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Effect of postharvest storage of whole fruit on physico-chemical and microbial changes of fresh-cut cantaloupe (*Cucumis melo* L. *reticulatus* cv. Glamour)

[1]Munira, Z. A., [1*]Rosnah, S., [2]Zaulia, O. and [3]Russly, A. R.

[1]Department of Process and Food Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia
[2]Horticulture Research Centre, Persiaran MARDI-UPM, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia
[3]Halal Product Research Institute, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia

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Abstract

Cantaloupes continue to ripen after harvesting which is caused by ethylene production due to climacteric behaviour during postharvest storage. In this study, the cantaloupe fruits harvested at commercial maturity were evaluated for quality attributes during three weeks of storage at 10°C and a relative humidity (RH) of 90±5%. In addition, fresh-cut samples were stored for a further 19 days at 2°C and 87% RH. The fresh-cut samples were prepared on a weekly basis by dipping into deionised water (control) at 2°C for 1 minute. The effect of postharvest storage of cantaloupe on the physico-chemical properties and microbial activity was observed prior to fresh-cut processing. It was found that firmness, luminosity (L^*), and titratable acidity (TA) decreased, while total soluble solids (TSS), pH, TSS:TA ratio, microbial activity (total plate count (TPC) and yeast and mould (YM)) of the fresh-cut increased over the postharvest storage period of the fruit. Meanwhile, the orange colour and the intensity (hue angle, h_{ab}, and chromaticity) of the flesh did not differ significantly during storage. The cantaloupe stored for three weeks at a low temperature indicated a successful potential for fresh-cut processing due to good maintenance of the product quality.

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Introduction

Fresh-cut fruit is defined by USDA (United State Department of Agriculture) and FDA (Food and Drug Administration) as the fruits have been freshly-cut, washed, packaged, and maintained with refrigeration condition (Beaulieu and Gorny, 2001). Commercialisation of fresh-cut cantaloupe is growing tremendously due to recent market demand. Over the past decade, with an estimated retail market value of $11 billion, fresh-cut products are rapidly growing in order to fulfill consumer demand on the convenient and healthy product (Luna-Guzmán *et al*., 1999). Beaulieu and Gorny (2001) identified cantaloupe, honeydew, strawberry, and pineapple to be fruits suitable for fresh-cut processing. The intake of these products can benefit to healthy diet, able to decrease the risk of cardiovascular diseases and cancer.

Fruits detached from their parent plant lead to rapid deterioration by physical, physiological, and microbiological processes (Perera and Smith, 2007). Postharvest handling such as sorting, grading, transporting, and storage normally takes a certain duration before the fruits are ready to be marketed. Fruits ready for sale may also take several days before they reach the fresh-cut processor. The postharvest shelf life of the cantaloupe varies according to harvesting stage, which normally means harvesting at 1/2 to 3/4 slip for the commercial market, and can survive for between 12 and 16 days (Cohen and Hicks, 1986). Therefore, delaying the fruit processing may affect its fresh-cut shelf life. Watada *et al*. (1996) investigated delays of between 4 and 7 days in the time of fresh-cut preparation and found that the product shelf life was reduced.

Fruits prior to postharvest storage were involved in the ripening process. This process particularly occurs with climacteric fruit, whereby the ripening is assisted by respiration and is associated with ethylene production (Alexander and Grierson, 2002). The fruits categorised in the climacteric group are melons (Miccolis and Saltveit, 1995; Taniwaki *et al*., 2009; Tijskens *et al*., 2009), bananas (Bagnato *et al*., 2002), and kiwifruits (Zhang *et al*., 2003).

*Corresponding author.
Email: *rosnahs@eng.upm.edu.my*

These fruits all show rapid quality degradation when put into storage. The quality reduction may be tolerated under optimum postharvest handling and a storage temperature of between 0°C and 1°C. These conditions have been previously recommended for delaying deterioration and for ripening (Hardenburg *et al*., 1986; Kienzle *et al*., 2011).

The initial quality of the cantaloupe, based on physical appearance such as the size, net development, background colour, and being free from defects (Lester, 1996; Luna-Guzmán and Barrett, 2000; Lamikanra *et al*., 2003; Silveira *et al*., 2011), is a basic criterion for fruit to be selected for fresh-cut processing. The loss in fruit quality during prolonged storage has been widely studied in recent years. However, these studies only consider the immediate processing of the fresh-cut cantaloupe or a postharvest storage exposure not exceeding 3 days (Luna-Guzmán and Barrett, 2000; Lamikanra and Watson, 2004; Gil *et al*., 2006; Lamikanra and Watson, 2007). Interest in reducing the amount of fruit dumping at fresh fruit markets has led to an observation of how the cantaloupe undergoing a longer duration of postharvest storage may preserve and maintain the fresh-cut quality after processing. The objective of this study is to determine the effect of postharvest storage duration of the whole fruit on the quality of fresh-cut cantaloupe during storage, based on the cultivar Glamour variety.

Materials and Methods

Fruit preparation

Cantaloupe melons (*Cucumis melo* L. var. *reticulatus*) cultivar Glamour harvested at commercial maturity of 3/4 of full slip during dry season (May) was received at ambient temperature from Pulau Indah, Klang. It took 3 hours driving by multi-purpose vehicle from the field to the laboratory. The melons were arranged in the basket and covered in canvas from the sun during transportation. Melons free of defects and have a similar size, background colour, net development, and abscission of the stem 3/4 slip as usual as commercial maturity were selected and stored immediately in a cold room at 10°C and 90±5% RH prior to postharvest ripening. The fruits were stored in cold storage for one, two, and three weeks in order to allow the retarding ripening process to take place. A similar quantity of fruits (23 melons) was withdrawn from the cold room for sample analysis each week prior to fresh-cut processing.

Fresh-cut preparation

The cantaloupe fruits withdrawn from cold storage were washed with water and scrubbed with a sponge to remove dirt on the outer surface of the melons. The cleaned melons were dipped in 150 ppm of sodium hypochlorite and rinsed with cold (~2°C) deionised water. Fresh-cut preparation began by sanitizing all the experimental facilities including the knife, cutting board, stainless steel table, spoon, basin, and basket with 1000 ppm sodium hypochlorite solution. The sanitized equipment was rinsed with cold deionised water and air-dried to reduce cross contamination during sample preparation.

Melons skin was peeled using a sharp knife in order to reduce flesh wounding, and the flesh was washed with cold deionised water before being cut into halves longitudinally. After removal of the seeds, the flesh was cut into eight wedges. Three similar sized cube-shaped melon chunks, approximately 2.5x2.5x2.5 cm, were obtained from each wedge. Therefore, a total of 24 fresh-cut samples were obtained from each melon. In this experiment, a total of 23 cantaloupe melons were used and prepared as fresh-cut for further analysis. An equal number of melons were used for sample preparation in every storage week.

Treatment application

The 540 fresh-cut cantaloupe cubes were prepared and treated with 2°C of deionised water. The treated samples were allowed to drain any excess solution and were evenly distributed into polypropylene lidded-containers. Each container contained 10 melon cubes accompanied by a water absorbent (Supasorb PE F2/2, Thermarite, Malaysia). All the containers were stored at 2°C and 87% RH for 19 days. The entire sample from each of three containers was measured on every evaluation day.

Analyses were carried out immediately after sample preparation and at 3±1 day intervals, for up to 19 days. The analyses included firmness, colour, total soluble solids (TSS), titratable acidity (TA), TSS:TA ratio, pH, and microbiological (total plate count (TPC) and yeast and mould (YM). All the analyses were conducted at ambient temperature (25°C and 56% RH).

Texture analysis

A TA.XTPlus Texture Analyser (Stable Micro Systems, Surrey, UK) with a 5 mm diameter (P/5) cylindrical probe attached was used to determine tissue firmness of the fresh-cut cantaloupe. A 500 N load was set on the equipment. A two-cycle compression test was performed with the settings as follows: preset speed, 2 mm/s; test speed 1 mm/s; post-test speed 2 mm/s; distance as 30% strain; time 1 s; trigger force 20 g (Lamikanra and Watson, 2007). The result was

recorded as the maximum load in Newtons (N). Five melon cubes were used on each replication. The results of three replicates were averaged to produce a single value.

Colour

Colour measurement was performed by using a colour spectrophotometer, UltraScan PRO (HunterLab, USA). The measurement began by calibrating the equipment once with black and white tiles. Then, the samples were inserted into a reflectance shelf as the samples were considered wet, and then clamped prior to colour measurement. Three melon cubes from each of three containers were measured on every evaluation day. Luminosity (L^*) values were recorded while chromaticity $C^*=[(a^*)2 + (b^*)2]0.5$ and hue angle $h_{ab}=tan\text{-}1[(b^*) \times (a^*)\text{-}1]$, where a^* represents sample greenness and b^* is yellowness, were calculated according to Machado *et al*. (2008).

Total soluble solids (TSS), titratable acidity (TA) and pH analyses

The juice of five melon cubes from each replicate was extracted by using a domestic juicer (Power Juicer, Smart Shop™, US) and analysed for TSS, TA, and pH. A drop of the extracted juice was pipetted onto the panel screen of a digital refractometer (AR2008, KRUESS, Germany) to determine the TSS value which was recorded as °Brix. A digital autotitrator (Model 785 DMP Titrino, Metrohm, Switzerland) was purposely used for the TA and pH measurement. The titration sample was made up of a mixture of 10 ml juice and 40 ml distilled water. Then, the autotitrator electrode was immersed into the sample solution and the measurement conducted by titration with 0.1 mol/L NaOH until the pH reached 8.5. During analysis, the sample solution was stirred thoroughly by a magnetic stirrer. The pH was recorded when it appeared immediately on the panel screen at the beginning of experiment whilst the TA readings in ml were obtained when the autotitrator had stopped operating. The TA was calculated as percentage citric acid by the equation $TA\%= [(EP1) \times (0.064) \times (C30) \times (100)] \times COO^{-1}$, where EP1 is the end point of NaOH in ml when the pH reached 8.5, C30 is the molarity of NaOH, and COO presents the sample volume in ml. The TSS:TA ratio also was calculated from the determination of the data.

Microbiological analysis

Microbiological growth in the melon cubes was observed as total plate count (TPC) and yeast and mould (YM). The following method was accordingly referred to Luna-Guzmán and Barrett (2000) and Silveira *et al*. (2011). From each replicate, three random melon cubes of 10 g were collected using sterile techniques from a polypropylene container and homogenized (Stomacher, Seward 400, United Kingdom) with 90 ml of sterile Ringer solution (Oxoid, Basingstoke Hampshire, England) in a sterile stomacher bag (Labchem Technology Centre, Malaysia) for 1 minute. Serial dilutions needed for sample plating were prepared in 9 ml of ringer solution. The pour plate method was performed using the following media and culture conditions: Plate Count Agar (Difco, Becton Dickinson Company, France) for TPC and Potato Dextrose Agar (Difco, Becton Dickinson Company, France) for yeast and mould counts with added 10% tartaric acid (Systerm, Malaysia) to attain pH 3.5. Both the media of the TPC and the yeast and mould count were incubated at 35±2°C for 48 hours and 25±2°C for 5 days, respectively. The microbial counts were expressed as $\log_{10}$ (cfu g^{-1}). According to microbial legislation, the maximum tolerated count is 7 $\log_{10}$ (cfu g^{-1}) for aerobic bacteria and 5 $\log_{10}$ (cfu g^{-1}) and 3 $\log_{10}$ (cfu g^{-1}) for yeast and mould respectively (Silveira *et al*., 2011).

Statistical analysis

The experiment was conducted with a completely randomized design of three replicates per treatment. SAS 9.2 system (SAS Institute Inc., Cary, NC, USA) was used for analyses of the mean standard error, variance (ANOVA), and a least significant difference test (t-test) ($P<0.05$) to compare differences among treatment and sample storage time.

Results and Discussion

Firmness

Figure 1 shows the effect of postharvest storage of cantaloupe on the firmness of the fresh-cut stored at 2°C and 87% RH for 19 days. The cantaloupes that were processed into fresh-cut after one (W1) and two (W2) weeks storage at 10°C and 90±5% RH had identical loss of firmness with 37% each (expressed as a percentage of the initial values). Storing the fruit for three weeks (W3) at 10°C before fresh-cut processing reduced the firmness by 20% which indicates a better survival. These large differences in the percentage loss were markedly affected by the fruits and sample storage duration. The initial value of the samples prepared at week three was 6.61 N less significant ($P<0.05$) than the week one and week two samples which gave results of 9.55 N and 8.44 N, respectively. This indicates that the firmness of the fresh-cut samples decreased as postharvest

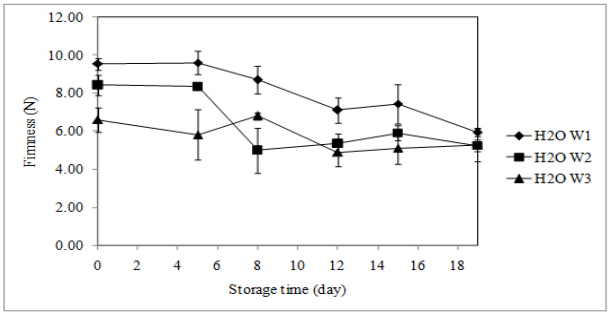

Figure 1. Firmness (N) of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and stored in air (2°C and 87% RH) for 19 days

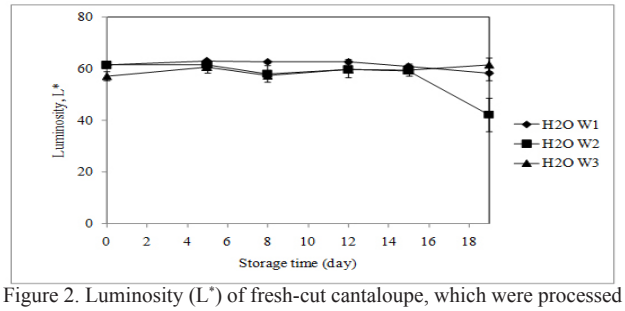

Figure 2. Luminosity (L*) of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

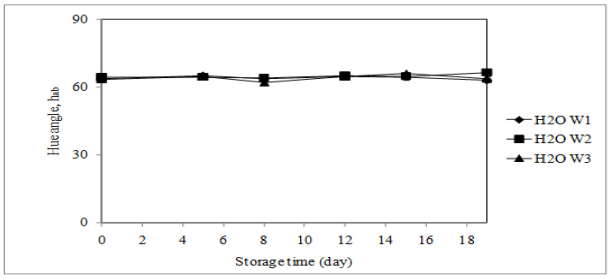

Figure 3. Hue angle (h_{ab}) of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

storage of the cantaloupe increased. By the end of the sample storage period, the firmness values were almost identical and were not significantly different (approximately 5 N) from each other. However, the tissue softening of the fresh-cut samples prepared after one and two weeks of fruit storage significantly decreased ($P<0.05$), while the week three samples remained stable for 19 days. The decreasing linear trend shown in Figure 1 was affected by the storage duration of the fresh-cut cantaloupe. From Table 1, mean values of firmness of fresh-cut cantaloupe decreased significantly from 8.44 N to 5.97 N as the duration of postharvest storage increased. This indicates that the delay of fresh-cut processing prior to postharvest ripening resulted in texture quality degradation over the sample storage period.

Table 1. Means for firmness, luminosity, hue angle, and chromaticity of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

Sample	Firmness (N)	Luminosity, L*	Hue angle, h_{ab}	Chromaticity
H2O W1	8.44 a	61.46 a	63.97 a	23.93 a
H2O W2	6.91 b	58.05 b	64.66 a	22.93 a
H2O W3	5.97 c	58.68 ab	63.95 a	23.08 a

*Means followed by the same letter are not significantly different at $P<0.05$ for each column

As would be expected, the cantaloupes held at a low temperature to allow postharvest ripening usually softened during storage (Miccolis and Saltveit, 1995). The main factor of tissue softening was related to the degradation of the middle lamella and disintegration of the primary cell wall when stored under high humidity (Deng *et al*., 2005; Chiabrando *et al*., 2009). The desirable texture attribute of fresh-cut cantaloupe should yield to chewing without being mushy, as reviewed by Barrett *et al*. (2010).

Colour

Figure 2 represents the luminosity (L*) of fresh-cut cantaloupe which was minimally processed on a weekly basis during three weeks of postharvest storage at 10 °C and 90±5 % RH and subsequently stored for 19 days at 2 °C and 87 % RH. As expected, the fresh-cut samples obtained from the cantaloupe after one (W1), two (W2), and three (W3) weeks of storage showed a better initial visual quality which reduced over time. At day 0, the L* of the fresh-cut samples processed at week one and two recorded very similar values of approximately 61. Over the three weeks of storage, the initial L* of the fresh-cut cantaloupe had a lower value of 57.09. Although the week three sample was less bright on the sampling day, no browning development was visually observed in the flesh cubes. The brightness of the fresh-cut sample processed at week two significantly decreased to 42.2, while the differences between the week one and the week three samples were not significant at the end of the storage life. These results show that the fresh-cut cantaloupe dipped in deionised water were possible to experience sliminess, which was caused by juice leakage from day 15 onwards. Meanwhile, the mean values of L* of the fresh-cut cantaloupe (shown in Table 1) decreased over the postharvest storage time of the fruit. The decrease of colour brightness in the fresh-cut cantaloupe was obviously associated with the ripeness stage of the fruit (Simandjuntak *et al*., 1996). Moreover, the decreasing of L* values also was related to the development of translucent or water-soaking symptom (Supapvanich and Tucker, 2011). The presence of translucency in the fresh-cut samples occurring instead of a browning reaction may reduce the quality of the appearance of the samples

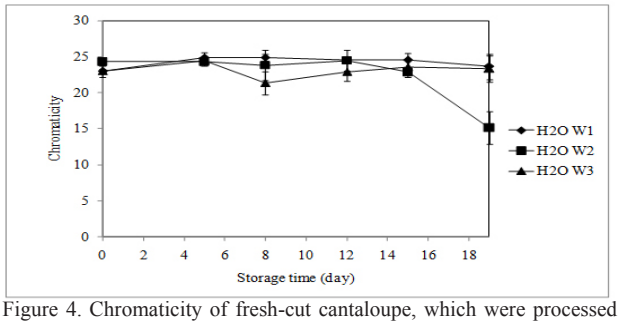

Figure 4. Chromaticity of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

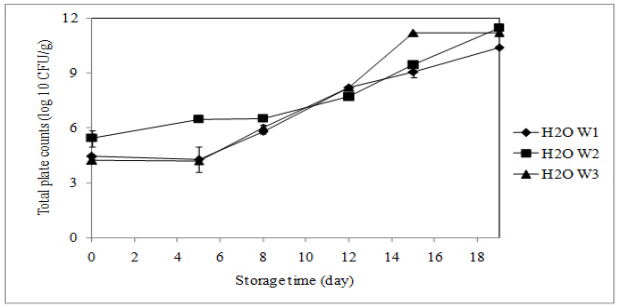

Figure 5.Total plate counts (TPC) of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

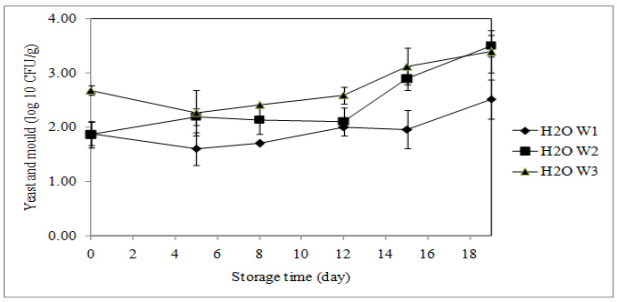

Figure 6.Yeast and mould (YM) of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

and hence the commercial value of the product.

Figure 3 shows the hue angle, h_{ab}, of the fresh-cut cantaloupe which was prepared from the fruit with an extended postharvest shelf life for one, two, and three weeks. The orange hue did not significantly differ from samples at day 0 during storage. Based on the results shown, the extended fresh-cut preparation did not significantly affect the orange colour in the flesh cubes throughout the 19 days of sample storage. It can be proved by the result shown in Table 1 that the mean h_{ab} values of the fresh-cut samples prepared each week did not significantly differ as the values were not affected by extending the postharvest storage of the fruit. The h_{ab} values recorded remained at approximately 64 throughout storage for all samples. Machado *et al*. (2008) observed the hab of fresh-cut

Table 2. Means for total soluble solids (TSS), pH, titratable acidity (TA), and TSS:TA ratios of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5 % RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

Sample	Total soluble solids (TSS °Brix)	pH	Titratable acidity (TA %)	TSS:TA ratio
H2O W1	9.013 b	6.398 b	0.109 a	85.755 c
H2O W2	9.633 a	6.369 b	0.098 a	102.829 b
H2O W3	9.608 a	6.585 a	0.085 b	119.536 a

*Means followed by the same letter are not significantly different at P<0.05 for each column

cantaloupe remained stable at approximately 67 over 18 days of storage at 5±1°C. In contrast, Simandjuntak *et al.* (1996) found the orange colour of cantaloupe increased during the fruit development and ripening process. The finding was reasonable as the β-carotene concentration increases through the ripening process (Pratt, 1971; Lester and Dunlap, 1985; Simandjuntak *et al*., 1996). However, fruit storage associated with a low temperature (10 °C) for three weeks allowed the colour of the fresh-cut to be maintained during the subsequent storage at 2°C and 87% RH.

The results for chromaticity as shown in Figure 4 were used to observe the orange colour purity of the fresh-cut cantaloupe. The chromaticity of the fresh-cut prepared after two weeks of postharvest storage decreased by the end of the sample storage. After 15 days of storage, the chromaticity value of the fresh-cut cantaloupe was dramatically decreased along with its brightness (L^*). The orange intensity in the flesh cubes of the week one and week three samples remained stable throughout the 19 days of subsequent storage. However, the fresh-cut samples prepared over the three different processing periods indicated that the storage did not significantly affect the mean values of chromaticity (Table 1). Taken as a whole, fruits extended for three weeks at 10 °C and 90±5% RH preserved most of the orange intensity in the fresh-cut samples.

The decrease in the colour purity may be caused by the occurrence of physical damage during fresh-cut processing. The lack of maintenance of the cutting utensils, for example using a blunt knife, can be the main cause of the development of surface darkness or a decrease in the yellow colour of the fresh-cut cantaloupe (Machado *et al*., 2008). Portela and Cantwell (2001) proved the application of sharp cutting utensils could preserve the quality of the initial appearance for a longer period and reduce the effect of flesh wounding during the fresh-cut preparation.

Total soluble solids (TSS), titratable acidity (TA) and pH analyses

Results for the total soluble solids (TSS), pH, titratable acidity (TA), and TSS:TA ratio of fresh-cut cantaloupe processed after one, two, and three weeks

Table 3. Means for total plate count (TPC) and yeast and mould (YM) of fresh-cut cantaloupe, which were processed after ripening at 10°C and 90±5% RH for one (W1), two (W2), and three (W3) weeks of postharvest storage, and subsequently stored in air (2°C and 87% RH) for 19 days

Sample	Microbial counts (log 10 CFU/g)	
	Total plate counts (TPC)	Yeast and mould (YM)
H2O W1	6.39 b	1.93 c
H2O W2	7.24 a	2.29 b
H2O W3	6.70 b	2.73 a

*Means followed by the same letter are not significantly different at P<0.05 for each column

after postharvest storage duration are presented in Table 2. There was a significant increase from 9.0 to 9.6 °Brix in the TSS mean values of fresh-cut prepared on a weekly basis during the three weeks of fruit storage. The results show that the TSS content increased during the ripening process which was undertaken over three weeks at 10 °C and 90±5% RH. Previous research found the TSS content in several fruits increased which indicated that the total sugar content (generally consisting of sucrose, glucose, and fructose) was synthesised during storage at a lower temperature (Cordenunsi *et al*., 2005; Amorós *et al*., 2003). The synthesis occurred while the ripening process of the fruits took place during storage (Mercado-Silva *et al*., 1998; Amorós *et al*., 2003). Machado *et al*. (2008) observed the TSS content in fresh-cut cantaloupe resulted in an average value of 9 °Brix and this remained stable throughout the storage period.

From Table 2, the pH content showed significantly (P<0.05) lower values in the fresh-cut cantaloupes prepared after both one and two weeks of storage at 10 °C. The mean value of the pH increased considerably to 6.58 after three weeks of postharvest storage. Meanwhile, the pH values of the fresh-cut samples remained stable over the 19 days of storage at 2 °C and 87% RH (data not shown). According to Lamikanra *et al*. (2000) and Portela and Cantwell (1998), the stability of the pH level and TSS values of fresh-cut cantaloupe were associated with a lower storage temperature.

TA mean values shown in Table 2 indicated a greater decrease after three weeks of storage at 10 °C and 90±5% RH. The TA decrease means the organic acid content in the fruit decreased during storage at 10 °C. The decreasing trend observed for cantaloupe was also found for other fruits such as loquat (Amarós *et al*., 2003), guava (Mercado-Silva *et al*., 1998), longan (Jiang and Li, 2001), and mango (Shivashankara *et al*., 2004). The decrease in the mean values of TA observed for fresh-cut cantaloupe and the simultaneous increase in TSS resulted in an increase of the TSS:TA ratio. The TSS:TA ratio of the fresh-cut cantaloupe ranged between 85 and 119.

Microbiological analysis

Storing the cantaloupes for three weeks at 10°C and 90±5% RH affected the microbial activity in the fresh-cut samples. The total plate counts (TPC) and yeast and mould (YM) of the fresh-cut stored at 2°C and 87% RH for 19 days were observed to increase throughout storage. At day 0 until day 5, the count of the TPC (Figure 5) for the week one and week three samples remained at low levels, approximately 4 $\log_{10}$ CFU/g, while the count recorded a higher value between 5 $\log_{10}$ CFU/g and 6 $\log_{10}$ CFU/g for the fresh-cut prepared after two weeks. It may caused by the longer storage of fruit before fresh-cut processing. The longer of storage may increase the bacteria growth in the intact fruit. The TPC counts started to increase to approximately 10 $\log_{10}$ CFU/g and 11 $\log_{10}$ CFU/g by day 8 up to day 19 in the week one and both week two and week three samples, respectively.

Equivalent initial counts of YM (Figure 6) in fresh-cut cantaloupe were observed in the week one and week two samples. The population remained at lower count levels for up to 8 days for the week one sample, whilst the counts of the week two sample gradually increased by day 5 until the end of the storage period. Meanwhile, the YM of fresh-cut samples prepared after the three week storage had a higher initial population count and consequently growth figures from 2 $\log_{10}$ CFU/g until 3 $\log_{10}$ CFU/g over the 19 days. This may indicate the YM already growth in the intact fruit before processing. Figure 6 shows the population of YM growth in the fresh-cut prepared after the cantaloupe were stored for one week at 10°C and 90±5% RH. The YM population remained at a low level compared to other samples throughout the sample storage time. The YM counts of fresh-cut cantaloupe in previous studies reported the population: (1) remained at a low count (Luna Guzmán and Barrett, 2000); and (2) could not be detected during storage (Portela and Cantwell, 2001).

As shown in Table 3, the mean values of TPC and YM count increased significantly (P<0.05), except for the TPC growth for the week three sample during the progress of the postharvest storage. The microbial growth occurred rapidly on the fresh-cut which correlated with increasing sugar levels found in fruit (refer to Table 1). Beaulieu and Gorny (2001) determined that the microbial activity occurs just as much in fresh-cut fruits as in vegetable products due to the high total sugar found in most fruits. Moreover, high pH (refer to Table 1) content in fresh-cut cantaloupe promotes a good barrier against bacterial growth, but does not affect the growth of

YM (Luna-Guzmán and Barrett, 2000; Beaulieu and Gorny, 2001). This observation shows the TPC and YM populations in the fresh-cut cantaloupe typically increased as the storage duration of the fruits was extended for three weeks at low temperature.

Conclusions

Cantaloupe allows for postharvest storage at a low storage temperature of 10 °C and 90±5% RH. This is a potential alternative for fresh-cut processing extension, since it provides for reduced physicochemical and microbial changes during storage at cold environment. Firmness, luminosity (L^*), and titratable acidity (TA) decreased, while the total soluble solids (TSS), pH, TSS:TA ratio, microbial activity (total plate count (TPC) and yeast and mould (YM)) of the fresh-cut increased over the postharvest storage period of the fruit. However, no significant differences were detected in the orange colour and the intensity (hue angle, h_{ab}, and chromaticity) of the flesh during storage. In conclusion, the fresh-cut cantaloupe processed within three weeks of postharvest storage may be stored for 19 days for commercialisation. Further studies are required to investigate the potential of calcium treatments on the quality of fresh-cut when the cantaloupe fruits undergo extended postharvest storage.

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