



UNIVERSITI PUTRA MALAYSIA

**OPTIMIZATION OF PROCESSING CONDITIONS AND ENHANCEMENT
OF QUALITY AND STORAGE STABILITY OF
CLARIFIED SAPODILLA (*ACHRAS ZAPOTA*) JUICE**

SIN HWEE NEE

FSTM 2007 3



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CLARIFIED SAPODILLA (*ACHRAS ZAPOTA*) JUICE**

By

SIN HWEE NEE

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

February 2007



*Specially Dedicated
To
My Family*



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

OPTIMIZATION OF PROCESSING CONDITIONS AND ENHANCEMENT OF QUALITY AND STORAGE STABILITY OF CLARIFIED SAPODILLA (*ACHRAS ZAPOTA*) JUICE

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February 2007

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This study was carried out to optimize conditions for hot water extraction (HWE) and enzymatic clarification in the production of clarified sapodilla juice. The effects of different level of fining treatment and storage condition on haze reduction of clarified sapodilla juice during storage were also investigated. The physico-chemical characteristics (physical measurement of fruits, total soluble solids, pH, titratable acidity, colour measurement, clarity and viscosity) of clarified sapodilla juice made from three fruit varieties were studied. The juice produced from the Subang variety possessed desirable lightness, clarity and viscosity and was therefore found to be suitable in the production of clarified sapodilla juice.

The optimum conditions of hot water extraction (HWE) for production of sapodilla juice were determined using Response Surface Methodology (RSM). Time and temperature combinations in the range of 30-120 min and 30-90°C were the



independent variables and their effects on juice yield, odour, taste and astringency were investigated. The results showed that extraction temperature was the most important factor that affected characteristics of the juice as it exerted a significant influence on all the dependent variables. Higher temperature increased juice yield, taste and odour but also showed an increased astringency, which affected the acceptability of the juice. The results implied that an optimum sapodilla juice extraction condition using HWE to be at 60°C for 120 min.

The optimum conditions for enzymatic clarification of clarified sapodilla juice were also determined using RSM. Sapodilla juice was treated with pectinase enzyme at different incubation times (30-120 min), temperature (30-50°C) and enzyme concentration (0.03-0.10%). These three factors were used as independent variables and their effects on turbidity, clarity, viscosity and colour (L values) of the juice were evaluated. Significant regression models describing the changes of turbidity, clarity, viscosity and colour (L values) with respect to the independent variables were established, with the coefficient of determination, R^2 , greater than 0.8. The results indicated that enzyme concentration was the most important factor that affected characteristics of the juice as it exerted a significant influence on all the dependent variables. The recommended enzyme clarification condition was 0.1% enzyme concentration at 40°C for 120 min.

The clarified sapodilla juice was then subjected to different level of fining treatments namely bentonite at 0.25% (X), 0.10% (Y) and control (Z-without treatment) and stored at 4, 25 and 37°C. The effects of bentonite fining at different levels and storage temperature on haze reduction were monitored during 24 weeks of storage.

Haze reduction was notable for samples stored at 4°C with 0.25% bentonite treatment (X) followed by samples stored at 4°C with 0.10% bentonite treatment (Y). Lower temperature slowed down the physical chemical changes that took place in juice and helped retain the quality and colour of juice during storage, while higher temperature induced and accelerated the physical chemical changes during storage. Fining treatment significantly reduced the turbidity and browning index of the juice during storage compared to samples without fining. The appropriate level of fining treatment was important in haze reduction where samples treated with 0.25% bentonite (X) showed greatly reduced haze formation followed by samples treated with 0.10% bentonite treatment (Y). All the samples passed the microbial test and were safe for consumption at the end of the storage period. Samples stored at 4°C with 0.25% bentonite treatment (X) possessed the highest overall acceptability scores after 24 weeks storage, while samples stored at 37°C without treatment (Z) showed the lowest overall acceptability.

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

**PENGOPTIMALAN PEMROSESAN DAN PENAMBAHBAIKAN KUALITI
SERTA KESTABILAN PENYIMPANAN JUS JERNIH SAPODILLA
(ACHRAS SAPOTA)**

Oleh

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Februari 2007

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Kajian ini dijalankan untuk mengoptimumkan keadaan pengekstrakan air panas (HWE) dan penjernihan jus menggunakan enzim dalam penghasilan jus jernih sapodilla. Pengaruh rawatan 'fining' pada kadar berbeza serta keadaan penyimpanan jus terhadap pengurangan kekeruhan dalam jus jernih sapodilla semasa penyimpanan juga dikaji. Sifat-sifat fizikal dan kimia (pengukuran fizikal buah, kandungan pepejal terlarut, pH, keasidan titratan, pengukuran warna, kejernihan dan kelikatan) jus jernih sapodilla yang disediakan daripada tiga jenis buah dikaji. Jus yang disediakan daripada jenis Subang mempunyai nilai kecerahan, kejernihan dan kelikatan yang diperlukan dan dengan itu didapati sesuai dalam penghasilan jus jernih sapodilla.

Keadaan optima pengekstrakan air panas (HWE) untuk penghasilan jus sapodilla ditentukan dengan methodologi "Response Surface Methodology"(RSM). Kombinasi masa dan suhu dalam julat 30-120 minit dan 30-90°C merupakan variasi tak berubah dan kesannya ke atas perolehan jus, bau, rasa dan kekelatan telah ditentukan.



Keputusan menunjukkan suhu pengestrakan merupakan faktor yang paling penting dalam mempengaruhi ciri-ciri jus di mana ia menunjukkan signifikansi pada semua variasi berubah. Suhu tinggi meninggikan perolehan jus, rasa dan bau tetapi juga meninggikan kekelatan yang boleh mempengaruhi penerimaan jus. Keputusan menunjukkan keadaan optima pengestrakan jus sapodilla menggunakan kaedah HWE adalah pada suhu 60°C selama 120 minit.

Keadaan optima dalam penjernihan jus menggunakan enzim juga ditentukan dengan metodologi RSM. Jus sapodilla dirawat dengan enzim pektin pada tempoh (30-120 minit), suhu (30-50°C) dan kepekatan enzim (0.03-0.10%) yang berbeza. Ketiga-tiga faktor ini digunakan sebagai variasi tak berubah dan kesannya terhadap kekeruhan, kejernihan, kelikatan dan kecerahan warna (nilai L) jus telah ditentukan. Model regresi yang bererti pada perubahan kekeruhan, kejernihan, kelikatan dan kecerahan warna (L value) terhadap variasi tak berubah telah ditentukan dengan R^2 (coefficient of determination) lebih daripada 0.8. Keputusan menunjukkan kepekatan enzim adalah faktor utama mempengaruhi ciri jus jernih di mana ia menunjukkan signifikansi pada semua variasi berubah. Keadaan optima penjernihan jus menggunakan enzim adalah dicadangkan pada 0.1% kepekatan enzim pada 40°C selama 120 minit.

Jus jernih sapodilla seterusnya dijalankan rawatan 'fining' pada kadar berbeza iaitu bentonite pada 0.25% (X), 0.10% (Y), dan kawalan (Z- tanpa rawatan) serta disimpan pada suhu 4, 25 dan 37°C. Kesan rawatan bentonite pada kadar berbeza dan kesan suhu penyimpanan terhadap pengurangan kekeruhan diperhatikan selama 24 minggu tempoh penyimpanan. Pengurangan kekeruhan adalah ketara pada sampel

yang disimpan pada 4°C dengan 0.25% bentonite (X) diikuti dengan sampel yang disimpan pada 4°C dengan 0.1% bentonite (Y). Suhu yang rendah melambatkan perubahan fizikal dan kimia pada jus serta membantu mengekalkan kualiti dan warna jus semasa penyimpanan, manakala suhu yang tinggi menggalakkan dan mempercepatkan perubahan fizikal dan kimia semasa penyimpanan. Rawatan 'fining' mengurangkan kekeruhan dan index keperangan jus semasa penyimpanan dengan bererti berbanding dengan sampel tanpa rawatan. Kadar yang tepat dalam rawatan 'fining' adalah penting dalam pengurangan kekeruhan, di mana sampel yang dirawat dengan 0.25% bentonite (X) menunjukkan pengurangan kekeruhan yang ketara diikuti dengan sampel yang dirawat dengan 0.10% bentonite (Y). Semua sampel telah melepasi ujian mikrobiologi dan adalah selamat diminum sehingga akhir tempoh penyimpanan. Sampel yang disimpan pada 4°C dengan 0.25% bentonite (X) menunjukkan skor keterimaan keseluruhan yang tertinggi selepas 24 minggu penyimpanan, manakala sampel yang disimpan pada suhu 37°C tanpa rawatan (Z) menunjukkan skor keterimaan keseluruhan yang paling rendah.



ACKNOWLEDGEMENTS

I wish to acknowledge generous individuals whose valuable support made this study a success and the completion of this thesis possible. I am immensely indebted to them and my only means of repaying them is to express a heartfelt gratitude and a sincere appreciation.

Foremost is to my supervisor, Prof. Salmah Yusof for her invaluable guidance, advice, encouragement and support. But most importantly, she gave me the necessary confidence from the very beginning to go through this graduate programme by believing in me.

Appreciation is also goes to Dr. Nazimah Sheikh Abdul Hamid, member of the Supervisory committee, for her valuable comments, ideas and for those precious words of encouragement which keeps me going when the progression becomes tough. Professor Dr. Russly Abdul Rahman, member of the Supervisory committee, was an invaluable resource in my research project and an enjoyable gentleman to work with. Special appreciations also go to Dr. Boo and Dr. Anuar Abdul Rahim, for their help, comments and guidance on the statistical analysis of the data.

I wish to express my gratitude to all my friends for their very generous help, cooperation, encouragement and warm friendship which made my work in the laboratory bearable and pleasant. Special appreciations also go to lab personnel, office staffs and faculty who help me in many ways during my research project. Thank you all and each of you.



Finally, but certainly not least, I wish to express my deepest appreciation to my beloved parents who had given me unconditional love and support and for their efforts in educating me. To my brothers, sister and Mr. Leong, for their patience and endurance and for standing by me through those difficult times. To them, I dedicate this work.



I certify that an Examination Committee has met on 22 February 2007 to conduct the final examination of Sin Hwee Nee on her Master of Science thesis entitled “ Optimization of Processing Conditions for the Production of Quality Clarified Sapodilla (*Achras zapota*) Juice ” 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 Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for 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.

SIN HWEE NEE

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
SAS	Statistical Analysis System
RSM	Response Surface Methodology
CCD	Central Composite Design
QDA	Quantitative Descriptive Analysis
NTU	Nephelometric Turbidity Unit
PVPP	Polyvinylpolypyrrolidone
cp	Centipoise
x g	Times Gravity
ppm	Part per million
rpm	Revolution per minute
μ	Micro