

## The Effect of the *Spinacia oleracea* Extract on the Control of the Green Mold '*Penicillium digitatum*' at the Post Harvested Citrus

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**Abstract :** *Penicillium digitatum*, the causal agent of citrus green mold, is responsible for 90% of post-harvest losses. Chemical fungicides remain the most used products for protection against this pathogen but are also responsible for damage to human health and the environment. The aim of this study is to evaluate the ability of *Spinacia oleracea* extract to serve as biological control agents, an alternative to harmful synthetic fungicides, against orange decay for storing fruit caused by *P. digitatum*. In this study, we studied the implication of a crude extract of a green plant, *Spinacia oleracea*, in the protection of oranges against *P. digitatum*. Thus, in vivo antifungal tests as well as adhesion test were done. For in vivo antifungal test, oranges were pulverized with the prepared crude extracts at different concentrations ranged from 25 g L<sup>-1</sup> to 200 g L<sup>-1</sup>, contaminated by the fungus and then observed during 8 weeks for their macroscopic changes at 24°C. For adhesion test, the adhesion index is defined as the number of *Penicillium digitatum* spores fixed per orange cell. An index greater than 25 is the indicator of a strong adhesion, whereas for an index less than 10, the adhesion is low. Ten orange cells were examined in triplicate for each extract, and the averages of adherent cells were calculated. Obtained results showed an inhibitory activity of the *Penicillium* development with the aqueous extract of dry *Spinacia oleracea* with a concentration of 50 g L<sup>-1</sup> considered as the minimal protective concentration. The prepared extracts showed a greater inhibition of the development of *P. digitatum* up to 10 weeks, even greater than the fungicide control Nystatin. Adhesion test's results showed that the adhesion of *P. digitatum* spores to the epidermal cells of oranges in the presence of the crude spinach leaves extract is weak; the mean of the obtained adhesion index was estimated to 2.7. However, a high adhesion was observed with water used a negative control. In conclusion, all these results confirm that the use of this green plant highly rich in chlorophyll having several phytotherapeutic activities, could be employed as a great treatment for protection of oranges against mold and also as an alternative for chemical fungicides.

**Keywords :** *Penicillium digitatum*, *Spinacia oleracea*, oranges, biological control, postharvest diseases

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