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Research Article

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Control of penicillium postharvest disease of valencia sweet orange using rosemary extract and thiabendazole

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ABSTRACT

In order to evaluate the effect of Rosemary extract and Thiabendazol fungicide on postharvest rot of Valencia sweet orange, was performed an experiment as factorial arrangement in completely randomized design with four replications. The first factor was storage type including cool (4 °C) and room temperature (25 °C) storages and the second factor was treatment type including unwounded control; wounded control; wounded control inoculated by Penicillium italicum spores; Rosemary extract 150, 300 and 450 mgL^{-1}; and Thiabendazol 1.0, 1.5 and 2.0 gL^{-1}. The treated fruits by extract and fungicide were inoculated with Penicillium italicum spores. The fruits were stored in room temperature and cool storage for two months and then the decay percent, TSS, vitamin C and total acid were measured in them. According to the results, the best treatment was Thiabendazol 2.0, 1.5 and 1.0 gL^{-1} respectively in room temperature storage and Rosemary extract could kept fruit quality in compare with controls.

Key words: Valencia, Rosemary extract, *Penicillium italicum*, Storage, postharvest disease, herbal extract.

INTRODUCTION

Citrus (namely species and hybrids of genera *Citrus*, *Fortunella and Poncirus*), with approximately 7 million hectare cultivated surface, is an important commercial fruit crop worldwide **[1]** with a total production of 105.4 million tons, which is grown in tropical and subtropical regions of the world **[2]**. The Citrus fruits in the postharvest time and during transportation, in the shop or storage are damaging due to attack of several fungal agents. Hence, control of postharvest diseases of Citrus is necessary to kept quality and quantity of fruits **[3]**. One of the most important fruit decay agents is *Penicillium italicum* **[4]**.

Hassani et al.**[5]** have examined the effects of essence of *Zataria multiflora*, *Ocimum basilicum* and *Rosmarinus officinalis* on growth of gray mold fungus on pear in cold storage. Statistical analysis of results at the end of the storage period showed that effect of essence on fungus growth was significant so that infected fruit percentage and severity of disease in fruits treated with essence have been reduced. Sharifi **[6]** in an experiment evaluated effects of herbal essences and thiabendazol fungicide on postharvest disease. The results showed that all tested essences had a significant effect and decreased fungus growth. Maximum inhibition was related to savory essence and fennel essence, fungicide thiabendazol, lavender and rosemary essences had the best results respectively. Ben Yehoshua et al. **[7]** reported that percentage of Penicillium digitatum decay of oranges kept at 30 ° C and 90% humidity for several days was less than that of fruits kept at room temperature. Chun **[8]** reported that thermotherapy of grapefruits at 34.5 ° C for 3 days decreased green and blue mold decays. The evidence obtained from the 5 years studies on the effect of thermotherapy using warm air shows that during the period time of treatment, skin wounds were healed and the fruit skin decay during storage was significantly decreased. Wright and Kader **[9]** reported that

spray of *Thymus vulgaris* essence on oranges infected with Penicillium, was effective as TBZ. Chalutz and Druby **[10]** reported that some strains of Penicillium have been found that are resistant to some fungicides. Therefore, continued use of a chemical to control pathogens has caused emergence of pathogen resistant strains and ineffective of the chemical.

EXPERIMENTAL SECTION

To compare the effect of rosemary extract and thiabendazol on Valencia orange decay caused by Penicillium, a factorial experiment was performed with a completely randomized design and two storage factors including cold and room temperature and various treatments including unwounded, not inoculated fruits control, wounded fruits inoculated with *Penicillium italicum* as control, wounded fruits inoculated with *Penicillium italicum* and treated with concentrations of 150, 300 and 450 mg/L of rosemary and 1, 1.5 and 2 ml/L of thiabendazol with four replications. Fruits were harvested in early May and moved to the laboratory. Then using a sharp knife, fruits were wounded. Fruits were immersed in different concentrations of rosemary and thiabendazol. After drying, fruits sprayed with suspension of *penicillium italicum* spores and then fruits individually were packed in plastic pockets and totally were kept in plastic boxes and kept for 2 months. After that, percentage of total dissolved solids (TSS) using a hand refractometer, Vitamin C by titration with iodine in potassium iodide, total acid by titration with 0.3 normal NaOH and the rate of decay by counting the number of decayed fruits in each replication were determined and expressed as a percentage.

After data collection, all the raw data was analyzed by MSTAT-C software and the means compared using Duncan's multiple range test.

RESULTS AND DISCUSSION

Results of the treatment effects of storage conditions and treatment type combination on the amount of TSS (sugar), vitamin C, total acid and percentage of decay summarized in table 1. These results showed that the maximum amount of sugar in a typical storage was seen in the treatment of unwounded and not inoculated and the lowest amount was in rosemary treatment of 150 mg/l and also in cold storage, the maximum amount of sugar was in rosemary treatment of 300 mg/l and the lowest amount was seen in the control.

The highest amount of Vitamin C was seen in a typical storage in rosemary treatment of 450 mg/l and the lowest amount was in control and rosemary treat 150 mg/l and also in cold storage, the maximum amount of Vitamin C was in unwounded, not inoculated control the lowest amount was in control treatment.

Table 1: Treatment effects of storage conditions and treatment type combination on the amount of TSS (sugar), vitamin C, total acid and percentage of decay

Treatment	TSS		Vitamin C		Total acid (mg)		Decay percentage	
	Room Tem. storage	Cold storage	Room Tem. storage	Cold storage	Room Tem. storage	Cold storage	Room Tem. storage	Cold storage
Control	0.00^{d}	0.00^{d}	0.00^{d}	0.00^{d}	0.000^{e}	0.000^{e}	100.0^{a}	100.0^{a}
Unwounded, not inoculated control	14.88^{a}	11.75^{c}	10.26^{ab}	9.44^{ab}	1.080^{abcd}	1.290^{abc}	81.2^{a}	0.0^{b}
Rosemary 150 mg/l	0.00^{d}	12.00^{c}	0.00^{d}	8.36^{ab}	0.000^{e}	1.520^{a}	100.0^{a}	87.5^{a}
Rosemary 300 mg/l	11.62^{c}	12.38^{bc}	8.95^{ab}	8.60^{ab}	0.850^{bcd}	1.230^{abc}	18.8^{b}	18.8^{b}
Rosemary 450 mg/l	14.25^{ab}	12.00^{c}	10.65^{a}	5.08^{c}	0.660^{d}	1.140^{abcd}	81.2^{a}	75.0^{a}
Thiabendazol 1/1000	12.12^{c}	11.50^{c}	8.14^{b}	8.45^{ab}	0.790^{cd}	1.000^{abcd}	6.2^{b}	6.2^{b}
Thiabendazol 1.5/1000	11.88^{c}	12.50^{bc}	8.78^{ab}	8.10^{b}	0.920^{bcd}	1.180^{abcd}	0.0^{b}	6.2^{b}
Thiabendazol 2/1000	11.75^{c}	12.50^{bc}	8.43^{ab}	9.31^{ab}	0.850^{bcd}	1.370^{ab}	0.0^{b}	0.0^{b}

The means with the same letters in each measurement case does not have significant differences (1%)

In room temperature storage in rosemary treatment by increasing concentration of 150 mg/l to 300 mg/l of rosemary, the total amount of acid insignificantly increased and the total amount of acid by increasing the concentration of 300 mg/l to 450 mg/l insignificantly decreased.

The maximum amount of infection in typical storage was seen in control and rosemary treatment of 150 mg/l and in cold storage was observed in control treatment and the lowest amount in typical storage was in thiabendazol treatments 1.5 and 2/1000 and in cold storage was in unwounded, not inoculated control. In typical storage and cold

storage by increasing rosemary concentration of 150 mg/l to 300 mg/l, the decay percentage rate was significantly decreased.

Regarding the storage type, there was a significant difference between typical storage and cold storage that amount of Vitamin C in cold storage was more than that of typical storage. Generally keeping fruits in cold storage resulted in Vitamin C stabilization. In a typical storage that usually has a higher temperature than cold storage, the amount of Vitamin C in kept fruits quickly decreased.

Regarding the storage type, there was a significant difference between a typical storage and a cold storage that the total amount of acid in cold storage was more than that of a typical storage. It seems that low acidity of a typical storage is due to the acid taking in fruit metabolic activities that are more in a typical storage Because of the high temperature.

Regarding the storage type, there was a significant difference between a typical storage and a cold storage that the amount of decay (infection percentage) was more in a typical storage than that of cold storage. This could be related to the effect of temperature, because the temperature of 20-25 ° C is an appropriate temperature for most of fungi causing postharvest decay. This result corresponds to the results of Rodov et al. **[11]** who reported that decay percentage in a typical storage is more than that of cold storage.

CONCLUSION

The obtained results of this study showed that Valencia orange quantitative and qualitative characteristics were affected by treatment type and storage conditions. Among the measured factors storage conditions had a significant effect on the total amount of soluble solids (sugar), Vitamin C, total acid content and infection percentage at the 1% level of Duncan′s test that the amount of sugar in control treatments were the same in both storage conditions and in a typical storage, the amount of sugar of unwounded control was more than that of a cold storage and in all rosemary treatments except 450 mg/l, the amount of sugar was more in a cold storage than that of a typical storage.

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