



UNIVERSITI PUTRA MALAYSIA

**ANTIOXIDATIVE ACTIVITIES OF SELECTED MALAYSIAN HERB
EXTRACTS DURING ACCELERATED OXIDATION TEST AND DEEP-
FAT FRYING**

FATIHANIM HJ MOHD NOR

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**MASTER OF SCIENCE
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FRYING**

By

FATHANIM HJ MOHD NOR

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

August 2008



To my beloved family....



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 : Suhaila Mohamed, PhD

Faculty : Food Science and Technology

The potential use of selected Malaysian herb (*Murraya koenigii*, *Curcuma longa*, *Citrus hystrix* and *Pandanus amaryllifolius*) leaf extracts as natural antioxidant were evaluated in antioxidant assay, accelerated oxidation test and deep fat frying. They were analyzed for antioxidant activity using 1-1-diphenyl-2-hydrazyl (DPPH) radical- scavenging activity assay and linoleic acid model system. The extracts at different concentrations were added to refined, bleached and deodorized (RBD) palm olein and heated to frying temperature, analyzed for peroxide value, anisidine value, free fatty acid and oxidative stability index (OSI). From there, optimum concentration was chosen and 40 hr frying experiment was being carried out. The polyphenol content ranged from 101.4 mg in *P. amaryllifolius* to 116.3 mg *C. longa*. The antioxidative activity of the extracts in both assays followed the decreasing order of: *C. longa* > *M. koenigii* > *C. hystrix* > *P. amaryllifolius*.



2000 ppm was chosen as the optimum concentration to be used in deep frying experiment. Extracts of *Pandanus amaryllifolius* and *Citrus hystrix* exhibited protective activity towards RBD palm olein that was comparable to BHT ($p>0.05$) during frying. The extracts were useful in improving and also maintaining the sensory characteristics of French fries. The French fries treated with herb extracts were acceptable by panelists until day 5 of frying. The natural antioxidants significantly ($p<0.05$) lowered the rate of oil oxidation during deep- fat frying and maintaining the quality of French fries. They exhibited excellent heat- stable antioxidant properties are good natural alternative to existing synthetic antioxidants for the food industry.



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

**AKTIVITI ANTIOKSIDA BAGI EKSTRAK HERBA- HERBA TERPILIH
MALAYSIA SEWAKTU UJIKAJI PENGGALAK OKSIDASI DAN
PENGGORENGAN**

Oleh

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Potensi kegunaan bagi ekstrak- ekstrak herba dedaun terpilih Malaysia (*Murraya koenigii*, *Curcuma longa*, *Citrus hystrix* dan *Pandanus amaryllifolius*) sebagai antioksidan telah dinilai dalam esei antioksidan, ujian penggalak oksidasi dan penggorengan minyak penuh. Ia dianalisa bagi aktiviti antioksidan menggunakan esei pemerangkapan radikal bebas DPPH dan sistem model asid linolik. Ekstrak- ekstrak pada kepekatan berbeza ditambah pada minyak sawit RBD olein dan dipanaskan ke suhu penggorengan, dianalisa untuk nilai peroksida, nilai anisidin, asid lemak bebas dan OSI. Dari situ, kepekatan optimum bagi ekstrak dipilih dan eksperimen penggorengan selama 40 jam dijalankan. Kandungan polifenol adalah antara 101.4 mg dalam *P. amaryllifolius* hingga 116.3 mg dalam *C. longa*. Aktiviti antioksidan bagi ekstrak- ekstrak tersebut dalam esei aktiviti antioksidan mengikuti turutan menurun seperti berikut: *C. longa* > *M. koenigii* > *C. hystrix* > *P. amaryllifolius*.



2000 ppm telah dipilih sebagai kepekatan optima untuk digunakan dalam eksperimen penggorengan. Ekstrak *Pandanus amaryllifolius* dan *Citrus hystrix* menunjukkan sifat pelindung ke atas minyak sawit RBD olein, setanding dengan BHT ($p > 0.05$) sewaktu penggorengan. Ekstrak- ekstrak tersebut bermanfaat dalam memperbaiki dan mengekalkan kriteria sensori bagi kentang goreng. Kentang goreng yang dirawat dengan ekstrak herba adalah diterima ahli panel hingga hari kelima penggorengan. Antioksida semulajadi merendahkan kadar pengoksidaan minyak secara signifikan ($p < 0.05$) sewaktu penggorengan dan mengekalkan kualiti kentang goreng. Ia menunjukkan sifat antioksida yang stabil pada suhu tinggi dan merupakan alternatif semulajadi bagi menggantikan antioksida sintetik bagi industri makanan.

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With all experience I gained, I am confident for something more challenging in the future. I am looking forward to work together with all these wonderful people in the future.



I certify that an Examination Committee has met on 20 August 2008 to conduct the final examination of Fatihanim Hj Mohd Nor on her Master of Science thesis entitled “Antioxidative Activities of Selected Malaysian Herb Extracts During Accelerated Oxidation Test and Deep- Fat Frying” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded Master of Science in Food Chemistry and Biochemistry.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been fully 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.

FATIHANIM HJ MOHD NOR

Date: 18 March 2009



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LIST OF ABBREVIATIONS

ACA	2',4'-dihydroxy-6'-methoxychalcone (cardamonin), 1' acetoxychavicol acetate
AV	Anisidine value
BHA	Butylated hydroxyanisole
BHT	Butylated hydroxytoluene
<i>C. hystrix</i>	<i>Citrus hystrix</i>
<i>C. longa</i>	<i>Curcuma longa</i>
DLGG	1,2- di-O- a-linolenoyl-3-O-b-galactopyrnosyl-sn-glycerol
DPPH	1-1-diphenyl-2-hydrazyl radical
EBV	Epstein- Barr virus
FFA	Free fatty acid
HPLC	High Performance Liquid Chromatography
IV	Iodine value
MNNG	N -methyl-N'-nitro-N-nitrosoguanidine
<i>M. koenigii</i>	<i>Murraya koenigii</i>
MPOB	Malaysian Palm Oil Board
<i>P. amaryllifolius</i>	<i>Pandanus amaryllifolius</i>
PV	Peroxide value
TBHQ	Tertiary butylted hydroxyquinone
RBD palm olein	Refined, bleached and deodorized palm olein



CHAPTER 1

INTRODUCTION

Plant extracts, especially antioxidants obtained from herbs and spices have been proposed for stabilizing frying oils. The phenolic compounds in herbs act as antioxidant in various ways. Several herbs reportedly retarded lipid oxidation during frying (Che Man and Jaswir, 2000; Naz *et al.*, 2005), in heated oil (Khan and Shahidi, 2001; Shyamala *et al.*, 2005; Nogala-Kalucka *et al.*, 2005) and in food (Jaswir *et al.*, 2001).

Synthetic antioxidants are often used to protect the fat from being oxidized during exposure to high temperature. The most commonly used antioxidant at the present time are butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and tertiary butylated hydroquinone (TBHQ). They are added to a wide variety of foods in the market (Chang *et al.*, 1997). However, their use is increasingly contested or even banned in certain countries. The recent consumer interest in ‘natural’ products also requires natural antioxidative substances to replace the conventional antioxidants (Cuvelier *et al.*, 1994).

Deep-fat frying influences many qualities of the finished product such as flavor, texture, shelf-life and nutritional attributes. It is the most complex edible fat and oil application, which is extensively, used both at home and on commercial scale. However, thermal treatment of the cooking oils results in oxidative and hydrolytic reactions; and chemical and physical changes take place leading to the formation of undesirable secondary products (Andrikopoulos *et al.*, 2003).



Curry leaves, kaffir lime leaves, pandan leaves and turmeric leaves are some of well-known Malaysian herbs, which are normally used as flavouring in Malaysian cuisine. These leaves contain numerous phenolic compounds (Kaur and Kapoor, 2002) which may act as antioxidant due to their redox properties; which allow them to act as reducing agents, hydrogen donors, single oxygen quenchers and metal chelators. The objective of this study is:

To evaluate the antioxidative activity of selected Malaysian herb extracts in antioxidant activity assay, accelerated oxidation test and deep- fat frying

CHAPTER 2

LITERATURE REVIEW

2.1 Oil palm

The oil palm is a monocotyledon belonging to the species *Elaies*. The genus comprises 2 species, namely *E. guineensis* that originates from West Africa and *E. oleifera* that originates from South America. The fleshy mesocarp produces palm oil, which is used mainly for edible purposes and the kernel; produces palm kernel oil for oleochemical industry.

Fatty acids in palm oil are any of a class of aliphatic acids- palmitic acid (40-45%), oleic acid (39-40%, linoleic acid (10-11%) and trace amount of linolenic acid. They present in the form of triacylglycerol (TAG). Main components in palm oil are palmitic acid, oleic acid, linoleic acid and trace amount of linolenic acid. Some of minor components in palm oil include the carotenoids, tocopherols, tocotrienols, sterols, phospholipids, triterpenes, aliphatic alcohols, ubiquinones and vitamin K (Berger, 2000; Sambanthamurthi, 2000).

The name vitamin E was used to refer to a fat- soluble factor discovered in 1922 to be essential in the diets of rats, to permit normal reproduction. 8 naturally- occurring substances have been found to have vitamin E activity in animal tests: d- α -, d- β -, d- γ - and d- δ - tocopherol, and d- α -, d- β -, d- γ - and d- δ - tocotrienol. Tocopherols have 3 assymmetric carbon atoms, giving 8 optical isomers. The vitamin E content in crude palm oil ranges between 600- 1000 ppm, and is a mixture of tocopherols (18-22%) and



tocotrienol (78- 82%). The major tocotrienols occurring in palm oil are α - tocotrienol (22%), γ - tocotrienol (46%) and δ - tocotrienol (12%) (Sambanthamurthi, 2000).

RBD palm olein is the liquid fraction obtained by fractionation of palm oil after crystallization at controlled temperatures. It gain its popularity is due to its good resistance to oxidation and formation of breakdown products at frying temperatures and longer shelf life of finished products. It has been proved as excellent frying oil either for industrial or domestic purposes (du Plessis and Meredith, 1999).

2.2 Herbs

Herb is a plant with special usage as medicine, flavor and scent enhancer. It has been used for centuries, throughout the world, in every culture. In order to protect itself, plant produces various compounds, namely antioxidants. They are present in most plants, concentrating in seeds, leaves, fruit skin or peel, bark and flower.

2.2.1 Curry leaves (*Murraya koenigii* Spreng.)



Figure 1 Curry leaves (*Murraya koenigii*)

Murraya koenigii, from the family of Rutaceae is a native of India and spreads as far as Sri Lanka, Thailand, Indo-China and Malaysia. It is a small evergreen, deciduous tree with hard, useful wood. The leaves contain essential oil and emit a distinctive smell when braised; slightly pungent, bitter and feebly acidulous taste after drying. They are widely used as flavoring in Indian and Malay curries as it gives a unique taste and aroma (Vimala *et al.*, 2003).

Curry leaves are used in curries; deep-fried aromatic chicken and some other Malaysian, Thais and Indonesian cooking (Anonymous, 2001).

2.2.1.1 Researches on *Murraya koenigii* and chemical compounds

The roots, bark as well as the leaves can be used both externally and internally as medicine. In the Ayurvedic system, it is prescribed for the improvement of the eye-sight due to its high vitamin A content and for strengthening the nervous and brain system.

Murraya koenigii could control damping-off disease of tomato up to 67% respectively in soil infected with *P. aphanidermatum* and 71% respectively in soil infected with *P. debaryanum*. The oil showed selective fungitoxicity and it was not phytotoxic (Pandey & Dubey, 1994). Aqueous extracts of curry leaves inhibited polymorphonuclear leucocytes activation induced by 12-O-tetradecanoyl phorbol-13-acetate (TPA) and lipid peroxides by 50%. That indicated curry leaves has antioxidative compounds to prevent lipid oxidation (Sujatha and Srinivas, 1995).

In mild and moderate diabetic rats, feeding of 5, 10 and 15% diet caused a maximal reduction in blood sugar (Yadav *et al.*, 2002). Dasgupta *et al.* (2003) reported that drinking water containing 10% and 20% fresh curry leaf was capable of reducing stomach and skin cancer in Swiss albino mice. The total phenolic content of aqueous extract was 25-30 mg gallic acid/g dry basis (Wong *et al.*, 2006).

Effects of daily oral feeding 15% of powdered leaves of *Murraya koenigii* (MK) and 10% powder of seeds of *Brassica juncea* (BJ) for 60 days on serum glucose concentrations and kidney functions in streptozotocin (STZ; 100mg/kg) diabetic rats were studied. Serum glucose levels, body weight, urine volume, serum creatinine, and urinary albumin (UAE)