UNIVERSITI PUTRA MALAYSIA

PHYSICO-CHEMICAL AND SENSORY CHARACTERISTICS OF BLENDS OF PALM OLEIN AND OTHER VEGETABLE OILS AND THEIR FRYING STABILITY

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DEDICATIONS

This work is dedicated to my parents and my country.

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

PHYSICO-CHEMICAL AND SENSORY CHARACTERISTICS OF BLENDS OF PALM OLEIN AND OTHER VEGETABLE OILS AND THEIR FRYING STABILITY

By

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Palm olein can easily be blended with other oils such as sesame and peanut oils. In this study, vegetable oil blends were prepared by blending, palm olein (PO) with sesame seed oil (SSO) or peanut oil (PnO) in proportions of 90:10, 80:20, 70:30 and 60:40 (v/v). The objectives of this study were to determine the physico-chemical characteristics of pure palm olein, sesame, peanut and their blends; to evaluate the sensory properties of banana chips fried in different oil blends in order to elucidate the best combination ratios to be used as frying oil; to determine the frying quality of palm olein blended with either PnO or SSO during deep fat frying; and to identify the best oil blends amongst them.

In this study, the physico-chemical properties of oil blends such as fatty acid composition (FA), color, viscosity, free fatty acid (FFA), iodine value (IV), peroxide value (PV), *p*-Anisidine value (*p*-AV), total oxidation (TOTOX) value, triacylglycerol

(TAG) profile and melting point were investigated. The results showed that blending of PO with SSO in ratios of 90:10, 80:20, 70:30 and 60:40 resulted in the reduction of palmitic acid content from 38.39% to 35.98%, 33.13%, 29.60%, and 27.03%, respectively. Whereas, for PO:PnO oil blends the palmitic acid was reduced to 35.30%, 32.58%, 28.29% and 26.39%, respectively. There was a significant ($P<0.05$) changes in oil blends color. The viscosity of PO:SSO oil blends were slightly higher than PO:PnO blends however, no significant ($P>0.05$) differences was observed among them. The increment of FFA in the blends occurs as the SSO and PnO amounts were increased. The IV of oil blends were significantly ($P<0.05$) increased with increasing amount of SSO and PnO from 64.38 to 77.55g I_2/100g oil and from 63.75 to 74.12g I_2/100g oil, respectively. The *p*-AV and TOTOX values of PO:SSO and PO:PnO oil blends were not significantly ($P>0.05$) different for all the oil blends studied. The percentage of TAG content which comprised of LLL, OLL, PLL, OOL and OOO in PO:SSO oil blends were found to increase, while in PO:PnO blends the percentage of the LLL, OLL, and PLL were found to increase compare with palm olein. Melting temperatures of PO:SSO and PO:PnO blends were significantly ($P<0.05$) decreased from 12.65°C to 9.74°C and 13.00°C to 10.06°C, respectively.

Sensory evaluation using quantitative descriptive analysis of banana chips fried in PO:PnO and PO:SSO oil blends by trained panelists, showed that no significant ($P>0.05$) different was found in terms of banana chips crispness, aroma and flavor. The nine-point hedonic scale was used to evaluate the acceptability of crispness, aroma, flavor and overall acceptability of banana chips fried in different oil blends by using 22

untrained panelists. Generally, high mean scores in acceptability of crispness, aroma and flavor were shown by banana chips fried in PO:PnO and PO:SSO oil blends of 70:30 and 90:10.

The frying quality of two types of oil blends which were, PO:SSO (90:10) and PO:PnO (70:30) after deep fat frying was based on evaluation of the FA composition, FFA, PV, *p*-AV, total polar compound (TPC), color and viscosity. Both oil blends were used for frying banana chips for six consecutive days. The frying process caused a significant ($P<0.05$) increase in the chemical parameters determined during frying. The melting point of PO:SSO and PO:PnO blends significantly ($P<0.05$) increased with increasing frying time. The aroma profiles of both oil blends were determined using zNose^{TM} and results of aroma evaluation showed significantly ($P<0.05$) different in aroma profiles from day 0 to day 6. Both PO:PnO and PO:SSO blends, contained 12 volatile compounds.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi sebahagian keperluan untuk Ijazah Master

FIZIKO-KIMIA DAN CIRI-CIRI SENSORI BAGI CAMPURAN MINYAK OLEIN KELAPA SAWIT DENGAN MINYAK SAYURAN LAIN DAN KESTABILAN PENGGORENGAN

Oleh

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Minyak olein kelapa sawit mudah untuk dicampurkan dengan minyak lain seperti minyak bijan dan minyak kacang tanah. Di dalam kajian ini campuran minyak sayuran dihasilkan melalui pencampuran minyak olein kelapa sawit (PO) dengan minyak bijan (SSO) dan minyak kacang tanah (PnO) dengan nisbah 90:10, 80:20, 70:30 dan 60:40. Objektif kajian ini adalah untuk menentukan ciri-ciri fiziko-kimia minyak olein kelapa sawit tulen, minyak bijan tulen, minyak kacang tanah tulen dan pencampurannya; untuk menilai sifat sensori kerepek pisang yang digoieng menggunakan campuran minyak berbeza bagi memperolehi kombinasi minyak goreng yang terbaik; untuk menentukan kualiti penggorengan minyak olein kelapa sawit campuran dengan minyak kacang tanah ataupun minyak bijan untuk penggorengan secara minyak-banyak; dan untuk mengenalpasti campuran minyak yang terbaik.

Di dalam kajian ini, ciri-ciri fiziko-kimia campuran minyak seperti komposisi asid lemak (FA), warna, kelikatan, asid lemak bebas (FFA), nilai iodin (IV), nilai peroksida (PV), nilai *p*-anisidin (*p*-AV), nilai pengoksidaan total (TOTOX), profil triasilgliserol (TAG) dan takat peleburan bagi campuran minyak telah dikaji. Keputusan menunjukkan bahawa pencampuran PO:SSO pada nisbah 90:10, 80:20, 70:30 dan 60:40 menyebabkan pengurangan dalam kandungan asid palmitik masing-masing kepada 35.98%, 33.13%, 29.60% dan 27.03 % daripade 38.39%. Manakala bagi campuran PO:PnO, kandungan asid palmitik mengurang masing-masing kepada 35.30%, 32.58%, 28.29% dan 26.39% daripade 38.39%. Terdapat perubahan warna yang signifikan ($P<0.05$) dalam campuran minyak dengan peningkatan nisbah SSO dan PnO. Pada umumnya, kelikatan campuran PO:SSO adalah lebih tinggi daripada campuran Pn:PnO, walau bagaimanapun, tiada perbezaan yang signifikan ($P<00.5$) didapati dikalangan minyak tersebut. Kandungan asid lemak bebas meningkat apabila jumlah SSO dan PnO bertambah. Nilai iodin meningkat secara signifikan ($P<0.05$) dengan peningkatan nisbah SSO dan PnO iaitu masing-masing daripada 64.38 kepada 77.55g I_2 /100g minyak dan daripada 63.75 kepada 74.12g I_2 /100g minyak. Nilai *p*-anisidin dan TOTOX dalam campuran PO:SSO dan PO:PnO adalah tidak berbeza secara signifikan ($P<0.05$) untuk kesemua minyak campuran. Peratus kandungan TAG termasuk LLL, OLL, PLL, OOL dan OOO di dalam campuran minyak PO:SSO didapati telah meningkat, manakala dalam campuran PO:PnO hanya peratusan LLL, OLL dan PLL sahaja yang meningkat berbanding dengan minyak olein kelapa sawit. Suhu peleburan bagi campuran PO:SSO dan PO:PnO didapati menurun dengan signifikan ($P<0.05$) masing-masing daripada 12.65 kepada 9.74°C dan 13.00 kepada 10.06°C.

Penilaian sensori terhadap campuran minyak PO:PnO dan PO:SSO dijalankan menggunakan analisis deskriptif kuantitatif dimana ahli panel terlatih menunjukkan tiada perbezaan yang signifikan ($P>0.05$) terhadap kerangupan, aroma dan perisa dalam kerepek pisang. Skala hedonik 9-poin telah digunakan untuk menganalisis tahap penerimaan terhadap kerangupan, aroma, perisa dan penerimaan keseluruhan kerepek pisang goreng oleh 22 ahli panel tidak terlatih. Umumnya, skor tertinggi dalam penerimaan diperolehi pada kerepek pisang yang digoreng di dalam campuran minyak PO:PnO dan PO:SSO pada nisbah 70:30 dan 90:10.

Kualiti penggorengan dua jenis campuran minyak, iaitu PO:SSO (90:10) dan PO:PnO (70:30) selepas penggorengan minyak-banyak adalah berdasarkan komposisi asid lemak, asid lemak bebas, nilai peroksida, nilai p-anisidin, jumlah komponen polar dan kelikatan. Kedua-dua jenis minyak campuran ini telah digunakan untuk menggoreng kerepek pisang selama 6 hari berturut-turut. Proses penggorengan menyebabkan peningkatan secara signifikan ($P<0.05$) bagi kesemua parameter kimia yang dikaji. Takat peleburan bagi campuran PO:PnO dan PO:SSO telah meningkat secara signifikan ($P<0.05$) dengan peningkatan masa penggorengan. Profil aroma bagi kedua-dua campuran minyak ditentukan menggunakan zNose^{TM}. Keputusan analisis aroma menunjukkan perubahan yang signifikan ($P<0.05$) pada profil aroma bermula dari hari 0 ke hari 6. zNose^{TM} merekodkan kehadiran 12 sebatian meruap di dalam kedua-dua campuran minyak sayuran.

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I certify that a Thesis Examination Committee has met on 2nd March 2010 to conduct the final examination of **Myat Myat Win** on her thesis entitled **"PHYSICO-CHEMICAL AND SENSORY CHARACTERISTICS OF BLENDS OF PALM OLEIN AND OTHER VEGETABLE OILS AND THEIR FRYING STABILITY"** in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

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

_____

MYAT MYAT WIN

Date: 6.4.2010

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LIST OF ABBREVIATIONS

ACP	Africa, Caribbean and Pacific
ANOVA	Analysis of variance
AOCS	American Oil Chemists' Society
CIE	Commission International del' Eclairage
CLO	canola oil
CSO	cotton seed oil
C12:0	lauric acid
C14:0	myristic acid
C16:0	palmitic acid
C18:0	stearic acid
C18:1	oleic acid
C18:2	linoleic acid
C18:3	linolenic acid
C20:0	arachidic acid
C22:0	behenic acid
C24:0	lignoceric acid
DAG	diacylglycerol
DSC	differential scanning calorimetry
EU	European countries
FA	fatty acid
FAO	Food and Agricultural Organization

FFA	free fatty acids
HDL	high density lipoprotine
HPLC	high performance liquidchromatography
IF	intermediate frequency
IUPAC	International union of pure and applied chemists
IV	iodine value
LDL	low density lipoprotine
LLL	linoleic-linoleic-linoleic
MPOB	Malaysian Palm Oil Board
MPOC	Malaysian Palm Oil Council
MAG	monoacylglycerol
mL	milliliter
MMT	million metric tones
MoO	moringa oleifera seed oil
MUFA	monounsaturated fatty acid
OLL	olein-2,3 dilinoleoyl glycerol
OOO	trioleoyl glycerol
OOL	dioleoyl-3-linoleoyl glycerol
p-AV	*p*-anisidine value
PCA	principle component analysis
PLL	palmitoyl-2,3 dilinoleoyl glycerol
PO	palm olein
POL	palmitoyl-oleoyl-linoleoyl glycerol

POO	1-palmitoyl-dioleoyl glycerol
PPL	dipalmitoyl-3-linoleoyl glycerol
PPO	dipalmitoyl-3-oleoyl glycerol
PORIM	Palm Oil Research Institute Malaysia
PnO	peanut oil
PSO	palmitoyl-stearoyl-oleoyl glycerol
PUFA	polyunsaturated fatty acid
PV	peroxide value
RBD	refined bleached and deodorized
RBDPO	refined bleached and deodorized palm olein
RI	refractive index
SAS	statistical analysis system
SAW	surface acoustic wave
SBO	soy bean oil
SFO	sunflower oil
SSO	sesame seed oil
TAG	triacylglycerol
TOTOX	total oxidation
TPC	total polar compound
TV	TOTOX value
UK	United Kingdom
USA	United State of America
USDA	United State Department of Agriculture