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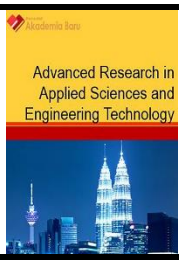

Postharvest quality and storage life of Kuini (*Mangifera Odorata Griff*) at different storage temperature

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O. Zaulia[1,*], O. Nur Allisha[1], M.A.I. Mohd Shukri[2], M.N. Suriani[1], W.I. Wan Mahfuzah[2], S. Noor Safuraa[1], G. Nur Syafini[2], M.N. Azhar[2], R. Khdijah[2], A.R. Razali[2], R. Mohd Azhar[1], M. Nur Izzati[2], A. Siti Nur Raihan[2], M. Razali[2], I. Salma[1], A. Khadijah[1], G. Mohd Nor Faizal[3]

[1] Industrial Crop Research Centre, Persiaran MARDI-UPM Headquaters, 43000 Serdang, Selangor, Malaysia
[2] Horticulture Research Center, Persiaran MARDI-UPM Headquaters, 43000 Serdang, Selangor, Malaysia
[3] Biodiversity and Environment, Persiaran MARDI-UPM Headquaters, 43000 Serdang, Selangor, Malaysia

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ABSTRACT

Mangifera Odorata or locally called Kuini, is a mango species with attractive striking orange flesh and have strong and unique smell, make it special in local market. Research is being carried out in MARDI from seed production to marketing to expose M. odorata to local and export market. Postharvest handling technology is one of importance aspect that has been develop to cater the market needs for commercialization. Proper postharvest handling will reduce postharvest losses, maintain freshness and to prolong storage life to make sure consumer get the premium quality of fruit. In postharvest handling, one of most important factors to maintain quality during handling, distribution and display is storage at the optimum temperature. Effect of different storage temperature on quality and storage life of M. odorata var. Tembaga were carried out. M. odorata at 11 to 12 weeks after fruit set were harvest at MARDI Sintok, Kedah and transported to packinghouse MARDI Serdang for storage study. On arrival at MARDI Serdang, fruit were sorted, washed, drain, packed and stored at different storage temperature (8, 10, 13, 15 and 25^{0}C). Visual quality assessment (appearance, disease quality changes), physical (texture, colour (Lightness, hue, chroma)) and chemical (pH, total titratable acidity (TTA), ascorbic acid, soluble solid content (SSC)) analysis were carried out weekly. Results of this study showed that storage duration and different storage duration significantly affected SSC. pH, TTA, chroma of M. odorata. The highest TSS, pH and chroma of M. odorata at 10^{0}C and the lowest at 25^{0}C. The highest TTA of M. odorata at storage temperature 8^{0}C and 13^{0}C, and the lowest TTA at 25^{0}C. Ascorbic acid content not significantly affected by different storage temperature from 8 to 15^{0}C, but significant different compare to ascorbic acid content at ambient storage temperature. Ascorbic acid content of M. odorata significantly lower at 25^{0}C compare to storage at 8 C - 15^{0}C. Lightness and texture of M. odorata slightly decrease during storage but not significant (P>0.05). Lightness of M. Odorata was not significantly affected by different storage temperature. Hue of M. Odorata significantly affected by storage duration and but not affected by different storage temperature. Hue of M. odorata significantly increased in the first weeks of storage, followed by significant decreased at week 2, maintain until week 4 and significantly decreased at week 5. Quality observed visually showed that

* *Corresponding author.*
E-mail address: zaulia@mardi.my

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freshness of M. Odorata maintain 5 weeks at 8^{0}C, 4 weeks at 10^{0}C, 2 weeks at 10 – 15^{0}C and 1 week at 25^{0}C.

Keywords:
Postharvest, Storage-life, Quality, Biochemical

1. Introduction

Mangifera odorata or locally called Kuini or kwini to local Malaysian. A mango species with attractive striking orange flesh and have strong and unique smell, make it special in local market. Unique and strong smell of Kuini contributed by oxygenated monoterpenes (45.4%), esters (33.0%) and α-terpineol (31.9%) [8]. *M. odorata* has high antioxidant activity in peel, pulp and seed [4]. Antioxidant activity in mangoes and wild Mangifera sp. including *M. odorata* were discussed by Yahia [10] and Mirfat *et al*., [5]. Hazniza *et al*., [3] found that extracts from both fermented and fresh kuini flesh and peel had antibacterial activity.

Research is being carried out in MARDI showed *M. odorata* has less fibrous and smell less strongly cultivated in MARDI from seed production to marketing to expose *M. odorata* to local and export market. Postharvest handling technology is one of importance aspect that has been develop to cater the market needs for commercialization. Proper postharvest handling will reduce postharvest losses, maintain freshness and to prolong storage life to make sure consumer get the premium quality of fruit. In postharvest handling, one of most important factors to maintain quality during handling, distribution and display is storage at the optimum temperature. In this study, effect of different storage temperature on quality and storage life of *M. odorata* were carried out.

2. Materials and Methods

M. odorata at 11 to 12 weeks after fruit set were harvest at MARDI Sintok, Kedah and transported to packinghouse MARDI Serdang for storage study. Kuini is wrapped using layers of newspaper to avoid bruise during transportation. Upon arrival at MARDI Serdang, fruit were sorted, washed, drain, packed in CFB boxes and stored at different storage temperature (8, 10, 13, 15 and 25°C). Results were taken on the initial stages and every week until fruits were rotten. Visual quality assessment (appearance, disease quality changes), physical (texture, colour (Lightness, chroma, hue) and biochemical test for example pH, total titratable acidity (TTA), ascorbic acid, soluble solid content (SSC) analysis were carried out weekly.

3. Results and Discussion

3.1 Soluble Solid Content (SSC)

SSC of *M. odorata* were considered high and very sweet fruit as compare to other fruits, which was range from 18 to 19.5% (Table 1, Figure 1). Total sugar (glucose, fructose and sucrose) of mangoes sp. between 10 -20 % depending on maturity and vareity [10]. *M. odorata* were slightly affected by storage duration and different storage temperature. Kuini fruits stored at 10 ^{0}C had the highest SSC and fruit stored at 25 ^{0}C had the lowest SSC during storage compare to other storage temperature. SSC of kuini fruits was related to maturity stages Mahfuzah *et al*., [6], storage duration and treatments Mahfuzah *et al*., [7].

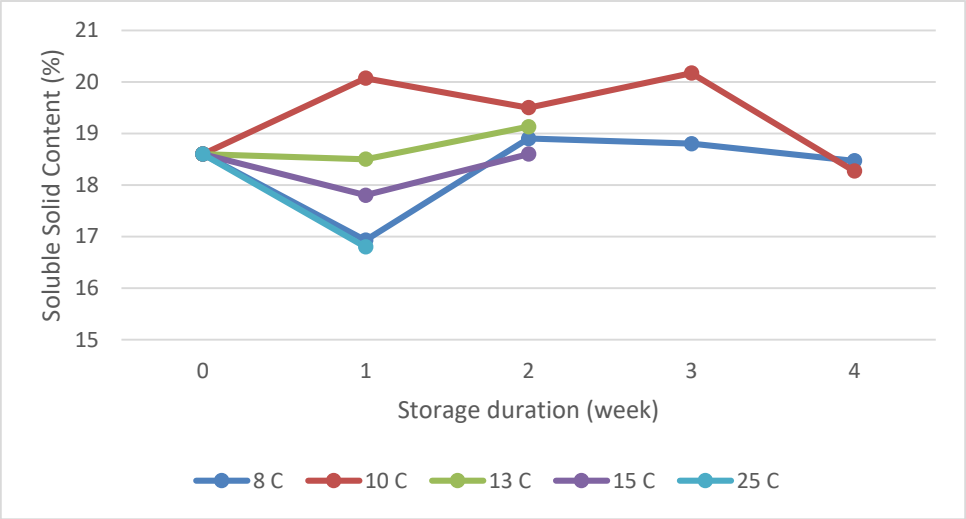


Fig. 1. Effect of storage temperature on SSC of *M. odorata* during storage

Increase of SSC may be due to the degradation of cell walls and hydrolysis of starch to sucrose in the ripening stage. Enzymes play important roles directly in biochemical and physiological processes that happened among there were some of the enzymes polygalacturonase, exocellulase and mannanase which seems to be associated with fruit softening and maturity. Sucrose is the major source for cellular growth in the young fruit, whereas during the sugar storage phase sorbitol is the major substrate for fructose accumulation [1].

3.2 pH

pH of *M. odorata* range from 4.10 to 4.55 showed that this fruit considered at acidic fruit as compare to other fruits. pH of *M. odorata* were fluctuate during storage (Table 1, Figure 2). pH of the fruit significantly decreases during first week of storage, significantly increased until week 3 and decrease thereafter. These trends also reported by Mahfuzah *et al*., [7] during storage. pH significantly affected by different storage temperature. The highest pH of *M. odorata* at storage temperature 10 ^{0}C and 25 ^{0}C. Coating treatments may slower the changes of pH during storage Mahfuzah *et al*. [7]. Mahfuzah *et al*. [6] showed that pH was significantly different at different maturity stages. pH significantly increased with increase maturity stage.

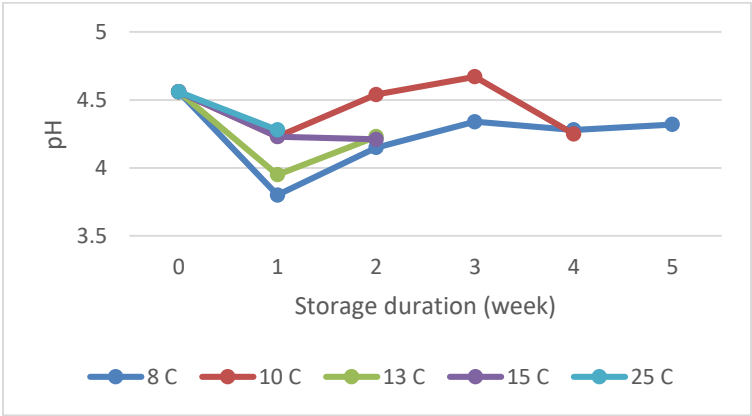


Fig. 2. Effect of storage temperature on pH of *M. odorata* during storage

3.3 Total Titratable Acidity (TTA)

M. odorata considered as acidic fruit as compare to other fruits, TTA range from 0.45 to 0.65 mg/100g (Table 1, Figure 3). TTA fluctuate during storage may be because of changed in organic acid during storage. TTA of *M. odorata* significantly increase during first week of storage, significantly decreased until week 3 and increase thereafter. TTA of *M. odorata* significantly affected by different storage temperature. The highest TTA of *M. odorata* at storage temperature 8^0C and 13^0C, and the lowest TTA at 25^0C. TTA of *M. odorata* fruits low at advance maturity stage [6] and high at senescence stage [7]. Organic acid in mango sp. are citric, succinic, malic and tartaric acid, and percentage depend on maturity and variety [10].

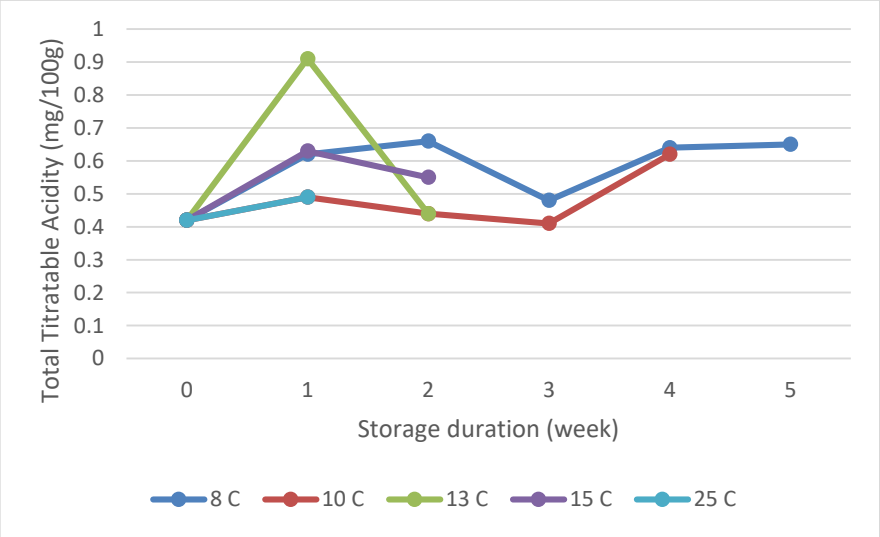


Fig. 3. Effect of storage temperature on TTA of *M. odorata* during storage

3.4 Ascorbic Acid Content (AAC)

Ascorbic acid content of *M. odorata* fruits considered as high ascorbic acid content fruit as compare to other fruits, range from 12.72 to 26.22 mg/100g (Table 1, Figure 4). AAC of *M. odorata* fruits fluctuate during storage. AAC *M. odorata* fruits significantly increase during the first 2 week of storage, significantly decreased until week 3 and increase thereafter. AAC of *M. odorata* fruits not significantly affected by different storage temperature from 8 to 15 ^{0}C, except at ambient storage temperature. AAC of *M. odorata* fruits significantly lower at 25 ^{0}C compare to storage at 8 ^{0}C - 15 ^{0}C. Mahfuzah *et al*. [6] showed that the lowest AAC at young maturity stage and senescence stage, the highest AAC achieve at optimum maturity stage. Ascorbic acid of mangoes sp range from 12 to 400 mg/100g depend on maturity, variety and methods of extraction [5,10].

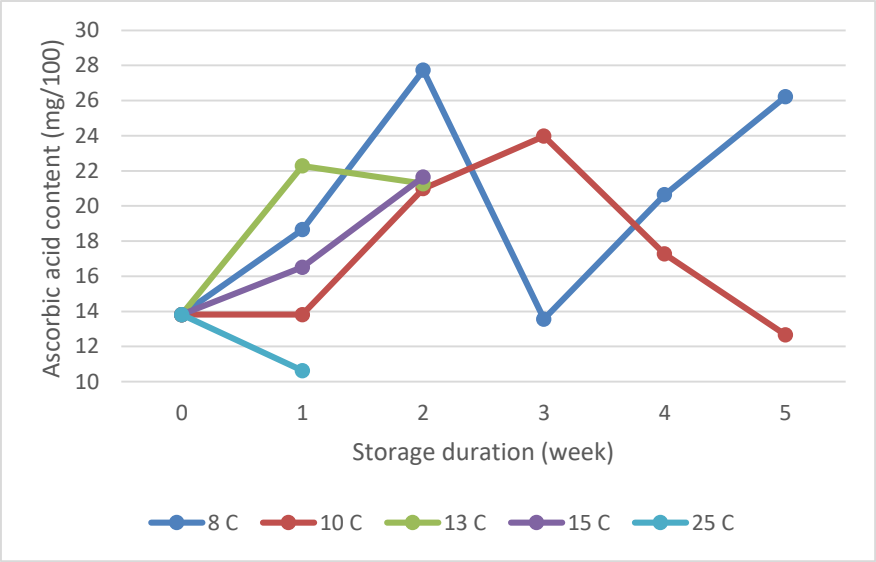


Fig. 4. Effect of storage temperature on ascorbic acid content of *M. odorata* during storage

3.5 Lightness (L)*

Lightness of *M. odorata* skin slightly decrease during storage but not significant (P>0.05) (Table 1, Figure 5). Lightness of *M. odorata* skin not significantly affected by different storage temperature. This is because flesh changes of *M. odorata* not related to skin colour changes. Most of green mango varieties turn green to yellow/red/orange upon ripening. The loss of chlorophyll then replace with increase of synthesis of carotenoids [9]. But, the green skin of *M. odorata* remain green during ripening and senescence.

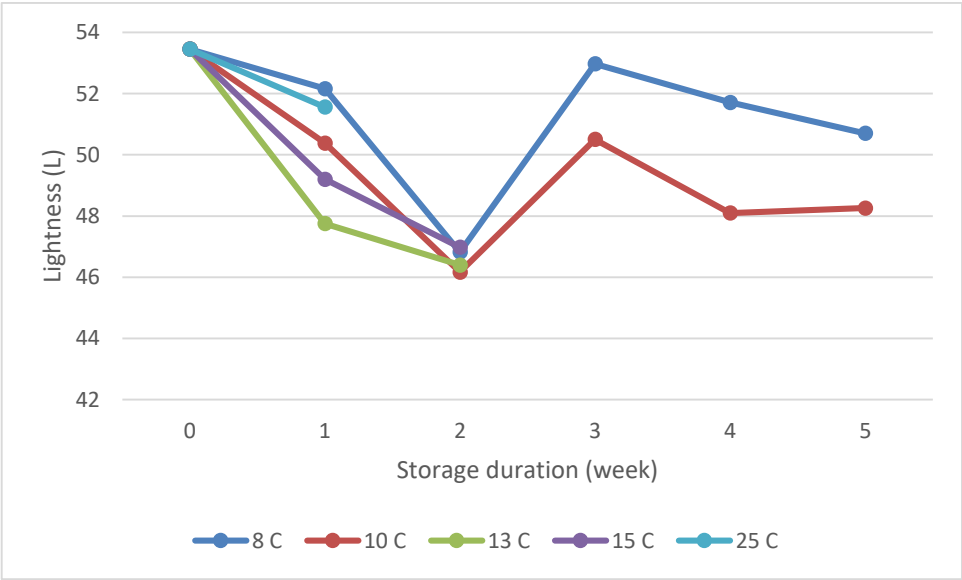


Fig. 5. Effect of storage temperature on Lightness (L) of *M. odorata* during storage

3.6 Chroma (C)*

Chroma of *M. odorata* skin significantly affected by storage duration and by storage temperature (Table 1, Figure 6). Chroma of *M. odorata* skin significantly decreased in the first 2 weeks of storage, followed by significantly increased at week 3 and significantly decreased thereafter. Chroma of *M. odorata* skin significantly affected by different storage temperature. The lowest chroma of *M. odorata* skin found at 10^0C indicate delay of colour changes during storage compare to other storage temperature. The decrease of skin chroma may be due to skin turn from dark green to light green during storage. These may be related to chlorophyll breakdown during ripening [10].

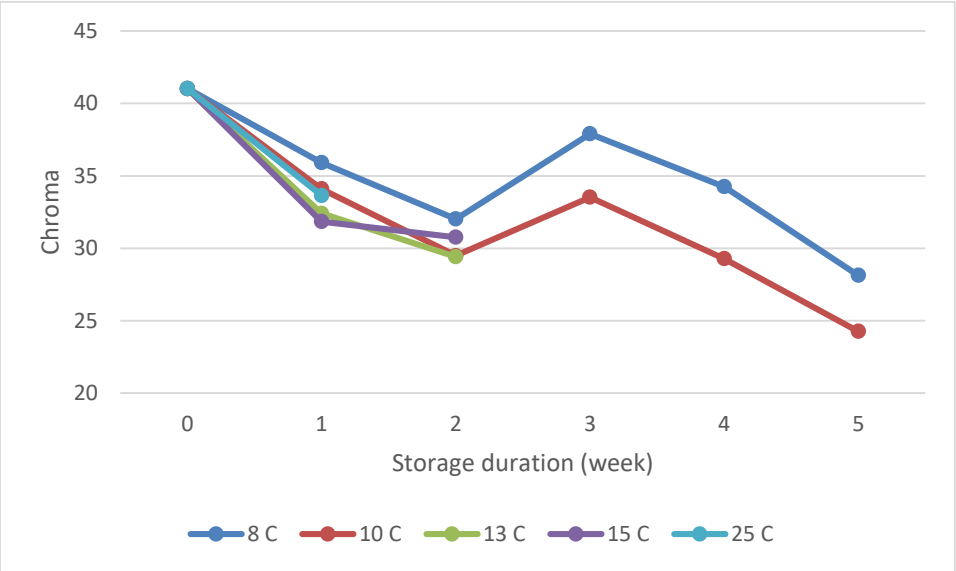


Fig. 6. Effect of storage temperature on chroma (C) of *M. odorata* during storage

3.7 Hue (hº)

Hue of *M. odorata* skin significantly affected by storage duration and but not affected by different storage temperature (Table 1, Figure 7). Hue of *M. odorata* skin significantly increased in the first weeks of storage, followed by significant decreased at week 2, maintain until week 4 and significantly decreased at week 5. Hue of *M. odorata* skin not significantly affected by different storage temperature. The decrease of hue during storage may be due tu dark green colour of matured fruit turn to light green, and may be also caused by brown/dark colour of anthracnose symptom.

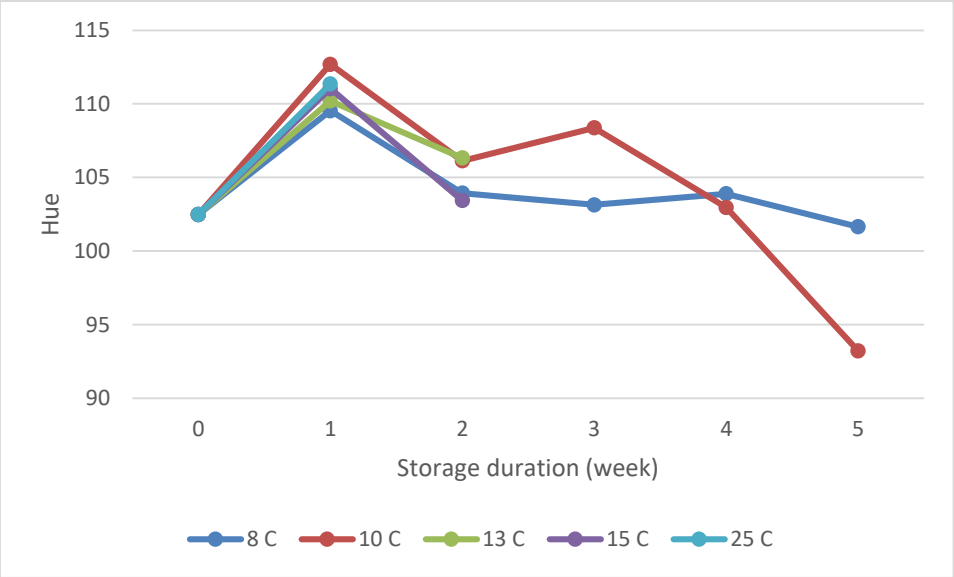


Fig. 7. Effect of storage temperature on hue of *M. odorata* during storage

3.8 Firmness (N)

Firmness of *M. odorata* skin was not significantly affected by storage duration and different storage temperature (Table 1). At week 1, firmness of fruit skin the highest (45 N) at 25^{0}C (Figure 8). Normal firmness of fresh *M. odorata* skin at harvest is about 26 N. Almost double skin firmness of fruit skin during storage at ambient temperature may be because of loss of water (transpiration) that harden the skin during storage. Firmness of *M. odorata* skin slightly decrease during storage but not significant different at storage temperature 13^{0}C and 15^{0}C showed that fruit became softer during storage at 13^{0}C and 15^{0}C. Therefore, storage at 8 – 10^{0}C effective to maintain the firmness of *M. odorata* fruit skin.

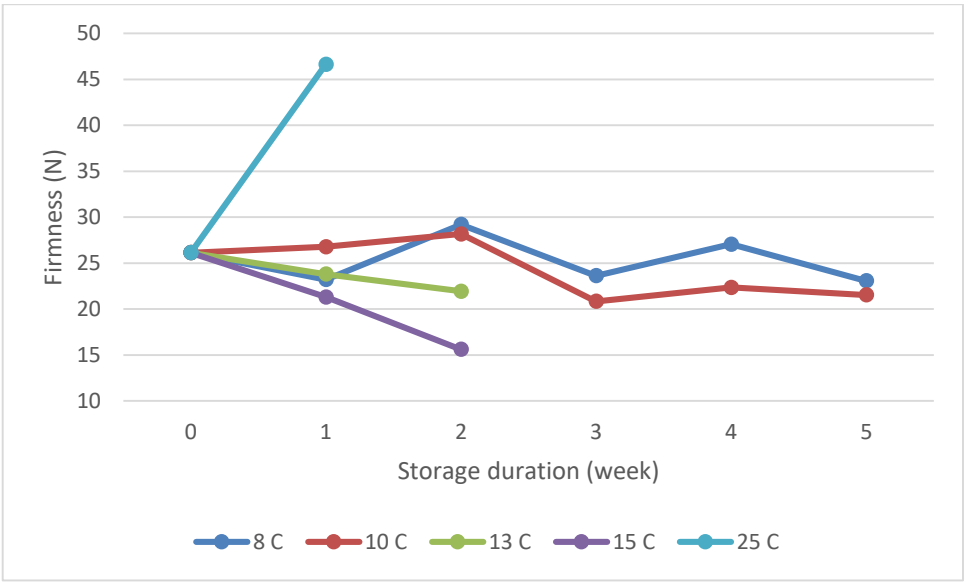


Fig. 8. Effect of storage temperature on firmness of *M. odorata* during storage

Jha *et al*. [2] also showed the range of mangoes firmness at harvest from 20 to 33N, 5 N firmness of peel mangoes are unacceptable. Decrease firmness that cause fruit softening related to solubility of cell wall pectin [10].

3.9 Visual Observation

In this study, *M. odorata* fruit stored at 25^{0}C for 1 week, 13^{0}C - 15^{0}C for 2 weeks and, 8^{0}C - 10^{0}C for 5 weeks. *M. odorata* fruit severely attack by anthracnose after 2 weeks of storage at 13^{0}C - 15^{0}C. Anthracnose attack slightly for fruit stored at 10^{0}C after 4 weeks of storage. At 8^{0}C, symptom of anthracnose slightly started to appear at 5 weeks of storage which is internal quality of flesh still fresh and acceptable. *M. odorata* did not stored at temperature less that 8^{0}C because according to literature and experience, mangoes sp. and tropical fruits susceptible to chilling injury at temperature less that 7^{0}C (See figure 9)[10].

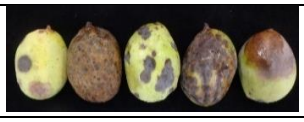
Storage Temperature / Storage Duration	Week 3	Week 4	Week 5
8 ^{0}C			
10 ^{0}C			
13 ^{0}C			
15 ^{0}C			

Fig. 9. Quality evaluation showed that storage life of *M. odorata:* 5 weeks (8 ^{0}C), 4 weeks (10 ^{0}C), 2 weeks (13-15 ^{0}C) dan less than 1 weeks (25 ^{0}C)

4. Conclusions

Storage duration and different storage temperature significantly affected SSC, pH, TTA, chroma of *M. odorata*. The highest TSS, pH and chroma of *M. odorata* at 10 ℃ and the lowest at 25 ℃. The highest TTA of M. odorata at storage temperature 8 ℃ and 13 ℃, and the lowest TTA at 25 ℃. Ascorbic acid content not significantly affected by different storage temperature from 8℃ to 15 ℃, but significant different compare to ascorbic acid content at ambient storage temperature. Ascorbic acid content of *M. odorata* significantly lower at 25℃ compare to storage at 8℃ - 15℃. Lightness and texture of *M. odorata* slightly decrease during storage but not significant (P>0.05). Lightness of *M. odorata* was not significantly affected by different storage temperature. Hue of *M. odorata* significantly affected by storage duration and but not affected by different storage temperature. Hue of *M. odorata* significantly increased in the first weeks of storage, followed by significant decreased at week 2, maintain until week 4 and significantly decreased at week 5. Quality observed visually

showed that freshness of *M. odorata* maintain 5 weeks at 8℃, 4 weeks at 10℃, 2 weeks at 10 – 15℃ and 1 week at 25℃.

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Table 1

Storage duration and storage temperature

Storage Duration (week)	SSC (Brixº)	pH	TTA	Ascorbic acid (mg/100g)	Lightness (L*)	Chroma(C*)	HUE	Firmness (N)
0	18.60 ab	4.55a	0.42 c	13.82 c	53.45 a	41.03 a	102.49b	26.13a
1	18.02 b	4.10c	0.63 ab	17.81 b	50.21 ab	30.55 bc	110.96a	28.32a
2	19.03 ab	4.29b	0.52 bc	23.16 a	46.59 b	30.43 cd	105.76b	23.73a
3	19.48 a	4.51a	0.45 c	15.42 bc	51.74 ab	35.72 b	105.76b	22.23a
4	18.37 ab	4.26b	0.63 a	16.65 bc	49.90 ab	31.77 bc	103.43b	24.70a
5	18.63 ab	4.32b	0.65 a	26.22 a	49.48 ab	26.20 d	97.44c	23.31a
Storage Temperature (^{0}C)	**SSC (Brixº)**	**pH**	TTA	**Ascorbic acid (mg/100g)**	**Lightness (L*)**	**Chroma(C*)**	**HUE**	**Firmness (N)**
8	18.42 ab	4.29b	0.56 a	18.92 a	51.61 a	35.73 ab	50.77a	23.71a
10	19.20 a	4.47a	0.47 ab	17.09 a	50.05 a	33.25 b	50.26a	24.30a
13	18.71 ab	4.33b	0.55 a	17.80 a	50.26 a	35.97 ab	50.05a	23.96a
15	18.40 ab	4.39ab	0.51 ab	16.42 a	50 72 a	36.17 ab	51.61a	21.02a
25	18.00 b	4.46a	0.45 b	12.76 b	52.82 a	38.57 a	52.82a	36.39a