



UNIVERSITI PUTRA MALAYSIA

**EFFECT OF COATING TREATMENT (PROTECTOR®) APPLICATION ON
QUALITY OF MANGO DURING STORAGE**

NURULAIN AMIRAH KAMALALDIN

FP 2015 226

EFFECT OF COATING TREATMENT (PROTECTOR®)
APPLICATION ON QUALITY OF MANGO DURING
STORAGE

NURULAIN AMIRAH BINTI KAMALALDIN

FACULTY OF AGRICULTURE
UNIVERSITI PUTRA MALAYSIA
SERDANG, SELANGOR

2014/2015

EFFECT OF COATING TREATMENT (PROTECTOR®) APPLICATION ON
QUALITY OF MANGO DURING STORAGE

By

NURULAIN AMIRAH BINTI KAMALALDIN

A project report submitted to the Faculty of Agriculture,
Universiti Putra Malaysia

as fulfillment of the PRT 4999 (Final Year Project)
for award of the degree of Bachelor of Agricultural Science

FACULTY OF AGRICULTURE
UNIVERSITI PUTRA MALAYSIA
SERDANG, SELANGOR

2014/2015

ACKNOWLEDGEMENTS

Alhamdulillah, first of all I would like to express my thanks and gratitude to Almighty ALLAH s.w.t for the gift to me the opportunity and strength to complete this project. The completion of this thesis would have been impossible without support, cooperation and commitments of many individual.

I would like to take this opportunity to give my appreciation to my supervisor, Prof. Dr. Mahmud Tengku Muda Mohamed for his supervision, encouragement and knowledge in completing this thesis. I also wish to thank to all UPM staff members in Physiology Lab of Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia especially Mr. Azahar .Special thanks to post-graduate student, Hamizah Binti Hassan for giving me her guidance and for hosting me from time to time in this project.

Great thanks also to all my fellow friends who were directly and indirectly involved especially Asmah, Aziera, Hidayah and Afiqah for an inspiration in completing this thesis.

Last but not least, my gratitude to my family members especially my beloved father Kamalaldin Abd. Latif, and my lovely mother Rohani bt Zakaria. Thank you for giving me all the strength, support and encouragement to complete my Bachelor of Agriculture Science.

CERTIFICATION

This study report entitled “EFFECT OF COATING TREATMENT (PROTECTOR®) APPLICATION ON QUALITY OF MANGO DURING STORAGE” is prepared by Nurulain Amirah Binti Kamalaldin and submitted to the Faculty of Agriculture in fulfillment of the PRT 4999 (Final Year Project) for award of the degree of Bachelor of Agricultural Science.

Student's name:

Student's signature:

Nurulain Amirah Binti Kamalaldin

161678

Certified by:

(PROF. DR. MAHMUD TENGKU MUDA MOHAMED)

Project Supervisor,

Department of Crop Science,

Faculty of Agriculture,

Universiti Putra Malaysia.

Date:

TABLE OF CONTENT

CONTENT	PAGE
ACKNOWLEDGEMENT	i
CERTIFICATION	ii
TABLE OF CONTENT	iii
LIST OF TABLES	vi
LIST OF APPENDICES	vii
LIST OF FIGURES	viii
LIST OF PLATES	ix
ABSTARCT	x
ABSTRAK	xi
CHAPTER	
1. INTRODUCTION	1
2. LITERATURE RIVIEW	3
2.1 Mango	3
2.2 Benefits of Mango	4
2.3 Postharvest Quality	5
2.4 Postharvest losses of Mango	6
2.4.1 Anthracnose	6
2.4.2 Physiological disorders	7

2.4.3 Chilling Injuries	7
2.4.4 Moisture losses	8
2.4.5 Causes of physiological disorders	8
2.5 Postharvest Treatment	9
2.5.1 Coating	9
2.5.2 Types of coating	10
2.5.3 Mode of coating	10
2.6 Paraffin oil	11
2.6.1 Benefits of Paraffin Oil	11
3. MATERIALS AND METHODS	13
3.1 Determination of physical properties	14
3.1.1 Weight loss	14
3.1.2 Determination of pulp firmness	14
3.1.3 Determination of external peel colour	15
3.1.4 Determination of disease incidence and disease severity	15
3.2 Determination of chemical properties	16
3.2.1 Determination of soluble solid concentration (SSC)	16
3.2.2 Determination of titratable acidity (TA)	16
3.2.3 Determination of ascorbic acid	17
3.2.4 Determination of pH	18
3.3 Experimental design and statistical analysis	18
4. RESULTS AND DISCUSSION	19
4.1 Weight loss	19

4.2 Pulp firmness	22
4.3 Peel colour	24
4.4 Disease incidence and disease severity	28
4.5 Titratable acidity (TA)	32
4.6 Ascorbic acid (Vitamin C)	34
4.7 pH	37
4.8 Soluble solid concentration	38
5. CONCLUSION	40
REFERENCES	41
APPENDICES	47

LIST OF TABLES

	Page
1 Nutrition fact of mango fruit	5
2 Effect of different concentration of Protector [®] and storage days on weight loss of Chokanan mango stored at cool room (10-13°C, 90-95%)	19
3 Effect of different concentrations of Protector [®] and storage days on pulp firmness of Chokanan mango stored at cool room (10-13°C, 90-95%)	22
4 Effect of different concentrations of Protector [®] and storage days on peel colour of Chokanan mango stored at cool room (10-13°C, 90-95%)	24
5 Effect of different concentrations of Protector [®] and storage days on disease incidence and disease severity of Chokanan mango stored at cool room (10-13°C, 90-95%)	28
6 Effect of different concentrations of Protector [®] and storage days on titratable acidity of Chokanan mango stored at cool room (10-13°C, 90-95%)	32
7 Effect of different concentrations of Protector [®] and storage days on ascorbic acid of Chokanan mango stored at cool room (10-13°C, 90-95%)	34
8 Effect of different concentrations of Protector [®] and storage days on pH of Chokanan mango stored at cool room (10-13°C, 90-95%)	37
9 Effect of different concentrations of Protector [®] and storage days on soluble solids concentration of Chokanan mango stored at cool room (10-13°C, 90-95%)	38

LIST OF APPENDICES

Appendix		Page
1	ANOVA - Weight loss	47
2	ANOVA - Pulp firmness	47
3	ANOVA - Peel Light	47
4	ANOVA - Peel chroma	48
5	ANOVA - Peel hue	48
6	ANOVA - Disease incidence	48
7	ANOVA - Disease severity	49
8	ANOVA - Titratable acidity	49
9	ANOVA - Ascorbic acid	49
10	ANOVA - pH	50
11	ANOVA - Soluble solid concentration	50

LIST OF FIGURES

Figure		Page
1	The relationship between weight loss and storage duration of 'Chokanan' mango (<i>Mangifera indica</i> Linn.)	20
2	The relationship between peel color L* and storage duration of 'Chokanan' mango (<i>Mangifera indica</i> Linn.)	25
3	The relationship between peel color C* and storage duration of 'Chokanan' mango (<i>Mangifera indica</i> Linn.)	26
4	The relationship between peel color h° and storage duration of 'Chokanan' mango (<i>Mangifera indica</i> Linn.)	27
5	The relationship between disease incidence and storage duration of 'Chokanan' mango (<i>Mangifera indica</i> Linn.)	29
6	The relationship between disease severity and storage duration of 'Chokanan' mango (<i>Mangifera indica</i> Linn.)	30
7	The relationship between ascorbic acid and storage duration of 'Chokanan' mango (<i>Mangifera indica</i> Linn.)	35

LIST OF PLATES

Plate		Page
1	'Chokanan' mango fruit in control treatment	21
2	'Chokanan' mango fruit in T1	21
3	'Chokanan' mango fruit in T2	21
4	'Chokanan' mango fruit in T3	21
5	'Chokanan' mango fruit in T4	21

ABSTRACT

Mango fruit usually has a short storage life to maintain its fruit quality during storage period, which is only about two to three weeks at 10-13°C. Decay is one of the most important causes of postharvest losses in mango. Thus, the objective of this study was to determine the effectiveness of Protector[®], a new chemical found in the market that claimed to be able to maintain quality of agriculture produce treatment on storage life of 'Chokanan' mango fruits. In order to prolong the storage life of the 'Chokanan' mango, the fruit were dipped in four different concentrations of Protector[®] diluted with distilled water (10ml: 1000ml, 10ml: 2000ml, 10ml: 3000ml and 10ml: 4000ml) before storage in cool room 10-13°C. 'Chokanan' mango fruit were treated with sodium hypochlorite before they were coated. Fruit were then analyzed after 28 days of storage for weight loss, pulp firmness (N), peel colour, percentage of disease incidence and diseases severity, titratable acidity, vitamin C, pH and soluble solid concentration. The application of different concentration of Protector[®] on mango fruit did showed significant effects on some storage qualities. Further studies are required in enhancing the effectiveness of this coating treatment in maintaining the quality of mango fruit working with a better ranges of concentrations.

ABSTRAK

Buah mangga biasanya mempunyai jangka hayat simpanan yang singkat untuk mengekalkan kualiti buahnya sepanjang tempoh simpanan, yang hanya kira-kira dua hingga tiga minggu pada suhu 10-13°C. Pereputan adalah salah satu perkara penting dalam kerugian lepas tuai dalam produk mangga. Oleh itu, objektif kajian ini adalah untuk menentukan keberkesanan Protector[®], sejenis bahan kimia baru yang terdapat dipasaran yang didakwa dapat mengekalkan kualiti rawatan hasil pertanian pada penyimpanan buah mangga 'Chokanan'. Dalam usaha untuk memanjangkan jangka hayat penyimpanan buah, mangga variety 'Chokanan' telah dicelup dalam empat kepekatan Protector[®] yang berbeza bersama air suling (10ml: 1000ml, 10ml: 2000ml, 10ml: 3000ml dan 10ml: 4000ml) sebelum disimpan di bilik sejuk bersuhu 10 - 13°C. Buah mangga 'Chokanan' telah dirawat dengan natrium hipoklorit sebelum disalut dengan Protector[®]. Buah mangga tersebut kemudian dianalisis selepas 28 hari penyimpanan untuk berat buah, kelunakan isi, warna kulit buah, peratusan penyakit, vitamin C, pH dan kepekatan pepejal larut. Walaubagaimanapun, aplikasi kepekatan Protector[®] yang berbeza pada buah mangga menunjukkan kesan terhadap beberapa kualiti penyimpanan. Penyelidikan lebih lanjut diperlukan untuk meningkatkan keberkesanan rawatan salutan ini dalam mengekalkan kualiti buah mangga dengan menggunakan julat kepekatan Protector[®] yang lebih baik.

CHAPTER 1

INTRODUCTION

Mango (*Mangifera indica* Linn.) has been considered the 'king of fruits' and always been the most important fruit crop (Purseglove, 1972). Mango has become a major fruit crop tropic, particularly in Asia. In Malaysia, the entire mango fruit is relatively small and insufficiency to supply consumer demand. However, the number of plantations area planted with mango has increased markedly in recent years, which are reflected in a register of over 110 clones being recorded at the Crop Production Centre of the Department of Agriculture in Serdang.

However, postharvest disease can reduce fruit quality and cause severe economic losses. In a situation where the fruit decay, the market demand for the blemished fruit is limited and this resulting in lower selling market price, which considerably lower than export prices. According to Yahia, (2005) mango are susceptible to physical damage at virtually every part of the postharvest handling chain, thus reduction of physical or mechanical injury is essential to reduce losses in quality and in postharvest life.

Among the postharvest disease of the mango, anthracnose is the most prevalent especially in humid growing regions. Postharvest anthracnose rots in mango can be initiated by two types of infection. The first types involves a superficial or skin infection where propagules of *C. gloesporioides* are on the surface of the skin but have not

penetrated into the fruit tissue, while the second types involve a deep-seated infection which becomes established in the peel of fruit in the field. However, it was found that in order to attack through wounds, the organism could penetrate the fruit through the cuticle and natural openings on the fruit surface.

Coating did not attain commercial use in storage of perishable produce until 1930s, (Kaplan, 1986). Many coating formulations are available in the market since been introduced and applied commercially for different product. Coatings can be classified into several types, which are solvent wax, water wax and edible coating. Protector® is the type of mineral oil coating that is water based emulsion composed of natural wax and oil. Coating application has been found to increase the quality of fruit. Firmness, colour, texture, acid concentration and ripening process are influenced to different extents by coatings (Ahmad and Khan 1987; Farooqi *et al.*, 1988).

The study on effect of Protector® application on Chokanan mangoes is still scarce. Thus, this experiment was carried out in order to determine the effectiveness of Protector® treatment on quality and storage life of 'Chokanan' mango fruit.

REFERENCES

Ahmad, A., and Khan, I. (1987). Effect of waxing and cellophane lining on chemical quality indices of citrus fruit. *Plant Food For Human Nutrition*, 37:47-57.

Amarante, C., and Banks, N.H. (2001). Postharvest physiology and quality of coated fruits and vegetables. *Horticultural reviews*, 26: 161-238.

Banks, N.H. (1984). Some effects of Thai Prolong coating on ripening bananas. *Journal of Experimental Botany*, 35: 127-137.

Banks, N.H., B.K., Dadzie and D.J. Cleland. (1993). Reducing gas exchange of fruits with surface coatings. *Postharvest Biology and Technology*, 3:269-284.

Ben- Yehoshua, S., Fang, DeQiu, Rodov, V., Fishman, S., and Fang, D.Q. (1995). New development in modified atmosphere packaging part II. *Plasticulture*, 107: 33-40.

Botting, K.J., Yong, M.M., Pearson, A.E., Harris, P.J. and Ferguson, L.R. (1999). Antimutagens in food plants eaten by Polynesians: micronutrient, phytochemicals and protection against bacterial mutagenicity of heterocyclic amino 2-amino-3-methylimidazo (4,5-f)quinoline. *Food and chemical Toxicology*, 37:95-103.

Brecht, J., and Yahia, E.M. (2009). Postharvest physiology, In *The mango : Botany, production and uses*, Litz R (Ed), CAB International, Wallingford, UK, second edition, 484-528.

Chattopadhyaya, P.K., Sadhukhun S.K., Sadhu M.K., and Bose T.K. (1978). Studies on the physiology of fruit growth in mango. *Indian Agriculture*, 22(4), 199.

Dodd, J.C. and Jefferies, P. (1989). Management strategies to control latent infection in tropical fruit. *Aspect of Applied Biology*, 20: 49-56.

Echeverria , E., and Ismail, M. (1990). Sugars unrelated to Brix changes in stored mango fruits. *Horticulture Science*, 25: 710.

El- Ghaouth, A., Arul, J., Ponnappalan, R., & Boulet, M. (1991). Chitosan coating effect on storability and quality of strawberries. *Journal Food Science*, 56: 1618-1620.

Elahi, M., and Khan, N. (1983). Physicochemical changes in some Pakistani Mango varieties during storage ripening. *J. Agriculture Food Chemistry* 21(2): 229.

FAO. (2010). Food and Agriculture organization. FAO Production Year Book. FAO Rome.

Farooqi, W.A., Ahmad, M.S. and Zain-ul- Abdin (1988). Effect of wax-coatings on the physiological and biochemical aspect of 'kinnow' fruit. *Pakistan Journal of Scientific and Industrial Research*, 31: 142-145.

Farooqi, Q.A., Sattar A., Daud K., and Hussain M. (1985). Studies on the postharvest chilling sensitivity of mango fruit (*Mangifera Indica L.*), *Proc Florida State Hort Soc*, 98: 220-221.

Fonseca, M.J.O., Salomao, L.C.C., Cecon, P.R., and Pushmann, R. (2004). Pulp and skin pigments in mango 'Haden' treated with fungicides and wax. *Acta Horticulturae*, pp. 557-563.

Freeman, S., Katan, T. and Shabi, E. (1998). Characterization of *Colletotrichum* species responsible for anthracnose disease of various fruits. *Plant disease*, 82:596-605.

Hagenmaier, R.D. (2002). The flavor of mandarin hybrids with different coatings. *Postharvest Biology and Technology*, 24, 79-87.

Hagenmeier, R.D., and Shaw P.E. (1992). Gas permeability of fruit coating waxes. *J. Am. Society Horticultural Science.*, 117,105-109.

Hallman, G.,J., and Foos, J.,F. (1996). Coating combined with dimethoate as a quarantine treatment against fruit flies (Diptera: *Tephritidae*). *Postharvest Biology and Technology*, 7: 177-81.

Illeperuma, C.K., & Jayasuria, P. (2002). Prolonged storage of 'Karuthacolomban' mango by modified atmosphere packaging at low temperature. *Journal of Horticultural Science & Biotechnology*, 77 (2), 153-157.

James, F.L. and R.L. Jagannath. (1983). Determination of paraffin wax and mineral oil on fresh fruits and vegetables by HPLC. Food Research Division, pp.119-129.

Kaplan, H.J. 1986. Washing, waxing and color-adding. In: Wardowski, W.E., *et al.*, ed., Fresh citrus fruits. AVI Publishing Co, pp.379-395.

Kasantikul, D. (1983). Studies on growth and development, biochemical changes and harvesting indices of mango (*Mangifera indica L.*) cultivar 'Nam Dorkmai'. MS Thesis. Kasetsart University, Bangkok, Thailand.

Katrodia, J.S (1988). Spongy tissue in mango-causes and control measures. *Acta Horticulturae*, 23, 814-826.

Lazan H., Ali Z.M., Soh J., and Talkan Z. (1993). The biochemical basis of differential ripening in mango, *Acta Horticulturae*, 341, 500-509.

Lee, S.K., and Kader, A.A. (2000). Pre-harvest and postharvest factors influencing vitamin C content on horticulture crops. *Postharvest Biology Technology*, 20, 207-220.

Lim, T.K., and Khoo K.C. (1985). *Diseases and disorders of mango in Malaysia*, Kuala Lumpur, Malaysia. Tropical Press.

Lonsdale, J.H. (1992). In search of an effective postharvest treatment for the control of postharvest diseases of mangoes. *South African Mango Growers Association Yearbook*, 12, 32-36.

Mahayothee, B., Leitenberger, M., Neidhart, S., Muhlbauer, W., and Carke, R. (2002). "Non-destructive determination of fruit maturity of Thai mango cultivars by near infrared spectroscopy. In *International Symposium Sustaining Food Security and Managing Natural resources in Southeast Asia*, Thailand.

Mathew, L. and Radha, T. (2007). Fruit crops. *Horticulture Science*, 3:221-256.

Mathur, P.B., and Srivastava H.C. (1955). Effect of skin coatings on the storage behavior of mango. *Food Research*, 20, 559-566.

Medlicott, A.P., and Thomson A.K. (1985). Analysis of sugar and organic acids in ripening mango fruit (*Mangifera Indica* var. Keitt) by high performance liquid chromatography. *J Science Food Agriculture*, 36,561-566.

Medlicott, A.P., Bhogal M., and Reynolds S. (1986). Changes in peel pigmentation during ripening of mango fruit (*Mangifera Indica* var. Tommy Atkins). *Annals Appl Biol*, 109. 651-656.

Medlicott, A.P., Sigrist J.M.M., and Sy O. (1990). Ripening of mangoes following low temperature storage. *J Amer Society Horticulture Science*, 115,430-434.

Modi, V.V., and Reddy V.V.R. (1967). Carotenogenesis in ripening mangoes. *Indian J Experimental Biology*, 5,233-235.

Muirhead, I.F., and Grattidge R. (1984). Postharvest diseases of mango. The Queensland experience, Proc First Aust Mango Workshop, CSIRO, Melbourne, Australia, pp.248-252.

Mukherjee, S.K. (1985). Systematic and Ecogeographic studies of Crop Gene Pools *IndicaMangifera L. International Board for Plant Genetic Resources, Rome.*

Nunes, M.C.N., and Emond, J.P. (2012). Relationship between weight loss and visual quality of fruits and vegetables. *Proceedings of the Florida State Horticulture Society*, 5, 221-223.

Ornelas-Paz, J. de J., Yahia E.M., and Gardea- Bejar A. (2007). Identification and quantification of xanthophylls esters, carotenes and tocopherols in the fruit of seven Mexican mango cultivars by liquid chromatography-APcI-time of flight mass spectrometry. *J Agric Food Chem*, 55, 6628-6635.

Paing, H., L. (2014). Research in Techonology of Taiwan. WJL Biotech Sdn. Bhd.

Paull, R.E., and Rohrbach, K.G. (1985).Symptoms development of chilling injury in pineapple fruit.*Journal of the American Society for Horticultural Science*, 110, 100-105.

Ploetz, R.C., Bensher D., Vasquez A., Colls A., Nagel J., and Schaffer B. (1996).Mango decline .Research in Florida on an apparently wide-spread disease complex. *Acta horticulturae*, 455, 547-553.

Policegoudra RS, Aradhya SM (2007) Biochemical changes and antioxidant activity of mango ginger (*Curcuma amada*Roxb.) rhizomes during postharvest storage at different temperatures. *Postharvest Biology and Technology*. 46:189-194.

Potjewijd, R., Nisperos, M.O., Burns, J.K., Parish, M., and Baldwin, E.A. (1995). Cellulose-based coatings as carriers for *Candida guilliermondii* and *Debaryomyces* sp. in reducing decay of oranges. *Horticulture Science*, 30: 1417–21.

Purseglove, J.W. (1972). Mangoes west of India.*Acta Horticulturae* 24, 107-174.

Ranganna, S. (1997).Manual of analysis of fruit and vegetable products.

Robinson, J.E., Brown, K.M., and Burton, W.G. (1975).Storage characteristics of some vegetables and soft fruits.*Annals of Applied Biology*, 81, 339-408.

Roe, B., and Bruemmer J.H. (1981).Changes in pectic substances and enzymes during ripening and storage of 'Keitt' mango.*J Food Science*, 46: 186-189.

Sapru, V., and Labuza, T.,P. (1994). Water vapour permeability in composite methyl cellulose-stearic acid edible films. *Journal of Food Processing and Preservation*, 18: 359–68.

Singh, R.N. (1954). Studies on floral biology and subsequent developments of fruit in the mango varieties, Dashehari and Longra. *Indian Journal of Horticulture*, 11: 69-88.

Subedi, P.,P., Bhattarai, S.,P., and Jaiswal, J.,P. (1998). Effect of maturity stages and anti-fungal treatment on post-harvest life and quality of mandarin oranges stored in a cellar store. *Working Paper Lumle Agricultural Research Centre*, 65: 12-22.

Subramanyam, H., Krishnamurthy S., Subhadra N.V., Dalal V.B., Randhawa G.S., and Chacko E.K. (1971). Studies on internal breakdown, a physiological ripening disorder in Alphonso mangoes (*Mangifera Indica L.*). *Tropical Science*, 13, 203-210.

Tefera, A., T. Seyoum and K, Woldetsdik, (2007). Effect of disinfection, packing and storage environment on the shelf life of mangoes. *Biosystem English.*, 96(2): 201-212.

Thomas, P. (1975). Effect of postharvest temperatures on quality, carotenoids and ascorbic acid contents in Alphonso mangoes on ripening. *J Food Science*, 40, 704-706.

Vazquez-Caicedo, A.L., Neidhart S., and Carle R. (2004). Postharvest ripening behaviour of nine Thai mango cultivars and their suitability for industrial applications, *Acta Horticulture*, 645, 617-625.

Wills, R.B.H., and Widjanarko, S.B. 1997. Effect of sub-ambient temperatures on ripening of mango. *Australian Journal of Experiments Agriculture*, 37:127-129.

Yahia, E.M. (2006). Modified and controlled atmospheres for tropical fruits. *Stewart Postharvest Review*. 2006(5).

Yahia, E.M. (2010). The contribution of fruits and vegetables to human health. Fruit and vegetable phytochemicals. Chemistry, nutrition value and stability. Oxford, UK and Cambridge, MA, Wiley-Blackwell Publishing, pp. 3-51.

Yahia, E.M., Ornelas-Paz, J. de J. and Ariza, F.R (2006a). *The mango*. Editorial Trillas, Mexico City, Mexico, pp. 224.

Yahia, EM. (2005). Postharvest technology and handling of mango, In Dris R (Ed), *Crops: Quality, growth and biotechnology*, WFL Publisher, Helsinki, Finland, 478-512.