



**UNIVERSITI PUTRA MALAYSIA**

***OPTIMISATION OF EXTRACTION METHODS  
AND RHEOLOGICAL CHARACTERISTICS OF  
SOURSOP JUICE***

**QUEK MEEI CHIEN**

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AND RHEOLOGICAL CHARACTERISTICS OF  
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**MASTER OF SCIENCE  
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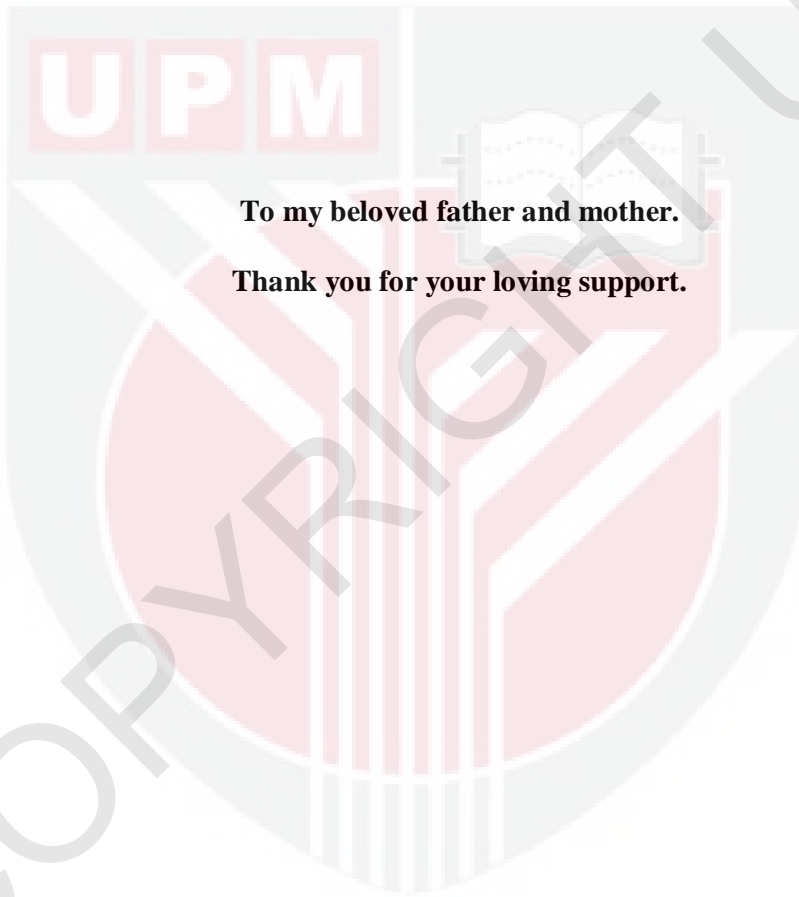


By

**QUEK MEEI CHIEN**

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

**August 2012**



**To my beloved father and mother.  
Thank you for your loving support.**

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

**OPTIMISATION OF EXTRACTION METHODS AND RHEOLOGICAL CHARACTERISTICS OF SOURSOP JUICE**

By

**QUEK MEEI CHIEN**

**August 2012**

**Chairperson: Associate Professor Ir. Chin Nyuk Ling, PhD**

**Faculty: Engineering**

The optimisation and comparison of various soursop juice extraction methods were investigated through quantitative and qualitative measurements in finding a suitable method for soursop juice processing. The effects of four individual extraction methods at various temperature or power and time combinations on juice yield, ascorbic acid, colour and total soluble solids of soursop juice were studied and optimised based on maximum responses in terms of juice yield, ascorbic acid, colour and total soluble solids. The optimum extraction conditions obtained for cold water blending, hot water blending, hot water extraction and microwave oven extraction were 30 °C, 90 °C, 65 °C for 30 minutes and 850 W for 2 minutes.

The four optimised extraction methods for soursop juice above were then compared for the responses of juice yield and ascorbic acid remained. The result obtained shows that the microwave oven extraction method has a greater capability in producing soursop juice. Juice yield was 73%, 93% and 7% higher than those obtained by cold water blending, hot water blending and hot water extraction

methods while the ascorbic acid preserved was at least 3% higher. For this reason, the optimised microwave oven extraction method at 850 W and for an extraction time of 2 minutes is recommended for processing of soursop juice in the beverage industry.

The flow behaviour and characteristics of soursop juice concentrates were investigated through rheological measurements and modelled using superposition technique by the double shifting method. The rheological studies were carried out using a rheometer with concentric cylindrical geometry over a wide range of temperatures (10-70 °C) and concentrations (10-50 °Brix) at shear rates of 0-400 s<sup>-1</sup>. The effect of temperature and concentration on rheological behaviour of freeze-dried soursop juice concentrates were investigated. Several rheological models were fitted to the rheological data, namely, Newtonian, Power law, Bingham, Casson and Herschel-Bulkley models. Power law is the best fitted model attributed to its high value of coefficient of determination ( $R^2=0.9989$ ). The soursop juice concentrates exhibited shear thinning or pseudoplastic behaviour with  $n<1$ . The consistency coefficients dependency on temperature and concentration were well described by Arrhenius relationship ( $R^2=0.8845$ ) and exponential relationship ( $R^2=0.9851$ ) respectively. The flow activation energy of soursop juice concentrates were 8.32 to 30.48 kJ/mol. The superposition technique has sufficiently modelled the overall rheological characteristics of soursop juice concentrates over a wide range of temperature and concentration into a single master curve using shift factors based on double shifting steps. This technique also showed that the soursop juice concentrates increases in viscosity and pseudoplasticity behaviour with concentration.

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

**PENGOPTIMUMAN KAEDAH PENGEKSTRAKAN DAN CIRI-CIRI REOLOGI BAGI JUS DURIAN BELANDA**

Oleh

**QUEK MEEI CHIEN**

**Ogos 2012**

**Pengerusi: Profesor Madya Ir. Chin Nyuk Ling, PhD**

**Fakulti: Kejuruteraan**

Pengoptimuman dan perbandingan kaedah pengekstrakan jus durian belanda telah dikaji-selidik melalui pengukuran kuantitatif dan kualitatif untuk mencari satu kaedah yang sesuai untuk pemprosesan jus durian belanda. Kesan empat kaedah pengekstrakan individu di pelbagai kombinasi suhu atau kuasa dan masa ke atas penghasilan jus, asid askorbik, warna dan jumlah pepejal larut bagi jus durian belanda telah dikaji dan dioptimumkan berdasarkan tindak balas yang maksimum. Keadaan pengekstrakan optimum yang diperolehi daripada pengadunan air sejuk, pengadunan air panas, pengekstrakan air panas dan pengekstrakan ketuhar gelombang mikro ialah 30 °C, 90 °C, 65 °C selama 30 minit dan 850 W selama 2 minit.

Empat kaedah pengekstrakan jus durian belanda yang telah dioptimumkan sebelum ini kemudiannya dibanding bagi tindak balas seperti hasil jus dan asid askorbik yang kekal. Keputusan eksperimen mendapati kaedah pengekstrakan ketuhar gelombang mikro mempunyai keupayaan yang lebih besar untuk menghasilkan jus durian

belanda. Penghasilan jus ialah 73%, 93 dan 7% lebih tinggi daripada yang diperolehi oleh kaedah pengekstrakan pengadunan air sejuk, pengadunan air panas dan pengekstrakan air panas manakala asid askorbik yang dikekalkan adalah sekurang-kurangnya 3% lebih tinggi. Atas sebab ini, kaedah pengekstrakan ketuhar gelombang mikro yang dioptimumkan pada 850 W selama 2 minit dicadangkan untuk pemprosesan jus durian belanda di industri minuman.

Sifat aliran dan ciri-ciri pekatan jus durian belanda telah dikaji-selidik melalui pengukuran reologi dan dimodel dengan menggunakan teknik superposisi melalui kaedah anjakan berganda. Kajian reologi telah dijalankan dengan menggunakan sebuah reometer yang dilengkapi dengan geometri silinder sepusat ke atas liputan suhu (10-70 °C) dan kepekatan (10-50 °Brix) pada kadar ricih 0-400 s<sup>-1</sup>. Kesan suhu dan kepekatan pada sifat reologi pekatan jus durian belanda yang telah dibekukan telah dikaji-selidik. Beberapa model reologi telah dimuatkan kepada data reologi, iaitu, model Newton, Power Law, Bingham, Casson dan Herschel-Bulkley. Power Law merupakan model yang terbaik dimuatkan disebabkan oleh nilai pekali penentuan yang tinggi ( $R^2=0.9989$ ). Pekatan jus durian belanda menunjukkan sifat penipisan ricih atau pseudoplastik dengan  $n<1$ . Pergantungan konsisten pekali pada suhu dan kepekatan telah diperihalkan dengan baik oleh hubungan Arrhenius ( $R^2=0.8845$ ) dan hubungan eksponen ( $R^2=0.9851$ ). Tenaga pengaktifan aliran pekatan jus durian belanda ialah 8.32 to 30.48 kJ/mol. Teknik superposisi berpadanan dalam memodel keseluruhan ciri-ciri reologi pekatan jus durian belanda yang merangkumi julat suhu dan kepekatan yang luas ke lengkung master tunggal dengan menggunakan faktor anjakan berdasarkan langkah-langkah anjakan



berganda. Teknik ini juga menunjukkan bahawa kelikatan dan sifat pseudoplastik pekatan jus durian belanda meningkat dengan kepekatan.



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I certify that a Thesis Examination Committee has met on 29 August 2012 to conduct the final examination of Quek Meei Chien on her thesis entitled “Optimisation of Extraction Methods and Rheological Characteristics of Soursop Juice” 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.

Members of the Thesis Examination Committee were as follows:

**Robiah Bt. Yunus, PhD**

Professor  
Faculty of Engineering  
Universiti Putra Malaysia  
(Chairman)

**Rosnita binti A. Talib, PhD**

Senior Lecturer  
Faculty of Engineering  
Universiti Putra Malaysia  
(Internal Examiner)

**Rosnah binti Shamsudin, PhD**

Senior Lecturer  
Faculty of Engineering  
Universiti Putra Malaysia  
(Internal Examiner)

**Cheow Chong Seng, PhD**

Associate Professor  
Faculty of Applied Sciences  
Universiti Teknologi Mara  
(External Examiner)

---

**SEOW HENG FONG, PhD**

Professor and Deputy Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date: 27 September 2012

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of **Master of Science**. The members of the Supervisory Committee were as follows:

**Ir. Chin Nyuk Ling, PhD**

Associate Professor  
Faculty of Engineering  
Universiti Putra Malaysia  
(Chairman)

**Yus Aniza Yusof, PhD**

Associate Professor  
Faculty of Engineering  
Universiti Putra Malaysia  
(Member)



---

**BUJANG BIN KIM HUAT, PhD**

Professor and Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date:

## 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 at any other institution.



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**QUEK MEEI CHIEN**

Date:

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