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# Efficiency of some Abiotic Treatments to Control Guava Fruit Rot Caused by *Phomopsis psidii* and its Effect on Fruit Quality

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Four isolates of *Phomopsis psidii* were obtained from naturally rotted fruits of guava, cvs. Maamora and Balady. They were proved to be pathogenic to guava fruits at and at room temperature. Disease incidence (DI%) and disease incidence (DS%) were greatly reduce at 8±1°C compared with 100% DI and 83% DS were recorded at room temperature, 15 days after inoculation. Fruits pre-treated with salicylic or citric acids showed highest decrease in DI and DS% of rot when fruits were stored at room temperature, whereas no infection was recorded in SA-treated fruits after 15 days of cold storage. When fruits were stored on 8±1°C, then treated with $CaCl_2$ or SA and stored at room temperature, no symptoms were detected till 6 days, shelf life period. Pre-treated fruits with $CaCl_2$ and SA, also, exhibited the lowest loss of weight values, either in inoculated or non-inoculated fruits. Total soluble solids content increased gradually, in all treatments, till the end of experiment in non-infected fruits, but in case of infected ones, the TSS% decreased after 10 days of stored period, except in fruits treated with CA which exhibited 9% increase until the end of storage period. Ascorbic acid (AA) % decreased gradually weight advanced storage. The percent of reduction in AA was higher in infected fruits than in non-infected ones. Fruits pre-treated with $CaCl_2$, SA or CA contained AA more than control. The highest values of total sugar content (8.8-8.3%) were recorded in fruits treated with SA, CA and $H_2O_2$, respectively, while the least values (7.4%) was recorded in fruits treated with $CaCl_2$ (27.1% increase than control).

**Keywords:** Abiotic treatments, fruit rot, guava and *Phomopsis psidii*.

Guavas are plants in the myrtle family (*Myrteaceae*), genus *Psidium,* which contains about 100 species of tropical shrubs and small trees. They are native to Mexico, Central America, and Northern South America. Now, guavas are cultivated and naturalized throughout the tropics and subtropics over all the world for their edible fruits. Guava *(P. guajava* L.*)* an important fruit of subtropical and tropical countries has an incredibly high content of pectin, reducing- and non-reducing sugars, vitamins C, A, $B_2$, folic acid and E, calcium copper, iron manganese, phosphorus and potassium. Guava, also, are being rich in dietary fiber, carotinoids and polyphenols- the major classes of antioxidant pigments-giving them relatively high potential antioxidant value among plant foods (Morton, 1987)

In Egypt, guava trees are widely planted, especially in Behera, El-Sharkia, around Alexandria Governorates, and in newly reclaimed lands, and in many house

gardens. The total guava area in Egypt is 33618 fed., produced approximately 231165 tons (9.15 tons/fed.) of guava fruits (Ann. Rept. of Agric. Statis. Dept., Min. Agric., 2003).

Guavas are affected by about 177 pathogens of which, 167 are fungal, 3 bacterial, 3 algal, 3 nematodes and one epiphyte as well as fruit and post harvest diseases are also important which causes serious loss (Singh *et al.*, 2005). *Colletotrichum gleosporiods, Gloeosporium psidii, Phomopsis psidii, Pestaliopsis versicolor, Stangospora psidii,* and *Rhizopus* were isolated from naturally infected guava fruits from different locations in Egypt and other countries over all the world (Abdul Wahid, 1997; Abdel-Latif *et al.*, 1999; El-Bana, 2000; Gabr *et al.*, 2000 and Srivastava and Tandon, 1969).

This study aimed to isolate the causal pathogen(s), to control this disease using some chemical compounds as alternative for the hazard fungicides, and to determine changes in nutritional value of post-harvest infected fruits.

## Materials and Methods

*Isolation and identification:*

Naturally infected fruits of guava (cvs. Maamora and Balady) were collected from El-Obour Market and from private orchards in Banha, Qalubia Governorate. Symptoms recorded are red spots, differed in wide between 2 mm to occupy more than the half of a fruit. The fruit samples were surface sterilized for 3 min with 1% sodium hypochlorite and rinsed in 4 successive changes of sterile distilled water. The surface-sterilized diseased fruits were sliced into small pieces (about 2 $mm^2$), then plated on sterile PDA in Petri dishes and incubated for a week at 25°C. Hyphal tips of the growing fungus were cut off and transferred into PDA to obtain pure cultures. Subcultures of the purified fungus were maintained on PDA slants to be used in the present studies. The identification of the fungal isolates was carried out using cultural, morphological and microscopical features according to Barnett and Hunter (1981) and Srivastava and Tandon (1969).

*Pathogenicity tests:*

Healthy, freshly harvested ripped guava fruits (Maamora and Balady cvs.) were surface sterilized, as mentioned before, and inoculated with the isolated fungal isolates as described by Gabr *et al.* (2000). Check fruits were similarly punctured and inoculated with sterile PDA discs. The inoculated fruits were placed in moistened plastic containers (3 fruits/container) and incubated at 25°C. After which observations on the development of infection were made. The fungus was re-isolated from the artificially inoculated fruits and found to be that isolated from the naturally infected ones.

*Effect of chemical treatments and storage temperature on disease incidence:*

Mature, yellowish green, healthy appearance guava fruits (cv. Maamora), immediately after harvesting, were washed with tap water, air dried and then were dipped for two minutes in the following solutions: $CaCl_2$ (2% w/v), $MgCl_2$ (2% w/v), salicylic acid (2% w/v), citric acid (2% w/v), $H_2O_2$ (2% v/v), or hot water

at 48°C. Fruits were dipped in sterilized, distilled water were used for chick control treatment. Treated fruits were inoculated with the isolated fungus as described by Gabr *et al.* (2000), then were divided into two groups, the first one were stored at 8±1°C and the second fruit group were kept at room conditions (18-28°C and 40-60% R.H). Each treatment was represented by 3 replicates, each of them (3 fruits) was packed in a hard paper bag. To determine some pathological, physical, and chemical properties, a sample was examined, at the beginning of experiment, immediately after inoculation, and then every five days intervals up to 15 days.

*Disease assessment:*

Effect of treatments on disease occurrence was determined as disease incidence (DI) and disease severity (DS). Disease incidence (DI) was calculated as a percentage of the total number of diseased fruits using the following equation:

$$DI\ (\%) = (N_1 \div N) \times 100$$

Whereas: N = total of inoculated guava fruits,
$N_1$ = Number of diseased ones.

Disease severity (DS) was determined according to modified methods described by Vakalounakis (1990) using a scale from 0 to 5 grades, 0= no visual symptoms, 1= >5 spots occupied <10% of fruit surface, 2= 5-10 spots occupied 10-24%, 3= 10-15 spots; 25-49%, 4= 16-20 spots; 50-74% and 5= <20 spots represented more than 75% of the fruit spotted area. For each treatment the DS was calculated according to the formula (Lui *et al.*, 1995):

$$DS = \frac{\Sigma d}{D\ max \times n} \times 100$$

Whereas: d= The disease rating on each fruit, D max= Maximum disease rating possible, and n= Total number of fruit examined in each replicate.

*Effect of chemicals pretreatment fruits on fruit quality:*

*1- Marketable (shelf life) period, in days:*

In other experiment, guava fruits (cv. Maamora) stored at 8±1°C for15 days, then fruits were taken out and inoculated with the fungus isolate as described before. Inoculated fruits were stored at room conditions in hard paper bags (3 fruits / bag as a replicate). Three replicates were used. Data, *i.e.* DI and DS, were recorded every 3 days intervals up to 9 days storage period. Days before disease symptoms appear indicate to the marketable (shelf life) period.

*2- Effect of infection and chemical treatments on some physical and chemical properties of guava fruits:*

Healthy appearance guava fruits at maturity stage (yellowish green colour) were treated with chemicals or by dipping in hot water then were inoculated by the isolated fungus, as previously mentioned. Other fruits were left un-inoculated used as control. Fruits were stored at room conditions in hard paper bags (3 fruits / bag as a replicate). Each treatment was represented by three replicates. A sample was examined to determine the changing in their physical and chemical properties, at 0, 5, 10 and 15 days after inoculation.

*2-1- Changing in physical properties:*

Fruit weight loss: Each bag was individually weighted to get initial weight (at the beginning of experiment) and then weighted after 5, 10 and 15 days. The loss percentages on weight were calculated according to the following formula:

$$\text{Fruit weight loss (\%)} = \frac{W - w}{W} \times 100$$

Whereas: W= the weight of fruits at the beginning of experiment (0 time) and w = the weight of fruits at sampling period (5, 10 or 15 days of storage).

*2-2- Changing in chemical properties:*

a- Soluble solids content (SSC) percent: was determined in clear, fresh juice of treated guava fruits by using Abbe refractometer at different periods of storage according to AOAC (1984).

b- Ascorbic acid (AA), (Vitamin C), content: was estimated using 2,6-dichlorophenol indophenol according to Sadasivam and Manickam (1996). It was calculated as milligrams AA/100 g of fruit fresh weight.

c- Total sugars (TS) percent: was determined according to Somogyi (1952) methods. TS% was calculated as mg glucose/100 fresh weight of guava fruits.

*Statistical analysis:*

Data were statistically analyzed according to Snedecor and Cochran (1980). Least significant differences (L.S.D) were used to verify means.

## Results and Discussion

Four fungal isolates were secured from natural infected guava fruits. All purified isolates ($I_1$ to $I_4$) were similar in their morphological and cultural characters. According to illustrations cited by Barnett and Hunter (1981) and Srivastava and Tandon (1969). The obtained isolates were identified as *Phomopsis psidii.* The isolated fungus has white floccose mycelium and produced numerous black, globose to irregular pycnidia (up to 300 µm). Alpha-conidia were one-celled, hyaline, and ellipsoidal (4.5-10.3 µm long X 1.8-2.1 µm wide), beta-conidia were one-celled, hyaline, filiform and straight or curved (16.8-7.5 µm long X 1.0 µm wide).

The pathogenicity test of all four isolates revealed that symptoms developed on inoculated guava fruits were typically to those on naturally infected ones (Fig. 1). When re-isolated, the fungus was identical to the initial isolate.

*Effect of chemical treatments and storage temperature on disease development:*

Data in Table (1) showed significant differences in both disease incidence (DI) and disease severity (DS) according to different degrees of temperature of storage. The fungus isolate invaded wounded guava fruits at the two tested temperatures degrees, *i.e.* 8±1°C or room temperature.


**Fig. 1. Mycelium and pycnidia of *Phomopsis psidii* (A), guava fruit, artificially inoculated (left), and naturally infected (right).**

A few numbers of lesions and decrease DS% were showed at low temperature degree (8°C), whereas 100% DI and high DS (83%) were occurred at room temperature at the end of incubated period (15 days). Similar results were recorded by Ramsey *et al.* (1951), Pendey *et al.* (1997), Abdel-Latif *et al.* (1999), Gabr *et al.* (2000) and El-Bana (2000). They found that DS of guava or peach anthracnose or fruit rots was increased at 20-25°C. These results explain, too, that guava fruit rots consistency showed in autumn (October and November) when temperature arranged between 20 and 28°C. Data presented in Table (1) indicate also that all chemical treatments significantly reduced the DI during 15 days. Citric acid and salicylic acid treatments caused the highest reduction in both DI and DS percentages when fruits stored at room temperature. No infection was detected in fruits treated by salicylic acid after 15 days of cold storage. These results are in harmony with those reported by El-Bana (2000) who found that antioxidant substances, *i.e.* ascorbic acid, and salicylic acid, when applied at 100 ppm, 2 days before inoculation with *Stagonospora psidi,* completely protected guava fruits and leaves. Also, antioxidants were successfully against anthracnose of avocado (Prusky, 1988), Fusarial disease of cowpea (Galal and Abdou, 1996) and dieffenbachia bacterial stem rot (Armanious *et al.*, 2011).

**Table 1. Effect of temperature of storage and chemical application on guava fruit rot occurrence**

| Treatment | Period of storage (days) | DI (%) at | | DS (%) at | |
|---|---|---|---|---|---|
| | | 8±1°C | Room temp. | 8±1°C | Room temp. |
| Control (0) | 5 | 0.0 | 44.4 | 0.0 | 22.0 |
| | 10 | 22.2 | 88.9 | 7.4 | 42.6 |
| | 15 | 44.4 | 100.0 | 25.9 | 83.3 |
| $CaCl_2$ (2%) | 5 | 0.0 | 11.1 | 0.0 | 1.8 |
| | 10 | 0.0 | 22.2 | 0.0 | 5.5 |
| | 15 | 11.1 | 22.2 | 3.7 | 9.1 |
| $MgCl_2$ (2%) | 5 | 0.0 | 33.3 | 0.0 | 5.5 |
| | 10 | 0.0 | 33.3 | 0.0 | 7.4 |
| | 15 | 11.1 | 44.4 | 7.4 | 9.1 |
| SA (2%) | 5 | 0.0 | 11.1 | 0.0 | 1.8 |
| | 10 | 0.0 | 11.1 | 0.0 | 1.8 |
| | 15 | 0.0 | 22.2 | 0.0 | 5.5 |
| CA (2%) | 5 | 0.0 | 11.1 | 0.0 | 1.8 |
| | 10 | 0.0 | 11.1 | 0.0 | 1.8 |
| | 15 | 11.1 | 22.2 | 3.7 | 3.7 |
| $H_2O_2$ | 5 | 0.0 | 22.2 | 0.0 | 3.7 |
| | 10 | 11.1 | 33.3 | 7.4 | 5.5 |
| | 15 | 22.2 | 33.3 | 18.6 | 7.4 |
| Hot water | 5 | 0.0 | 33.3 | 0.0 | 5.5 |
| | 10 | 11.1 | 33.3 | 11.1 | 7.4 |
| | 15 | 33.3 | 44.4 | 25.9 | 16.6 |
| L.S.D.5% for: Treatments (A) = | | 0.16 | | 2.35 | |
| Temperature (B) = | | 0.66 | | 1.16 | |
| Storage period (C)= | | 0.89 | | 0.91 | |
| A x B x C = | | 0.36 | | 4.35 | |

When the fruits of guava were stored at 8±1°C for 15 days, then were taken out, treated with chemicals and inoculated with the tested fungal isolate and stored under room conditions, were recorded (Table 2). Results showed a significant decrease in both DI% and DS% in all treatments. Transport fruits from cool to warm conditions led to express and increase fruit rot occurrence. Disease incidence (DI) reduced from 100% (in control; non-treated fruits) to 22.2 and 33.3% and DS% reduced from 66.7 to 8.9 and 13.3% by using salicylic acid and calcium chloride, respectively, after 9 days storage at room temperature. No disease (rot) symptoms were observed on fruits treated with $CaCl_2$ or SA till 6 days from inoculation. Whereas, at the same period, 6 days, DI was 11.1 and 22.2% and DS was 4.4, 6.7 and 8.9% on fruits treated with $H_2O_2$, $MgCl_2$ and citric acid, respectively.

This result indicate that disease occurrence and severity, in all treatments, was more increase in fruits stored at cold conditions (8±1°C) then transported to room conditions comparative to those not stored in cold temperature. The highest DI

(77.7%) and DS (42.2%) were in fruits dipped in hot water (48°C for 2 min.). That may be due to hot water help the primary infection, spores germination or growth of the fungus in wounded fruits.

These results are in agreement with Hajhamed *et al.* (2007) who found that SA, $CaSO_4$, and $KSO_4$ were the most effective against bacterial soft rot of potatoes. As well as, SA was not caused a direct effect against the pathogen but its effect appears from induction of plant defence response (Malamy and Klessing, 1992). Ye *et al.* (1995) reported that many chemicals changes occur during systemic acquired resistance, such as pathogenesis-related proteins (PRs). Acidic PRs including acidic ß-1,3 gluconase and chitinase are secreted in the intercellular spaces, where they would act against fungal pathogens at early stages of infection process. Basic ß-1,3 gluconase and chitinase accumulate in the vacuoles may interact with pathogens at a late stages of infection, during host cell deterioration.

**Table 2. Effect of some chemicals or hot water pre-treatments on marketable (shelf life) / days of guava fruits**

| Treatment | DI (%), days after inoculation | | | DS (%), days after inoculation | | |
|---|---|---|---|---|---|---|
| | 3 | 6 | 9 | 3 | 6 | 9 |
| $CaCl_2$ | 0 | 0.0 | 33.3 | 0.0 | 0.0 | 13.3 |
| $MgCl_2$ | 0 | 22.2 | 55.6 | 0.0 | 6.7 | 20.0 |
| SA | 0 | 0.0 | 22.2 | 0.0 | 0.0 | 8.9 |
| CA | 0 | 22.2 | 55.6 | 0.0 | 8.9 | 26.7 |
| $H_2O_2$ | 0 | 11.1 | 4.4 | 0.0 | 4.4 | 22.2 |
| Hot water | 11.1 | 33.3 | 77.7 | 2.2 | 11.1 | 42.2 |
| Control | 0 | 44.4 | 100.0 | 0.0 | 22.2 | 66.7 |

*Effect of post-harvest treatment and fungus inoculation on some physical and chemical properties of guava fruits:*

*1-Physical properties: Percent of fresh weight loss:*

Concerning storage period in (Table 3), infection with *Phomopsis psidii* exhibited higher reduction percentages on guava fruit weights (between 4.9 and 15.8%) comparative to non-inoculated ones (4.24 and 10.7%).

Fruits treated with $CaCl_2$ and SA exhibited the lowest loss weight values (*i.e.* 4.38 for non-inoculated fruits and 4.9 and 5.19 for inoculated ones). Whereas, fruits treated by dipping in hot water (48±1°C for 2 min) showed the highest weight loss (5.97 and 8.37). This result was very close to those observed by Embaby (2007) who found that fresh weight of strawberry fruits was reduced due to infection with *Pestalotia* sp. Shaaban (2006) and Ismail *et al.* (2010) reported that dipping guava fruits in $CaCl_2$ solutions (0.5-2% w/v) reduced fresh weight loss and respiration rat.

Calcium chloride is known as hydroscorpic substance, *i.e.* absorbs moisture, which is believed to be one of the reasons for the effectiveness in controlling weight loss. Water vapour absorbed from atmosphere around fruits helps to provide a continuous solution of $CaCl_2$ on the guava fruit surfaces throughout the storage period.

**Table 3. Effect of infection and chemical treatments on fresh weight loss (%) of guava (cv. Maamora) fruits**

| Treatment | Weight loss (% ) on un-inoculated fruits, after | | | Weight loss (%) on inoculated fruits, after | | |
|---|---|---|---|---|---|---|
| | 5 days | 10 days | 15 days | 5 days | 10 days | 15 days |
| Control (untreated) | 2.99 | 4.97 | 10.67 | 3.75 | 6.30 | 15.80 |
| $CaCl_2$ (2%) | 1.15 | 3.23 | 4.38 | 2.54 | 3.65 | 4.86 |
| $MgCl_2$ (2%) | 1.54 | 3.95 | 5.71 | 2.51 | 4.44 | 6.72 |
| SA (2%) | 2.14 | 2.89 | 4.39 | 2.14 | 3.39 | 5.19 |
| CA (2%) | 1.83 | 2.89 | 5.38 | 2.63 | 3.68 | 5.99 |
| $H_2O_2$ (2%) | 1.56 | 2.79 | 4.24 | 3.29 | 4.22 | 6.49 |
| Hot water | 1.57 | 3.56 | 5.97 | 2.45 | 4.58 | 8.37 |
| L.S.D.5% for: Treatment (A) = 1.50 | | | | 2.40 | | |
| Period (B) = 0.55 | | | | 0.72 | | |
| Interaction (A x B)= 1.45 | | | | 1.89 | | |

*2- Chemical properties:*

*a) Total of soluble solids (TSS %):*

Table (4) clear indicated that TSS% was significantly reduced due to infection from 9.46-11.5% to 6.3-9.0%. The content of SS% increased gradually till the end of storage period (15 days) in non-infected fruits, but in the infected ones SS % increased through 10 days of storage then decreased by the rate of reduction ranged between 0.0 and 16.9%, except Citric acid which exhibited increasing (9%) in SS % until the end of experimental period in the infected fruits.

This result is in harmony with those found by Dubey (1995) and Embaby (2007) who reported that *Pestalotia* sp. infected fruits of guava or strawberry, respectively, contained low levels of total soluble solids than healthy fruits. Nawar and Ezz (1994), Sabry (1998), Aly and Ismail (2000), Shaaban (2006) and Ismail *et al.* (2010) reported that guava or apple fruits treated with $CaCl_2$ had lower SSC % compared to the control ones.

*b) Ascorbic acid content:*

Data in Table (5) showed that ascorbic acid amounts decreased gradually in either infected or non-infected guava fruits with advanced storage. Generally, infected fruits contain ascorbic acid less than non-infected ones. The percentages of AA in infected fruits, pre-treated with different tested applications, were higher than non-infected fruits. This increase ranged between 15.1 and 24.3%. Data in Table (5) indicate also that fruits treated with Ca $Cl_2$, CA or SA showed non-significant increase (3.42-4.57%) in AA content than untreated fruits. Where, AA percent decreased (8.95%) in fruits pre-treated by dipping in Mg $Cl_2$, $H_2O_2$, or hot water. This results 0agree with those reported by Dubey (1995), Majumdar and Pathak (1989) and Amusa *et al.* (2005) whose reported that AA content declined in guava fruits infected by *Botryodiplodia theobromae, Colletotrichum gloeosporioides, Pestalotiopsis versicolor, Phomopsis psidii* or *Rhizopus arrhizus*. Nawar and Ezz (1994), Aly and Ismail (2000), Shaaban (2006) and Ismail *et al.* (2010) reported that

**Table 4. Effect of infection and chemical treatments on total soluble content of guava fruits**

| Chemical Treatment | TSS (%) on uninoculated fruits, after (days) | | | | | TSS (%) on inoculated fruits, after (days) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | Increase (%)[1] | 0 | 5 | 10 | 15 | Increase (%)[2] |
| $CaCl_2$ | 7.30[3] | 8.03 | 8.26 | 9.46 | 22.83 | 7.30[3] | 7.97 | 8.5 | 7.37 | 13.3 |
| $MgCl_2$ | 7.30 | 8.13 | 8.77 | 9.83 | 25.74 | 7.30 | 7.63 | 8.40 | 7.40 | 11.9 |
| SA | 7.30 | 8.20 | 9.10 | 10.3 | 29.13 | 7.30 | 7.93 | 8.33 | 8.20 | 1.6 |
| CA | 7.30 | 8.57 | 9.70 | 10.3 | 29.13 | 7.30 | 8.1 | 8.26 | 9.00 | -9.0 |
| $H_2O_2$ | 7.30 | 7.95 | 8.30 | 10.8 | 32.41 | 7.30 | 8.2 | 7.90 | 7.90 | 0.0 |
| Hot water | 7.30 | 8.20 | 9.13 | 10.7 | 31.78 | 7.30 | 7.93 | 8.10 | 6.73 | 16.9 |
| Control | 7.30 | 9.47 | 10.2 | 11.5 | 36.52 | 7.30 | 8.1 | 7.07 | 6.30 | 10.7 |
| LSD 5% for: Treatment= 0.57<br>Period = 0.54<br>Interaction= 1.44 | | | | | | 0.69<br>0.50<br>1.34 | | | | |

[1] Increase (%) = $\frac{V_1 - V_2}{V_1}$

Whereas: $V_1$ and $V_2$ are values at 15 and 0 days, respectively.

[2] Increase (%) = $\frac{V_1 - V_2}{V_1}$

Whereas: $V_1$ and $V_2$ are values at 10 and 15 days, respectively.

[3] Each value representing the mean of 3 replicates, each contain 3 fruits.

**Table 5. Effect of infection and chemical treatments on ascorbic acid (vitamin C) content on guava fruits**

| Treatment | AA on uninoculated fruits, after (days) | | | | | AA on inoculated fruits, after (days) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | Reduction(%)[1] | 0 | 5 | 10 | 15 | Reduction(%) |
| $CaCl_2$ | 59.6[2] | 54.3 | 51.6 | 50.3 | 15.6 | 59.6 | 52.0 | 48.3 | 40.1 | 32.8 |
| $MgCl_2$ | 59.6 | 53.7 | 50.6 | 43.3 | 27.4 | 59.6 | 49.3 | 42.3 | 37.7 | 36.8 |
| SA | 59.6 | 53.0 | 52.3 | 49.7 | 16.7 | 59.6 | 53.3 | 45.3 | 39.3 | 34.1 |
| CA | 59.6 | 51.3 | 52.6 | 50.3 | 15.6 | 59.6 | 50.3 | 43.3 | 39.5 | 33.8 |
| $H_2O_2$ | 59.6 | 52.6 | 49.7 | 43.3 | 27.4 | 59.6 | 43.7 | 41.0 | 35.7 | 40.1 |
| Hot water | 59.6 | 51.7 | 50.0 | 43.7 | 26.7 | 59.6 | 43.3 | 40.0 | 37.0 | 38.0 |
| Control | 59.6 | 52.3 | 50.0 | 48.0 | 19.5 | 59.6 | 47.3 | 31.3 | 30.3 | 49.2 |
| LSD 5% for: Treatment= 3.14<br>Period = 2.49<br>Interaction= 6.57 | | | | | | 2.65<br>1.96<br>5.19 | | | | |

[1] Increase (%) = $\frac{V_1 - V_2}{V_1}$

Whereas: $V_1$ and $V_2$ are values at 0 and 15 days, respectively.

[2] Each value representing the mean of 3 replicates, determined as mg/100g fresh weight.

guava fruits treated with $CaCl_2$ had higher AA content compared with untreated ones. Singh *et al.* (2005) reported that about the half amount of vitamin C (AA) found in skin layer, and Morton (1987) reported that AA mainly in the skin, secondary in the film flesh, and little in the central pulp, varies from 56 to 600 mg, that explain the cause of the level of AA more decreased (15.3-36.9%) in infected fruits comparative to healthy ones, after 15 days of inoculation.

*2-Total sugars content:*

Concerning the effect of post-harvest treatment, results presented in Table (6) demonstrated that total sugars content increased gradually in all healthy (un-inoculated) fruits compared to control (untreated) ones with the advance in room conditions storage period up to 15 days. The highest values (8.8-8.3%) were recorded in fruits treated with SA, CA and $H_2O_2$, respectively, while the least values (7.4%) was recorded in fruits treated with $CaCl_2$ (27.1% increase than control). Where, the total sugars content increased, in all infected fruits, during the first five days of storage at room conditions, then decreased (between 44.6 and 71.1%) gradually, compared to healthy fruits, after 15 days storage period.

**Table 6. Effect of infection and chemical treatments on total sugars content on guava fruits**

| Treatment | TS on uninoculated fruits, after (days) | | | | | TS on inoculated fruits, after (days) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | Increase (%)[1] | 0 | 5 | 10 | 15 | Reduction(%)[2] |
| $CaCl_2$ | 5.4[3] | 6.0 | 6.6 | 7.4 | 27.1 | 5.4[2] | 6.3 | 4.4 | 4.1 | 44.6 |
| $MgCl_2$ | 5.4 | 7.0 | 7.2 | 7.8 | 30.6 | 5.4 | 6.2 | 3.2 | 3.0 | 61.5 |
| SA | 5.4 | 8.1 | 8.3 | 8.8 | 38.7 | 5.4 | 7.4 | 5.6 | 3.9 | 55.7 |
| CA | 5.4 | 8.0 | 8.5 | 8.7 | 38.0 | 5.4 | 7.4 | 4.1 | 3.0 | 65.5 |
| $H_2O_2$ | 5.4 | 7.0 | 7.6 | 8.3 | 35.0 | 5.4 | 7.2 | 5.1 | 2.4 | 71.1 |
| Hot water | 5.4 | 7.1 | 7.4 | 7.8 | 30.8 | 5.4 | 7.1 | 3.7 | 3.1 | 60.3 |
| Control | 5.4 | 5.7 | 6.0 | 6.5 | 17.0 | 5.4 | 6.0 | 3.4 | 2.3 | 64.6 |
| LSD 5% for: Treatment = 1.45 | | | | | | | | | 1.12 | |
| Period = 0.9 | | | | | | | | | 0.53 | |
| Interaction = 2.38 | | | | | | | | | 1.40 | |

[1] Increase (%)= $\frac{V_1 - V_2}{V_1}$ where: $V_1$ and $V_2$ are values at 15 and 0 days, respectively.

[2] Reduction(%)= $\frac{V_1 - V_2}{V_1}$

Whereas: $V_1$ and $V_2$ are values of total sugars in uninoculated and inoculated fruits, after 15 days, respectively.

[3] Each value representing the mean of 3 replicates, determined as g glucose/100 g fresh weight.

Similar results were recorded by Majumdar and Pathak (1989) and Amusa *et al.* (2005) who found that contents of AA, total sugars and proteins declined in infected guava fruits. Also, Ismail *et al.* (2010) recorded very little infection with Rhizopus rot when guava fruits treated with chemicals or hot water then stored at 8°C for 15 days.

Nickhah *et al.* (1999), Shaaban (2006) and Ismail *et al.* (2010) found that pear or guava fruits pre – or post-treated with $CaCl_2$ solution or hot water contained the lowest values of sugar contents. Farouk *et al.* (2008) found that application of SA (100 mg/l) and CHI (0.05%) on cucumber plants significantly reduced downy mildew occurrence and severity, and increased both photosynthetic pigments and carbohydrate content in cucumber shoots.

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# فاعلية بعض العوامل غير الحيوية لمكافحة مرض عفن ثمار الجوافة المتسبب عن الفطر *Phomopsis psidii* وتأثيرها على جودة الثمار

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تُعتبر الجوافة من محاصيل الفاكهة الهامة في الدول تحت الاستوائية والاستوائية حيث تحتوي ثمارها علي البكتين والسكريات والفيتامينات (هـ ، أ ، ب٢ ، جـ ) وحمض الفوليك وعناصر الكالسيوم والنحاس والحديد والماغنسيوم والفسفور والبوتاسيوم وكذلك فهي غنية بالألياف والكاروتين وعديدات الفينول التي تعتبر من المكونات الأساسية لمضادات الأكسدة .

تم عزل ٤ عزلات من الفطر *Phomopsis psidii* من ثمار جوافة ( صنفى المعمورة وبلدى) مصابة طبيعياً وقد ظهر عدد قليل من البقع ودرجة منخفضة من شدة الإصابة عند حفظ الثمار المعدية صناعياً لمدة ١٥ يوم في الثلاجة (٨ ± ١٥م ) ، بينما بلغت نسبة الإصابة ( DI ) ١٠٠% وشدة الإصابة Ds ٨٣% عند الحفظ في درجة حرارة الغرفة وقد انخفضت كل من شدة الإصابة ونسبة الإصابة في الثمار عند معاملتها قبل التخزين بحمض السالسيلك أو حمض الستريك عند حفظها علي درجة حرارة الغرفة ، بينما لم تحدث أي إصابة في الثمار المعاملة بحمض السالسيلك والمحفوظة في الثلاجة حتي مدة ١٥ يوم من المعاملة والعدوى الصناعية.

لم تسجل أي إصابة حتي ٦ أيام من العدوى والمعاملة بكلوريد الكالسيوم أو حمض الاكساليك عند حفظ الثمار علي درجة حرارة الغرفة كما أدت هاتين المعاملتين إلي حدوث اقل فقد في وزن الثمار السليمة أو المعدية وقد زاد المحتوي من المواد الصلبة بالتدريج في جميع المعاملات في الثمار غير المعدية، بينما في الثمار المصابة انخفضت نسبة المواد الصلبة الكلية بعد ١٠ أيام من التخزين ما عدا الثمار المعاملة بالستريك وقد انخفض محتوي الثمار من فيتامين ج تدريجياً مع زيادة فترة التخزين خاصة في الثمار المعاملة سابقاً بحمض الستريك وحمض السالسيلك بالمقارنة بغير المعاملة. كذلك احتوت الثمار المعاملة بحمض الستريك وفوق أكسيد الهيدروجين ٢% علي معدل أعلي من السكريات الكلية بينما انخفضت إلي أقل معدل في الثمار المعاملة بكلوريد الكالسيوم مقارنة بغير المعاملة.