UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT OF PROCESSING TECHNIQUE FOR THE PRODUCTION OF CHILLI (*CAPSICUM ANNUUM* VARIETY KULAI) PUREE

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FSTM 2007 8

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2007

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By

ERMINA SARI

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

June 2007

Dedicated to

My mother, Gusmi Harwati and my late father, Sofyan Tana

My beloved husband,
Totok Suswanto

My beloved son,
Nabiha Tegar Suswanto

You are just beyond comparison……

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 PROCESSING TECHNIQUE FOR THE PRODUCTION OF CHILLI (*CAPSICUM ANNUUM* VARIETY KULAI) PUREE

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June 2007

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Faculty : Food Science and Technology

Chilli puree is a product in semi-solid form having quality close to the fresh ones and is convenient to use. At present, the quality of chilli puree in the market is not acceptable to the food manufacturers as a raw material for making other products derived from chilli as it contains high amount of preservatives and has unattractive dark colour. Therefore, development of an appropriate processing technique for production of chilli puree having a quality acceptable to the users is of prime importance.

Response surface methodology (RSM) was used to determine the optimum conditions for drying chilli. Fresh chilli was dried using two different techniques; cabinet and vacuum oven dryer. Changes in the Hunter colour parameters (*L*, *a*, *b*) of chilli during drying were investigated. Sensory evaluation was used to determine the quality of dried chilli in terms of colour, texture, aroma and overall acceptability. It

was found that changes in colour during drying of chilli by cabinet oven drying were apparent. On the other hand, an increase in the temperature of vacuum oven dryer did not give significant effect on the colour of dried chilli produced. The optimum conditions for the cabinet oven drying of chilli were found to be at 50^{o}C for 5 days, while that of vacuum oven drying was at 80^{o}C for 7 hours.

Dried chillies (*Capsicum annuum* variety Kulai) were reconstituted using two different soaking techniques (cold water and boiled water soakings), crushing and stone-grinding into fine puree and pasteurized with and without citric and/or acetic acids. The quality attributes of chilli puree were evaluated in terms of pH, moisture, Hunter surface colour (*L*, *a*, *b* and hue angle and chroma), extractable colour (ASTA units) and capsaicinoid content. Results showed that different soaking techniques had a pronounced effect on the pH, moisture content, Hunter surface colour, extractable colour, hue angle and chroma and of the puree. However, chilli puree prepared by boiled-water soaking had lower capsaicin and di-hydro capsaicin concentrations compared to cold water soaking. Pasteurization at different pHs did not seem to give an effect on the Hunter surface colour (*L*, *a*, and *b*), ASTA unit and pungency of the purees produced. Overall, the combined treatments of boiled water soaking and pasteurized in the presence of acid(s) conferred purees of similar quality attributes.

The colour degradation kinetics of chilli puree prepared from dried chilli (*Capsicum annuum* variety Kulai) was evaluated using a fraction conversion technique during thermal treatment at 60, 70, 80 and 90^{o}C (up to 30 min) and storage of chilli puree at 5, 28 and 45^{o}C (up to 10 weeks). Chilli puree was subjected to heat treatment at different temperatures in a well-stirred water bath. Test samples were removed from

the water bath at selected time intervals (0-30 min after come-up), cooled immediately and analyzed for colour using Hunterlab colorimeter. Chilli puree colour was expressed in terms of tristimulus colour value a and combination (*L* x *a* x *b*). First order reaction kinetics adequately described the change in colour values during both thermal treatment and storage of puree. The quality of chilli puree stored at three different storage conditions during 10 weeks of storage were evaluated in terms of pH, water activity, Hunter colour (*L*, *a*, *b* and hue angle and chroma), extractable colour (ASTA units), capsaicinoid content, volatile compounds and microbiological quality. Different storage conditions used had significant effects on the hunter surface colour, extractable colour, hue angle and chroma, volatile compounds and microbiological quality of the final puree product. Capsaicinoids, pH and water activity values were retained during storage. Data obtained in this study showed that a combination of low temperature storage, pH and heat treatment synergistically enhanced the quality of chili puree and prolonged its shelf life.

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

PEMBANGUNAN TEKNIK PEMPROSESAN UNTUK PENGHASILAN PURI CILI (*CAPSICUM ANNUUM* VARIETI KULAI)

Oleh

ERMINA SARI

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Puri cili adalah produk berbentuk separuh pepejal yang mempunyai kualiti menyerupai cili segar dan sangat mudah untuk diguna. Pada masa ini, kualiti puri cili di pasaran tidak dapat diterima oleh pengusaha makanan sebagai bahan mentah untuk membuat produk lain berasaskan cili, kerana ianya mengandungi bahan pengawet yang tinggi dan memiliki warna gelap yang tidak menarik. Oleh yang demikian, pembangunan teknik yang sesuai untuk pembuatan puri cili yang mempunyai kualiti yang dapat diterima oleh pengguna adalah penting.

Response surface methodology (RSM) telah diguna bagi menentukan keadaan optimum pengeringan cili. Cili segar dikeringkan dengan mengguna dua kaedah yang berbeza, iaitu pengering ketuhar dan pengering vakum. Perbezaan warna (nilai *L*, *a* dan *b*) cili diselidiki semasa pengeringan. Pengamatan deria digunakan untuk menentukan kualiti cili kering dari segi warna, tekstur, bau dan penerimaan keseluruhan. Didapati bahawa perubahan warna semasa pengeringan cili menggunakan pengering ketuhar kelihatan

ketara. Sebaliknya, kenaikan suhu pengering vakum tidak memberikan perbezaan yang ketara terhadap warna cili kering yang dihasilkan. Keadaan yang optimum untuk mengeringkan cili menggunakan pengering ketuhar diperolehi pada suhu 50^{o}C selama 5 hari, manakala pengeringan dengan pengering vakum diperolehi pada suhu 80^{o}C selama 8 jam.

Cili (*Capsicum annuum* variety Kulai) kering direndam meggunakan dua kaedah perendaman yang berbeza (perendaman air sejuk dan air mendidih), penghancuran dan penggilingan kepada puri yang halus dan pempasteuran dengan penambahan atau tanpa asid. Kualiti puri cili dianalisis dari segi pH, kelembapan, warna permukaan (*L*, *a*, *b* dan *hue angle* dan *chroma*), warna ekstrak (ASTA unit) dan kandungan capsaicinoid. Hasil penyelidikan menunjukkan perbezaan teknik perendaman memberikan pengaruh yang ketara berbeza terhadap pH, kelembapan, warna permukaan (*L*, *a*, *b* dan *hue angle* dan *chroma*), warna ekstrak (ASTA unit) puri yang dihasilkan. Walau bagaimanapun, puri cili yang diperbuat dengan perendaman dalam air mendidih menghasilkan kandungan capsaicin dan di-hydro capsaicin yang lebih rendah berbanding puri cili yang diperbuat dengan cara perendaman air sejuk. Pempasteuran pada pH yang berbeza tidak memberikan perbezaan yang ketara terhadap warna permukaan (nilai *L*, *a*, dan *b*), warna ekstrak dan tahap kepedasan puri yang dihasilkan. Keseluruhannya, gabungan perendaman dalam air mendidih dan pempasteuran dengan penambahan asid menghasilkan kualiti puri yang serupa.

Kinetik perubahan warna puri cili yang diperbuat dari cili kering (*Capsicum annuum* variety Kulai) dianalisis menggunakan teknik konversi fraksi (*fraction conversion technique*) semasa perlakuan panas pada suhu 60, 70, 80 dan 90^{o}C (selama 30 min)

dan penyimpanan puri cili pada suhu 5, 28 and 45^{o}C (selama 10 minggu). Puri cili diberi perlakuan panas pada suhu yang berbeza di dalam kukusan air yang dikacau dengan baik. Sampel yang akan dianalisis dikeluarkan dari kukusan air pada selang masa yang tertentu (0-30 min setelah dikeluarkan), disejukkan sejurus dikeluarkan dan dianalisis warna permukaannya menggunakan pengukur warna Hunter Lab. Warna permukaan puri cili ditunjukkan dari segi nilai *a* dan kombinasi *L* x *a* x *b*. Reaksi kinetic urutan pertama (*First-order reaction kinetics*) menunjukkan dengan jelas perubahan nilai warna semasa diberi perlakuan panas dan penyimpanan puri. Kualiti puri cili yang disimpan pada tiga keadaan penyimpanan yang berbeza selama 10 minggu dianalisis dari segi pH, aktiviti air, warna permukaan (*L*, *a*, *b* dan *hue angle* dan *chroma*), warna ekstrak (ASTA unit), kandungan capsaicinoid, kandungan bahan meruap dan kualiti mikrobiologi. Keadaan penyimpanan yang berbeza memberikan pengaruh yang berbeza secara ketara terhadap warna permukaan (*L*, *a*, *b* dan *hue angle* dan *chroma*), warna ekstrak (ASTA unit), kandungan bahan meruap dan kualiti mikrobiologi puri yang dihasilkan. Capsaicinoids, pH and aktiviti air tidak mengalami perubahan yang ketara semasa penyimpanan. Data yang diperolehi dari kajian ini menunjukkan, gabungan suhu penyimpanan yang rendah dan pH serta perlakuan panas dapat meningkatkan kualiti puri cili dan memanjangkan jangka masa hayat.

ACKNOWLEDGEMENTS

I would like to express my appreciation and sincere gratitude to my supervisor, Assoc. Prof. Dr. Nazamid Saari for his invaluable guidance, suggestions, constructive criticisms and constant encouragement throughout the course of study and in the preparation of this thesis. My deep appreciation and gratitude also goes to Dr. Nazimah Sheikh Abdul Hamid, Assoc. Prof. Dr. Azizah Osman and Mr. Dzulkifly Mat Hashim, members of my supervisory committee for their invaluable guidance and suggestions, constructive criticisms and encouragement.

I would like to thank the Department of Food Science and Technology, Universiti Putra Malaysia for providing the research facilities. I wish to thank to Mr Azman, Mrs. Jamaliah, Ms. Norlinawati for kind cooperation during experiment.

Last but not least, I am greatly indebted to my mother, Mrs. Gusmi Harwati, for her great loving support and my late father, Mr. Sofyan Tana who really wants me to finish my study. Appreciation also goes to my father in law, Mr. Kustomo and mother in law, Mrs. Suliyanti. I wish to express my deepest appreciation to my beloved husband, Mr. Totok Suswanto, my son, Nabiha Tegar Suswanto and my sister Mrs. Nora Sofiani, for their encouragement. Special thanks to my late aunty Mrs. Media Sandra and also Mrs. Puspita Deswina, who kindly offered help encouragement during my study.

I also would like to thank all my friends (Mr. Joko Susilo Utomo, Mrs. Greiche and husband, Raja Rohaya, Mohd. Reza, Mr. Willy, Mr. Asep, Noranizan, Azimah, Azura, Wan Zunairah and Afizah) who gave me encouragement and support during the period of my study at Universiti Putra Malaysia (UPM).

Finally, I am grateful to the Ministry of Science, Technology and Innovation Malaysia through the Intensification Research in Priority Areas (IRPA) for providing the scholarship for me to complete my study.

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:

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Date: 15 November 2007

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CHAPTER 1

INTRODUCTION

1.1 Background

The *Capsicum* family belongs to the *Solanaceae* and is related to eggplants, potatoes and tomatoes (Bosland *et al*., 1996). They most probably originated in Bolivia and Peru (Purseglove *et al*., 1981; Bosland *et al*., 1996) and were distributed after the discovery of America to other parts of the world. They now grow in all parts of the world (Somos, 1984) and are part of many cuisines. *Capsicum* fruit are berries, even though they are considered vegetables by consumers, and are either consumed as sweet or hot types.

The main uses of *Capsicums* vary according to their pungency and colour. Uses range from salads, using capsicum to add flavour, to cooked dishes, using fresh green and red chillies to add pungency, to using dried powdered spice of paprika and chilli to add red colour and pungency (Biacs *et al*., 1989), to pickles, using for example Jalapeno chillies, and to sauces, using for example Tabasco and Habanero chillies. Fruit colour can be green, yellow or red; for dried spice production red fruit are used, which have ripened from their green unripe form.

Fresh *Capsicum* production grew worldwide from 11 in 1990 to 16 million tones (MT) in 1997 (FAO, 1999). Of that 9.5 MT are produced in Asia (FAO, 1999), with