



UNIVERSITI PUTRA MALAYSIA

**EFFECT OF STORAGE ON FLAVOUR, COLOUR AND OTHER
SENSORY QUALITIES OF SUGARCANE JUICE (SACCHARUM
OFFICINARUM) YELLOW CANE**

KHALEEL ABDUL FATTAH MAHMOUD AL-HASAN

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By

KHALEEL ABDUL FATTAH MAHMOUD AL-HASAN

**Thesis Submitted in Fulfilment of the Requirements for the
Degree of Master of Science in the Faculty of
Food Science and Biotechnology
Universiti Putra Malaysia**

November 2000



DEDICATION

To those who are proud of my success

**my mother
and my
father**



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

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Chairman: Associate Professor Salmah Yusof, Ph.D.

Faculty: Food Science and Biotechnology

A study was conducted to determine the effects of storage on the flavour and sensory attributes of sugarcane juice. Freshly extracted sugarcane juice was stored at $25 \pm 2^\circ\text{C}$ and $5 \pm 2^\circ\text{C}$ for 15-days. The parameters measured were colour, acidity (pH and TA), acidic phenolics and flavour. The sensory attributes tested were colour, viscosity, sweetness, sharpness, appearance, jaggery and fresh flavour. Phenolic compounds were separated using solid phase extraction technique and HPLC method was used for isolation and identification. Major volatiles were extracted using vacuum steam distillation (VSD) technique. Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC-MS) were used for separation of the volatiles and identification of their molecular weights.

Results indicated that sugarcane juice stored at $5 \pm 2^\circ\text{C}$ retained its colour and acidity until 10-days meanwhile, a drastic change occurred on the colour and acidity of juice stored at $25 \pm 2^\circ\text{C}$. The sensory results showed that no remarkable changes occurred on the quality (colour, viscosity, sweetness, sharpness, appearance,



jaggery and fresh flavour) of samples stored at $5 \pm 2^\circ\text{C}$ up to 10-days. There were no significant differences ($P>0.05$) observed between samples stored for 5 and 10-days. However, at the end of the 15-days, there were significant differences ($P<0.05$) in terms of colour, sweetness, sharpness, jaggery and freshness compared to the fresh, the 5 and the 10-days stored juices (except for appearance and viscosity).

Six types of phenolic compounds were identified in sugarcane juice namely 3,4-dihydroxybenzoic, chlorogenic, *p*-hydroxybenzoic, caffeic, *p*-coumaric and 2,3-dihydroxybenzoic acids. Changes in the phenolics contents were observed in samples stored at both temperatures ($5 \pm 2^\circ\text{C}$ and $25 \pm 2^\circ\text{C}$). Changes in the phenolics' concentrations were more noticeable in the juice stored at $25 \pm 2^\circ\text{C}$. This occurred despite the fact that the polyphenol oxidase (PPO) was deactivated at the beginning before juice extraction. At the same time, there seemed to be increases and decreases in their concentrations. This may indicate that not only enzymatic reaction, which consumed the phenolics but also autoxidation reaction, may have occurred. Sugarcane juice was found to consist of about 17 major volatile compounds. Upon storage at $5 \pm 2^\circ\text{C}$ the major volatiles were retained until 10-days; after that some compounds were lost and others were evolved. After two days of storage at $25 \pm 2^\circ\text{C}$ the major volatiles were lost and many other new compounds were evolved.

A strong relationship ($R^2 \geq 0.90$) was observed between some of the phenolics and the sensory attributes (colour, appearance, viscosity, sweetness, sharpness, jaggery and fresh flavour). The changes in colour (ΔE) was also correlated well ($R^2=0.90$) with the sensory evaluation results.

In general, sugarcane juice stored at $5 \pm 2^{\circ}\text{C}$ retained its quality until 10-days. However, undesirable colour, flavour and the change in taste from sweet to sour occurred after the end of the 15-days at $5 \pm 2^{\circ}\text{C}$. Significant changes in acidity, colour, flavour and phenolics were observed at $25 \pm 2^{\circ}\text{C}$ compared to $5 \pm 2^{\circ}\text{C}$. In fact, the flavour of the sample stored at $25 \pm 2^{\circ}\text{C}$ changed significantly after 2 days. This indicated that the juice will lose its quality if kept at $25 \pm 2^{\circ}\text{C}$ and deterioration of the juice stored at $5 \pm 2^{\circ}\text{C}$ was only noticeable after the end of the 15-days.

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

**KESAN PENYIMPANAN KEATAS CITARASA, WARNA DAN
KUALITI DERIA JUS TEBU (*SACCHARUM OFFICINARUM*) TEBU
KUNING**

Oleh

KHALEEL ABDUL FATTAH MAHMOUD AL-HASAN

November 2000

Pengerusi: Profesor Madya Salmah Yusof, Ph.D.

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Satu kajian telah dijalankan untuk menentukan kesan penyimpanan terhadap citarasa dan ciri-ciri deria jus tebu. Jus tebu yang diekstrak segar disimpan pada $25 \pm 2^{\circ}\text{C}$ dan $5 \pm 2^{\circ}\text{C}$ selama 15 hari. Parameter yang dikaji adalah warna, keasidan (pH dan TA), fenolik asidik dan citarasa. Ciri deria yang ditentukan pula ialah warna, kelikatan, kemanisan, rasa ketajaman, rupa, rasa "jaggery" dan kesegaran citarasa. Bahan fenolik di pisahkan menggunakan teknik pengekstrakkan fasa pepejal. Kaedah HPLC digunakan untuk mengasingkan dan mengenalpasti kompond-kompond tersebut. Bahan meruap (volatiles) diekstrak dengan menggunakan teknik penyulingan stim (Vacuum Steam Distillation). Kromatografi gas (GC) dan gas kromatografi spektrometri jisim (GCMS) telah digunakan untuk mengasingkan dan mengenalpasti berat molekul bahan meruap.

Keputusan yang diperolehi menunjukkan jus tebu yang disimpan pada suhu $5 \pm 2^{\circ}\text{C}$ dapat mengekalkan warna dan keasidannya sehingga 10 hari. Pada masa yang sama, perubahan yang ketara berlaku keatas warna dan asiditi jus yang disimpan pada $25 \pm 2^{\circ}\text{C}$. Keputusan ujian deria dari sampel yang disimpan pada suhu $5 \pm 2^{\circ}\text{C}$ hingga 10 hari menunjukkan tiada perubahan yang ketara berlaku keatas kualiti (warna, kelikatan, kemanisan, ketajaman, rasa “jaggery” dan kesegaran). Tiada perbezaan yang ketara ($p>0.05$) antara jus yang disimpan selama 5 hari dan 10 hari pada suhu $5 \pm 2^{\circ}\text{C}$. Walau bagaimanapun selepas 15 hari, terdapat perbezaan yang ketara ($p<0.05$) di antara kualiti warna, kemanisan, ketajaman, rasa “jaggery” dan kesegaran berbanding jus segar dan jus yang disimpan selama 5 hingga 10 hari (kecuali dari segi rupa dan kelikatan).

Enam jenis bahan fenolik telah dikenalpasti di dalam jus tebu iaitu 3,4-dihydroxybenzoic, chlorogenic, *p*-hydroxybenzoic, caffeic, *p*-coumaric dan 2,3-dihydroxybenzoic asid. Perubahan pada bahan fenolik telah diperhatikan pada sampel yang telah disimpan pada kedua-dua suhu $25 \pm 2^{\circ}\text{C}$ dan $5 \pm 2^{\circ}\text{C}$. Perubahan pada kepekatan kandungan fenolik didapati lebih nyata bagi sampel jus yang disimpan pada suhu $25 \pm 2^{\circ}\text{C}$. Ini berlaku meskipun polifenoloksidase (PPO) telah dinyahaktifkan sebelum jus diekstrak. Terdapat juga pengurangan dan penambahan pada

sesetengah bahan pada masa yang sama. Ini mungkin bererti bahawa bukan sahaja tindakbalas enzimatik yang menggunakan bahan fenolik telah berlaku tetapi tindakbalas auto pengoksidaan mungkin juga turut terlibat. Jus tebu didapati mengandungi lebih kurang 17 jenis bahan meruap yang utama. Penyimpanan pada $5 \pm 2^{\circ}\text{C}$ dapat mengekalkan, bahan meruap ini selama 10 hari; selepas tempoh tersebut kemerosotan berlaku. Disamping itu bagi sampel yang disimpan pada $25 \pm 2^{\circ}\text{C}$, bahan meruap yang utama didapati hilang manakala banyak sebatian baru lain didapati wujud.

Terdapat pertalian yang kuat ($R^2 \geq 0.90$) diantara sesetengah fenolik dengan sifat-sifat deria (warna, rupa, kelikatan, kemanisan, ketajaman, rasa "jaggery" and kesegaran). Perubahan di dalam warna (ΔE) juga turut berkait rapat ($R^2 > 0.90$) dengan keputusan penilaian deria.

Secara amnya, jus tebu yang disimpan pada $5 \pm 2^{\circ}\text{C}$ berupaya mengekalkan kualiti sehingga 10 hari. Walau bagaimanapun, perubahan warna, rasa dan perubahan rasa dari manis ke masam berlaku hanya selepas 15 hari pada suhu $5 \pm 2^{\circ}\text{C}$. Perubahan pada keasidan, warna, rasa dan bahan fenolik didapati lebih ketara bagi jus yang disimpan pada suhu $25 \pm 2^{\circ}\text{C}$ jika dibandingkan dengan

jus pada $5 \pm 2^{\circ}\text{C}$. Citarasa jus tersebut didapati berubah dengan ketara selepas 2 hari. Ini menunjukkan bahawa jus tebu akan kehilangan kualitinya dengan cepat jika disimpan pada $25 \pm 2^{\circ}\text{C}$ manakala jus yang disimpan pada suhu $5 \pm 2^{\circ}\text{C}$, perubahan kualiti hanya ketara selepas 15 hari.

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I certify that an Examination Committee met on 13th November 2000 to conduct the final examination of Khaleel Abdul Fattah Mahmoud Al-Hasan on his Master of Science thesis entitled “Effect of Storage on Flavour, Colour and Other Sensory Qualities of Sugarcane Juice (*Saccharum officinarum*) Yellow Cane” 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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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.



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LIST OF ABBREVIATIONS

Symbol	Meaning
HPLC	High Performance Liquid Chromatography
GC	Gas Chromatography
GCMS-SIM	Gas Chromatography Mass Spectrometry-Selective Ion Mode
FID	Flame Ionisation Detector
EI	Electron Impact
AUFS	Absolute Unit of Full Scale
mL	Millilitre
°C	Degree Celsius
pH	Hydrogen Ion Concentration
TA	Titratable Acidity
v/v	Volume Per Volume
w/v	Weight Per Volume
PPO	Polyphenol oxidase
QDA	Qualitative Descriptive analysis
VSD	Vacuum Steam Distillation
mg	Milligram
Ca	Calcium
P	Phosphorous
Fe	Iron
O	Orhtho
M	Meta

