JOURNAL OF AGROBIOTECHNOLOGY 2024, VOL 15(S1):62-68.
e-ISSN: 2180-1983
http://dx.doi.org/10.37231/jab.2024.15.S1.374
https://journal.unisza.edu.my/agrobiotechnology/index.php/agrobiotechnology/index

Elevating Harumanis Mango Postharvest Physico-Chemical Quality Using Preharvest Treatments Approach

Wan Mahfuzah Wan Ibrahim[a,*], Muhd Luqman Nul Hakeem Nasree[a] and Wan Mohd Reza Ikhwan Wan Hussin[b]

[a] Horticulture Research Centre, Malaysian Agricultural Research and Development Institute (MARDI) Sintok,06050 Bukit Kayu Hitam, Kedah
[b] Horticulture Research Centre, Malaysian Agricultural Research and Development Institute (MARDI), Persiaran MARDI-UPM, 43400 Serdang, Selangor

***Corresponding author: mahfuzah@mardi.gov.my**

Received: 01/08/2023, Accepted: 17/01/2024, Available Online: 30/01/2024

ABSTRACT

Postharvest activities are mainly carried out to maintain fruit quality and prolong the shelf life of produce. However, the produce quality is limited to the quality during the harvesting. Preharvest treatment can be used as an alternative to improve fruit quality. Harumanis mango is one of the important seasonal fruits in Malaysia and only available within few months period per year. This study was conducted to evaluate the effects of different chemical foliar at preharvest stage on fruit physicochemical properties. Experiment was conducted using Randomized Complete Block Design (RCBD) with 4 replicates and three treatments were used on 20 years old Harumanis tree in this preliminary study in Sintok, Kedah (1% calcium chloride(T2), 0.15%Chelated zinc(T3) and 0.02% salicylic acid (T4)) with tap water as control (T1). Mango trees were sprayed on week 10-11 after fruit set before fruit were harvested on week 14. Results shows there are significant finding for total soluble solid (TSS), vitamin C, total titratable acidity (TTA), and peel color. Control fruits have significantly higher values compared to other treatments but scored the lowest for vitamin C and TTA content with T4 yield highest vitamin C content. Thus, this treatment (T4) has higher sugar acid ratio (123.72%) than other treatments. In terms of peel colour, zinc treatment produces more greenish skin hue compared to other treatments. In conclusion, T4 yields the best results in term of fruit quality (vitamin C, TTA and sugar acid ratio). However, more research needs to be done on the combination of zinc (T3) and salicylic acid (T4) sprays.

Keywords: Foliar spray, salicylic acid, physicochemical, skin color, calcium spray,

INTRODUCTION

Harumanis mango is a highly sought-after variety of mango that is produced mainly in Northern peninsular of Malaysia and usually harvested from late April to early July. This fruit are known for its sweet non-fibrous flesh and delicate aroma. However, fruit quality is only as good as it is during the harvesting process and additional postharvest treatments will only aid to preserve the fruit's freshness by delaying the senescence

process. Thus, preharvest treatments is one of the options to improve the quality of fruit and usually done on few weeks prior to the harvesting period. These treatments aim to improve fruit quality, extend shelf life, and prevent postharvest diseases. Preharvest treatments can have a significant impact on the quality and shelf life of fruits. There are various preharvest treatments available such as UV-B treatment that has been found to improve the quality and shelf life of strawberries where the treatment affects fruit appearance, quality traits, and the expression of UV-B responsive genes in fruits during the growth stage (Zhu et al., 2023).

Calcium are common treatments to be use in pre or postharvest stages to improve texture of fruit by increasing cells turgidity and prevent the swelling (Schumann et al., 2022). It is inexpensive and easy to dissolve in water for the ease of application. Numerous fruit trees have proven to benefit from zinc spray in terms of nutritional status, fruit set, fruit retention, reduced fruit drop, yield, and fruit quality (Meriño-Gergichevich et al., 2021). Zinc sprays may be necessary for sweet cherry, which are particularly vulnerable to Zn deficiency, and can be used throughout fruit set and premature phases (Usenik & Stampar, 2002). It is crucial to note that too much zinc and heavy application rates can severely harm shoots, buds, leaves, and fruits. The beneficial effects of combined spraying of boron and zinc have also been reported in several cropped species, particularly as a supplementation program frequently recommended during springtime in fruit orchards. Preharvest salicylic acid spray on fruit plants can have positive effects on fruit quality, reduce fruit rot, and extend postharvest life of fruit. Extensive studies have been conducted with various crop such as grape (Champa et al., 2015) and sweet orange (Ahmad et al.,2015) and preharvest elicitors spray, including salicylic acid, can improve antioxidant activity, alleviate chilling injury, and maintain quality in harvested fruit (Gong et al., 2022). Thus, this study was conducted to evaluate the effect preharvest spray of calcium, zinc and salicylic acids on Harumanis mango physico-chemical quality.

MATERIALS AND METHODS

In field preparation

Experiment was conducted in MARDI Sintok, Kedah (GPS Location: 6.4883° N, 100.4822° E) by using existing Harumanis mango plot with trees at the age of 10 years old with plant distance 3 m x 3 m. The maintenance and management of tree are conducted following the standard practice as recommended by Malaysia Agricultural Research and Development Institute (MARDI). Each treatment and replicate are divided by a guard row on all sides to avoid contamination from other treatments during spraying process. Fruits were bagged using white paper beg after fruit circumference reach around 16 cm to following the practice for Harumanis mango.

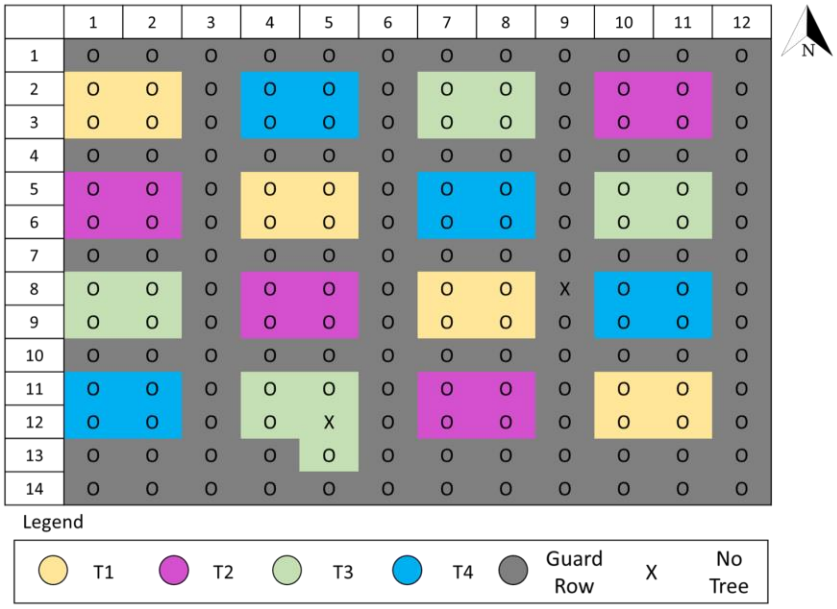

Fig 1: Experiment layout for four treatments used in this study. T1=Control, T2=Calcium Chloride 1%, T3=Chelated Zinc 0.15% and T4=Salicylic acid 0.02%

Preharvest treatments application

Preharvest treatments were applied using spraying method on week 8 after fruit set stage. Three treatments (1% Calcium chloride, $CaCl_2$ (T2), 0.15% chelated zinc (T3), and 0.02% salicylic acid (T4)) with tap water as control were used. The solutions were sprayed on to fruit and tree using a knapsack sprayer until drenched in the morning between 8.00 to 9.30 am.

Fig 2: Spraying of calcium chloride, zinc and salicylic acid were carried out using knapsack sprayer

Harvesting and quality assessment

Fruit was harvested after week 12 and washed with clean water before the ripening process by using calcium carbide for 24 hours and held for three days at room temperature (± 27°C) in corrugated fibreboard box (CFB)

for the fruits to fully ripen. After ripen, quality assessment was conducted to analyse the peel and flesh colours, total soluble solids (TSS), pH, titratable acidity (TA), and sugar-acid ratio. A digital handheld refractometer (ATAGO CO. LTD PAL-) was used to measure total soluble solids (TSS), and a pH meter (HANNA Instrument HI2211) was used to determine pH. The amount of titratable acidity was determined by titrating 20 mL of a sample with 0.1 M 1-1NaOH until it reached pH 8.2, whereas the amount of ascorbic acid was determined by titrating 10 mL of a sample with 100 ml of 3% metaphosphoric acid until the extract turned a pale pink colour. Fruits were also observed to see if there were any obvious alterations, such as incidence of main mango diseases (anthracnose or stem end rot) and the external quality like extreme browning or significant signs of senescence such as skin wrinkling.

Fig 3: Harvested Harumanis Mango were sorted and washed prior to the ripening process using calcium carbide.

Statistical analysis

Experiment was designed using Randomized Complete Block Design (RCBD) with four replications. Statistical analysis was performed by using ANOVA and difference of means was determined by using Duncan Multiple Range Test at 5% level.

RESULTS AND DISCUSSION

Skin and flesh colour

Table 1 and 2 shows the value of Lightness (L), a*,b*, hue and chroma for peel and flesh of fruits treated with different chemical during preharvest stage. Fruit sprayed with zinc shows significantly different number in few parameters for peels colour where the peel was slightly darker based on the L values and b* values indicate the peel has greenish skin hue compares to other treatment. The same observation also applied to fruit flesh colour where zinc-treated fruit having a slight orangery hue compares to fruit that had received other treatments including the control samples. This is in agreement with previous studies that use of zinc at preharvest stage can gives effect on peel and flesh colour (Rasouli et al., (2018; Swietlik, 2001). Halil and Ozgur (2021) concluded spraying of zinc during preharvest stages of Granny Smith apples can increased the concentration of bioactive compounds, which can affect fruit colour too.

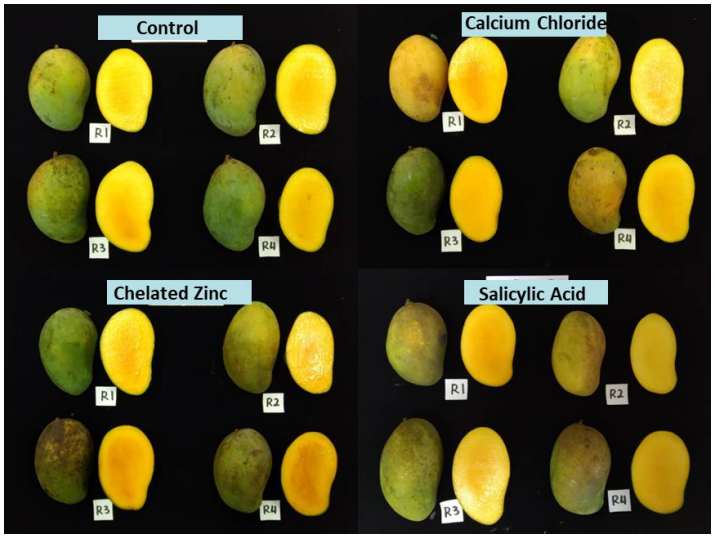

Fig 4: Peels and flesh of Harumanis mango treated by different chemicals (calcium chloride, zinc and salicylic acid) and control (tap water) after ripening process

Table 1. Value of lightness (L), a*, b*, hue and chroma on peel of Harumanis mango fruit treated with four different treatments at preharvest stage.

	TREATMENT	L	a*	b*	Hue	Chroma
T1	Control	56.400a	-7.408a	45.239a	70.862b	46.300a
T2	Calcium Chloride 1%	54.715a	-6.736a	44.790a	80.671a	45.615a
T3	Chelated Zinc 0.15%	50.884b	-8.982a	39.022b	76.796ab	40.215b
T4	Salicylic acid 0.02%	55.384a	-7.200a	45.209a	79.341ab	46.046a

*Means separation within columns and main effect by Duncan's Multiple Range test at P≤0.05.

Table 2. Value of lightness (L), a*, b*, hue and chroma on peel of Harumanis mango fruit treated with four different treatments at preharvest stage.

	TREATMENT	L	a*	b*	Hue	Chroma
T1	Control	71.647a	6.297b	73.905a	85.165b	74.220a
T2	Calcium Chloride 1%	71.286a	5.779bc	72.493a	85.545ab	72.762a
T3	Chelated Zinc 0.15%	66.968b	8.249a	71.925a	83.452c	72.422a
T4	Salicylic acid 0.02%	72.660a	4.136c	70.765a	86.514a	70.930a

*Means separation within columns and main effect by Duncan's Multiple Range test at P≤0.05.

Chemical quality of fruit

Table 3. Chemical qualities of Harumanis mango fruit treated with four different chemicals at preharvest stage.

	Treatment	Total Soluble Solid (°Brix)	pH	Ascorbic Acid Content (mg/100ml)	Total Titratable Acidity (g/L)	Sugar Acid Ratio (%)
T1	Control	16.373a	4.857a	1.095c	0.184a	98.437a
T2	Calcium Chloride 1%	15.880b	4.886a	1.410b	0.172ab	114.030a
T3	Chelated Zinc 0.15%	14.625b	5.120a	1.469b	0.143bc	106.350a
T4	Salicylic acid 0.02%	15.100b	5.081a	1.762a	0.131c	123.723a

*Means separation within columns and main effect by Duncan's Multiple Range test at P≤0.05.

However, from Table 3, data shows that in terms of fruit chemical content, Zinc treated fruit (T3) does not yield the high value for total soluble solid and total titratable acidity in comparison to other treatments. For total soluble solid, control fruit (T1) has the highest number (16.373) with T3 have the lowest value of soluble solid content (14.625). Although T1 has high TSS, it also has the highest total acidity contents which causing control fruit have lowest sugar acid ratio. The sugar acid ratio refers to the balance between the amount of sugar and acid in a fruit. The ratio of sugar to acid is a crucial factor that impacts the flavour, consistency, and feel of fruits. The calculation involves dividing the acid concentration (reported in percentage) by the sugar amount (measured in °Brix). When the fruit ripens, a higher sugar/acid ratio is usually preferred since it suggests a sweeter flavor. In this study, fruit treated with salicylic acid (T4) has highest sugar acid ratio followed by T2, T3 and T1. T4 fruit also has the highest ascorbic acid content follows by T3, T2 and T1. Previous study on salicylic application to apple shows there was influence from the application on ascorbic acid content of apple fruit (Kazemi, Aran & Zamani, 2011).

CONCLUSION

Application of preharvest chemical treatments can gives effect to the fruit quality in terms of both physical and chemical quality at the postharvest stages. Use of zinc can enhance the green colour of the Harumanis peel and Further study on combination of salicylic acid and zinc needs to be conducted to see the potential in the future.

ACKNOWLEDGMENTS

We are grateful to all members of working group in MARDI Sintok for endless support and cooperation to complete this study.

REFERENCES

Ahmad, Saeed & Singh, Zora & Iqbal, Z. (2013). Effect of preharvest sprays of salicylic acid on the shelf life and quality of 'lane late' sweet orange (Citrus sinensis L.) cold storage. Acta Horticulturae. 1012. 103-112.

Champa WA, Gill MI, Mahajan BV, & Arora NK. (2015) Preharvest salicylic acid treatments to improve quality and postharvest life of table grapes (Vitis vinifera L.) cv. Flame Seedless. Journal of Food Science and Technology. 2015 Jun;52(6):3607-3616.

Gong D, Bi Y, Li Y, Wang Y, Prusky D, & Alkan N. (2022) Preharvest Elicitors Spray Improves Antioxidant Activity, Alleviates Chilling Injury, and Maintains Quality in Harvested Fruit. Acta Horticulturae.; 8(12):1208. 164-170

Halil Erdem & Ozgur Sahin (2021) Foliar Zinc Sprays Affected Yield and Bioactive Compounds of Granny Smith Apple, International Journal of Fruit Science, 21:1, 670-680

Jia Zhang, Ji-yun Nie, Jing LI, Hui Zhang, Ye Li, Saqib Farooq, Syed Asim Shah Bacha, & Jie Wang (2020) Evaluation of sugar and organic acid composition and their levels in highbush blueberries from two regions of China,Journal of Integrative Agriculture,Volume 19, Issue 9, 2352-2361

M. Kazemi, M. Aran & S. Zamani, 2011. Effect of Salicylic Acid Treatments on Quality Characteristics of Apple Fruits During Storage. American Journal of Plant Physiology, 6: 113-119.

Meriño-Gergichevich C, Luengo-Escobar A, Alarcón D, Reyes-Díaz M, Ondrasek G, Morina F & Ogass K (2021) Combined Spraying of Boron and Zinc During Fruit Set and Premature Stage Improves Yield and Fruit Quality of European Hazelnut cv. Tonda di Giffoni. Frontier in Plant Science 12:661542. 1-17

Rasouli, Masoud & Koushesh saba, Mahmoud. (2018). Pre-harvest zinc spray impact on enzymatic browning and fruit flesh color changes in two apple cultivars. Scientia Horticulturae. 240.

Schumann, C., Winkler, A. & Knoche, M. (2022) Calcium decreases cell wall swelling in sweet cherry fruit. Scientific Report 12, 16496.

Swietlik, D. (2001). Zinc Nutrition of Fruit Trees by Foliar Sprays. Acta Horticulturae. 93. 123-129

Usenik, V. & Stampar, Franci. (2002). Effect of foliar application of zinc plus boron on sweet cherry fruit set and yield. Acta Horticulturae. 594. 245-249.

Zhu X, Trouth F, & Yang T. Preharvest UV-B Treatment Improves Strawberry Quality and Extends Shelf Life. Horticulturae. 2023; 9(2):211.

How to cite this paper:
Wan Ibrahim, W.M., Hakeem Nasree, M.I.N., and Ikhwan Wan Hussin, W.M.R. (2024). Elevating Harumanis Mango Postharvest Physico-Chemical Quality Using Preharvest Treatments Approach. Journal of Agrobiotechnology, *15*(S1), 62-68.