



**UNIVERSITI PUTRA MALAYSIA**

**DEVELOPMENT OF FROZEN GRATED CASSAVA PASTE AS A BASE  
FOR MALAYSIAN TRADITIONAL CAKES**

**GAN HORNG ENG**

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**DEVELOPMENT OF FROZEN GRATED CASSAVA PASTE AS A BASE FOR  
MALAYSIAN TRADITIONAL CAKES**

By

**GAN HORNG ENG**

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

**NOV 2008**



**Dedicated to My Beloved Parent, Wife and Teachers**



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

**DEVELOPMENT OF FROZEN CASSAVA GRATED PASTE AS A BASE FOR MALAYSIAN TRADITIONAL CAKES**

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**Chairman : Roselina Karim, PhD**

**Faculty : Food Science and Technology**

The optimum formulation for production of baked cassava cake i.e. a type of Malaysian traditional cake was determined using response surface methodology (RSM). The effects of amount of ingredients such as sugar (10-30%) and coconut milk (15-35%) on the instrumental textural characteristics and sensory acceptance of cakes were investigated. Based on superimposed plots, the basic formulation for production of baked cassava cake with desired sensory quality was obtained by incorporating 25 % of white granulated sugar and 20 % of coconut milk to the basic formulation.

Physicochemical analyses were carried out to evaluate the changes in the quality of frozen cassava paste whereas; instrumental measurements and sensory tests were performed to assess the quality of baked cassava cake at monthly interval for a period of six months during frozen storage. The drip loss was increased initially for the three months of storage and decreased slightly in the following month onwards. The



prolonged frozen storage had led to a brighter frozen grated cassava paste. The ice crystals formation and enlargement had negative impact on textural properties i.e. firmness and rheological of the cassava paste during frozen storage. When viewed under an electron microscope, it was confirmed that the cell wall structures and membranes of cassava paste were damaged during the frozen storage. Furthermore, both the changes in the textural profile and sensory attributes of baked cassava cake had also showed similar trend of results with the instrumental data and this further supported t the changes in the quality of baked cassava cake was solely due to the freezing process, frozen storage and subsequent thawing. The degree of acceptability of all the attributes was also reduced after six months of frozen storage and the recommended storage period for frozen grated cassava paste was up to four months.

The effects of different concentration of xanthan gum (0 %, 0.2 %, 0.4 %, 0.6 % and 0.8 %, w/w) on frozen grated cassava paste were also studied. Results showed that xanthan gum had effectively reduced the drip loss and at the same time improved the textural properties i.e. firmness and rheological parameter of the cassava paste during frozen storage. However, the degree of acceptability for the sensory attributes of baked cassava cake were reduced as the concentration of xanthan gum was increased. Hence, the most suitable concentration of xanthan gum to be added was 0.2% w/w.

The effect of five successive freeze-thaw cycles on physicochemical, textural and rheological properties as well as sensory qualities of frozen grated cassava paste was studied. The drip loss was significantly higher in sample that was subjected to five freeze-thaw cycles when compared with the control (zero cycle). The firmness and rheological properties of the cassava paste as well as the degree of acceptability of the baked cassava cake was decreased gradually as the number of cycles was increased.

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

**PERKEMBANGAN PES UBI KAYU PARUT DISEJUKBEKU SEBAGAI ASAS  
KEPADA KUIH TRADISI MALAYSIA**

Oleh

**GAN HORNG ENG**

**NOV 2008**

**Pengerusi : Roselina Karim, PhD**

**Fakulti : Sains dan Teknologi Makanan**

Pengoptimuman formulasi bagi penghasilan bingka ubi kayu iaitu sejenis kuih tradisi di Malaysia telah ditentukan dengan menggunakan kaedah respons permukaan (RSM). Kesan kandungan bahan seperti gula kasar (10-30%) dan santan kelapa (15-35%) keatas sifat tesktur dan penerimaan sensori bingka ubi kayu telah disiasat. Berdasarkan plot superimposisi, formulasi asas bagi menghasilkan bingka ubi kayu yang mempunyai kualiti sensori yang disukai telah dicapai dengan mencampurkan 25% gula kasar dan 20% santan kelapa ke dalam formulasi asas.

Analisis fizikokimia dijalankan untuk menilai perubahan kualiti bagi pes ubi kayu yang disejukbeku, manakala, pengukuran instrumentasi dan ujian sensori dijalankan bagi menilai perubahan kualiti bingka ubi kayu setiap bulan selama 6 bulan penyimpanan sejukbeku.. Semasa penyimpanan sejukbeku, peratusan kehilangan air meningkat pada tiga bulan yang pertama dan menurun sedikit pada bulan berikutnya. Peningkatan tempoh penyimpanan sejukbeku juga mengakibatkan warna ubi kayu menjadi semakin

cerah. Pembentukan dan pembesaran kristal ais memberi impak negatif terhadap sifat tekstur seperti kekerasan dan parameter reologi ubi kayu pes yang diparut sewaktu penyejukbekuan. Apabila dilihat di bawah elektron mikroskop, dapat disahkan bahawa struktur dinding sel dan selaput sel telah mengalami kerosakan sewaktu penyimpanan sejukbeku. Tambahan pula, perubahan kepada kedua-dua profil tekstur dan keamatan sifat sensori bingka ubi menunjukkan corak keputusan yang sama dengan data dari instrumentasi. Ini menyokong rumusan bahawa perubahan kualiti dalam bingka ubi kayu adalah semata-mata disebabkan oleh process pendinginan, penyimpanan sejukbeku dan juga nyah-penyejukbekuan. Darjah penerimaan terhadap sifat sensori bingka ubi kayu juga telah menurun selepas disejukbeku selama enam bulan dan cadangan tempoh penyimpan sejukbeku bagi pes ubi kayu yang diparut adalah selama empat bulan.

Kesan penambahan kepekatan gum xanthan yang berbeza (0 %, 0.2 %, 0.4 %, 0.6 % dan 0.8 %, w/w) ke atas ubi kayu yang disejukbeku juga telah dikaji. Keputusan menunjukkan bahawa gam xanthan sangat efektif dalam menahan kehilangan air dan dalam masa yang sama memperbaiki sifat tekstur seperti kekerasan dan reologi pes ubi kayu parut semasa penyimpanan sejukbeku dan nyah-penyejukbekuan. Akan tetapi, darjah penerimaan bagi atribut sensori bingka ubi kayu menurun apabila kepekatan gam xanthan bertambah. Oleh itu kepekatan gum xanthan yang paling sesuai untuk ditambah ialah 0.2% berdasarkan berat basah.

Kesan daripada lima kitaran sejukbeku-nyahsejukbeku terhadap sifat fizikokimia, tekstur, reologi dan juga kualiti sensori pes ubi kayu parut yang disejukbeku juga dikaji. Peningkatan kehilangan air dapat dilihat secara ketara dalam sampel yang diberi perlakuan lima kitaran sejukbeku-nyahsejukbeku berbanding dengan kawalan (sampel tanpa kitaran). Kekerasan dan reologi pes ubi kayu diparut dan juga darjah penerimaan

bagi semua atribut sensori bingkai ubi kayu telah menurun perlahan-lahan apabila bilangan kitaran yang dialami bertambah.





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I certify that an Examination Committee has met on date of viva to conduct the final examination of Gan Horng Eng on his Master of Science thesis entitled “Development of Frozen Grated Cassava Paste As A Base For Malaysian Traditional Cakes” 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:

**Chairman, PhD**

Associate Professor Dr. Azizah Hamid  
Faculty of Food Science and Technology  
Universiti Putra Malaysia

**Examiner 1, PhD**

Associate Professor Badlishah Sham Baharin  
Faculty of Food Science and Technology  
Universiti Putra Malaysia

**Examiner 2, PhD**

Associate Professor Dr. Tan Chin Ping  
Faculty of Food Science and Technology  
Universiti Putra Malaysia

**External Examiner, PhD**

Professor Abdul Karim Alias  
Bahagian Teknologi Makanan  
Pusat Pengajian Teknologi Industri,  
Universiti Sains Malaysia

---

**HASANAH MOHD GHAZALI, PhD**

Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date:



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:

**Roselina Karim, PhD**

Senior Lecturer  
Faculty of Food Science and Technology  
Universiti Putra Malaysia

**Russly Abdul Rahman, PhD**

Professor  
Faculty of Food Science and Technology  
Universiti Putra Malaysia

**Jamilah Bakar, PhD**

Professor  
Faculty of Food Science and Technology  
Universiti Putra Malaysia

**Sharifah Kharidah Syed Mohamed, PhD**

Associate Professor  
Faculty of Food Science and Technology  
Universiti Putra Malaysia

---

**HASANAH MOHD GHAZALI, PhD**

Professor and Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date: 12 February 2009



## **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.

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**GAN HORNG ENG**

Date:

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grated cassava paste

- 2.30 Mean sensory score (Hedonic scale) on the baked cassava cake, 95  
made from frozen grated cassava paste subjected up to five freeze-thaw  
cycles

## LIST OF ABBREVIATIONS

g	gram
kg	kilogram
mg	milligram
°C	degree celsius
μ	micrometre
RSM	Response Surface Methodology
$G'$	storage modulus
$G''$	loss modulus
$\tan \delta (G'/G'')$	storage tangen
SEM	Scanning Electron Microscopy
$R^2$	regression coefficient
N	Newton
cm	centimeter

## CHAPTER 1

### GENERAL INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is an important vegetable crop in the tropical regions and on a food energy production basis it ranks forth after rice, wheat and corn as a source of complex carbohydrates. Cassava is grown for various uses. In the Western countries, the dried chips are used for the production of starch employed in the cosmetic, pharmaceutical and animal feed industries. In the tropics, cassava roots are consumed after they were either boiled or after processing into fried products such as ‘gari’ or ‘farina’ or into fermented pastes for use in local foods such as ‘fufu’, ‘miondo’, ‘bobolo’ and ‘kumkum’ (Beleia *et al.*, 2005). However, in Malaysia, besides being consumed directly after cooking, cassava is also used as the base for producing many types of traditional cake. The fresh cassava flesh when mixed with other ingredients can be used to make baked cassava cake (“bingka ubi kayu”), steamed cassava cake (“lepat ubi kayu”) and fried cassava cake (“ubi ketuk”). The traditional way of preparing these traditional cakes is also time-consuming and tedious. It involves washing, peeling and soaking and molding prior to mixing and baking, steaming or frying and the cassava flesh is usually prepared daily to maintain its freshness. Furthermore, the demand of frozen market has steadily grown in recent years due to as more and more consumers enter the work place, the demand for convenient food ingredient and high quality frozen products is on the increase. Thus, this work concentrates on studying the behaviour, characteristics as well as the changes on quality of cassava flesh during frozen storage in





an attempt to develop a convenient grated cassava base for making certain Malaysian traditional cassava cakes.

Baked cassava cake, which is made from cassava flesh, is one of the famous traditional cakes among the Malay society. The ingredients for making this cake include grated cassava flesh, sugar, coconut milk and small amount of salt. Even though the formulation for making this cake is recommended by several homemade recipes books, no study on the optimization of the basic formulation of this cake is carried out.

Response surface methodology (RSM) is a statistical tool that can be used for optimization of the formulation in term of ingredient levels, processing condition and type of raw materials to be used in the final products. RSM consists of a group of mathematical and statistical procedures that can be used to study the relationships between one or more responses (dependent variables) and factors (independent variables) and to minimize the numbers of trials and provide multiple regression approach to achieve optimization (Murphy *et al.*, 2003). Hence, the optimization of the basic formulation using RSM is carried out to produce good quality baked cassava cake. The best formulation will be adopted in studying the changes of cassava flesh during frozen storage and subsequent thawing.

Freezing is a common method of preservation of food products which promotes and extends the shelf life of many food products. The effects of freezing on the quality of tubers such as potatoes and sweet potatoes have been studied (O'leary *et al.*, 2000; Redmond *et al.*, 2002; Redmond *et al.*, 2003). However, data on the influence of frozen