UNIVERSITI PUTRA MALAYSIA

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By

WONG MEI CHEE

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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DEDICATION

Beloved mum, dad, brothers, teachers and friends

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

PHYSICO-CHEMICAL AND BIOCHEMICAL CHANGES OF *CAPSICUM ANNUUM* VAR. KULAI DURING DEVELOPMENT AND EFFECTS OF MODIFIED ATMOSPHERE PACKAGING IN PROLONGING ITS SHELF LIFE

By

WONG MEI CHEE

August 2004

Chairman : Associate Professor Nazamid Saari, PhD

Faculty : Food Science and Technology

The objective of this study is to determine the optimal harvesting stage for *Capsicum annuum* var. kulai. *Capsicum annuum* var. kulai was harvested weekly from day 21 to day 49 after anthesis and analysed for its physico-chemical and biochemical changes during growth, maturation and ripening. Analysis were carried out at five stages: immature green (d 21), mature green (d 28), breaker (d 35), red (d 42) and ripen red (d 49). Physico-chemical and biochemical parameters were analysed. They included determining of the fruit colour, weight loss, firmness, ethylene and carbon dioxide (CO_2) production, pigment contents, carotenoid contents, organic acids contents, sugars, starch, pectin, capsaisinoids contents, and cell wall degradative enzymes activities. This study also aims to determine the effects of Modified Atmosphere Packaging (MAP) in prolonging its shelf life. Experiments were carried out using packaging materials such as Poly Vinyl Chloride (PVC) cling wrap, Low Density Polyethylene (LDPE), High Density

Polyethylene (HDPE) and Propylene (PP) to determine the effects of different packaging materials on shelf life of *Capsicum annuum* var. kulai. The effects of combined LDPE and MAP on shelf life of *Capsicum annuum* var. kulai were also evaluated. Results showed c*apsicum annuum* var. kulai was fully developed between day 35 and day 42 after anthesis, but no significant changes in fresh weight from day 35 to day 42 after anthesis were recorded. Whist the colour of the fruits turned from breaker (day 35) to red (day 42). Pungency components such as capsaicin and dihydrocapsaicin reached maximum on day 42 after anthesis and began to decrease thereafter. Therefore, in order to maintain pungency components, the fruits should be harvested before day 42 of anthesis. Specific activity of degradative enzymes such as polygalacturonase (PG), pectin methylesterase (PME), α-D-mannosidase, β-D-galacturonase, cellulase and xylanase were identified at various stages of growing, maturation and ripening. PG activity which reached maximum at day 42 after anthesis was found to be relatively higher than PME and cellulase activity in *capsicum annuum*. Cellulase, xylanase, β-D-galacturonase and α-D-mannosidase activities did not show any effect in promoting softening of the fruit. Production of ethylene and CO_2, which are important during ripening of *Capsicum annuum*, increased from 4.54 to 12.24 μL/hr/kg and 1.72 to 3.14 μL/hr/kg respectively. Physical appearance of LDPE packaged *Capsicum annuum* did not change significantly until after 30 days of fruits storage. This was indicated by delay in shriveling, insignificant loss of fresh weight, firmness, absence of pedicel and calyx discolouration and decay. Study on firmness and freshness of capsicum showed no significant changes when

stored under combined sealed LDPE bag for 30 days compared to perforated LDPE bag. It was also found that sealed LDPE bag was able to prolong fruit freshness which moisture loss was recorded less than 0.45% during the 30 days storage. Capsaicin and dihydrocapsaicin, which are important for pungency of the fruits, did not show any significant changes during the storage. In addition, physical appearance and natural nutrients of capsicum were maintained when packed in sealed LDPE bags. Results also indicated that sealed LDPE bag was found to be the best for extension of the storage life of *Capsicum annuum* var. kulai up to 30 days after harvesting at day 42 from anthesis.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

PERUBAHAN CIRI-CIRI FIZIK0-KIMIA DAN BIOKIMIA PADA *CAPSICUM ANNUUM* VAR. KULAI PADA PERINGKAT TUMBESARAN DAN KESAN PEMBUNGKUSAN ATMOSFERA TERUBAHSUAI KE ATAS JANGKA HAYATNYA

Oleh

WONG MEI CHEE

Ogos 2004

Pengerusi : Profesor Madya Nazamid Saari, PhD

Fakulti : Sains dan Teknologi Makanan

Objektif kajian ini ialah untuk menentukan masa pemetikan yang sesuai bagi *Capsicum annuum* var. kulai. *Capsicum annuum* var. kulai dituai setiap minggu, bermula daripada hari ke-21 hingga hari ke-49 selepas pembungaan dan ciri-ciri fiziko-kimia dan perubahan biokimia dianalisis pada peringkat pembesaran, kematangan dan penuaan. Analisis telah dijalankan pada lima peringkat, iaitu pada hari ke-21 selepas pembungaan (hijau muda); hari ke-28 selepas pembungaan (hijau tua); hari ke-35 selepas pembungaan (hijau-kemerahan); hari ke-42 selepas pembungaan (merah) dan hari ke-49 selepas pembungaan (merah tua). Parameter-parameter fiziko-kimia dan biokimia telah dianalisis. Ia termasuk penentuan warna buah, kehilangan berat, tekstur, penghasilan gas etilin dan karbon dioksida (CO_2), kandungan pigmen, kandungan karoten, kandungan asid organik, kandungan gula, kanji, pektin, capsaisin dan aktiviti enzim pada dinding sel. Kajian ini juga bertujuan menentukan kesan Pembungkusan Atmosfera

Terubahsuai (MAP) ke atas pemanjangan jangka hayat bagi buah *capsicum*. Experimen ini telah dijalankan dengan menggunakan bahan-bahan bungkusan seperti selaput nipis poli vini klorida (PVC), polietilina berketumpatan rendah (LDPE), polietilina berketumpatan tinggi (HDPE) dan polipropilena (PP) untuk menentukan kesan bahan bungkusan yang berbeza terhadap jangka hayat *Capsicum annuum* var. kulai. Kesan kombinasi bahan pembungkusan LDPE dan MAP untuk memanjangkan jangka hayat *Capsicum annuum* var. kulai juga telah dikaji. Keputusan juga menunjukkan buah *Capsicum annuum* var. kulai didapati membesar dengan sempurna dalam jangka masa hari 35 hingga hari 42 selepas pembungaan, tetapi berat basahnya direkod tidak berubah dengan ketara daripada hari 35 hingga hari 42 selepas pembungaan. Warna buah juga telah berubah daripada hijau-kemerahan (hari ke-35) kepada warma merah (hari ke-42). Kandungan yang menentukan kepedasan iaitu capsaisin dan dihidrocapsaisin telah mencapai maksima pada hari ke-42 selepas pembungaan dan mula menurun selepasnya. Maka, untuk mengekalkan kandungan yang menentukan kepedasan, buah perlu dituai sebelum mencapai hari ke-42 selepas pembungaan dalam kajian ini. Aktiviti spesifik untuk enzim pengurai seperti poligalakturonase (PG), pektin metil esterase (PME), α-D-mannosidase, β-D-galakturonase, selulase dan xilanase telah dikenalpasti pada tahap yang berbeza iaitu pada peringkat pembesaran, kematangan dan penuaan. PG aktiviti mencapai maksima pada hari ke-42 selepas pembungaan dan didapati menujukkan aktiviti relatif yang lebih tinggi berbanding PME dan selulase. Aktiviti-aktiviti selulase, xilanase, β-D-galakturonase dan α-D-mannosidase tidak menunjukkan sebarang kesan

terhadap pelembutan dinding sel pada buah. Penghasilan gas etilin dan CO_2 iaitu penting dalam menentukan kematangan *capsicum annuum* telah meningkat daripada 54 to 12.24 μL/hr/kg dan 1.72 to 3.14 μL/hr/kg masing-masing. Penampilan fizikal capsicum annuum di dalam bahan pembungkusan LDPE tidak berubah dengan ketara selepas penstoran selama 30 hari. Ini menunjukkan bahawa ia dapat melambatkan kesan kekedutan, kehilangan berat basah dan tekstur yang tidak ketara, ketiadaan kesan pelunturan warna dan kerosakkan. Kajian terhadap tekstur dan kesegaran pada buah didapati tidak berubah dengan ketara jika disimpan pada bungkusan LDPE yang bertutup berbanding yang bungkusan LDPE yang berlubang selama 30 hari. Ia juga didapati bungkusan LDPE yang bertutup dapat memanjangkan kesegaran buah dimana kehillangan air didapati kurang daripada 0.45% setelah penstoran selama 30 hari. Capsaisin dan dihidrocapsaisin, iaitu penting dalam menentukan kepedasan buah, tiada perubahan yang ketara semasa penstoran selama 30 hari. Tambahan pula, bungkusan LDPE yang bertutup dapat memberi penampilan yang baik dan mengekalkan kandungan nutrien yang semulajadi pada buah capsicum. Keputusan ini menunjukkan bungkusan LDPE yang bertutup adalah terbaik untuk memanjangkan jangka hayat simpanan *Capsicum annuum* var. kulai selama 30 hari dengan penggunaan buah capsicum hari ke-42 selepas pembungaan.

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I certify that an Examination Committee met on 20th August 2004 to conduct the final examination of Wong Mei Chee on her Master of Science thesis entitled "Physico-chemical and Biochemical Changes of *Capsicum annuum* var. Kulai During Development and Storage Using Modified Atmosphere Packaging Systems" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Univesrsiti Putra Malaysia and has been accepted as fulfillment of the requirements for the degree of Master of Science. The members of the Supervisory Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for the quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

WONG MEI CHEE

Date: 7/6/05

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES