



UNIVERSITI PUTRA MALAYSIA

**FRYING PERFORMANCE OF PALM OLEIN WITH
ADDED NATURAL ANTIOXIDANT MIXTURES AND
ACCEPTABILITY OF FRIED POTATO CHIPS**

IRWANDI

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By

IRWANDI

**Thesis Submitted in Fulfilment of the Requirement for the
Degree of Doctor of Philosophy in the Faculty of Food Science and Biotechnology
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*Especially dedicated
to my beloved wife
and parents*



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

FRYING PERFORMANCE OF PALM OLEIN WITH ADDED NATURAL ANTIOXIDANT MIXTURES AND ACCEPTABILITY OF FRIED POTATO CHIPS

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Faculty : Food Science and Biotechnology

A comprehensive study on the feasibility of use of natural antioxidants, namely rosemary and sage, together with citric acid acting as a synergist during repeated deep-fat frying process of potato chips in palm olein was carried out. The study was inclusive of evaluation of oxidative behaviour of these antioxidants, monitoring of physico-chemical changes of oil during frying, development of some new instrumental methods for detecting quality parameters of used oil, effect of addition of the antioxidants on organoleptic properties of fried product and relationship between quality indices of the oil and sensory acceptability of the fried product.



Results showed that rosemary and sage extracts are feasible to be used in retarding the palm olein deterioration during repeated deep-fat frying of potato chips. The two natural antioxidants were proven to significantly ($P < 0.05$) lower the rate of oxidation of the oil during frying, while having very good thermal resistance. Organoleptically, both rosemary and sage extracts could improve acceptability of fried potato crisps. There were significant correlations between sensory attributes of fried potato chips and quality parameters of palm olein used.

Optimization study on the effect of use of the natural antioxidants during deep-fat frying on fatty acid composition of palm olein revealed that C18:2 and C16:0 fatty acids were the most important fatty acids for predicting changes in oil quality after frying. However, for optimization purposes, the use of the C18:2/C16:0 ratio best predicted the efficacy of natural antioxidants in preserving palm olein during deep-fat frying.

This study also successfully developed instrumental methods for monitoring the physico-chemical changes of palm olein during repeated deep-fat frying. The alkaline contaminant materials (ACM) contents in palm olein could be determined spectrophotometrically at 540 nm, whereas the use of Fourier transform infrared (FTIR) spectroscopy to monitor changes in the iodine value, peroxide value and free fatty acid contents in palm olein during frying was found to be a viable alternative to the wet chemical methods, with FTIR providing rapid results taking less than 2 min per sample and minimum use of solvent and labour.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi syarat untuk Ijazah Doktor Falsafah

**PRESTASI PENGGORENGAN MINYAK SAWIT OLEIN DENGAN
PENAMBAHAN CAMPURAN-CAMPURAN ANTIOKSIDAN SEMULAJADI
DAN PENERIMAAN DERIA KEPINGAN KENTANG GORENG**

Oleh

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Satu kajian menyeluruh tentang keupayaan penggunaan antioksidan-antioksidan semulajadi, iaitu rosemary dan sage, bersama-sama dengan asid sitrik yang bertindak sebagai agen sinergi semasa proses penggorengan kepingan kentang dalam minyak sawit olein telah dijalankan. Kajian ini merangkumi penilaian sifat oksidatif antioksidan, penelitian perubahan-perubahan sifat fiziko-kimia minyak selama penggorengan, pengembangan kaedah-kaedah baru berdasarkan instrumen untuk mengesan ciri-ciri kualiti minyak terpakai, kesan penambahan antioksidan ke atas sifat-sifat deria produk yang digoreng dan hubungan diantara parameter kualiti minyak dengan penerimaan ujian deria ke atas produk yang digoreng.

Keputusan-keputusan kajian ini menunjukkan bahawa ekstrak rosemary dan sage berkeupayaan dan boleh digunakan untuk menghalang kerosakan minyak sawit olein semasa penggorengan keropok kentang. Kedua-dua antioksidan semulajadi tersebut telah terbukti berkesan ($P < 0.05$) dalam merendahkan kadar pengoksidaan minyak semasa penggorengan. Pada masa yang sama, kedua-dua antioksidan juga mempunyai ketahanan haba yang sangat baik. Ujian deria juga menunjukkan bahawa rosemary dan sage mampu memperbaiki penerimaan kepingan kentang yang digoreng. Keputusan kajian ini juga menunjukkan bahawa terdapat hubungkait secara berkesan antara ciri-ciri deria kepingan kentang dengan parameter kualiti minyak sawit olein selama penggorengan.

Kajian mengoptimumkan kesan penggunaan antioksidan semulajadi semasa proses penggorengan ke atas komposisi asid lemak dalam minyak sawit olein menunjukkan bahawa asid-asid lemak jenis C18:2 dan C16:0 merupakan asid-asid lemak paling utama dalam mengangarkan perubahan-perubahan kualiti minyak selepas penggorengan. Walau bagaimanapun, untuk tujuan pengoptimuman, penggunaan nisbah C18:2/C16:0 telah berjaya mengangarkan keupayaan antioksidan-antioksidan semulajadi dalam mengekalkan kualiti minyak sawit olein semasa proses penggorengan.

Kajian ini juga berjaya mencipta kaedah-kaedah berdasarkan instrumen dalam meneliti perubahan-perubahan fiziko-kimia minyak sawit olein semasa penggorengan. Kandungan bahan-bahan kontaminan beralkali (ACM) dalam minyak sawit olein boleh ditentukan secara spektrofotometri pada 540 nm, manakala penggunaan spektroskopi transformasi Fourier inframerah (FTIR) untuk meneliti perubahan-perubahan dalam nilai

iodine, nilai peroksida dan kandungan asid lemak bebas dalam minyak sawit semasa penggorengan telah didapati berkemungkinan menjadi alternatif kepada kaedah-kaedah kimia. Penggunaan FTIR mampu memberikan keputusan secara pantas, iaitu kurang dari dua minit untuk satu sampel, dan meminimumkan penggunaan pelarut dan pekerja.

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