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EFFECT OF SOME NATURAL ACIDS AND CALCIUM ON TASTE PRESERVATION AND QUALITY OF "WASHINGTON" NAVEL ORANGES AFTER COLD STORAGE.

A: PREHARVEST TREATMENTS OF MATURE- GREEN FRUITS.

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ABSTRACT

Preserving the taste of cold stored "Washington" Navel orange fruits by preventing or reducing the sweetness and maintaining the fruit quality by applicable means would increase the opportunity of export. This study was conducted during two seasons 2004 and 2005 on mature "Washington" Navel orange fruits. Trees were growing in a private orchard in El_Behira governorate. Trees were sprayed at the mature-green stage before harvest by using a hand sprayer to run off point on November 7 and 15 in both seasons respectively. The treatments were: Citric acid, malic acid, oxalic acid each at 1% (w / v), and calcium chloride at 2% (w / v), in addition to the control (water spray). The non-ionic surfactant Tween 60 was added to all treatments at 0.1% v/v. Four replications were used with each treatment and one tree represented one replication. At the mature yellow stage on December 22 and 15 in both seasons, respectively. Random samples were collected at the spray and harvest times to determine the initial physical and chemical properties. Fruit samples were transported to El-Wady Station for Exporting Agricultural Crops where they were exposed to commercial processing (washing, rinsing in water, drying with warm air them packing in perforated carton boxes). All carton boxes were transported to a commercial cold rooms facility (Lashine Station) for storage

at 5°C and 85-90 % relative humidity for 3 months. Monthly periodical determination were made of cold-stored fruits indicated that preharvest spray with various treatments, regardless the storage period factor, caused a significant reduction in SSC of fruit juice. However, oxalic acid-treated fruits had significantly lower SSC than that of other natural acids. Juice acidity of all sprayed fruits was higher than that of the control, with highest acidity in the oxalic acid-treated fruits. Thus, SSC/acidity ratio of the control was significantly higher than that found in the juice of natural acid and $CaCl_2$ treatments. On the other hand, SSC of the albedo took similar direction to that found in SSC of the juice while acidity of the albedo in the control fruits was lower than that found with citric and malic acid-treated fruits. Vitamin C content of the juice in the control was higher than that found in the treatments in both seasons. Total sugars of the juice in the control fruits was higher than that found in citric or malic acid treatments but lower than that obtained with $CaCl_2$-treated fruits. Juice content of calcium was significantly increased by citric, malic and $CaCl_2$ as compared with the control in both seasons. Carotene content of the peel was significantly increased by all natural acids and $CaCl_2$ treatment relative to carotenes in the control fruits. The study also demonstrated the effect of the interaction between various treatments and the cold storage period and the random panel taste. It could be recommended to use natural acids treatments ,especially citric or malic acids, at the mature-green stage before harvesting at the mature-yellow stage in order to retard or prevent the development of sweetness of cold stored Navel oranges especially those targeted for export.

INTRODUCTION

Egyptian Navel oranges are very popular and demanded for export in many foreign markets. The fruit is juicy and tasty with many other quality attributes. The European and American markets desire a taste

that is balanced between the soluble solids content and acidity. Thus, it is important to maintain the balance between these two properties in such a way that appeal those consumers especially after cold storage. Even though "Washington" Navel oranges are not climacteric, the juice becomes sweeter after storage whether on the tree or in cold storage rooms. It has been recognized that there was a reduction in juice acidity in stored oranges in rate faster than that of sugars (Samson, 1986). The decline in fruit acidity after harvest was mainly ascribed to the occurance of the gluconeogensis process in the orange juice (Echeverria and Valich, 1989). In spite of the very limited changes that occur to oranges after harvest since they are nonclimacteric, there is still a possibility of cell wall hydrolysis by some enzymes such as galactosidases and glycosidases resulting in considerable changes in soluble solids of the juice even during cold storage (Echeverria and Ismail, 1989). Farmers and "Washington" Navel oranges producers lack a safe and feasible method that maintain the desired balance between the total soluble solids and acidity of the juice after cold storage, which would enable the orange industry to store Navel oranges for longer duration and extend their marketing seasons. Since the juice contains many natural acids such as malic, malonic, succinic, oxalic, ascorbic acids, it would be safe to maintain such balance by using some of these acids before harvest on a commercial scale. Furthermore, citric acid accounts for most of the acidity in citrus fruit acidity in the juice (Kefford and Chandler, 1970). Even within the peel, there are variations in organic acids in the falvedo and albedo tissues (Clements, 1964). To the best of our knowledge, no attempts have been made to exploit some of the already present natural acids before harvest as a mean of maintaining the balance between soluble solids contents (SSC) and acidity during postharvest cold storage. The objectives of this study were to employ some natural acids and calcium solutions through applying them on mature green Navel oranges before harvest in order to preserve the taste and quality of "Washington" Navel oranges after cold storages which would provide exporter with safe and feasible mean to control juice sweetness and prolong the marketing season.

MATERIALS AND METHODS

The present investigation was carried out during two successive seasons 2004 and 2005 using "Washington" Navel orange fruits. Twenty three years old orange trees were grown in a clay soil, in a private orchard at kaffr El-Dawar province, El-Behira Governorate. Trees were uniform, grafted on sour orange rootstock, and under standard cultural practices**.** Preharvest treatment was carried out when orange fruits reached the mature green stage on November 7 and 15 in both seasons, respectively.Twenty trees were randomly selected. Treatments were: Trees treated with citric, malic and oxalic acids, each at 1% (w/v); calcium chloride (2%,w/v) and water as the (control). Non-ionic surfactant agent (Tween-60), at 0.1% was used with all treatments to reduce the surface tension and increase the contact angle of spray droplets. Four trees per each treatment represented four replications. Samples of thirty two mature green orange fruits were picked just prior to the spray and were analyzed, as the initial, for both physical and chemical properties. Sprayed fruits were then left to reach the mature yellow stage on December 22 and 15 in both seasons, respectively, sample of 160 treated orange fruits for each treatment were harvested. Fruits were at similar size, and free from visible defects or mechanical damage. Before cold storage, samples of thirty two fruits from each treatment were used to determine the physical and chemical properties of the treated fruits (initial). Moreover, the rest fruit samples (128) were translocated as soon as possible to, El-wady station for Exporting Agriculture crops, in Kaffr El-Dawar province to expose to the following treatment: Washing (water mixed with 0.5% v/v of Freshgard fungicide at 38°C and pH ranged from 11.8-12 for 3 minutes), Rinsing in water, drying with heated air then packing in perforated cartons (16 orange fruits/carton). After that, all cartons were translocated to Lashin refrigerator for cold storage in cold chamber at 5°C and 85-90% relative humidity (according to Demirkol *et al.*, 2001), for 3 months. Every month, orange fruits of each treatment (32 fruits) were subjected to the following determinations. Fruits, of each treatment, were weighed before storage to obtain the initial weight. Then, weighed every one month. During cold storage, changes in fruit weight were mentioned at each sampling date and fruit weight loss

was calculated as a percentage from the initial weight (Ghoname,1992). Taste panel was carried out after three months of cold storage by ten panelists per each treatment to compare the effect of each used treatment on color, flavor and taste of orange juice according to a hedonic scale as follows in a taste panel questionnaire (Kramer and Twigg, 1962). The percentage of soluble solid contents was measured at 20°C using hand Refractometer. The percentage of soluble solid contents of albedo was determined by homogenizing 5 gms of albedo in 50 ml distilled water for 5 minutes and lasted to 15 minutes. The solution was filtered and the extract was used to determine the total soluble solids and acidity (Egan *et al*., 1987). Titratable acidity for both juice and the aqueous extract of albedo were determined by titration against 0.1N and 0.01 N, respectively, sodium hydroxide in the presence of phenol phthaline indicator according to the method of Spayed and Morries (1981). Acidity was expressed as gms citric acid per 100 ml of fruit juice or per 100 gm of albedo. The ratio between soluble solid contents and acidity was calculated by dividing the total soluble solids value on that of titratable acidity of juice. Vitamin C was determined as milligrams ascorbic acid/100 ml juice by titration against 2,6 dichlorophenol indophenol blue dye in the presence of oxalic/glycial acetic acid indicator according to the method of Egan *et al.*, (1987). Half-gram of fresh peel was extracted by 15 ml of 85% acetone with 0.5 gm calcium carbonate. The mixture was filtered through a glass funnel and the residue was washed with a small volume of acetone and completed to 25 ml. The extract was measured at wave length of 622, 644 and 440 nm for chlorophyll A,B and carotene using spectrophotometer (Wintermans and Mots, 1965).

Sugars were extracted from 10 ml of filtered juice of each sub-sample. The extraction was carried out by using distilled water according to Loomis and Shull (1937). Total sugars were determined color metrically by using 1 ml of the extract mixed with 1ml phenol 5% and 5ml sulphuric acid concentrated. The developing color intensity after 30 minutes was measured against blank at 480 nm using a spectrophotometer (Egan *et al*., 1987).

Calcium content of orange juice was determined by aching 25 ml of orange juice on the Muffle at 550°C/6 hours and dissolving the

preceperitate by Hcl 6N and filtration by using filter paper. The extracted calcium was determined according to Egan *et al.,* (1987)

Calcium content of orange albedo was determined by using one gram of albedo was ashed by using the Muffle at 550°C/6 hours and the precipitate which was dissolved by 6N Hcl. The extraction of albedo was used to determine calcium content by the method mentioned above according to Egan *et al.,* (1987).

The experiment was laid out as split plot design with the exception of the part of taste panel which was laid out as Randomized Completely Block Design (RCBD). All the data were subjected to the analysis of variance. The least significant difference to compare the means (LSD) was calculated as outlined by Steel and Torrie (1980)

RESULTS & DISCUSSIONS

I- Treatments and fruit characteristics regardless the storage duration factor:

Effects of some natural acids on weight loss and some chemical properties of "Washington" Navel oranges are shown in Tables 1 and 2. Control treatment caused significantly higher SSC of the juice as compared with other applied treatments. Moreover, natural acids, namely citric and malic and calcium chloride caused a significant increase in SSC of the juice (the differences among these treatments were not big enough to be significant) when compared with oxalic acid treatment which resulted significantly the lowest SSC of the juice. This trend of the results was consistent in both seasons of study.

Acidity of the juice was significantly increased by using natural acids relative to the control. This increase was higher with the use of oxalic acid than citric and malic acids in both seasons of study. Calcium chloride treatment led to significantly higher juice acidity than the control in both seasons. Acid treatments with oxalic, citric and malic acids caused a significant increase in juice acidity while calcium chloride treatment had significantly lower effect on juice acidity (Tables 1 and 2).

The ratio of SSC to acidity was also affected by acid treatments significantly. There was a significant reduction in SSC to acidity ratio

when compared with calcium chloride treatment and with the control. The highest SSC / acidity was obtained with control treatment followed by calcium chloride treatment in both seasons. Malic acid in both seasons, caused significantly higher SSC / acidity ratio than oxalic acid treatment which caused significantly the lowest SSC / acidity ratio. SSC to acidity ratio of the juice was not consistently influenced by citric acid treatment since this compound reduced significantly SSC / acidity ratio in the juice in the first season as compared with malic acid treatment which had significantly higher SSC / acidity ratio of the juice. While in the second season, citric acid treatment did not significantly result in different SSC / acidity ratio of the juice from that obtained with malic acid treatment. All treatments, in general, significantly caused lower SSC / acidity ratio of the juice than control and this trend was consistent in the two studied seasons.

The effect of various treatments on soluble solid contents of the albedo, regardless the storage duration, is shown in Tables 1 and 2. Control treatment in both seasons of study caused a significant increase in SSC of the albedo when compared with calcium chloride and other three acids (citric, malic and oxalic) treatments. In the first season of study, citric acid, calcium chloride and malic acid treatments caused a significant increase in SSC of the albedo as compared with oxalic acid treatment. Citric acid, calcium chloride and malic acid treatments did not significantly result in different SSC of the albedo. Even malic acid treatment which increased SSC of the albedo did not result in significantly different from that obtained with oxalic acid treatment. On the other hand, in the second season, citric acid increased significantly SSC of the albedo as compared with calcium chloride and with other two natural acids. Moreover, SSC values of the albedo in Navel oranges treated with calcium chloride were significantly equal to that obtained in oranges treated with malic acid. SSC of the albedo were not consistently influenced by oxalic acid treatment since this compound significantly reduced SSC of the albedo only in the second season of study.

With regard to acidity of the albedo tissue, it was found that malic acid treatment caused a significant increase in albedo acidity in both seasons of study. Moreover, malic acid treatment increased significantly albedo acidity as compared with oxalic acid, calcium

chloride and control treatments. This trend of results was consistent in both seasons of study. Calcium chloride treatment in the first season did not significantly result in different acidity of the albedo from that obtained with oxalic acid and control treatments, while in the second one, Navel oranges treated with calcium chloride had significantly the lowest acidity of the albedo as compared with that treated with oxalic acid control treatments.

The influence of various treatments on vitamin C content in the juice is shown in Tables 1 and 2. The data revealed that the highest increase in vitamin C of the juice occurred with control treatment as compared with other applied treatments. Moreover, all used natural acids led to a significant increase in vitamin C of the juice in both seasons of study. However, calcium chloride treatment resulted significantly in lower vitamin C than that occured with other applied treatments. The differences among the effects of all used natural acids were not big enough to be significant. This trend of results was consistent in both seasons of study.

Weight loss of Navel oranges was also influenced by various treatments. It was found that all natural acids and control treatments were effective in increasing weight loss. However, more weight loss occurred with oxalic acid than citric and malic acids in both seasons of study. On the other hand, calcium chloride treatment resulted significantly in the lowest weight loss as compared with other applied treatments. In the first season, Navel oranges treated with oxalic acid had significantly the highest weight loss, but in the second season, untreated Navel oranges had significantly the highest weight loss than that treated with oxalic acid treatment. Citric acid treatment, in both seasons of study, was more effective in reducing fruit weight loss than malic acid treatment. Generally, control and various natural acids treatments increased weight loss as compared with calcium chloride treatment in both seasons (Tables 1 and 2).

Carotene content of the peel was significantly increased by natural acids and calcium chloride treatments in both seasons of study. Navel oranges treated with citric acid achieved the highest amount of carotenes in the peel in both seasons. Moreover, oxalic acid and calcium chloride treatments resulted in a significant increase in

amount of carotenes in the peel as compared with malic acid and control treatments. Even malic acid treatment caused significantly higher amount of carotenes in the peel as compared with that in control treatment. This trend was consistent in both seasons of study.

The response of total sugars in the juice to various treatments, regardless the storage duration, is also shown in Tables 1 and 2. The results indicated to a significant increase in these sugars by calcium chloride treatment as compared with other applied treatments. In both seasons of study, control and oxalic acid treatments were equally effective in increasing total sugars of the juice relative to the malic and to citric acids treatments. Malic acid treatment resulted significantly in higher amount of carotene in the peel than that amount in citric acid treatment which had significantly the lowest amount of carotenes in the peel. This trend of increasing in the amount of carotenes in the peel was consistent in both seasons of study.

With regard to calcium content of the juice as influenced by natural acids and calcium chloride, it was evident that the highest calcium content in the juice was achieved with calcium chloride treatment in both seasons, where the juice had superior amount of calcium when compared with the control and natural acids (Tables 1 and 2). Oxalic acid treatment caused a significant increase in calcium content of the juice as compared with control and other two acid treatments. Even, control treated fruits had significantly higher calcium content of the juice than that treated with malic and citric acids. Navel oranges treated with citric acid had significantly the lowest calcium content of the juice as compared with that treated with calcium chloride, control and other two natural acids. These results were similary in both seasons of study.

Navel oranges response in terms of their content of calcium in the albedo clearly showed a significant decrease in natural acids – treated fruits in both seasons of study as compared with calcium chloride and control. Calcium chloride, on the other hand, caused the highest content of calcium in the albedo of Navel oranges in both seasons of study. The albedo treated with calcium chloride had even much more calcium content than that treated with malic acid. Control treatment also resulted in a significant increase in calcium content of

the albedo as compared with natural acids treatments. Navel oranges treated with malic and citric acids had significantly higher calcium content of the albedo than that treated with oxalic acid which had significantly the lowest calcium content of the albedo. The presented results were consistent in both seasons of study.

The reported increase in soluble solids content, in this study, after harvesting Navel oranges then storing them agreed with Salunke and Desai, (1986) and was mainly ascribed to total sugars in the juice that could reach 70 to 85 % of the total soluble solids. However, there are small amount of other material in the juice including lipids, nitrogen and phosphorus-containing compounds especially pectin (Mc Cready, 1977). Even though, orange fruits are nonclimacteric which means that there are very limited changes occurring after harvest. However, the hydrolysis of cell wall by some cell wall hydrolyses such as galactosidases or glycosidases might cause considerable changes in the juice soluble solids. Changes in the activity such enzymes during cold storage was observed by Echeverria and Ismail (1990). The release of sugars such as galactose, glucose, arabinose or other cell –wall total soluble solids and acidity would lead to a noticeable change in juice taste. The reduction in fruit acidity after harvest was mainly attributed to the occurrence of gluconeogensis (conversion of some acids back to sugars) in the orange juice (Echeverria and Valich, 1989). Decline in juice acidity after cold storage was reported to be faster than that of sugars (Samson, 1986). The migration of natural acids from albedo to the juice has been reported (Sasson and Monselise, 1977) which agreed with our findings in this study.

II- The Interaction between Treatments and Storage Period:

Data of soluble solids contents of the juice as influenced by the interaction between treatments and the storage period was shown in Table 3. The data revealed that SSC of the control fruits increased as the fruit developed from mature green to mature yellow and this increase continued as storage period progressed. This trend was consistent in both seasons and applied for all treatments as well. However, calcium chloride-sprayed fruits had significantly higher SSC in the juice at the end of cold storage as compared with those

fruits sprayed with natural acids. Moreover, when sprayed fruits reached to the mature yellow stage, citric acid-treated oranges had higher SSC than those sprayed with malic or oxalic acids. It was also evident that SSC of acid sprayed fruits did not significantly vary from the control ones after three months of cold storage.

With regard to juice acidity as affected by the interaction between the treatments and the storage period (Table 4), it was evident that such acidity was similar for all fruits at the spray time at the mature green stage. There was a decline in juice acidity as the fruits developed to the mature-yellow stage even though calcium-treated ones possessed higher acidity than that of the control fruits at that stage. After one month of cold storage, oxalic acid treated fruits had significantly higher juice acidity than the control. This trend continued until the end of cold storage since oxalic acid-treated fruits had significantly higher juice acidity than that of the control in both seasons followed by malic-treated fruits. Even those fruits sprayed with calcium chloride, had higher juice acidity than that of the control after 3 months of cold storage in both seasons.

Changes in the ratio of SSC to acidity as influenced by the interaction between various treatments and storage period (Table 5) proved that such ratio did not significantly vary at the spray time during the mature-green stage for all treatments and the control. However, there was a drastic increase in the SSC / acidity ratio as the fruit progressed from the mature-green to mature yellow stage. Furthermore, the control mature-yellow fruits had significantly higher SSC to acidity ratio of juice as compared with all other treatments. This trend continued until even after 3 months of the cold storage especially for natural acid treated fruits. Nevertheless, there was higher SSC/acidity in Navel orange juice that were sprayed with malic acid relative to those sprayed with citric or oxalic acids at the end of cold storage in both seasons.

Soluble solids content in the albedo tissue of sprayed oranges as affected by the interaction between various treatments and the cold storage period was reported in Table 6. The data revealed that all fruits had a similar SSC in the albedo at the mature-green stage in both seasons. Howeve, as the storage duration increased to one month, the control fruits had higher SSC in the albedo when compared with the spray time but these SSC values significantly declined after 3

months of cold storage in the control. Moreover, citric acid-treated fruits had significantly lower SSC in the albedo than that of the control. Similar conclusion was reached with regard to malic acid at the end of cold storage while those fruits treated with calcium chloride did not vary significantly from those of the control in their SSC of the albedo at the end of cold storage in both seasons.

. Changes in albedo acidity as influenced by the interaction between the treatments and storage duration were reported in Table 7. It was found that such acidity was similar for all fruits at the spray time when they were mature-green. However, when they reached to the mature-yellow stage, albedo acidity dropped in all natural acid-treated fruits as well as those treated with calcium chloride while albedo acidity of the control did not change at mature-yellow stage. The acidity of the albedo in the control fruits continued to decline significantly as the storage progressed from on month to another. Furthermore, natural acids-treated fruits after 3 months of cold storage had higher acidity in the albedo than that of the control. The highest albedo acidity among acid-sprayed fruits was obtained in citric acid-sprayed ones at the end of cold storage in both seasons. On the other hand, albedo acidity of $CaCl_2$-sprayed fruits was still relatively higher than that of control at the end of cold storage. There conclusions were also true for the two months storage where all treated fruits had higher albedo acidity than the control ones in both seasons. Thus, the decline in albedo acidity was at a similar magnitude in natural acids-treated fruits and $CaCl_2$-sprayed ones as compared with such decline occurring in the albedo acidity of the control fruits. Vitamin C content in the juice as affected by the interaction between the treatments and the cold storage period (Table 8) revealed that all sprayed fruits at the mature green stage did not significantly vary in their vitamin C content. It was also found that as the fruits reached to the mature yellow stage, vitamin C content decreased significantly in the juice of control and all other treatments. Although the content of vitamin C continued to drop from one month –storage to another in all fruits, the reduction of vitamin c in either oxalic acid or $CaCl_2$ sprayed fruits was higher than that of the control fruits. Moreover, vitamin C content in the juice of the control did not significantly vary from those sprayed with citric or malic acids after 3 moths of cold storage.

With regard to the effect of the interaction between treatments and the storage period on total sugars in the juice (Table 9), the data showed that the juice contained similar amounts of total sugars at the mature-green stage in all treatments and the control. However, harvested fruits of the control at the mature-yellow stage had lower total sugars than those sprayed with malic, oxalic acids, or $CaCl_2$ in both seasons. On the contrary, the control fruits at mature-yellow stage had higher total sugars in the juice as compared with those fruits sprayed with citric acid. As cold storage progressed, total sugars continued to increase in a significant manner in the control fruits in both seasons. However, after 2 months of cold storage, the control fruits had significantly higher content of total sugars than those sprayed with natural acids, but $CaCl_2$-treated fruits at that time were still similar to the control fruits in their total sugars. By the end of cold storage after 3 months, oxalic acid-treated fruits had significantly lower amount of total sugars than those of the control and all other treatments. The highest total sugar in the juice was found in those fruits treated with $CaCl_2$ after 3 months of storage in both seasons. Malic acid-treated fruits, however, had total sugars in the juice similar to that found in the control fruits at the end of cold storage.

Calcium content in the juice was affected by the interaction between various treatments and the storage period as shown in Table 10. The results indicated that calcium content did not significantly vary in the juice at the mature-green stage in both seasons with all treatments and the control. As the fruit progressed to the mature-yellow stage, calcium increased significantly in all fruits. The highest calcium accumulation in the juice was found in $CaCl_2$-treated fruits that had superior amount of calcium relative to the control and natural acid-sprayed fruit since the first sample until the end of cold storage after 3 months. Moreover, oxalic acid treated fruits attained the highest calcium content in the juice among all other acid treatments followed by citric acid-treated fruits as compared with the control. Data of calcium in the albedo of Navel oranges as influenced by the interaction between various treatments and cold storage was reported in Table 11. The data indicated that calcium content in the albedo was similar in the control fruits and all treatments at the mature-green stage. This content significantly declined in the albedo until the end of cold storage after 3 months. Fruits sprayed with $CaCl_2$ retained the

highest calcium content in the albedo at the mature yellow stage as compared with the control and natural acid-treated fruits. This trend was true at all sampling times. Thus, the decline in calcium content in the albedo over time took an opposite direction to what was found in juice content of calcium. Furthermore, calcium content in albedo of natural acids-treated fruits was significantly lower than that found in the control after 3 months of cold storage.

III- The taste panel data:

With regard to the effect of natural acids and calcium chloride treatments on juice color, flavor and taste, the data in Table 12 show that after three months of cold storage, citric and malic acids were able to maintain the juice color similar to other applied treatments. Also, those oranges treated with either oxalic acid and calcium chloride had more favorable juice color than the control. The least color score was gained with oranges of control treatment.

Flavor data, however, did not take the same trend as color data. The highest flavor score was given by the panel to the juice extracted from oranges previously treated with oxalic or malic acids while control or citric acid treatments resulted in less favorable than the calcium chloride treatment.

The taste was also influenced by various treatments where malic or oxalic or citric acid – treated fruits resulted in the most favorable taste as compared with the control. The differences among the three natural acids were not remarkable enough to be significant. Moreover, the taste of calcium chloride – treated fruits was significantly better than that of the control.

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الملخص العربى

تاثير بعض الاحماض الطبيعية و الكالسيوم على حفظ مذاق و جودة ثمار البرتقال ابوسرة صنف " واشنجطن" بعد التخزين المبرد.
A: معاملات ما قبل الجمع للثمار مكتملة النمو الخضراء.

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أن حفظ مذاق ثمار البرتقال ابوسرة صنف " واشنجطن" بعد التخزين المبرد عن طريق منع او تقليل حدوث زيادة حلاوة العصير مع المحافظة على جودة الثمار باستخدام طرق عملية قابلة للتطبيق يعنى زيادة فرصة تصدير تلك الثمار. اجريت هذه الدراسة خلال موسمين 2004, 2005 باستخدام ثمار البرتقال ابوسرة صنف " واشنجطون", كانت الاشجار نامية فى مزرعة خاصة بمحافظة البحيرة, تم رش الاشجار فى مرحلة اكتمال النمو الخضراء باستحدام رشاشة يدوية حتى نقطة الجريان السطحى و بتاريخ 7 , 15 ديسمبر فى كلا الموسمين على الترتيب واشتملت المعاملات على: حامض

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الستريك, حامض الماليك, حامض الأوكساليك كل منهم بتركيز 1٪ (وزن الى حجم) , كلوريد الكالسيوم بتركيز 2٪ (وزن الى حجم), بالاضافة للكنترول (الرش بالماء), وتم اضافة المادة الناشرة توين 60 لكل محاليل المعاملات و بتركيز 0.1 % (حجم الى حجم). استخدمت اربع مكرارت لكل معاملة حيث كانت الشجرة الواحدة تمثل مكررة. عندما وصلت الثمار لمرحلة اكتمال النمو و التلوين Mature yellow بتاريخى 22 , 15 ديسمبر فى كلا لموسمين على الترتيب, جمعت عينات الثمار لاجراء التخزين المبرد (160 ثمره لكل معاملة), كما استعملت 32 ثمرة / معلملة لتقدير صفات البداية للثمرة سواء طبيعية او كيماوية Initial ونقلت ثمار المعاملات و الكنترول الى محطة الوادى التجارية لتصدير الحاصلات الزراعية حيث تعرضت للعمليات المختلفة من غسيل و نقع فى الماء و تجفيف بالهواء و تعبئة فى صناديق كرتون تجارية مثقبة , ثم نقلت الصناديق الى محطة تبريد تجارية (محطة لاشين) حيث خزنت الصناديق الكرتون على 5 درجة مئوية و رطوبة نسبية 85 – 90 %, و لمدة ثلاثة شهور , و تم كل شهر قياس الصفات الطبيعية و الكيماوية للثمار. و قد اشارت النتائج الى ان رش ما قبل الجمع بواسطة المعاملات المختلفة , بغض النظر عن عامل فترة التخزين, قد سببت خفض معنوى فى محتوى المواد الصلبة الذائبة فى العصير. و مع ذلك فقد ادت معاملة حمض الاوكساليك الى خفض المواد الصلبة الذائبة فى العصير بطريقة معنوية بالمقارنة مع الاحماض الطبيعية الاخرى.

كما وجد ان حموضة العصير فى كل الثمار كانت اعلى من تلك الموجودة بالكنترول و احتوت الثمار التى عوملت بحمض الاوكساليك على اعلى حموضة بين المعاملات, و هكذا وجد ان نسبة المواد الصلبة الذائبة الى الحموضة لثمار الكنترول كانت اعلى بدرجة معنوية من حموضة عصير ثمار معاملات الاحماض الطبيعية او كلوريد الكالسيوم. و من ناحية اخرى, فقد اخذت نتائج المواد الصلبة الذائبة فى الالبيدو اتجاها مشابها لما وجد فى العصير, بينما كانت حموضة الالبيدو لثمار الكنترول اقل من تلك التى وجدت مع معاملتى حمض الستريك و حمض الماليك. اما فيتامين ج فى عصير ثمار الكنترول فقد كان اعلى من تلك التى وجدت فى المعاملات فى كلا الموسمين, اما محتوى السكريات الكلية للعصير فى ثمار الكنترول فقد كان اعلى مما وجد فى عصير ثمار معاملتى حمض الماليك و الستريك, و لكنة اقل مما وجد مع معاملة كلوريد الكالسيوم. و قد ادت معاملات حمض الستريك و الماليك و كلوريد الكالسيوم الى زيادة محتوى الكالسيوم فى عصير الثمار بالمقارنة بثمار الكنترول فى كلا الموسمين, اما محتوى القشرة من الكاروتين فقد زاد بشكل معنوى مع جميع معاملات الاحماض الطبيعية و كلوريد الكالسيوم بالمقارنة بمحتوى الكاروتين فى قشرة ثمار الكنترول, و قد تناولت هذة الدراسة ايضا تاثير التفاعل بين المعاملات المختلفة و مدى طول فترة التخزين المبرد, و اختبار التذوق للثمار عشوائيا, و توصى الدراسة برش الثمار المكتملة النمو الخضراء قبل الجمع بمعاملات الاحماض الطبيعية المستخدمة خاصة حمض الستريك والماليك مع جمع الثمار فى مرحلة اكتمال النمو الصفراء حتى نعيق او نمنع من ظهور حلاوة العصير بعد فترة التخزين المبرد لثمار البرتقال ابو سرة خاصة المستهدفة للتصدير.

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