

The use of lemon essential oil to control green mold (*Penicillium digitatum*) in Tucumán

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Abstract

Citrus Green mold disease caused by *Penicillium digitatum* Sacc is the most important postharvest disease of lemon in Tucumán. The use of lemon essential oil (LEO) is a promissory alternative to control this mould. The objective of this work was to evaluate LEO effectiveness at two doses to control citrus Green mold in lemon fruit. Mature fruits were inoculated using a punch previously dipped in a suspension of 1×10^6 spore/ml of a strain isolated from packing house, and incubated in chamber at 22 °C. Subsequently the fruits were dipped during 30 seconds with the following treatments: T1 Control water, T2 Lemon essential oil 0.5%, T3 Lemon essential oil 1%. The experimental unit was composed by 10 fruits. A DCA design with tree replicates (30 fruits per treatment) was used. After 10 days stored at 6 °C the sporulation grade (SG) was evaluated using a 5 grade scale (0-4) at 10 intervals. Disease Progress Area Curve (DAPAC) was constructed and ANOVA was used to compare mean values with the Fisher test (5%). Both treatments with LEO were different (DAPAC 56.0; $p=0.0012$) to control, the best treatment was T3 (28.7) presenting no difference with T2 (36.4) Although more studies should be conducted to further characterize LEO in comparison with commercial fungicides, this result constitute a promissory alternative to control citrus green mould caused by *P. digitatum*.

Keywords

Lemon, essential oil, *P. digitatum*

1. Introduction

Argentina is the largest world lemon producer and 90% of this production is located in Tucuman. The economic losses caused by postharvest diseases represent one of the main problems of world citriculture, being 80% of them produced by fungal infections. Citrus Green mold caused by *Penicillium digitatum* (PD) is the disease with the highest incidence and severity during export of lemon fruits. Actually these diseases are controlled using synthetic fungicides. Due to severe restrictions imposed to these products by ambient and health regulations there is a great demand for alternative control methods (Carbajo 2011). The use of natural products is a promissory alternative to minimize use of chemical products, since they can fulfill conditions of commercial restriction and alimentary security policies.

Among natural substances we can mention plant extracts, ozone applied in water and as gas in storage chamber, products generally regarded as safe (GRAS). The action mechanism of essential oils is not well known, nevertheless it has been reported to affect microbe membranes due to lipophilic constituents (Shelz, et al., 2006) and changes in fungus morphology, damage of reproductive structures (e.g. conidia and hyphae) and toxin production (Park, et al, 2009).

The aim of this research was to evaluate effectiveness of lemon essential oil at two different doses as alternative methods to control citrus green mold (*Penicillium digitatum*)

2. Materials and methods

Experimental work was carried out at INTA EXPERIMENTAL STATION in Famaillá Tucuman (Argentina). Mature lemon fruits of Eureka variety were previously disinfected by immersion in 0.5% sodium hypochlorite solution during 1 minute.

Fruits were inoculated using a punch previously dipped in a suspension of 1×10^6 spore/ml of sensitive strain at two opposite equatorial site and incubated in chamber at 22 °C, 24 hours.

As inoculum a sensitive strain previously isolated from citrus packing house was used. The experimental unit consisted in 10 fruits, and a DCA design with tree replicates (30 fruits per treatment) was applied.

Subsequently the fruits were dipped during 30 seconds with the following treatments: T1 Control water, T2 Lemon essential oil 0.5%, T3 Lemon essential oil 1%. Then treated fruits were stored in cool chamber at 6 °C and 90 % RH during 30 days, followed with further 7 days at 20 °C to mimic the commercialization period usually employed.

After this incubation period fruits were maintained at 6 °C during 10 days. The sporulation grade (SG) was evaluated every 10 days using a 5 grade scale (0-4) according to Carbajo (2011), in which Grade 0 represents sound fruits; Grade 1, incipient softening; Grade 2, presence of white mycelium; Grade 3, green sporulation at one fruit side; Grade 4, fruits completed covered with green sporulation of fruit. Four evaluations were performed along the experimental time. Disease Progress Area Curve (DAPAC) was constructed and ANOVA was used to compare mean values with the Fisher test (5%).

3. Results and discussion

Table 1. Disease Progress Area (grade per day) and sporulation grade

Treatment	Media	n	E.E	
3	28.7	3	2.79	A
2	36.35	3	2.79	A
1	56.03	3	2.79	B

Test: LSD Fisher Alfa=0.05 DMS=9,66028. Error: 23.3794 gl: 6. Values with different letter mean statistical different ($p < 0.05$)

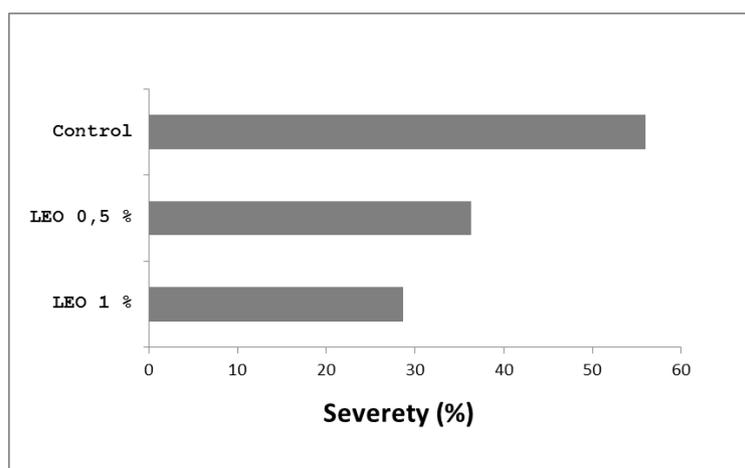


Figure 1. Control of *P. digitatum* (severity) by lemon essential oil treatments

Results obtained revealed that both treatments with LEO used to control the pathogen growth present statistical difference (DAPAC 56.0; $p=0.0012$). Table I and Figure I shows that the best treatment was T3 (28.7) presenting no difference with T2 (36.4). Although more studies should be conducted to further characterize LEO in comparison with commercial fungicides, this result constitutes a promissory alternative to control citrus green mould caused by *P. digitatum*.

4. Conclusion

Essential lemon oil treatment as natural product could be used as strategy to control citrus green mold for its innocuous characteristic. Its use could allow reducing the use of synthesis fungicides with high residual level, lessening the impact on environment and human health.

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