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EFFECT OF POST-HARVEST FUNGICIDES AND HEAT TREATMENTS ON SOME QUALITY PARAMETERS OF AWAIS MANGO FRUITS DURING AND AFTER COLD STORAGE

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ABSTRACT : In two successive seasons (1996 and 1997) , mature Awais mango fruits were treated with water, Savlon at 500 ppm, Thiobendazole (TBZ) at 1000 ppm and hot (52°C) TBZ at 1000 ppm for 5 minutes. The fruits were then stored for 7 weeks at 13 (1°C. In addition, ripe fruits of the same cv were treated with TBZ at 1000 ppm and hot (52°C) TBZ at 1000 ppm and stored also at 8 (1°C for 7 weeks. After each week of cold storage fruits of each treatment were kept under supermarket condition (20°C and 60-70% RH) for 5 days for detecting shelf life effect .

Generally , treatments with Savlon and TBZ decreased fruit decay index (FDI) during cold storage but hot TBZ was the most effective treatment to depress FDI during 7 weeks of cold storage and during shelf life. Ripe fruits indicated lower fresh weight losses (FWL) , lower respiration rate, higher juice TSS and pH values than mature fruits during 7 weeks of cold storage and the shelf life. Treatments with hot TBZ decreased peel color index and firmness compared with unheated TBZ and Savlon during cold storage and shelf life .

INTRODUCTION

Mango is one of the most popular fruit in Egypt. Awais is an important cultivar which appears in market in Sept. and lasts for only about three weeks. Fruits of this cv. usually gain the highest prices for its favorite quality .

Cold storage of Awais mangoes can be the promising solution to prolong their local marketing seasons and increase the chance of exportation .

Prestorage disinfestation of fruits is an important practice which is usually performed by chemical compounds (mostly fungicides). However, it can be also performed through many physical treatments, i.e. hot water, low temperature, irradiation, vapor heat or high temperature air (APHIS, 1986).

Disinfestation by hot water was previously tried on mango fruits by Heather *et al.* (1991). However, the margin between the effective temperature for disinfestation and that causing fruit injury is rather narrow. As such, external and internal injuries to fruits of a range of mango varieties have been reported following to hot water or hot air treatments (Jacobi and Wong, 1992). Nevertheless, mangoes are heat disinfested in many countries, i.e. Mexico , Florida (USA) and Haiti for exportation to the U.S. mainland (Sharp *et al.*, 1989) . In addition, hot water treatment (52 - 2°C) using 1% $CaCl_2$ was the most effective treatment to retard fruit ripening for 5-8 days and to reduce fruit spoilage (Abdul -'Gafur *et al.*, 1997). In addition, Joseph and Aworth (1992) found that dipping wild mangoes in hot water (55°C) delayed ripening, controlled decay, minimized weight losses and extended the shelf life without adverse effect on visual or chemical qualities. Moreover, Lakshminarayana *et al.* (1974) reported that dipping mangoes of the cv Alfonso in hot water (54 ± 1°C) for 5 min. accelerated ripening, reduced spoilage, hastened the onset of the respiratory climacteric by 3-6 days.

As for fungicides treatments, Shivarama Reddy *et al.*, (1989) revealed that the best storage life of mango fruits was achieved by TBZ treatments at 1000 ppm, which surpassed both benlate (benomyl) and bavestin (carbendazine) also that treatment with thiobendozole (TBZ) at 1000 ppm with 6% wax emulsion decreased spoilage during 20 days of storage in Alfonso mango. On the other hand, Muller and Burt (1989) reported that hot water dip at 50°C or 0.1% TBZ at 50°C did not control stem end rot of mango fruits.

The present investigation was outlined to study the effect of hot water (52°C) and / or some fungicides (Savlon and TBZ) applied on mature or start - ripe mango fruits (cv Awais) before cold storage . The effect of tested treatments on fresh weight losses, peel color , fruit decay , firmness, respiration rate, pannel test, total soluble solids and activated acidity were considered to evaluate the tested treatments .

MATERIALS AND METHODS

This study has been carried out during 1996 and 1997 seasons on Awais mangoes harvested on September, 2nd from a private mango orchard at Anchas, Sharkeya Governorate. The orchard soil was fine sandy and the trees were more than 60-year - old budded on seedling rootstock and were irrigated with Nile water using the traditional basin irrigation system and uniformly received the usual horticultural practices .

Harvesting took place in the morning . Fruits for the present

study were harvested in two stages:

1.Mature green fruits. 2. fruit starting to ripe with a slight yellow blush. The fruits were then directly taken to post harvest laboratory in Hort. Dept. Fac of Agric., Zagazig Univ..

All fruits were washed with water and soap and then washed with water for removing the residue of soap.

The number of experimental mature (M) fruits was 840 divided into 4 main groups (treatments), i.e. 210 fruit / treatments shared between 3 replicates, i.e. 70 fruits / replicate. The four treatments adapted for (M) fruits were : water, Savlon (Chlorohexidine 0.3% + Citrimide 3%) at 500 ppm, TBZ at 1000 ppm and hot (52°C) at TBZ 1000 ppm. In addition, two groups of ripe (R) fruits (i.e. 420 fruit) received TBZ at 1000 ppm or hot TBZ (52°C) at 1000 ppm at 52°C.

The weight, of each fruit was were recorded individually before treatments and every week during cold storage.

All treatments using M fruits were stored in a cold room under 13±1°C with a fine thermostat. However, treatments using R fruits were stored in cold room under 8 ± 1°C.

The tested disinfestation treatments were :

1.M fruits dipped in water for 5 min.
2. M fruits dipped in 500 ppm Savlon for 5 min.
3. M fruits dipped in 1000 ppm TBZ for 5 min.
4. R fruits dipped in 1000 ppm TBZ for 5 min.
5. M fruits dipped in hot (52°C) TBZ solution at 1000 ppm for 5 min.
6- Ripe fruits dipped in hot (52°C) TBZ solution at 1000 ppm for 5 min.

The hot TBZ treatments were applied by submerging naked fruits in stirred hot water bath 52°C for 5 minutes after the pulp temperature next to the endocarp reached 52°C, then transformed immediately to cold water.

After each week of cold storage , samples were taken out to evaluate storage period effects. Moreover, beginning with the 3rd week of cold storage , samples were taken to investigate fruit behavior during shelf life under conditions of 20°C and 60-70% RH in an incubator for five days (i.e. the same as supermarket conditions).

Evaluation of sold storage and shelf life periods on Awais mango fruits were carried out through the following parameters:

1.Fresh weight losses (FWL) (%) : The fruits were weighed before cold storage, after each week of cold storage and after 5

days of the shelf life; the fresh weight losses were calculated .

2. **Peel color index (PCI) :** It was subjectively scored on scale of 0 to 10 where 0 = 100% green ; 2 = 1-25% yellow; 4= 26-40%; 6=41-60%; 8=61-80% ; 10 = 81-100% yellow . Average values were calculated .

3. **Fruit decay index (FDI) :** It was subjectively rated on a scale of 0 to 8, where 0 = without decay, 2 = spots , 5 = 25% and 8 = 50 % of peel surface decay . Average values were calculated .

4. **Pannel test index (PTI) :** Each replicate was judged by 5 persons gave the score as follows : 4 = Excellent test, 3= very good test ; 2 = good test; 1= acceptable test and 0= bad test. Averages values of the five persons were calculated.

5. **Fruit pulp firmness (FPF) :** It was determined on three fruits per replicate ; three measurements taken from each fruit after removing peel and using Push pull dynamometer (Model FT 327) with pluger tip 5/16 . The average firmness of the sample was expressed as (Lb) .

6. **Juice total soluble solids (TSS) .% :** Three fruits were picked from each sample, the juice was extracted and the TSS (%) was determined using a hand refractometer .

7. **Juice active acidity (pH value):** It was determined using pH meter (style Hanna 8514) .

8. **Respiration rate :** Thee fruits from each storage replicate were selected at random and placed in 3.8 L glass jars (respiration chambers) mounted in groups of four pieces , three of which were used for the respiration rate while the fourth was used as the air blank . The air stream from each jar, was passed through two gas dispersion tubes connected in series (double trap) containing a 0.1 N barium hydroxide and 0.2% barium chloride solution. CO_2 output was recorded by titration and respiration rate was calculated as mg CO_2 K_g^{-1} h^{-1} . Respiration rate of fruits were determined under 20°C .

The complete randomized block design with three replicates and with factorial arrangement was followed throughout the whole work (Snedecor and Cochran, 1980) . The means of main factors and their interactions were compared using the Now LSD method at 0.05.

RESULTS AND DISCUSSION

1. Fresh Weight Losses (FWL)

1.1 During cold storage period :

Table 1 shows the effect of tested treatments, cold storage period and their interaction on (FWL). The tested treatments

significantly affected FWL in the two seasons, which ranged 4.5-6.4% in the first season and 4.5-6% in the second season. The highest FWL, in both seasons, resulted from the treatments: (M+Savlon), (M+ TBZ) and (M+ hot TBZ) without significant differences among them. On the other hand , the least FWL were obtained by the two treatments : (R + hot TBZ) and (R + TBZ) without significant differences between them . The other tested treatments, i.e. M+ water gave in between values .

As expected, the effect of cold storage period was clear in both seasons. As such, FWL were significantly increased from the 3rd week to reach uppermost values in the 7th week.

The interaction (treatments x period) was significant in the second season only . The highest values were obtained from all tested treatments in the 7th week, and from (M + Savlon), (M + TBZ) and (M + hot TBZ) in the 6th week as well as from (M + Savlon) in the 5th week without significant differences among them . On the other hand , the least FWL came from all tested treatments in the 1st and 2nd seasons from (M+TBZ) , (R + TBZ) and (R + hot TBZ) in the 3rd week as well as (R + hot TBZ) in the 4th week .

1.2 After five-day shelf life :

Table 1 also shows the effect of the tested treatments, cold storage periods and their interaction on FWL after five-days shelf life in the two seasons . The uppermost FWL resulted for the treatments (M + water), (M + Savlon) . and (M+TBZ) without significant differences among them. However, the other three treatments, i.e. (R + TBZ), (M + hot TBZ) and (R+ hot TBZ) gave significantly lower FWL .

Regarding the effect of cold storage period on FWL after five-days shelf life, data clarified higher FWL during the weeks from the 3rd to 5th, then FWL decreased in the 6th and7th weeks. However, the interaction was insignificant .

Generally, ripe fruits revealed lower FWL than mature ones in both seasons during cold storage period which might be due to storing ripe fruits in a lower temperature (8°C) than mature ones (13°C). Worthwhile mature fruits cannot ripe after cold storage temperature lower than 12°C (Chaplin 1989) .

The obtained results are in line with those obtained by Joseph and Aworth (1992) who reported that dipping wild mangoes in hot (55°C) water or hot 0.1% benomyl minimized weight loss . The data also interfere with those obtained by Larsminarayana *et al.* (1974) who found that hot water caused higher weight losses.

2. Peel Color Index (PCI)
2.1 During cold storage :

From Table 2 it is clear that the tested treatments significantly affected PCI during cold storage period in the two experimental seasons. The values ranged 5.7-6.6 in the first season and 5.6-6.7 in the second season. Only one treatment (R + TBZ) consistently indicated higher values in the two seasons (6.6 and 6.7) . On the other hand , the three treatments of (M + water), (M + hot TBZ) and (R + hot TBZ) showed significantly lower PCI in the two seasons. The other tested treatments revealed different trends in the two seasons.

The PCI was gradually increased with the advance in cold storage period. However, the highest values were recorded at the last three weeks, i.e. from the 5th to the 7th week without significant differences among them. Moreover, the interaction was insignificant .

2.2 After five-day shelf life :

The data indicate higher PCI values after five-day shelf life with four treatments, i.e. (M + water) , (M + Savlon), (M + TBZ) and (R + TBZ) . The heat treatments, i.e. (M+ hot TBZ) and (R + hot TBZ) consistently gave lower values in both seasons.

The PCI values after five-day shelf life were significantly increased from the 5th to 7th weeks of cold storage without significant differences among them. Whereas, the interaction was insignificant.

These results are in line with those obtained by Abdul Gofur *et al.* (1997) who reported that hot water treatment retarded fruit ripening and with Zambrano and Materano (1998) , who found that maximum inhibition of carotenoid formation occurred in heated fruit at 54°C .

3. Fruit Decay Index (FDI)
3.1. During cold storage period :

Table 3 shows that FDI ranged from 1.6 to 3 in the two experimental seasons . The highest values resulted from (M + water) . On the other hand , the least values (1.6 and 1.7) in both seasons consistently came from the treatments of hot TBZ for ripe and mature fruits respectively in the two seasons. The treatments using TBZ and Savlon without heat indicated in between values.

FDI values significantly increased in the 6th and 7th weeks without significant differences between them . However , FDI was nil after one week of cold storage, while gradually increased afterwards .

The interaction was significant in both seasons . The least values were observed with almost all tested treatments in the first, second and third weeks . On the

other hand , the uppermost FDI resulted with the treatment (M + water) in the 7th week .

3.2 After five -day shelf life :

Data of both seasons (Table 3) reveal significantly higher FDI during shelf life with the treatment (M+water). However significantly , lower FDI values were recorded in both seasons with four treatments , i.e. (M + TBZ) , (R + TBZ) , (M + hot TBZ) and (R + hot TBZ) without significant differences among them. Meanwhile, the treatment of (M + Savlon) gave in between values .

The cold storage period also significantly affected FDI after five- day in both seasons . The values were relatively low after three weeks of cold storage (2.1) , then gradually increased to reach a peak (5.0 and 4.9 in the two seasons) at the 7th week.

The interaction was significant in the two seasons . The treatments (R + TBZ), (M + hot TBZ) and (R + hot TBZ) indicated lower values after the shelf life along the whole cold storage period. (seven weeks) without any significant differences among them. The other three treatments, i.e. (M + water) , (M + Savlon) and (M + TBZ) indicated higher FDI up to the 6th week .

These results are in harmony with those obtained by Spalding and Reeder (1979) and Joseph and Aworth (1992) .

4. Fruit Firmness

As show in Table 4 , fruit firmness was determined in the 4th week of cold storage period and after the five-day shelf life of this period .

After four weeks of cold storage, fruit firmness ranged from 1.7 to 2.1 Lb. in the first season and from 1.8 to 2.1 Lb. in the second season . The least values in both seasons (1.7 and 1.8 Lb.) resulted from the treatment (M + hot TBZ) . All other treatments recorded close values without any significant differences .

After five-day shelf life , two treatments indicated significantly higher fruit firmness, i.e. (M + TBZ) and (R + TBZ) without significant differences between them in both seasons (Table 4) . The other four treatments recorded lower value without significant differences among them.

These results are in line with those obtained by Spadling and Reeder (1979).

5. Respiration Rate

Table 4 shows fruit respiration rate determined in the 2nd and 4th week of cold storage period in the two experimental seasons. The data revealed significantly lower respiration rate in both seasons (2.31 and 2.2 mg CO_2 / Kg fruits / hour) with the treatment (R + hot TBZ) as compared with other treatments . Meanwhile , significantly

higher respiration rater in both seasons were recorded by four treatments , i.e. (M + water), M+ Savlon), (M + TBZ) and (M +hot TBZ) without significant differences among them. The values recorded by those four treatments ranged from 2.83 to 3.01 mg CO_2/ Kg / hour in the first season and from 2.90 to 3.1 mg CO_2 / kg / hour in the second season.

Differences due to cold storage period were significant in the second season only where fruits of 2nd weeks cold storage and five days shelf life revealed higher respiration rate than those of four-weeks cold storage and five-days shelf life. These results may be due to the onset of climacteric rise or to the effect of cold storage temperature on respiration rate. The interaction was insignificant in both seasons .

6. Panel Test Index (PTI)
6.1 During cold storage :

As shown in Table 4 , differences between fruits of all treatments in their PTI were insignificant in the two seasons .

The PTI gradually increased during the cold storage period to reach a peak at the 6th week, then tended to decrease in the 7th week. This was true in the two experimental seasons. The interaction was also insignificant .

6.2 After five-day shelf life :

The effect of tested treatments on PTI after five-day shelf life was significant (Table 4). Fruits of the four treatments, i.e. (M + water), (M+ Savlon) , (M + TBZ) and (R + TBZ) recorded PTI= 3 in both seasons . However, the treatment of (R + hot TBZ) indicated lower PTI in the two seasons (2.4) .

The five-day shelf life after each week of cold storage period also affected the PTI of fruits in both seasons. As such, fruits indicated higher. PTI after five-day shelf life following four and five weeks of cold storage than longer cold storage periods. On the other hand, the interaction was insignificant.

These results are in line with those obtained by Murthy and Rao (1983) , who found that captain and thiobendazole (TBZ) had no effect on fruit ripening , and those obtained by Joseph and Aworth (1992) , who reported that dipping wild mangoes in hot (55°C) water delayed ripening .

7. Total Soluble Solids (TSS)
7.1 During cold storage :

Table 5 shows highered TSS (%) with two treatments, i.e. (R + TBZ) and (R + hot TBZ) which recorded 17.6 and 16.7%, respectively in the first season and 17.9 and 17% , respectively in the second season . The least values achieved from the treatments (M + water) and (M + Savlon); . This was true in the two seasons. The

other treatments exhibited inbetween values.

The effect of cold storage period on TSS (%) was also significant in the two seasons. The least TSS values were recorded after one week (12.3 and 12.5% in the two seasons) . However, TSS values gradually increased with the advance of storage period to reach a peak at the fourth week (17.5 and 17.6% in the first and second season, respectively) .

The interaction was significant in both seasons. The highest values resulted from the treatments: (M + TBZ) and (R + TBZ) in the 3rd and 4th weeks as well as the treatments (M + hot TBZ) and (R+ hot TBZ) in the 4th week without significant differences among them in both seasons . All other interactions gave lower TSS values in both seasons without significant differences among them.

7.2 After five-day shelf life :

The data also indicated higher TSS (%) after five-day shelf life with three treatments in both seasons, i.e. (R + TBZ) , (M + hot TBZ) and (R + hot TBZ) without significant differences among them in both seasons (Table 5). TSS values of the three treatments ranged from 20.6 to 22.6% in the first season and from 21.6 to 22.9% in the second season without significant differences among them. On the other hand , the least TSS values came from two treatments, i.e. (M + water) and (M + Savlon) without significant differences between them in the two seasons.

In both seasons TSS values recorded after five-day shelf life following four weeks of cold storage were higher than those recorded after shelf life following three weeks of cold storage. The differences were significant in both seasons, but the interaction effect was insignificant .

Increasing cold storage period led to enhance ripening and consequently led to increasing hydrolytic enzyme activity, which promotes soluble materials and TSS.

The obtained results are in line with those obtained by Zambrano and Materano (1998), who found that TSS was higher in mango fruits heated up to 38 °C compared to those heated up to 54°C.

8. Active Acidity (pH)

8.1 During cold storage :

From Table 5 it is clear that juice pH value was significantly higher with three treatments, i.e. (M + Savlon) , (M+ TBZ) and (R + hot TBZ) without significant differences among them in the two seasons. The other three treatments indicated significantly lower values .

The effect of cold storage

period was also significant in both seasons. As such, the pH values were relatively low after one week of cold storage, then gradually increased to reach a peak at the 4th week. However, the interaction was insignificant.

8.2. After five-day shelf life

In both seasons, the pH value after five-days' shelf life was higher with two treatments, i.e. (M + TBZ) and (R + hot TBZ) without significant differences between them. The three treatments of (M + water), (M + Savlon) and (M+hot TBZ) recorded significantly lower pH values in the two seasons without significant differences among them.

The five-day shelf life following each cold storage period also affected pH values in both seasons. These values recorded in the 4th week were significantly higher than those recorded in the 3rd week. However, the interaction was insignificant.

The obtained results are in line with those obtained by Zambrano and Materano (1998), who found that titratable acidity was significantly higher in fruits heated at 54°C .Than in control ones.

Conclusively, treatments with Savlon at 500 ppm, TBZ at 1000 ppm decreased fruit decay index (FDI) during cold storage . However, hot TBZ (52°C) was the most effective treatment to depress FDI during seven weeks of cold storage and the following five-days shelf life . Ripe fruits indicated lower FWL , lower respiration rate, higher juice TSS and pH values than mature ones during the seven weeks of cold storage and the shelf life . Treatments with hot TBZ decreased peel color index and fruit firmness compared with unheated TBZ or Savlon during cold. storage and shelf life .

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Table 1 . Effect of some fungicides and heat treatments on fresh weight losses (%) of Awais mangoes during cold storage period and shelf life (1996 and 1997 seasons) .

Treatments(T)	Fresh weigh losses (%)													
	Cold storage period (weeks)								5 days shelf life after cold storage					
	1	2	3	4	5	6	7	Treat avg.	3	4	5	6	7	Treat avg.
								1996 season						
Mature fruits (M)+ water	1.6	2.3	5.0	5.9	6.2	7.8	9.4	5.4	2.9	2.8	3.2	2.9	2.2	2.8
M+ Savlon at 500 ppm	1.6	2.6	4.5	6.6	8.6	9.8	11.4	6.4	2.7	3.1	2.8	2.2	2.1	2.6
M+TBZ at 1000 ppm	1.3	2.6	4.1	5.7	7.6	8.9	10.9	5.9	3.2	3.1	2.7	2.1	2.0	2.6
Ripe fruits (R+TBZ (1000 ppm)	1.1	2.1	3.2	5.1	6.2	7.3	9.1	4.9	2.4	2.7	2.3	2.1	1.8	2.3
M+hot (52°C) TBZ (1000 ppm)	2.0	3.8	4.9	6.3	7.8	8.7	9.9	6.2	2.5	2.6	2.8	2.3	2.1	2.5
R+hot (52°C) TBZ (1000 ppm)	1.2	2.2	3.0	4.1	5.6	6.9	8.8	4.5	2.1	2.7	2.4	2.2	1.7	2.2
Period avg.(P)	1.4	2.4	4.1	5.6	7.0	8.2	9.9	-	2.6	2.8	2.7	2.3	2.0	-
NLSD0.05	P = 1.13		T = 0.52						P = 0.53		T = 0.29			
	PxT = NS								PxT = NS					
								1997 season						
Mature fruits (M)+ water	1.5	2.2	5.0	5.8	6.3	7.7	9.3	5.4	2.7	2.9	3.0	2.8	2.0	2.7
M+ Savlon at 500 ppm	1.6	2.7	4.5	6.5	8.4	9.6	11.0	6.3	2.6	3.0	2.9	2.1	2.1	2.5
M+TBZ at 1000 ppm	1.4	2.7	4.1	5.6	7.2	8.8	10.7	5.8	3.0	3.2	2.8	1.9	1.9	2.6
Ripe fruits (R+TBZ (1000 ppm)	1.1	2.2	3.2	5.1	6.1	7.4	8.9	4.8	2.3	2.6	2.2	2.0	1.7	2.2
M+hot (52°C) TBZ (1000 ppm)	2.0	3.2	4.8	6.3	7.4	8.6	9.7	6.0	2.4	2.5	2.6	2.1	1.9	2.3
R+hot (52°C) TBZ (1000 ppm)	1.2	2.2	3.0	4.1	5.4	6.8	8.9	4.5	2.2	2.6	2.3	2.2	1.7	2.2
Period avg. (P)	1.4	2.6	4.1	5.5	6.8	8.1	9.7	-	2.5	2.8	2.6	2.2	1.9	-
N LSD 0.05	P = 1.45		T = 1.88						P = 0.49		T = 0.22			
	PXT = 3.21								PXT = NS					

Table 2 . Effect of some fungicides and heat treatments on peel color index (PCI) of Awais mangoes during cold storage period and shelf life (1996 and 1997 seasons) .

Treatments(T)	Peel color index (PCI)													
	Cold storage period (weeks)								5days Shelf life after cold storage (weeks)					
	1	2	3	4	5	6	7	Tred avg.	3	4	5	6	7	Treat avg.
								1996 season						
Mature fruits (M)+ water	0.0	3.0	4.0	4.3	10.0	10.0	10.0	5.9	7.0	9.0	10.0	10.0	10.0	9.2
M+ Savlon at 500 ppm	0.0	2.3	4.0	5.3	10.0	10.0	10.0	5.9	8.0	10.0	10.0	10.0	10.0	9.6
M+TBZ at 1000 ppm	0.3	3.2	3.7	5.4	10.0	10.0	10.0	6.1	8.0	10.0	10.0	10.0	10.0	9.6
Ripe fruits (R+TBZ (1000 ppm)	2.2	3.3	3.3	7.7	10.0	10.0	10.0	6.6	7.0	9.0	10.0	10.0	10.0	9.2
M+hot (52°C) TBZ (1000 ppm)	2.8	3.1	3.6	3.8	7.1	10.0	10.0	5.8	6.0	7.5	10.0	10.0	10.0	8.7
R+hot (52°C) TBZ (1000 ppm)	2.1	3.2	3.3	3.4	8.1	10.0	10.0	5.7	6.2	7.4	10.0	10.0	10.0	8.7
Period avg.(P)	1.2	3.0	3.6	5.0	9.2	10.0	10.0	-	7.0	8.8	10.0	10.0	10.0	-
NLSD0.05	P = 0.89 T = 0.48 PxT = NS								P = 1.17 PxT = NS		T = 0.66			
								1997 season						
Mature fruits (M)+ water	0.0	2.4	4.	4.2	10.0	10.0	10.0	5.8	8.2	9.5	10.0	10.0	10.0	9.5
M+ Savlon at 500 ppm	0.0	2.4	4.6	5.4	10.0	10.0	10.0	6.0	8.1	10.0	10.0	10.0	10.0	9.6
M+TBZ at 1000 ppm	0.3	3.9	4.4	6.4	10.0	10.0	10.0	6.4	8.3	10.0	10.0	10.0	10.0	9.7
Ripe fruits (R+TBZ (1000 ppm)	3.0	3.1	3.2	7.7	10.0	10.0	10.0	6.7	8.5	9.0	10.0	10.0	10.0	9.5
M+hot (52°C) TBZ (1000 ppm)	2.1	3.0	3.2	3.7	7.5	10.0	10.0	5.6	6.1	7.2	10.0	10.0	10.0	8.7
R+hot (52°C) TBZ (1000 ppm)	3.0	3.1	3.3	3.4	8.3	10.0	10.0	5.8	6.1	7.1	10.0	10.0	10.0	8.6
Period avg. (P)	1.4	3.0	3.8	5.1	9.3	10.0	10.0	-	7.5	8.8	10.0	10.0	10.0	-
N LSD 0.05	P = 1.27 T = 0.78 PXT = NS								P = 1.09 PXT = NS		T = 0.72			

Table 3 . Effect of some fungicides and heat treatments on fruit decay index (FDI) of Awais mango fruits during cold storage period and shelf life (1996 and 1997 seasons) .

Treatments(T)	Fruit decay index (FDI)													
	Cold storage period (weeks)								5 days Shelf life after cold storage					
	1	2	3	4	5	6	7	Tred on	3	4	5	6	7	avg
	1996 season													
Mature fruits (M)+ water	0.0	1.6	2.0	2.6	3.0	3.6	8.0	3.0	3.1	3.7	4.3	4.8	8.0	4.8
M+ Savlon at 500 ppm	0.0	1.3	1.6	2.1	2.6	3.6	4.3	2.2	2.3	2.9	3.4	4.4	5.1	3.6
M+TBZ at 1000 ppm	0.0	1.4	1.5	2.0	2.5	3.4	4.0	2.1	2.1	2.6	3.2	4.0	4.9	3.4
Ripe fruits (R+TBZ (1000 ppm)	0.0	1.5	1.5	1.8	2.4	3.3	3.9	2.1	2.0	2.4	3.0	3.9	4.5	3.2
M+hot (52°C) TBZ (1000 ppm)	0.0	1.0	1.2	1.4	2.0	2.9	3.5	1.7	1.7	1.9	2.5	3.4	4.0	2.7
R+hot (52°C) TBZ (1000 ppm)	0.0	0.2	1.4	1.3	1.9	2.7	3.3	1.6	1.8	1.8	2.5	3.2	3.6	2.6
Period avg.(P)	0.0	1.3	1.5	1.8	2.4	3.2	3.4	-	2.1	2.5	3.1	3.9	5.0	-
NLSD0.05	P = 0.51		T = 0.39						P = 0.58		T = 1.17			
	PxT = 1.67								PxT = 2.97					
	1997 season													
Mature fruits (M)+ water	0.0	1.5	2.0	2.7	2.9	3.9	8.0	3.0	3.2	3.8	4.2	4.9	8.0	48
M+ Savlon at 500 ppm	0.0	1.4	1.5	2.0	2.5	3.7	4.8	2.3	2.2	2.8	3.3	4.2	5.0	3.5
M+TBZ at 1000 ppm	0.0	1.3	1.4	1.9	2.4	3.4	3.9	2.1	2.0	2.5	3.1	3.9	4.7	3.2
Ripe fruits (R+TBZ (1000 ppm)	0.0	1.5	1.3	1.7	2.3	3.2	3.8	2.0	1.9	2.3	2.9	3.8	4.4	3.1
M+hot (52°C) TBZ (1000 ppm)	0.0	1.1	1.1	1.5	2.1	3.0	3.4	1.7	1.6	1.8	2.3	3.3	3.8	2.6
R+hot (52°C) TBZ (1000 ppm)	0.0	0.7	1.3	1.4	2.0	2.6	3.2	1.6	1.7	1.9	2.3	3.1	3.5	2.5
Period avg. (P)	0.0	1.2	1.4	1.9	2.4	3.3	3.9	-	2.1	2.5	3.0	3.9	4.9	-
N LSD 0.05	P = 0.64		T = 0.36						P = 0.73		T = 1.21			
	PXT = 2.01								PXT = 3.07					

Table 4 . Effect of some fungicides and heat treatments on pulp firmness, respiration rate and panel test index of Awais mango fruits during cold storage period and shelf life (1996 and 1997 seasons) .

Treatments(T)	Firmness Lb/ inch2		Respiration rate mg/Co_2/kg/ hours			Pannel Test index (PTI)									
	Cold storage	Shelf life	Cold storage (weeks)			Cold storage period (weeks)					Sdays shelf life after cold storage (weeks)				
	4	4	2	4	Treat avg.	4	5	6	7	Treat avg.	4	5	6	7	Treat avg.
						1996 season									
Mature fruits (M)+ water	2.0	1.1	3.19	2.61	2.90	2.3	2.4	2.3	2.0	2.2	3.0	3.0	3.0	3.0	3.0
M+ Savlon at 500 ppm	2.1	1.2	3.07	2.65	2.86	2.2	2.4	2.9	3.0	2.6	3.0	3.0	3.0	3.0	3.0
M+TBZ at 1000 ppm	2.0	1.6	3.09	2.58	2.83	2.6	2.8	3.0	3.0	2.8	3.0	3.0	3.0	3.0	3.0
Ripe fruits (R+TBZ (1000 ppm)	2.0	1.6	2.21	2.33	2.27	2.0	2.6	2.9	3.1	2.6	3.0	3.0	3.0	3.0	3.0
M+hot (52°C) TBZ (1000 ppm)	1.7	1.0	3.80	2.22	3.01	2.3	2.6	2.9	2.0	2.4	3.0	2.7	2.6	2.0	2.6
R+hot (52°C) TBZ (1000 ppm)	1.9	1.1	2.00	2.63	2.31	2.6	2.9	2.9	2.0	2.6	3.0	2.7	2.0	2.0	2.4
Period avg.(P)	-	-	2.89	2.67	-	2.3	2.6	2.8	2.5	-	3.0	2.9	2.8	2.7	-
NLSD0.05	0.16	0.31	P = NS T = 0.64 PxT = NS			P = 0.21 T = NS PxT = NS					P = 0.19 T = 0.39 PxT = NS				
						1997 season									
Mature fruits (M)+ water	2.1	1.0	3.21	2.71	2.96	2.1	2.2	2.3	2.0	2.1	3.0	3.0	3.0	3.0	3.0
M+ Savlon at 500 ppm	2.1	1.0	3.16	2.69	2.92	2.2	2.3	2.4	2.8	2.4	3.0	3.0	3.0	3.0	3.0
M+TBZ at 1000 ppm	2.0	1.5	3.18	2.62	2.90	2.4	2.7	3.0	3.0	2.8	3.0	3.0	3.0	3.0	3.0
Ripe fruits (R+TBZ (1000 ppm)	2.1	1.6	2.19	2.28	2.23	2.8	2.9	3.0	3.0	2.9	3.0	3.0	3.0	3.0	3.0
M+hot (52°C) TBZ (1000 ppm)	1.8	1.0	3.90	2.30	3.10	2.0	2.7	2.8	2.0	2.4	2.9	2.6	2.5	2.0	2.5
R+hot (52°C) TBZ (1000 ppm)	1.9	1.0	2.00	2.41	2.20	2.3	2.8	3.0	2.0	2.5	3.0	2.6	2.0	2.0	2.4
Period avg. (P)	-	-	2.94	2.50	-	2.3	2.6	2.7	2.5	-	3.0	2.9	2.7	2.7	-
N LSD 0.05	0.19	0.39	P = 0.39 T = 0.7 PxT = NS			P = 0.71 T = NS PxT = NS					P = 0.17 T = 0.47 PxT = NS				

Table 5. Effect of some fungicides and heat treatments on total soluble solids (TSS) % and activated acidity (pH) of Awaiss mangoes juice during cold storage period and shelf life (1996 and 1997 seasons).

Treatments (T)	TSS (%)								Activated acidity (pH)							
	Cold storage period (weeks)					5days shelf life after cold storage			Cold storage period (weeks)					5days shelf life after cold storage		
	1	2	3	4	Treat av.	3	4	Treat av.	1	2	3	4	Treat av.	3	4	
1996 seasons																
Mature fruits (M)+ water	10.8	13.0	11.6	11.6	11.7	12.7	14.0	13.3	3.42	4.89	4.70	4.79	4.45	4.77	4.85	4.81
M+ Savlon at 500 ppm	12.0	12.6	11.7	12.6	12.2	12.5	14.8	13.6	4.87	4.87	4.80	4.94	4.87	4.85	4.99	4.92
M+TBZ at 1000 ppm	11.2	12.1	15.9	19.5	14.6	17.0	21.1	19.0	4.10	4.91	5.22	5.83	4.89	5.41	5.85	5.63
Ripe fruits (R+TBZ (1000 ppm)	14.1	16.2	18.3	22.0	17.6	20.1	23.2	21.6	4.11	4.12	4.39	4.49	4.28	4.51	4.62	4.56
M+hot (52°C) TBZ (1000 ppm)	12.0	12.9	14.1	17.9	14.1	19.1	22.2	20.6	3.91	4.12	4.62	4.75	4.36	4.91	5.23	5.07
R+hot (52°C) TBZ (1000 ppm)	14.1	14.9	15.8	22.0	16.7	22.1	23.1	22.6	4.72	4.79	4.88	4.88	4.8	5.81	5.95	5.88
Period avg.(P)	12.3	13.6	14.5	17.5	-	17.2	19.7	-	4.18	4.61	4.77	4.86	-	5.04	5.29	-
NLSD0.05	P=0.91 ; T = 2.45				T = 2.45				P = 0.09		T = 0.21			P = 0.16 T = 071		
	PxT = 6.12								PxT = NS					PxT = NS		
1997 seasons																
Mature fruits (M)+ water	11.1	13.1	12.0	12.0	12.0	12.6	14.9	13.7	3.81	4.69	4.72	4.79	4.50	4.52	4.91	4.86
M+ Savlon at 500 ppm	12.1	12.3	11.9	12.7	12.1	12.8	14.9	13.8	4.37	4.72	4.82	4.91	4.70	4.92	5.01	4.96
M+TBZ at 1000 ppm	11.2	12.6	15.6	19.5	14.7	16.8	21.0	18.9	4.20	4.69	4.98	5.21	4.77	5.39	5.88	5.63
Ripe fruits (R+TBZ (1000 ppm)	14.3	16.9	18.4	22.1	17.9	20.5	22.9	21.7	4.11	4.31	4.51	4.69	4.40	5.29	5.93	5.61
M+hot (52°C) TBZ (1000 ppm)	12.0	13.2	14.3	17.9	14.3	20.1	23.1	21.6	3.89	4.0	4.59	4.95	4.36	5.11	5.33	5.22
R+hot (52°C) TBZ (1000 ppm)	14.3	14.9	16.9	22.1	17.0	22.3	23.5	22.9	4.72	4.81	4.91	4.95	4.85	5.91	5.99	5.95
Period avg. (P)	12.5	13.8	14.8	17.6	-	17.5	20.0	-	4.18	4.54	4.75	4.92	-	5.29	-	-
N LSD 0.05	P = 0.86			T = 2.54		P=2.23		T= 2.19	P = 0.11		T = 0.26			T = 0.20 P = 0.13		
	PXT = 6.92					PxT = NS			PxT = NS					T= 0.65		
														PxT = NS		

تأثير معاملات ما بعد الجمع بالمطهرات الفطرية والمعاملات الحرارية علي صفات الجودة لثمار المانجو العويس خلال التخزين المبرد واثناء فترة العرض

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خلال موسمى ١٩٩٦ ، ١٩٩٧ عوملت ثمار المانجو العويس المكتملة النمو بالماء ، السافلون بتركيز ٥٠٠ جزئ فى المليون ، الثيوبندازول TBZ بتركيز ١٠٠٠ جزئ فى المليون والـ TBZ الساخن على درجة ٥٢°م لمدة ٥ دقائق . الثمار خزنت بعد ذلك لمدة ٧ أسابيع على درجة ١٣ ± ١°م . بالإضافة إلى ذلك عوملت ثمار ناضجة من نفس الصنف بالـ TBZ الساخن علي درجة ٥٢°م وخزنت على درجة ٨ ± ١°م لمدة ٧ أسابيع . أخذت ثمار من كل المعاملات بعد كل أسبوع من التخزين المبرد ووضعت تحت ظروف العرض فى السوبر ماركت (٢٠°م و ٦٠ - ٧٠٪ رطوبة نسبيه) لمدة ٥ أيام لدراسة تأثير مدة العرض عليها .

أدت المعاملات بالمطهرات الفطرية المستخدمة إلى تقليل تلف الثمار وكانت المعاملة بالـ TBZ الساخن الاكثر فاعلية فى تقليل التلف خلال التخزين المبرد وخلال مدة العرض. اظهرت الثمار الناضجة نقص اقل فى الوزن الطازج ومعدل التنفس ونسبه اعلى من المواد الصلبة الذائبة وقيمة الـ pH عن الثمار المكتملة النمو خلال التخزين المبرد ومدة العرض. ادت المعاملة بالـ TBZ الساخن إلى تقليل تلوين الثمار وصلابتها مقارنة بالثمار المعاملة بالـ TBZ الغير ساخن خلال التخزين المبرد ومدة العرض .