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**Managing chilli (*Capsicum* spp.) quality attributes:  
the importance of pre-harvest and postharvest  
factors**

**A thesis presented in partial fulfilment of the requirements for the degree of  
Doctor of Philosophy  
at Massey University, New Zealand**

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**2012**



## Abstract

Demand for chillies and peppers continues to increase in many parts of the world as chillies (*Capsicum spp.*) are a good source of beneficial compounds. Optimising postharvest storage of chilli fruit is not enough to gain highest quality products in the market place if there is a significant variation in the quality such as size, colour and phytochemical compounds at the time of harvest, which may be a result of pre-harvest factors. The objectives of this research were to understand effects of pre-harvest and postharvest factors on chilli quality in order to produce consistent quality chilli fruit.

Storing of Habanero and Jalapeño at 8 °C can maintain low respiration rates and delay loss of firmness without the development of chilling injury symptoms for 4 - 5 weeks, while Paprika requires warmer storage temperatures as loss of firmness was found during storage at 8 °C, although overall appearance was still marketable. Chillies were very susceptible to shrivel when stored above 8 °C. In Jalapeño, water loss occurred approximately equally through fruit skin and through the calyx and pedicel area until cracking appeared on Jalapeño fruit which stimulated a significant increase in skin water loss. A model was developed to predict the shelf life (using 5 % water loss as time to shrivel development) of Jalapeño during storage by conducting a sensitive analysis on the potential factors (such as fruit weight, water vapour permeance ( $P'_{H_2O}$ ), temperature and RH); RH was the most important factor on the impact on rate of water loss and time to shrivel. Application of wax on fruit skin or the whole fruit is recommended as waxing on calyx and pedicel of Jalapeño increased shelf-life by 10 % compared to control fruit.

Pre-harvest factors such as time of planting, position on plant, maturity at harvest and crop load significantly influence Jalapeño quality (i.e. fruit size, colour and phytochemical composition). Fruit weight, colour and ascorbic acid varied with time of planting and time of fruit set during the season demonstrating that growing conditions affected plant and fruit growth. Fruit from plants planted late in the season (October) were small and contained low ascorbic acid concentration. Position on plant also affected fruit size and ascorbic concentration despite fruit being of the same maturity stage. Different fruit size may be explained by the competition between plant

and fruit growth and also the distance from nutrients and water supply rather than fruit to fruit competition as there was no influence of crop load on fruit size. However, ascorbic acid accumulation in fruit was stimulated by competition between fruit on the plant as fruit from high crop load plants showed higher ascorbic acid concentration than fruit from low crop load plants. In addition, it may be influenced by plant age or time of fruit set during season, as late season or upper node fruit produce low ascorbic acid concentration. Maturity had a major effect on colour at harvest, but colour change was influenced by position on plant and growing conditions. Colour development of fruit at lower nodes which were set at cooler temperatures was slower than fruit at higher nodes which were set at warmer temperature. Capsaicinoid concentration seemed to be consistent along the plant. However, the observed results showed that measurement of total capsaicinoid concentration can be affected by the sub-sampling error from the proportion of each individual tissue (i.e. pericarp, placenta and seed) contained in the sample due to large differences in capsaicinoid concentration among tissues. Similar to capsaicinoids, antioxidant activity (AOX) and total phenolic concentration (TPC) seemed to be consistent along the plant. A weak correlation was found between AOX and TPC or AOX and ascorbic acid indicating that ascorbic acid or TPC was not a major contributor of the AOX in Jalapeño. Further work in this area is required, but needs to start with harmonisation of extraction solvents.

In conclusion, this research generates an overall understanding on the effects of pre-harvest and postharvest factors on chilli quality which will assist chilli growers in controlling sources of variation and help to produce more uniform chillies. Based on these results, to produce larger Jalapeño fruit with high concentrations of health beneficial compounds such as ascorbic acid, Jalapeño plants should be pruned not to higher than 12 nodes. Thinning leaders during production is essential for decreasing the risk from plant collapse due to weight but does not influence fruit size. As this research was focused on plants with two leaders and a single first flush fruit per node at high crop load, investigating the role of more leaders, a higher number of fruit per node and the second flush of fruit production should be investigated in future work.

## **Acknowledgements**

I would like to express my appreciation to my academic supervisors - Dr. Andrew East, Professor Julian Heyes, Professor Errol Hewett, Institute of Food, Nutrition & Human Health, Massey University and Professor John Mawson, School of Agricultural and Wine Sciences at Charles Sturt University, Australia for their advice, guidance, encouragement, and support throughout my study. I wish to thank you all of them for their time spent teaching me how to think critically, read, and understand my writing and make me confident in my work.

My research was done in many places; my sincere appreciation is extended to Sue Nicholson for her guidance and support in Postharvest Lab, Plant Growth Unit staff - Steven Ray, Lesley Taylor, Lindsay Sylva and Scott for their help with chilli planting, Microbiology lab staff - Ann-Marie Jackson, Judy Farrand-Collins and John Sykes for teaching and advising me while I was doing my experiment in their lab. IFNHH staff - Steve Glasgow, Michelle Tamehana, Garry Radford, Warwick Johnson, and Byron McKillop for their assistance and guidance on my experiments, Dr. Abdul Lateef Molan and James Liu for their guidance on antioxidant measurement, Dr. Gillian Norris from Institute of Molecular BioSciences for allowing me to use HPLC with fluorescence detector, and Trevor Loo for the assistance with HPLC, Plant and Food Research - Dr. Erin O'Donoghue for the guidance and support on tissue section and staining, Dr. David Lewis for the guidance on HPLC, Steve Arathoon and Sheryl Somerfield for their support and assistance during my work at P&FR, and P&FR staff for their help and support particularly Jieun Jung for her friendship and the protocol for tissue fixation.

I would like to sincerely thank you Peter Jeffrey and Matthew Levin for their professional help with my computer and programs, Dr. Bruce Mackay for his help on the statistical analysis on my first year data, Christine Ramsay for her help with the financial process with ordering experiment stuff and on my travel to the conference and Yvonne Parkes for her help with administration work.

A special thank you to Orcona Chillis 'N Peppers (Anne and Kelvin) who supplied chillies for my experiment, shared their experience on chilli growing and gave me a great opportunity to work in their commercial glasshouse.

I would like to express my deeply gratitude to Agricultural Research Development Agency (ARDA) for my PhD scholarship and Office of The Civil Service Commission in Thailand and Australia for the financial process and support during my study. Also special thanks to Intira Lichanporn who introduced me to this scholarship.

I wish to acknowledge Associate Professor Dr. Sirichai Kanlayanarat who gave me a good opportunity and experience while I was doing my Master's Degree in Postharvest technology, all postharvest lecturers from King Mongkut's University of Technology Thonburi, Thailand who taught and initiated me to Postharvest field and Prof. Dr. Adel A. Kader who inspired me to further my study in Postharvest.

I would like to express my appreciation to Wissanu and Arunee Srichantra, the owner of 'Chada Thai' restaurant, who gave me an opportunity to work (part-time) at their restaurant and all staff for the wonderful experiences and fun working condition, and also to Vattanachai and Sirirat Kampeng, the previous owners of 'Thai Orchid' restaurant who gave me a great opportunity to work with you and all staff.

I would like to thank you friends in Fresh Technology - Aziz, Ximena, Palash, Khairul, Pilirani, Gayani, Himani, Majid, Srikanth, and all postgraduate friends for their friendship and support.

Special thanks to all Thai friends in Palmy - in particular Weerawate (P'Arr) and his family, Thammarat and Pattamawadee (P'Ann and P'Kae), Supornpan and Chumphon (P'Tu and P'Boy), Jantana (P'On), Phatcha (P'Keng), Piyamas (P'Pla), Parussaya (P'Ink), Pittiporn (Ople), Tiyaorn (Tar), Sureewan (Daw), Chalida (Aom), Wattana (Yu) and especially Sireenthorn (N'Tuck) for their friendship, support and encouragement throughout my study. Also I would like to thank all my

friends from RB 69, CU, and KMUTT in Thailand who are always in touch with me and give me support. Without everyone, I may not get through the loneliness time in NZ. Also, I would like to thank Panida Mudpanya (N'Now), who writes an online diary, for her optimistic thinking and fun stories which often encourage me and make me smile everytime I read it.

Finally, I would like to sincerely thank you my family in particular my father (Somboon Jansasithorn) who always encourages me and believes in me, my mother (Somsri Jansasithorn) who gives me everything. Without both of your love and support, my success wouldn't have been possible. A warm thank you goes to my lovely brother (Por) and sister (Khaopun), my grandparents, my aunts and uncles and my cousins from The Jansasithorns, The Sorachaimethas and The Kaewngams for their love and encouragement. Last, my special thanks go to Pruet Kaekratoke; no matter what happens, you are always with me.





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## Abbreviations

A	pre-exponential factor
AOX	antioxidant activity
a*	CIE Lab 'a' value measured by colorimeter
a <sub>w</sub>	water activity
b*	CIE Lab 'b' value measured by colorimeter
C.A.N.	calcium ammonium nitrate
C <sub>a</sub>	chlorophyll a
CaCO <sub>3</sub>	calcium carbonate
C <sub>b</sub>	chlorophyll b
CO <sub>2</sub>	carbon dioxide
C <sub>x+c</sub>	carotenoids
d	day
ρ	density of fruit
dpi	dots per inch
DW	dry weight
E <sub>a</sub>	activation energy
Eq.	equation
FAA	formalin alcohol acetic acid
FeSO <sub>4</sub> .7H <sub>2</sub> O	ferric sulfate
FRAP	ferric reducing antioxidant power
FW	fresh weight
H	high crop load
HPLC	high performance liquid chromatography
J	joule
K	potassium
KOAc	potassium acetate
kPa	Kilopascal
L*	CIE Lab 'L' value measured by colorimeter
L	low crop load
LDPE	low density polyethylene
LSD	least significant difference



M	fruit mass during time of storage
$M_0$	fruit mass at the beginning of the experiment
N	nitrogen
$\text{Na}_2\text{CO}_3$	sodium carbonate
$P_{\text{CO}_2}^{\text{initial}}$	$\text{CO}_2$ concentration immediately after closing container ( %)
$P_{\text{CO}_2}^{\text{final}}$	$\text{CO}_2$ concentration after certain period ( %)
$P^{\text{total}}$	total air pressure
$P'_{\text{H}_2\text{O}}$	water vapour permeance
$\Delta P_{\text{H}_2\text{O}}$	the difference in partial pressure of water vapour between the environment and fruit
$P_{\text{H}_2\text{O}}^f$	the partial pressure of water vapour in fruit
$P_{\text{H}_2\text{O}}^e$	the partial pressure of water vapour in the environment
$p_{\text{H}_2\text{O}}^{\text{sat}}(T)$	saturated partial pressure of water vapour at temperature
Pa	Pascal
PGU	Plant Growth Unit
$\gamma$	psychrometric constant
R	ideal gas constant
$R_c$	predicted respiration rate
RH	Relative humidity
$r'_{\text{H}_2\text{O}}$	rate of water loss
$r_{\text{CO}_2}$	respiration rate
SA	surface area
SE	standard error
t	storage time
T	temperature
$T_e$	temperature of environment
$T_f$	temperature of fruit skin
$T_w$	wet bulb temperature
TPC	total phenolic concentration
TPTZ	2,4,6 tripyridyl-s-triazine
UV	ultra violet radiation
Vf	fruit volume
Vjar	volume of jar

W	width
WAF	weeks after flowering
WAFS	weeks after fruit set

