



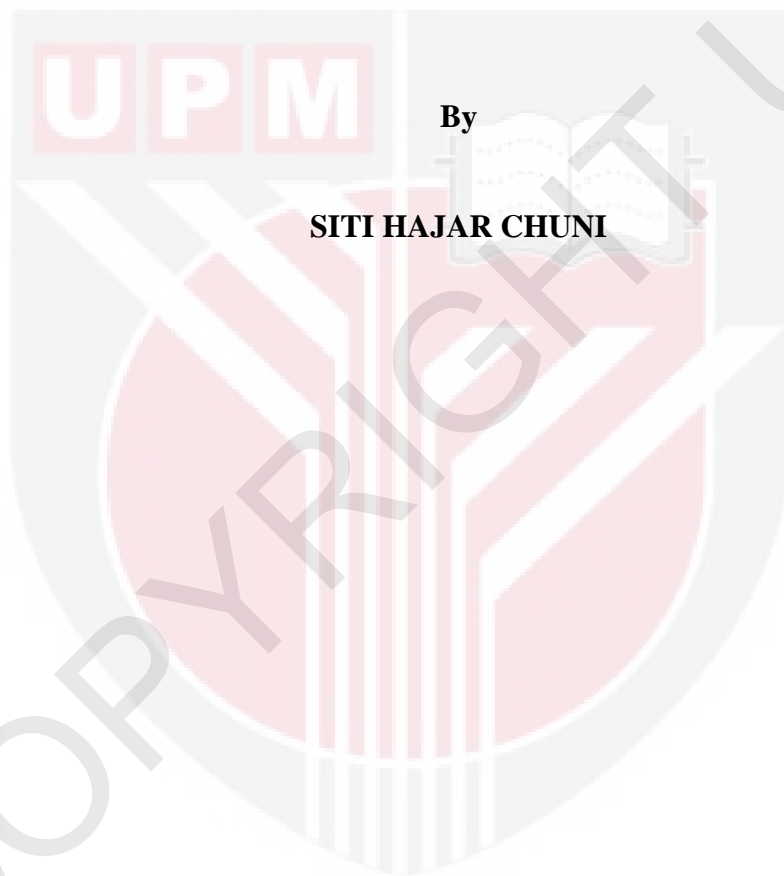
UNIVERSITI PUTRA MALAYSIA

**EFFECTS OF CALCIUM TREATMENT ON DRAGON FRUIT
[*Hylocereus polyrhizus* (F.A.C. WEBER) BRITTON & ROSE]
QUALITY AND ACTIVITIES OF POLYGALACTURONASE AND
PECTIN METHYLESTERASE**

SITI HAJAR CHUNI

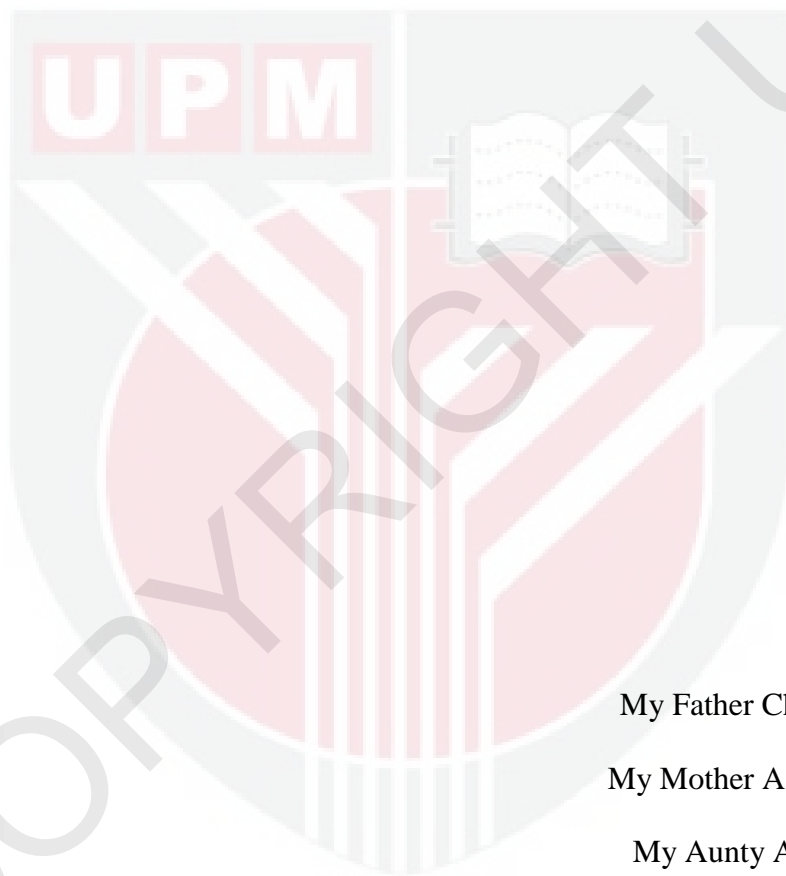
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polyrhizus* (F.A.C. WEBER) BRITTON & ROSE] QUALITY AND
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METHYLESTERASE**



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

December 2010



Dedicated to:

My Father Chuni bin Ahamad

My Mother Azimah binti Alias

My Aunty Azizah binti Alias

My Sister Siti Farhana binti Chuni

My Brother Muiz Hakim bin Chuni

My Younger Brother Shafiq Hakim bin Chuni

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

EFFECTS OF CALCIUM TREATMENT ON DRAGON FRUIT [*Hylocereus polyrhizus* (F.A.C. WEBER) BRITTON & ROSE] QUALITY AND ACTIVITIES OF POLYGALACTURONASE AND PECTIN METHYLESTERASE

By

SITI HAJAR CHUNI

December 2010

Chair: Associate Professor Dr. Yahya Awang, PhD

Faculty: Faculty of Agriculture

Effects of different concentrations of calcium (Ca) from calcium chloride (CaCl₂) on activities of two cell wall degrading enzymes; polygalacturonase (PG) and pectin methylesterase (PME) and fruit quality of dragon fruit (*Hylocereus polyrhizus*) were evaluated. Dragon fruit in this study were obtained from a commercial farm in Batang Benar in Nilai, Negeri Sembilan. Before any Ca treatments were given, it was important to establish the optimum temperature and pH for PG and PME enzymes as these were the two very important physical parameters influencing activity of an enzyme. PG and PME were assayed with different pH range of buffer solutions (pH 3.0 – 8.0) and different temperatures (30 – 70 °C) and results obtained were used in further experimentations. The activities of PG and PME were measured on dragon fruit of different maturity indices; index 3, 4 and 5. This study was carried out using a completely randomized design (CRD) with three replications. To determine the effect of Ca on PG and PME activities, different Ca concentrations (0, 2.5, 5 and 7.5

g/L Ca from CaCl₂) were then treated to dragon fruit of two maturity indices (index 3 and 5) and stored for seven days at ± 20 °C. The experiment was conducted in a randomized completely block design (RCBD) with three replications. Effect of varying concentrations of Ca from CaCl₂ (0, 2.5 and 7.5 g/L Ca from CaCl₂) and dipping duration (0, 4, 8 and 12 mins) on PG and PME activities and fruit quality parameters (firmness, color, pH, calcium content, ascorbic acid content, titratable acidity and soluble solids concentration) of fresh-cut dragon fruit after five days of storage at 12 ± 1 °C were also examined. The experiment was carried out using RCBD with three replications.

Results showed that the activity of PG was highest at 41 °C (6.233 nkat/g) and at pH 6.0 (4.818 nkat/g) while PME activity reaches its maximum level at 47.8 °C (60.864 neqv g⁻¹ s⁻¹) and at pH 5.8 (72.782 neqv g⁻¹ s⁻¹). Fruits of varying maturity indices have different activity of PG and PME activities. A very low PG activity was found in unripe *H. polyrhizus* (Index 3), but the activity of the enzymes increased as the fruit ripened (Indices 4 and 5) with their values being 1.26, 2.57 and 3.04 nkat/g respectively. In contrast, PME activity was higher in unripened fruit (Index 3) than fruit with maturity Index 4 and Index 5 being 25.73, 22.57 and 17.19 neqv g⁻¹ s⁻¹, respectively. It is proven that increasing calcium concentrations markedly reduced the activities of PG and PME enzymes in dragon fruit. At 7.5 g/L Ca from CaCl₂, the activities of PG and PME were lowest followed by fruit treated with 5, 2.5 and 0 g/L Ca from CaCl₂. The significant interaction between Ca concentration and duration of dipping showed the effect of Ca on the activity of PG and PME and dependent on duration of exposure to the chemical. Overall, dragon fruit treated with 7.5 g/L Ca from CaCl₂ and eight minutes dipping significantly reduced the activities of PG and

PME enzyme the lowest compared to other treatments. Duration of dipping did not affect fruit color, pH, titratable acidity and ascorbic acid content while soluble solids concentration and calcium content increased at a longer duration of dipping. There was an interaction found between Ca concentration and duration of dipping on firmness. The firmness of fruit slices treated at the highest Ca concentration (7.5 g/L) increased at the beginning of the treatment (2.31 N) but decreased as the duration increased to 8 and 12 mins being 1.91 and 2.18 N respectively. A correlation between parameters measured in this study showed that both PG and PME activities were negatively correlated with the fruit Ca content. The correlation result also showed that fruits with high Ca concentration contained low ascorbic acid content. Understanding on the cell wall degrading enzymes would give us a better opportunity to manipulate their activities, thus allowing us to extend the fruit economic life.

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

**KESAN RAWATAN KALSIUM KE ATAS KUALITI BUAH NAGA
[*Hylocereus polyrhizus* F.A.C. WEBER) BRITTON & ROSE] SERTA
AKTIVITI POLIGALAKTURONASE DAN PEKTIN METILESTERASE**

Oleh

SITI HAJAR CHUNI

Disember 2010

Pengerusi: Profesor Madya Dr. Yahya Awang, PhD

Fakulti: Fakulti Pertanian

Kesan perbezaan kepekatan kalsium (Ca) daripada kalsium klorida (CaCl_2) ke atas aktiviti dua enzim pemecah dinding sel; poligalakturonase (PG) dan pektin metilesterase (PME) dan kualiti buah naga (*Hylocereus polyrhizus*) dinilai. Buah naga yang digunakan di dalam kajian ini diperolehi daripada ladang komersil di Batang Benar di Nilai, Negeri Sembilan. Adalah penting untuk menstabilkan suhu dan pH optimum bagi enzim PG dan PME sebelum sebarang rawatan Ca diberikan kerana dua faktor ini adalah parameter fizikal yang sangat penting dalam mempengaruhi aktiviti enzim. PG dan PME telah diasai dengan larutan penimbal yang mempunyai julat pH yang berbeza (pH 3.0 – 8.0) dan julat suhu yang berbeza (30 – 70 °C). Keputusan yang diperolehi digunakan di dalam eksperimen yang seterusnya. Aktiviti PG dan PME di dalam buah naga yang berbeza indeks kematangan; Indeks 3, 4 dan 5 telah dikaji. Kajian dijalankan menggunakan rekabentuk rawak lengkap dengan tiga replikasi. Untuk mengkaji kesan Ca ke atas

aktiviti PG dan PME, kepekatan Ca yang berbeza (0, 2.5, 5 dan 7.5 g/L Ca daripada CaCl₂) telah diberikan kepada buah naga yang berbeza indeks kematangan (Indeks 3 dan 5) dan buah disimpan selama tujuh hari pada ± 20 °C. Kajian dijalankan menggunakan rekabentuk blok rawak lengkap dengan tiga replikasi. Kesan kepekatan Ca yang berbeza (0, 2.5 dan 7.5 g/L Ca daripada CaCl₂) dan masa rendaman yang berbeza (0, 4, 8 dan 12 minit) ke atas aktiviti PG, PME dan beberapa parameter kualiti buah (kekerasan buah, warna, pH, kandungan kalsium, kandungan asid askorbik dan kepekatan pepejal larut) ke atas buah naga yang telah dipotong dan disimpan pada 12 ± 1 °C selama lima hari turut dikaji. Kajian dijalankan menggunakan rekabentuk blok rawak lengkap dengan tiga replikasi.

Keputusan kajian menunjukkan aktiviti PG mencapai keadaan optimum pada suhu 41 °C (6.233 nkat/g) dan pH 6.0 (4.818 nkat/g) manakala aktiviti PME mencapai kadar optimum pada 47.8 °C (60.864 neqv g⁻¹ s⁻¹) dan pH 5.8 (72.782 neqv g⁻¹ s⁻¹). Buah yang berbeza indeks kematangan mempunyai kadar aktiviti enzim pemecah dinding sel yang berbeza. PG dengan aktiviti yang rendah telah dijumpai di dalam buah naga yang kurang matang (Indeks 3) dan apabila indeks kematangan mula meningkat (Indeks 4 dan 5), terdapat kadar peningkatan yang agak ketara pada aktiviti PG dengan nilai aktiviti masing-masing adalah 1.26, 2.57 dan 3.04 nkat/g. Berbeza dengan PG, aktiviti PME adalah lebih tinggi pada buah yang kurang matang (Indeks 3) berbanding dengan buah yang lebih matang dengan nilai aktiviti masing-masing 25.73, 22.57 dan 17.19 neqv g⁻¹ s⁻¹. Dengan peningkatan kepekatan Ca daripada CaCl₂ telah terbukti aktiviti PG dan PME telah berjaya diturunkan. Interaksi di antara kepekatan Ca dengan kadar masa rendaman menunjukkan kesan yang ketara pada aktiviti PG dan PME. Buah naga yang dirawat dengan 7.5 g/L Ca

daripada CaCl_2 dan 8 minit masa rendaman memberikan kadar penurunan yang paling tinggi pada aktiviti PG dan PME. Bagi kualiti buah naga pula, kepekatan kalsium dan kadar masa rendaman tidak memberikan kesan kepada warna, pH, keasidan titratan dan kandungan asid askorbik manakala kandungan pepejal larut dan kandungan kalsium meningkat apabila kadar masa rendaman ditingkatkan . Terdapat interaksi di antara kepekatan Ca dan kadar masa rendaman terhadap kepejalan buah. Kepejalan buah yang dirawat pada kepekatan Ca tertinggi (7.5 g/L) meningkat pada awal rawatan (2.31 N) tetapi kemudian menurun apabila kadar masa rendaman meningkat dari 8 min kepada 12 min dengan nilai kepejalan buah masing-masing 1.91 dan 2.18 N. Korelasi di antara parameter yang diuji di dalam kajian ini menunjukkan kedua-dua aktiviti PG dan PME adalah berkorelasi negatif dengan kandungan Ca buah. Keputusan analisis korelasi juga menunjukkan buah yang mengandungi kepekatan Ca yang tinggi mengandungi kandungan asid askorbik yang rendah. Pemahaman mengenai enzim pengurai dinding sel ini membolehkan kita mengawal tindakan enzim-enzim ini dan seterusnya memanjangkan jangka hayat ekonomi buah.

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I certify that a Thesis Examination Committee has met on 20 December 2010 to conduct the final examination of Siti Hajar binti Chuni on her thesis entitled “Effects of Calcium Treatment on Dragon Fruit [*Hylocereus polyrhizus* (F.A.C. Weber) Britton & Rose] Quality and Activities of Polygalacturonase and Pectin Methylesterase” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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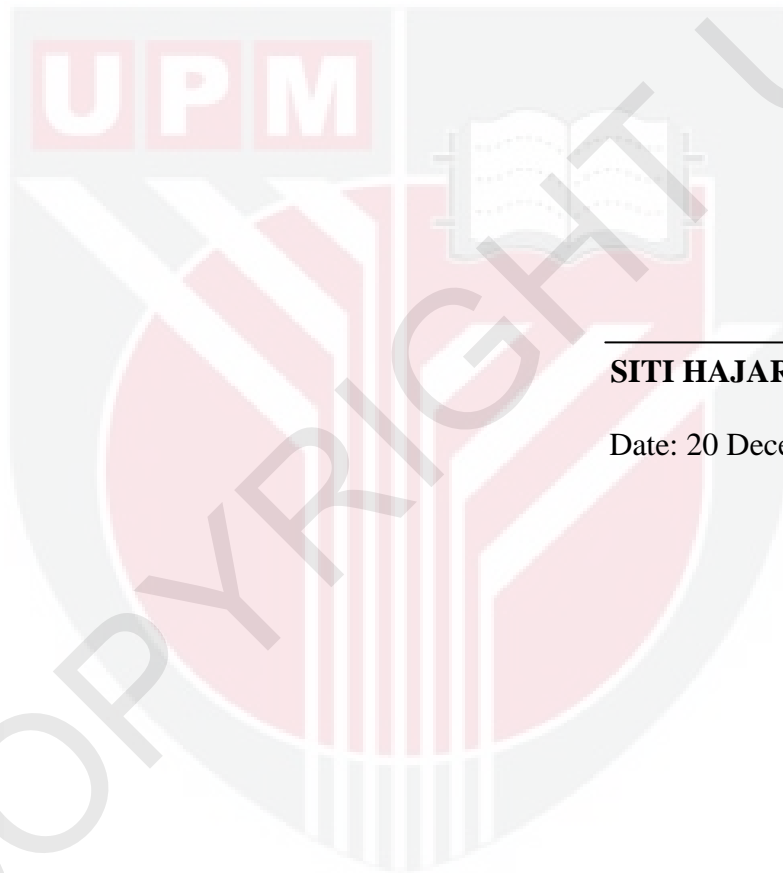
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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or any other institution.



SITI HAJAR BINTI CHUNI

Date: 20 December 2010



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