UNIVERSITI PUTRA MALAYSIA

FRYING PROPERTIES OF PALM OLEIN, CANOLA OIL, SESAME OIL AND THEIR BLENDS

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By

ALIREZA SERJOUIE

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

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DEDICATION

Specially Dedicated to

My Wife whoever supported and encouraged me

And Parents father, Mother Because of their

Unlimited supports,

And my Brother.

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Abstract of the thesis presented to the senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

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Chairman : Associate Professor Tan Chin Ping, PhD

Faculty : Food Science and Technology

Deep fat frying is a multifunctional procedure which is conducted by immersing a wet product in a high-boiling-point liquid such as oil which causes all flavours and the juices to be retained by the crisp crust. This study was carried out to investigate the effect of frying on the physicochemical properties of refined, bleached, and deodorized (RBD) palm olein, canola oil and blends of palm olein, canola oil and/ or sesame oil during deep-fat frying (at 180°C) of potato chips for 3.5 h/d for five consecutive days in six formulations . The formulations were RBD palm olein (POo), canola oil (CO), RBD palm olein-sesame seed oil (POo:SO, 1:1), RBD palm olein-canola oil (POo:CO, 1:1), sesame seed oil-canola oil (SO:CO, 1:1) and RBD palm olein-sesame seed oil-canola oil (POo:SO:CO, 1:1:1). The frying oils were analyzed in terms of peroxide value (PV), ρ-anisidine value (AV), iodine value (IV), free fatty acid (FFA) content, polymer content, total polar compounds, viscosity, TOTOX, $E^{1\%}_{1\,cm}$ at 233 and 269 nm, color, fatty acid composition, and C18:2/C16:0 ratio.

In general, the results showed that there were significant ($p < 0.05$) differences among the proposed fried oils in terms of PV, AV, IV, FFA content, polymer content, viscosity, TOTOX, $E^{1\%}_{1\ cm}$ at 233 and 269 nm and color. In addition, the physicochemical analysis also showed that there were significant ($P<0.05$) differences in PV, AV, IV, FFA content, polymer content, viscosity, TOTOX, $E^{1\%}_{1\ cm}$ at 233 and 269 nm and color in each formulation during five consecutive days of frying (day 0 to 5) with some exceptions for $E^{1\%}_{1\ cm}$ at 233 nm observed in frying medium POo and yellow color in frying medium POo:SO and SO:CO within five different days of frying.

As shown in this study, POo was the most stable frying medium, while CO was found to be an unstable frying oil due to the undesirable physicochemical changes that occurred after the frying process. In term of total polar compounds, the oil blend POo:SO:CO was shown to be the most stable frying medium among the six treatments. However, the oil blend POo:SO showed the better oxidative stability in term of PV.

The fatty acid analysis showed that there was a decrease in both linolenic acid (C18:3) and linoleic acid (C18:2) contents. The chemical analysis exhibited that there was a significant ($p < 0.05$) difference among the six frying oils in terms of IV during five consecutive days of frying (day 0 to 5). Oil CO had the least stability in term of deep-fat frying due to high level of unsaturated fatty acids; conversely, oil blend POo:CO had the highest stability due to the lowest reduction in the C18:2/C16:0 ratio and IV. Considering what have been mentioned all above, it was concluded that POo was the best frying media. Although sesame oil has high level of

natural antioxidants (phenolic compounds e.g., sesamin, sesamol, and sesamolin), it is more costly than POo and CO. In this study, oils blending helped to make frying oils more stable against the heating process without using any kind of chemical reactions such as hydrogenation, partial hydrogenation, interesterification, etc. Therefore, blended oil is economically option for frying process.

Potato chips fried in POo and POo:SO:CO were chosen to be applied in the process of the accelerated storage test. All oils were separately utilized to fry the potato, then the potatoes were sampled and kept in eight metalized foil bags at 50 °C in an oven. Every five day for a period of 40 days, one of these bags was removed and PV, p-AV, TOTOX, TPC, colour, $E^{1\%}_{1cm}$ at 233 and 269 nm and FACs tests were conducted on the oil extracted from the fried potato. Potato samples which were fried in POo:SO:CO oil had the highest stability in term of the change in FACs, reduction in C18:2/C16:0 ratio and yellow colour. In most analyses, the extracted oils had significant changes ($p < 0.05$) during the storage period. On the whole, it can be concluded that the potato samples fried in POo show the best stability in accelerated storage condition.

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

HARTANAH MENGGORENG BAGI OLEIN SAWIT, MINYAK CANOLA, MINYAK BIJAN DAN CAMPURAN MEREKA

Oleh

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Penggorengan merupakan operasi pelbagai fungsi yang melibatkan pemasakan bahan basah di dalam cecair yang bertakat didih tinggi seperti minyak, supaya semua perisa dan jus dapat dikekalkan dalam kepingan rangup. Dalam kajian ini, kesan penggorengan terhadap sifat fizikokimia minyak sawit olein RBD (bertapis, dinyah warna dan bau), minyak kanola dan campuran minyak sawit olein, minyak kanola dan/ atau minyak bijian semasa penggorengan kerepek ubi kentang (pada 180°C) selama 3.5 jam/ hari selama 5 hari berturut-turut dalam 6 formulasi telah dikaji. Enam formulasi minyak tersebut ialah minyak sawit olein (POo), minyak kanola (CO), campuran minyak sawit olein RBD/minyak bijan (POo:SO, 1:1), campuran minyak sawit olein RBD/minyak kanola (POo:CO, 1:1), campuran minyak bijan/minyak kanola (SO:CO, 1:1), campuran minyak sawit olein RBD/minyak bijan/minyak kanola (POo:SO:CO, 1:1:1). Minyak yang telah digunakan untuk menggoreng dijalankan analisa nilai peroxide (PV), nilai ρ-anisidine (AV), nilai iodin (IV), kandungan asid lemak bebas (FFA), kandungan polimer, jumlah

komponen berpolar, kelikatan, TOTOX, nilai $E^{1\%}_{1\,cm}$ pada 233 dan 269 nm, warna, komposisi asid lemak, dan nisbah C18:2/C16:0.

Secara amnya, keputusan menunjukkan wujudnya perbezaan ketara ($p < 0.05$) di kalangan sampel minyak yang telah digoreng dari segi kandungan PV, AV, IV, kandungan asid lemak bebas, kandungan polimer, kelikatan, TOTOX, nilai $E^{1\%}_{1\,cm}$ pada 233 dan 269 nm dan warna. Tambahan pula, analisa fizikokimia juga menunjukkan wujudnya perbezaan ketara ($p < 0.05$) pada kandungan PV, AV, IV, kandungan asid lemak bebas, kandungan polimer, kelikatan, TOTOX, nilai $E^{1\%}_{1\,cm}$ pada 233 dan 269 nm dan warna pada setiap formulasi semasa penggorengan selama 5 hari berturut-turut (hari 0 hingga hari kelima), dengan pengecualian untuk nilai $E^{1\%}_{1\,cm}$ pada 233 nm diperhatikan pada medium goreng POo dan warna kuning pada medium goreng POo:SO dan SO:CO dalam lima hari penggorengan.

Seperti yang diperhatikan dalam kajian ini, POo merupakan medium penggorengan yang sesuai. Manakala CO didapati tidak stabil disebabkan oleh perubahan fizikokimia yang tidak diingini berlaku selepas proses penggorengan. Dari segi komponen berpolar, campuran minyak POo:SO:CO merupakan medium penggorengan yang paling stabil di kalangan 6 formulasi. Namun begitu, campuran minyak POo:SO menunjukkan kestabilan oksidatif yang lebih baik dari segi nilai PV.

Asid lemak analisa menunjukkan kedua-dua kandungan asid linolenik (C18:3) and linolik acid (C18:2) mengalami penurunan dengan pemanjangan masa penggorengan. Analisis kimia menunjukkan kewujudan perbezaan ketara ($p < 0.05$) di kalangan 6 formulasi sampel minyak goreng dari segi nilai IV semasa penggorengan selama 5

hari berturut-turut (hari 0 hingga hari kelima). Minyak CO paling tidak stabil untuk penggorengan disebabkan kehadiran kandungan asid lemak tak tepu yang tinggi; sebaliknya, minyak campuran POo:CO paling stabil disebabkan nisbah C18:2/C16:0 ratio dan nilai IV yang rendah. Secara keseluruhannya, POo merupakan minyak goreng yang terbaik. Walaupun minyak bijian mempunyai kandungan antioksidan semula jadi yang tinggi, kosnya adalah lebih tinggi berbanding POo dan CO. Dalam kajian ini, pencampuran minyak masak dapat menghasilkan minyak goreng yang stabil terhadap pengaruh suhu tinggi tanpa sebarang reaksi kimia seperti penghidrogenan, penghidrogenan separa, interesterifikasi dan sebagainya. Dengan itu, pencampuran minyak merupakan pilihan yang lebih ekonomikal.

Kerepek ubi kentang yang telah digoreng dalam minyak POo dan POo:SO:CO telah dipilih untuk ujian penstoran dipercepat. Ubi kentang telah digoreng dalam minyak, dikumpul dan disimpan dalam lapan beg kerajang aluminium pada suhu 50°C dalam oven. Satu beg telah dikeluarkan bagi setiap lima hari bagi jangkamasa penyimpanan selama 40 hari. Ujian berikut telah dilakukan ke atas minyak yang telah diekstrak dari ubi kentang goring: PV, p-AV, TOTOX, TPC, warna, $E^{1\%}_{1cm}$ at 233 and 269 nm and komposisi asid lemak. Ubi kentang yang digoreng dengan POo:SO:CO telah menunjukkan kestabilan yang tinggi dari segi komposisi asid lemak, penurunan nisbah C18:2/C16:0 dan warna kuning. Dalam kebanyakan analisis yang telah dijalankan, minyak yang diekstrak telah mengalami berubahan yang ketara ($p < 0.05$) semasa penyimpanan. Secara keseluruhannya, kajian ini telah menunjukkan bahawa ubi kentang yang telah digoreng dalam POo mempunyai kestabilan terbaik dalam keadaan penyimpanan dipercepat.

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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 other institutions.

ALIREZA SERJOUIE

Date: 23 May 2011

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LIST OF ABBREVIATIONS

AOAC	Association of Official Analytical Chemists
AOM	Active Oxygen Method
FID	Flame Ionization Detector
FFA	Free Fatty Acid
FA	Fatty Acid
g	gram
GC	Gas Chromatography
HPLC	High Performance Liquid Chromatography
L	liter
m	meter
mg	milligram
min	minute
mm	millimeter
MUSFA	Monounsaturated Fatty Acid
PUSFA	Pollyunsaturated Fatty Acid
USFA	Unsaturated Fatty Acid

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