

Efficacy of Biocontrol Yeasts Against *Penicillium Expansum* and Patulin on Different Cultivars of Apple in Postharvest

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Abstract

The postharvest environment is particularly delicate for the maintenance of quality and safety of fruits, due to its length that can approach ten months. Quantity and quality losses due to fungal diseases in the field, during storage, as well as in transit and commercialization can be really severe, but some fungi can also produce toxic metabolites, known as mycotoxins.

At present, control in conventional agriculture is mainly achieved through chemical strategies, which can also have many disadvantages, such as the public's growing concern for the human health conditions and the environmental pollution associated with pesticide usage in orchards, the development of fungicide-resistant strains of postharvest pathogens.

One promising alternative to pesticides is the biological control that fits in well with the concept of sustainable agriculture and organic farming, because it mostly exploits natural cycles with reduced environmental impact. Among the biological strategies applicable to postharvest, the induction of resistance in the fruit, the use of plant or animal products with a fungicidal activity, and, above all, the application of antagonistic microorganisms can be considered.

*This latter strategy could also be used against *Penicillium expansum*, the causal agent of blue mould rot on apples and pears and the main producer of a mycotoxin named patulin. Acute symptoms of patulin consumption can include agitation, convulsions, edema, ulceration, intestinal inflammation, and vomiting. Chronic health effects of patulin include genotoxicity, immunotoxicity, and neurotoxicity in rodents, while its effects on humans are not clear yet. The maximum permitted level of patulin in fruit juices and nectars, in particular apple juices and apple juice ingredients in other beverages marketed in Europe is 50 µg kg⁻¹.*

*The aim of the present study was to study the efficacy of different antagonistic yeasts belonging to the genera *Debaryomyces*, *Hanseniaspora*, *Kloeckera*, *Metschnikowia*, *Pichia*, and *Rhodotorula* in reducing the development of *P. expansum* on apples and its capacity to produce patulin. The biocontrol effectiveness was assessed on four apple cultivars (*Golden delicious*, *Stark delicious*, *Granny smith*, and *Royal gala*).*

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The fruits were artificially wounded and inoculated with a conidial suspension of P. expansum (10^5 conidia ml⁻¹). After storage at room and low temperatures, the diameter of the rotten area, the percentage (w/w) of the rot and the concentration of patulin were measured. A particular protocol was adapted for patulin extraction and analysis through HPLC-DAD.

The results showed that the highest biocontrol activity was provided by a strain of Metschnikowia pulcherrima on the four cultivars. The efficacy was higher on the in cv Golden delicious. Others promising results were provided by two strains of Hanseniaspora uvarum and Rhodotorula spp., active in controlling the pathogen growth and the patulin production on the cv Golden delicious.

Work is in progress to ascertain whether the reduction of patulin is due to an absorbance or to a biodegradation established by the antagonistic yeasts.