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EFFECTS OF PLANT ESSENTIAL OILS IN REDUCING FUNGAL CONTAMINATON OF ORGANIC DRIED FIGS DURING STORAGE

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Abstract

As in many other fig growing countries, aflatoxin contamination due to fungal agents is an important problem in fig production in Turkey, which is the world's biggest dry fig exporter. Contamination of fungal agents starts when fruits are still on trees and continue to progress after harvest, especially under inappropriate processing as well as storage conditions. The aim of this study was to investigate the possibilities of using some natural essential oils in reducing the post-harvest (dried fig fruits) decays caused by microbial contamination. Sarilop dried fig fruits were dipped to solutions containing essential oils of laurel *(Laurus nobilis L)* and origanum *(Origanum onites L)* at different doses. Fruits were then stored in boxes indoor conditions during 3 months. Fruit sections (each 1 g) from outside of fruits were taken 2, 30, 60 and 90 days after treatments and given to petri dishes containing potato dextrose agar (PDA) with three replications. Petri dishes were then incubated at 25 ^{0}C for 5 days. They were then evaluated for the occurrence of molds. Results showed that essential oils showed limited efficacy which can be attributed to the low doses used in the study. Also low temperature during storage caused a natural decline in microbial population, so that the effects of treatments could have been masked. Further studies are needed with higher doses of essential oils under climatic conditions favoring the growth of microorganisms.

Key words: *dried figs, essential oils, Laurus nobilis L, Origanum onites L., storage*

Introduction

Fig (*Ficus carica*) is an important crop grown in many Mediterranean countries primarily in Turkey. The world's total dry fig production is about 95 000 tones, of which Turkey produce about 50-60 000 tones corresponding about 50-60%. About 90% of Turkey's dry fig production is exported. Since fig fruits have high water activity in both ripening stage (0.91-0.97 a_w) or drying stage before falling down from trees (0.80-0.89 a_w), it is an attractive crop for microorganisms that produce mycotoxins.

Aspergillus niger, A. flavus, *A. parasiticus*, *Fusarium* spp and *Penicillium* spp are dominant fungal flora of dried figs causing mycotoxins formation. Aflatoxin and okratoxin A are two most important mycotoxins in dried figs. One gram dry fig contains these microorganisms in numbers from several hundreds to one thousand (Frazier anda Westhoff, 1988). Unsuitable storing conditions with high humidity and temperature can stimulate the increase of these microorganisms.

Apart from other fruits, fig fruits dry on trees and fall down by themselves to ground. They are then collected from ground and further dried under sunshine naturally. After drying period they are classified to the qualities and stored under room conditions until processing. Before processing stored fruits are dipped to salty water to remove the soil particles or dusts (Özen et al., 2007).

Since molds decay fruit quality and consequently public health, investigations on the prevention of mold formation on fruits should be investigated. General aim of the methods applied for food preservation is to avoid or limit the microbial and enzymatic activities. Since

fungis causing mycotoxins can attack fruits in orchards as well as during storage, special attention should be taken before processing the fruits. Therefore it was aimed with this study to investigate the effects of natural essential oils of two different plants laurel *(Laurus nobilis L)* and origanum *(Origanum onites L.*) in reducing the post-harvest (dried fig fruits) decays caused by microbial contamination, hence to extend the storage duration without quality loss in organic dried fig production.

Material and Methods

The study was conducted between 2th October and 31th December 2012 in Fig Research Station in Aydin province of Turkey. Sarilop variety of dry fig fruits grown organic and essential oils of laurel (*Laurus nobilis* L.*)* and Origanum *(Origanum onites* L.) were used as material for this study.

Experiment was designed according to randomized plot design with three replications, each replication contained 5 kg dry fig fruits. Essential oils of investigated plant species were used at three different concentrations (100 µl/l, 200 µl/l, 400 µl/l). Each concentration of essential oils was dissolved in 10 ml ethanol and given to 10 l dipping water. Dry fig fruits (5 kg) were then dipped to the solution containing essential oils for 10 seconds, while control fruits were dipped only to water without essential oils. Fruits were then stored under room conditions 90 days long.

During storage, 2, 30, 60 and 90 days after treatments, fruit samples were taken from outer parts of 10 randomly chosen fruits (each 1 g). They were then homogenized by mixing in a magnet mixer for 5 minutes within 90 ml sterilized distilled water containing 0,1 % pepton. So, 10^{-1} dilution was obtained. Further dilutions (up to 10^{-5}) were obtained by adding 1 ml from each dilution level to 9 ml sterilized distilled water containing 0,1 % pepton.

After each dilution was finished, 1 ml sample was taken from each dilution level then given to petri dishes containing potato dextrose agar (PDA) with three replications. Petri dishes were then incubated at 25 ^{0}C and after 5 days they were evaluated for the occurrence of molds (cfu/g).

Data was subjected to ANOVA and means were compared by means of Duncan multiple comparison test.

Results and Discussion

The amount of mold contaminations after 2, 30, 60 and 90 days after treatments with essential oils in different doses and non-treated fruits are shown in Table 1. ANOVA results showed that the effects of treatments on mold occurrence were not significant 2 and 30 days after treatments. Although significant differences were observed 60 and 90 days after treatments, differences among treatments were very close to each other which can be attributed to the natural population decline, rather than the application of essential oils. However, it can be generally observed that origanum treatments resulted with less mold contamination, especially at the 90th day.

Results obtained from this study showed that treatments did not affect mold occurrence significantly at the doses investigated. This can be due to that the doses used in this study were not high enough to obtain more reliable results under semi controlled conditions. Results from in vitro studies showed however that origanum had significant fungicidal effects on molds even at 50 µl/l doses (Yegen et al., 1992; Yonucu, 1997; Lambert et al., 2001; Burt, 2004). In another study Holley and Patel (2005) reported that origanum inhibited aflatoxin production. Low and inhomogeneous mold infestation of fruits can be another reason for inconsistent results in this study.

In Table 1 it can also be seen that the mold amount has decreased naturally during storage and reached to a minimum level at 60th and 90th days at all treatments. Since fruits were stored under room conditions and the storage period (3 months) was between October and

December, this reduction can be closely associated with the reduction of room temperatures during that period. It is well known that cold storage is one of the most important preservation methods for stored foods, because microbial activities are limited under such cool conditions. Özen et al. (2007) stated also that for dry figs that should be cold stored to maintain the Quality.

Table 1**.** Mold amounts on Sarilop dry fig fruits as affected by different essential oil treatments at different doses (cfu/g)

Days after treatment	**2**	30	**60**	**90**
Treatment	Mold colonie number (X 10^3 cfu/g)			
Control	7,90	1,30	0,45 bc	0,35 b
Origanum 100 µl/l	9,80	1,40	0,50 abc	0,15 c
Origanum 200 µl/l	6,50	1,25	0,60 ab	0,30 bc
Origanum 400 µl/l	5,40	2,15	0,40 c	0,25 bc
Laurel 100 µl/l	5,20	1,90	0,45 bc	0,25 bc
Laurel 200 µl/l	7,65	2,05	0,45 bc	0,25 bc
Laurel 400 µl/l	7,15	1,05	0,65 a	0,55 a
Significance (ANOVA)	0,054	0,084	0,025	0,001

Conclusion

These results showed that essential oils showed limited efficacy which can be attributed to the low doses used in the study. Also reduced temperature during storage period caused a natural decline in microbial population, so that the effects of essential oil treatments couldn’t have been observed. Therefore, further studies are needed with higher doses of essential oils under storage conditions favoring the growth of microorganisms, such as high temperature with fruits having higher mold populations. So the effects of plant essential oils on mold formation can be observed more clearly.

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