monilinia*