EFFECTS OF DIFFERENT SOLVENT AND EXTRACTION METHODS ON PHYTOSTEROLS AND ANTIOXIDANT ACTIVITY OF COCOA BUTTER AND APPLICATION OF COCOA BUTTER IN SALAD DRESSING

ROIAINI BINTI MOHAMAD

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By

ROIAINI BINTI MOHAMAD

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

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the Degree of Master of Science

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The addition of phytosterols and antioxidant into food product may give additional health benefit towards consumers. Their stability in a food product may also decrease as the storage increase. Therefore, the objectives of this study were: i) to screen the most suitable solvent for extraction of CB using Soxhlet extraction and ii) to optimize the most suitable extraction methods in producing high amounts of phytosterols and antioxidant activity, iii) to formulate CB based salad dressing (CBSD) and iv) to determine the stability of phytosterols, antioxidant activity and physicochemical properties of CBSD during storage.

Dried cocoa beans was treated with four different types of solvents: Hexane (HE), Petroleum ether (PE), Isopropanol (PR) and Ethanol (ET) using Soxhlet extraction. Then, the selected solvent was applied in four different extraction methods: Soxhlet extraction (SE), Ultrasonic extraction (USE), Supercritical extraction CO_2 (SCO_2) and Supercritical extraction CO_2 with Ethanol (SCO_2-Ethanol). The CB extracted from selected extraction method was applied in salad dressing formulation with different ratios of cocoa butter (CB) and soybean oil (SB). The selected ratio of CB and SB (30:70) was studied for their stability during 28 days storage at two different temperatures.

The yield of CB produced from ET (14.25%) was significantly the lowest than HE and PE (43.24% and 39.31% respectively). ET had significantly ($p<0.05$) the highest phytosterols (4974 µg/100 g of extract), DPPH assay (64.8%) and Total Phenolic Content (TPC) (22.38 mg GAE/100 g of extract). CB extracted from SCO_2-Ethanol showed significantly ($p<0.05$) the highest content of yield (37.05%), total phytosterols (6441 µg/100 g of extract) and DPPH assay (84%) compared to SE, SCO_2 and USE method. For the physicochemical properties of CBSD, the commercial and control salad dressing (without CB) shared insignificantly ($p>0.05$) similar characteristics (shear stress to shear rate, oscillating sweep stress and emulsion stability test) with CBSD containing 30% CB compared to other ratios.

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Thus, 30% CBSD with the most stable emulsion was selected for storage study at 4 and 30ęC. However, the physicochemical characteristic, the amount of phytosterols, DPPH assay and TPC of 30% CBSD during storage were decreased with time (from 0 day to 28 days) and increased with temperature suspected due to oxidation of the oil. Thus, the most desirable storage temperature for salad dressing was at 4ęC compared to 30ęC.An excellent stability of 30% CBSD at different temperatures for 28 days offers high potential application in food industries to produce CB based salad dressing enriched with phytosterols and antioxidants. Therefore, the selection of the solvent and the extraction method of cocoa beans is very crucial and may be applicable for the cocoa industry to broaden the application of CB as emulsion products.

Keywords: Cocoa butter, extraction method, phytosterols, antioxidant activity, salad dressing

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Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN PELARUT DAN KAEDAH PENGESTRAKAN YANG BERBEZA TERHADAP FITOSTEROLS DAN AKTIVITI ANTIOKSIDAN OLEH LEMAK KOKO DAN APLIKASI LEMAK KOKO DALAM SOS SALAD

Oleh

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Penambahan fitosterols dan antioksidan ke dalam produk makanan boleh memberikan beberapa manfaat kesihatan tambahan terhadap pengguna. Kestabilannya di dalam produk makanan juga boleh menurun semasa simpanan. Oleh itu, objektif kajian ini adalah untuk: i) menyaring pelarut yang paling sesuai menggunakan pengekstrakan Soxhlet untuk mengeluarkan CB dan ii) mengoptimumkan kaedah pengekstrakan yang paling sesuai dalam menghasilkan jumlah yang tinggi fitosterols dan aktiviti antioksidan, iii) untuk memformulasikan sos salad berasaskan lemak koko (CBSD) dan iv) untuk menentukan kestabilan fitosterols, aktiviti antioksidan dan fizikokimia CBSD semasa penyimpanan.

Biji koko kering telah diuji menggunakan empat jenis pelarut: Heksana (HE), Petroleum eter (PE), Isopropanol (PR) dan etanol (ET) menggunakan pengekstrakan Soxhlet. Kemudian, pelarut terpilih telah diaplikasi ke dalam kaedah pengekstrakan yg berbeza: Pengekstrakan Soxhlet (SE), pengekstrakan ultrasonik (USE), Supercritical pengekstrakan CO_2 (SCO_2) dan Supercritical pengekstrakan CO_2 dengan Etanol (SCO_2-Etanol). Lemak koko yang diekstrak daripada kaedah pengekstrakan yang terpilih diaplikasikan ke dalam formulasi sos salad dengan nisbah yang berbeza lemak koko dan minyak kacang soya. Nisbah lemak koko dan minyak soya (30:70) telah dikaji kestabilannya selama 28 hari penyimpanan pada dua suhu yang berbeza.

Hasil lemak koko daripada ET (14.25%) adalah terendah berbanding HE dan PE (masing-masing 43.24% dan 39.31%). ET menghasilkan kandungan fitosterols (4974 µg/100 g ekstrak , DPPH assay (64.8%) dan jumlah kandungan fenolik (TPC) (22.38 mg GAE/100 g ekstrak)yang signifikan ($p<0.05$) tertinggi. Lemak koko yang diekstrak daripada SCO_2-Etanol menunjukkan hasil ekstrak (37.05%), jumlah fitosterols (6441 µg/100 g ekstrak) dan DPPH assay (84%) yang signifikan tertinggi ($p<0.05$) berbanding SE, SCO_2 dan USE. Sifat fizikokimia 30% CBSD, sos salad komersial dan kawalan (tanpa CB) menunjukkan ciri-ciri (tegasan ricih ke ricih kadar, tekanan menyapu berayun dan kestabilan ujian emulsi) tidak signifikan ($p>0.05$) berbanding nisbah lain.

Oleh itu, 30% CBSD telah dipilih kerana menunjukkan sifat emulsi yang paling stabil dan sesuai untuk kajian penyimpanan pada 4 dan 30°C. Walau bagaimanapun, ciri-ciri fizikokimia, jumlah fitosterols, DPPH assay dan TPC 30% CBSD menurun mengikut masa (daripada 0 hari hingga 28 hari) dan meningkat mengikut suhu semasa penyimpanan disebabkan oleh pengoksidaan minyak. Oleh itu, suhu penyimpanan yang paling sesuai untuk sos salad adalah pada 4°C berbanding 30ęC.Kestabilan yang sangat baik oleh 30% CBSD pada suhu yang berbeza selama 28 hari menawarkan aplikasi yang berpotensi tinggi di dalam industri makanan untuk menghasilkan sos salad berasaskan lemak koko diperkaya dengan fitosterols dan antioksidan. Oleh itu, pemilihan pelarut dan kaedah pengekstrakan biji koko adalah sangat penting dan boleh digunakan untuk industri koko bagi meluaskan penggunaan lemak koko sebagai produk emulsi.

Kata kunci: Lemak koko, kaedah pengekstrakan, fitosterols, aktiviti antioksidan, sos salad

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I certify that a Thesis Examination Committee has met on 17 December 2015 to conduct the final examination of Roiaini binti Mohamad on her thesis entitled "Effects of Different Solvent and Extraction Methods on Phytosterols and Antioxidant Activity of Cocoa Butter and Application of Cocoa Butter in Salad Dressing" 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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LIST OF ABBREVIATIONS

LD	Low density lipoprotein
HDL	High density lipoprotein
CBSD	Cocoa butter salad dressing
GAE	Gallic acid equivalents
ECE	Epicatechin equivalents
CHD	Coronary heart disease
SCO_2	Supercritical carbon dioxide
HPLC	High Performance Liquid Chromatography
SEM	Scanning Electron Micrographs
MPa	milli Pascals,
O/W	Oil in water
W/O	Water in oil
ET	Ethanol
HE	Hexane
PE	Petroleum ether
PR	Isopropanol
DPPH	2,2-diphenyl-1-picrylhydrazyl
TPC	Total phenolic content
PV	Peroxide value
IV	Iodine value
AV	Acid value
FFS	Free fatty acid
KOH	Potassium hydroxide

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USE	Ultrasonic extraction
SE	Soxhlet extraction
BPR	Back Pressure Regulator
SLI	Italian salad dresssing
PS	Phytosterols esters
UV	Ultraviolet
SBO	Soybean oil
PKDG	Palm kernel diacyglycerol
GGM	Galactoglucomannan
RME	Rapeseed oil methyl esters
FAME	Fatty acids methyl esters
FA	Fatty acid
HPKO	Hydrogenated palm kernel oil
POPs	Phytosterol oxidation products

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CHAPTER 1

INTRODUCTION

The predominant raw material used for the preparation of chocolate products is cocoa beans (*Theobroma cacao L.*). Cocoa butter (CB) is a product of cocoa beans. CB handles the melting properties of chocolate and it is obtained from cocoa beans around 50±57% yield of dry weight (Steinburg et al., 2003). In order to extract CB or other fats and oils from oil contained sources, hexane as a solvent extraction has been widely used. Despite that, there is an issue on the health and safety hazards related to the use of organic solvents. Contaminants produced from CB using a hydraulic method must be removed after the process of extraction. Thus, over disposal of the toxic organic solvents and their effect on the environment has led towards safe extraction method (Nair, 2010).

At present, a number of methods engage in the extraction of CB either from mass, liquor, or from other sources, including hydraulic press, mechanical press, screw presses, supercritical extraction, and solvent extraction method (Asep et al., 2008). The hydraulic press, mechanical press, screw presses, and solvent extraction methods are not very good in extraction because (a) need high temperature, thus affects the nutritional quality of the CB, (b) unsuitable for heat sensitive labile natural compounds, and (c) contain toxic solvent in the final products which may have an effect towards human health (Hultin, 1994). The different extraction methods may produce a different yield of bioactive compounds. A study from Beveridge et al. (2005) found that supercritical CO_2 produces higher total phytosterols content compared to the traditional method using petroleum ether for grape seed oils.

Phytosterols (200±300 mg/100 g fat) of cocoa bean exist in free and esterified forms. Most abundantly found are -sitosterol and stigmasterol that amount to 59 and 22% of total phytosterols of cocoa beans, respectively (Staphylakis and Gegiou, 1985). A natural compound such as phytosterols, tocopherol and antioxidant content shows increasing attention due to their capabilities towards health benefits today. The chemical composition of phytosterols is similar to cholesterol. However, they are only available in humans through consuming food from plant such as vegetable oils, nuts, seeds, cereals, legumes, fruits, and vegetables or industrial supplements from plant origin (Piironen et al., 2000). Nuts and oils contain higher levels (>1%) of phytosterols than fruits and vegetables (<0.05%) (Abidi, 2001).

The diet containing high amount of phytosterols and phytostanols are able to lessen the level of LDL (low density lipoprotein) cholesterol in blood serum by restraining its absorption. This helps in prevention of hypercholesterolemia and cardiovascular system diseases (Fernandes and Cabral, 2007). Phytosterols are able to enhance the function of the urinary system and eradicate the symptoms of prostate gland enlargement (Tapiero et al., 2003). In addition, phytosterols reveal the protective effect on the oxidation of lipids due to the synergistic interactions with tocopherols, and also

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during high temperature processing (Polagruto et al., 2006). In most previous studies, phytosterols were added into high-fat foods, such as dressings, margarine, or spreads to facilitate their solubility. A daily intake of phytosterols in the range of 1-2 g/day is recommended for hypercholesterolemic patients (NCEP, 2001).

The suitability of solvent and extraction methods in extracting phytosterols and antioxidant content in cocoa beans is crucial for the food industry to maintain the bioactive compounds added into foods. Therefore, the application of CB with the high amount of phytosterols and antioxidant activity in emulsion product may give some additional health benefit towards consumers such as decrease the level of cholesterols in the blood, reduce heart disease and delay some types of cell damage. The addition of CB in newly formulated salad dressing may also produce different perspective for the food industry on the use of CB containing preserved bioactive compound. Therefore, the specific objectives of this study were:

i) to screen the most suitable solvent using Soxhlet extraction in producing high amounts of phytosterols and antioxidant activity.
ii) to optimize the most suitable extraction methods in producing high amounts of phytosterols and antioxidant activity.
iii) to formulate cocoa butter based salad dressing (CBSD).
iv) to determine the stability of phytosterols, antioxidant activity and physicochemical properties of CBSD during storage.

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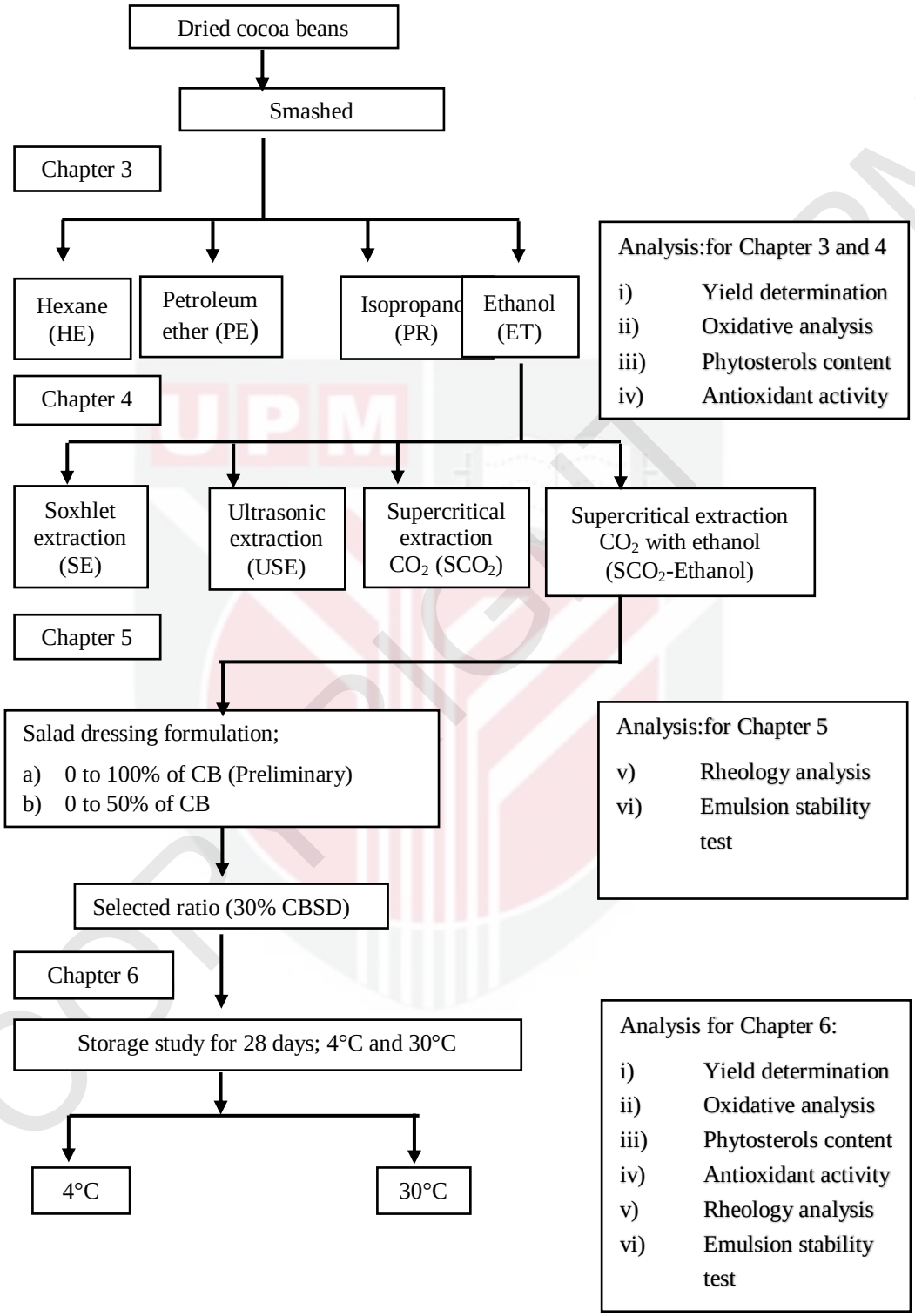

Figure 1.1. Experimental flow of the study

REFERENCES

Abidi, S.L. 2001. Chromatographic analysis of plant sterols in foods and vegetable oils. Journal of Chromatography A 935(1-2): 173-201.

Abramovic, H., Butinar, B. and Nikolic, V. 2007. Changes occurring in phenolic content, tocopherol composition and oxidative stability of *Camelina sativa* oil during storage. Journal of Food Chemistry 104(3): 903-909.

Abu Ghoush, M., Samhouri, M., Al-Holy, M. and Herald, T. 2008. Formulation and fuzzy modeling of emulsion stability and viscosity of a gum±protein emulsifier in a model mayonnaise system. Journal of Food Engineering 84: 348-357.

Abumweis, S.S., Barake R. and Jones P.J.H. 2008. Plant sterols/stanols as cholesterol lowering agents: A meta-analysis of randomized controlled trials. Food and Nutrition Research 52.

Adamson, G.E., Lazarus, S.A., Mitchell, A.E., Prior, R.L., Cao, G., Jacobs P.H., Kremers, B.G., Hammerstone, J.F., Rucker, R.B., Ritter, K.A. and Schmitz, H.H. 1999. HPLC method for the quantification of procyanidins in cocoa and chocolate samples and correlation to total antioxidant capacity. Journal of Agricultural and Food Chemistry 47(10): 4184-4188.

Adeyeye, E.I., Akinyeye, R.O., Ogunlade, I., Olaofe, O. and Boluwade, J.O. 2010. Effect of farm and industrial processing on the amino acid profile of cocoa beans. Journal of Food Chemistry 118(2): 337-363.

Ahmed, J. 2004. Rheological behaviour and colour changes of ginger paste during storage. International Journal of Food Science and Technology 39(3): 325-330.

Albu, S., Joyce, E., Paniwnyk, L., Lorimer, J.P. and Mason, T.J. 2004. Potential for the use of ultrasound in the extraction of antioxidants from *Rosmarinus officinalis* for the food and pharmaceutical industry. Ultrasonic Sonochemistry 11(3): 261-265.

Alothman, M., Rajeev, B. and Karim, A.A. 2009. Antioxidant capacity and phenolic content of selected tropical fruits from Malaysia, extracted with different solvents. Journal of Food Chemistry 115(3): 785-788.

American Heart Association (AHA), 2006. Diet and Lifestyle Recommendations Revision. A Scientific Statement from the American Heart Association Nutrition Committee.

$PHULFDQ2LO&KHPLVWV¶RFLHW\&&60HWKRGV16, 1998. Official Methods and 5HFRPPHQGHG3UDFWLFHVRIWKH$PHULFDQ2LO&KHPLVWV¶RFLHW\&KDPSDLJQ

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AmeULFDQ2LO&KHPLVWV¶6RFLHW\$&60HWKRG&G92G, 1993c. Official Methods DQG 5HFRPPHQGHG 3UDFWLFHV RI WKH $HULFDQ 2LO &KHPLVWV¶6RFLHW\ Champaign.

$HULFDQ2LO&KHPLVWV¶6RFLHW\$&60HWKRG&G8E, 1993d. Official Methods and Recommended PracticeV RI WKH $HULFDQ 2LO &KHPLVWV¶6RFLHW\ Champaign.

Amin, I., Jinap, S., Jamilah, B., Harikrisna, K. and Biehl, B. 2002. Oligopeptide patterns produced from *Theobroma cacao L*. of various genetic origins. Journal of Science of Food and Agriculture 82(7): 733-737.

Andersson, S.C., Rumpunen, K., Ohansson, J.E. and Olsson, M.E. 2008. Tocopherols and tocotrienols in sea buckthorn (*Hippophae Rhamnoides L*.) berries during ripening. Journal of Agricultural and Food Chemistry 56(15): 6701-6706.

Arlorio, M., Locatelli, M., Travaglia, F., Coïsson, J.D., Del Grosso, E., Minassi, A., Appendino, G. and Martelli, A. 2008. Roasting impact on the contents of clovamide (N-caffeoyl-L-DOPA) and the antioxidant activity of cocoa beans (*Theobroma cacao L*.). Journal of Food Chemistry 106(3): 967-975.

Asep, E.K., Jinap, S., Jahurul, M.H.A., Zaidul, I.S.M. and Singh, H. 2013. Effects of polar cosolvents on cocoa butter extraction using supercritical carbon dioxide. Innovative Food Science and Emerging Technologies 20: 152-160.

Asep, E.K., Jinap, S., Tan, T.J., Russly, A.R., Harcharan, S. and Nazimah, S.A.H. 2008. The effects of particle size, fermentation and roasting of cocoa nibs on supercritical fluid extraction of cocoa butter. Journal of Food Engineering 85(3): 450-458.

Association for Dressing and Sauces, History of Salad Dressing, 2015. Retrieved from http://www.dressings-sauces.org/history-salad-dressings?

Awad A.B., Hartati, M.S. and Fink, C.S. 1998. Phytosterol feeding induces alteration in testosterone metabolism in rat tissues. The Journal of Nutritional Biochemistry 9(12): 712-717.

Azizah, A.H., Nik Ruslawati, N.M. and Swee Tee, T. 1999. Extraction and characterization of antioxidant from cocoa by-products. Journal of Food Chemistry 64(2): 199-202.

Battey, A.C., Duffy, S. and Schaffner, D.W. 2002. Modeling yeast spoilage in cold-filled ready-to-drink beverages with *Saccharomyces cerevisiae, Zygosaccharomyces bailii*, and *Candida lipolytica*. Applied and Environmental Microbiology 68(4): 1901-1906.

Berger, A.P., Jones, J.H. and Abumweis, S.S. 2004. Plant sterols: factors affecting their efficacy and safety as functional food ingredients. Lipids in Health Disease 3:5.

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Bernardo-Gil, M.G, Grenha, J., Santos, J. and Cardoso, P. 2002. Supercritical fluid extraction and characterisation of oil from hazelnut. European Journal of Lipid Science and Technology 107(7): 402-409.

Beveridge, T.H.J., Girard, B., Kopp, T. and Drover, J.C.G. 2005. Yield and composition of grape seed oils extracted by supercritical carbon dioxide and SHWUROHXPHWKHU9DULHWDO(IIHFWV Journal of Agriculture and Food Chemistry 53(5): 1799-1804.

Bhatnagar, A.S. and Krishna, A.G.G. 2013. Effect of extraction solvent on oil and bioactives composition of commercial Indian niger (*Guizotia Abyssinica (L.f.) CassVHHG$PHULFDQ2LO&KHPLVWV¶6RFLHW* 1203-1212.

Bienvenue, R. Jiménez-Flores, H. and Singh, H. 2003. Rheological Properties of Concentrated Skim Milk: Importance of Soluble Minerals in the Changes in Viscosity during Storage. Journal of Dairy Science 86(12): 3813-3821.

Blekasand, G. and Boskou, D. 2010. Oxidation, nutrient and non-nutrient antioxidant, biologically active compound and high temperature. In *Frying of Food*, ed. D. Boskou, and E. Ibrahim,. pp. 225-249. CRC Press: Boca Raton, Florida.

Bouaid, A., Diaz, Y., Martinez, M. and Aracil, J. 2005. Pilot plant studies of biodiesel production using Brassicacarinata as raw material. Catalysis today 106(1): 193-196.

Bouaid A., Martinez M. and Aracil J. 2007. Long storage stability of biodiesel from vegetable and used frying oils. The Science and Technology of Fuel and Energy 86(6): 2596-2602.

Bruni, R., Bianchini, E., Bettarello, L. and Sacchetti, G. 2000. Lipid composition of wild *Ecuadorian Theobroma subincanum Mart.* seeds and comparison with two varieties of *Theobroma cacao L.* Journal of Agriculture and Food Chemistry 48(3): 691-694.

Bruni, R., Guerrini, A., Scalia, S., Romagnoli, C. and Sacchetti, G. 2002. Rapid techniques for the extraction of vitamin E isomers from Amaranthus caudatus seeds: Ultrasonic and supercritical fluid extraction. Phytochemical Analysis 13: 257-261.

Cai, Y., Luo, Q., Sun, M. and Corke, H. 2004. Antioxidant activity and phenolic compounds of 112 traditional Chinese medicinal plants associated with anticancer. Life Science 74(7): 2157-2184.

Calvo, L., Cocero, M.J. and Diez, J.M. 1994. Oxidative stability of sunflower oil extracted with supercritical carbon dioxide. American Oil &KHPLVWV¶6RFLHW\ 71(11): 1251-1254.

Campanella, O.H., Dorward, N.M. and Singh, H. 1995. A study of the rheological properties of concentrated food emulsions. Journal of Food Engineering 25(3): 427-440.

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Canakci, M. 2007. The potential of restaurant waste lipids as biodiesel feedstocks. Bioresource Technology 98(1): 183-190.

Careri, M., Elviri, L. and Mangia, A. 2001. Liquid chromatography-UV determination and liquid chromatography-atmospheric pressure chemical ionization mass spectrometric characterization of sitosterol and stigmasterol in soybean oil. Journal of Chromatography A 935(1-2): 249-257.

Casas, J.A., Santos, V.E. DQG*DUFtD-*Ochoa, F. 2000. Xanthan gum production under several operational conditions: molecular structure and rheological properties. Enzyme and Microbial Technology 26(2-4): 28-291.

Cercaci, L., Rodriguez-Estrada, M.T., Lercker, G. and Decker, E.A. 2007. Phytosterol oxidation in oil-in-water emulsions and bulk oil. Journal of Food Chemistry 102(1): 161-167.

Chakrabarty, M.M. 2003. Chemistry and Technology of Oils and Fats. In *Oils and Fats,* ed. M.M. Chakrabarty, pp. viii-752. Chennai: Allied Publishers Pvt. Ltd.

Chemat, S., Lagha, A., AitAmar, H., Bartelsand, P.V. and Chemat, F. 2004. Comparison of conventional and ultrasound-assisted extraction of carvone and limonene from caraway seeds. Flavour And Fragrance Journal 19(3): 188-95.

Chimel, M.J., Hammerstone, J.F., Johnson, J.C., Myers, M.E., Synder, R.M. and Whitacre, E.J. 2008. Bars and confectioneries containing cocoa solids having a high cocoa polyphenol content and sterol/stanol esters and processes for their preparation (US7329429 B2).

Choe, E. and Min, D.B. 2006. Mechanisms and Factors for Edible Oil Oxidation. Comprehensive Reviews in Food Science and Food Safety 5(4): 169-186.

Chukwu, O. and Sadiq, Y. 2008. Storage Stability of Groundnut Oil and Soya Oil-Based Mayonnaise. Food Technology 6(5): 217-220.

Clapperton; J., Lockwood; R., Romanczyk; L. and Hammerstone, J.F. 1994. Contribution of genotype to cocoa (*Theobroma cacao* L.) flavour. Tropical Agriculture 71(4): 303-308.

Clark, J. 1996. Tocopherols and sterols from soybeans. Lipid Technology 8:111-114.

Clifton, P.M., Noakes, M., Sullivan, D., Erichsen, N., Ross, D., Annison, G., Fassoulakis, A., Cehun, M. and Nestel, P. 2004. Cholesterol-lowering effects of plant sterol esters differ in milk, yoghurt, bread and cereal. European Journal of Clinical Nutrition 58: 503-509.

Cravotto, G., Binello, A., Merizzi, G. and Avogadro, M. 2004. Improving solvent-free extraction of policosanol from rice bran by high-intensity ultrasound treatment. European Journal of Lipid Science and Technology 106(3): 147-151.

Crowe, T.D., Crowe, T.W., Johnson, L.A. and White, P.J. 2002. Impact of extraction method on yield of lipid oxidation products from oxidized and unoxidized walnuts. 3HULFDQ2LO&KHPLVWV¶6RFLHW453-456.

Da Porto, C., Porretto, E. and Decorti, D. 2013. Comparison of ultrasound- assisted extraction with conventional extraction methods of oil and polyphenols from grape (*Vitis vinifera L.*) seeds. Ultrasonic Sonochemistry 20(4): 1076-1080.

Darby, R. 1996. Determining settling rates of particles. In *Chemical engineering fluid mechanics, Chemical engineering*, ed. R. Darby, pp. 109. New York: Marcel Dekker.

Davidson, M.H., Maki, K.C., Umporowicz, D.M., Ingram, K.A., Dicklin, M.R., Schaefer, E., Lane, R.W., McNamara, J.R., Ribaya-Mercado, J.D., Perrone, G., Robins, S.J. and Franke, W.C. 2001. Safety and tolerability of esterified phytosterols administered in reduced-fat spread and salad dressing to healthy adult men and women. American College of Nutrition 20(4): 307-319.

Davis, S.S. 1969b. Viscoelastic properties of pharmaceutical semisolids, II: Creams. Pharmaceutical Science 58(4): 418-421.

Dickinson, E. and Stainsby, G. 1988. Advances in food emulsions and foams. In *Advances in food emulsions and foams*, ed. E. Dickinson, pp. 397. UK: Elsevier Applied Science Publishers Ltd.

Dickinson, E. 2001. Milk protein interfacial layers and the relationship to emulsion stability and rheology. Colloids and surfaces B: Biointerfaces 20(3): 197-210.

Diftis, N.G., Biliaderis, C.G. and Kiosseoglou, V.D. 2005. Rheological properties and stability of model salad dressing emulsions prepared with a dry-heated soybean protein isolate±dextran mixture. Food hydrocolloids 19(6): 1025-1031.

Dimitreli, G. and Thomareis, A.S. 2004. Effect of temperature and chemical composition on processed cheese apparent viscosity. Journal of Food Engineering 64(2): 265-271.

Do, Q.D., Angkawijaya, A.E., Tran-Nguyen, P.L., Huynh, L.H., Soetaredjo, F.E., Edi, F., Ismadji, S. and Ju, Y. 2014. Effect of extraction solvent on total phenol content, total flavonoid content, and antioxidant activity of Limnophila aromatic. Journal of food and drug analysis 22:296-302.

Dreosti, I.E. 2000. Antioxidant polyphenols in tea, cocoa, and wine. Journal of Nutrition 16(7-8):692-694.

Duh, P.D., Tu, Y.Y. and Yen, G.C. 1999. Antioxidant Activity of Water extract of harng Jyur (*Chrysanthemum morifolium Ramat*). Lebensmittel-Wissenschaft and Technology 32(5): 269-277.

Durling, N.E., Catchpole, O.J., Grey, J.B., Webby, R.F., Mitchell, K.A., Foo, L.Y. and Perry, N.B. 2007. Extraction of phenolics and essential oil from dried sage (*Salvia Officinalis*) using ethanol±water mixtures. Journal of Food Chemistry 101(4): 1417-1424.

Elliott, J.H. and Ganz. A.J. 1977. Salad Dressings-Preliminary Rheological Characterization[1]. Texture Studies 8(3): 359-371.

El-Saied, H.M., Morsi, M.K. and Amer, M.M.A. 1981. Composition of cocoa shell fat as related to cocoa butter. Zeitschrift Für Ernährungswissenschaft 151(2): 145-151.

Engel, R. and Schubert, H. 2005. Formulation of phytosterols in emulsions for increased dose response in functional foods. Innovative Food Science and Emerging Technology 6(2): 233-237.

Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, 2001. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). The Journal of the American Medical Association 285(19): 2486-97.

Farrell, K.T. 2000. Spices, condiments and seasoning. In *Flavor trends*, ed K.T. Farrell. Baltimore, MD: McCormick Company.

FDA, 2003. Regulation 21 CFR Part 101 FEDERAL Register, 68 (133).

Fernandes, P. and Cabral, J.M.S. 2007. Phytosterols: Applications and recovery methods. Bioresource Technology 98(12): 2335-2350.

Fomuso, L.B., Corredig, M. and Akoh, C.C. 2001. A comparative study of mayonnaise and Italian dressing prepared with lipase-catalyzed transesterified olive oil and FDSUOLFDFLGBHULFDQ2LO&KHPLVWV¶RFLHW\-774.

Ford, L.D., Borwankar, R., Pechak, D. and Schwimmer, B. 1997. Dressings and sauces. In *Food Science and Technology*, ed. L.D. Ford, pp 361-412. New York: Marcel Dekker.

Francisco, J.C. and Dey, E.S. 2003. Supercritical Fluids as Alternative, Safe, Food processing Media: an overview. Acta Microbiologica Polonica 52: 35-39.

Friedman, M. and Brandon, D.L. 2001. Nutritional and Health Benefits of Soy Proteins. Agriculture and Food Chemistry 49(3): 1069-1086.

García-Llatas, G. and Rodríguez-Estrada, M.T. 2011. Current and new insights on phytosterol oxides in plant sterol-enriched food. Chemistry and Physics of Lipids 164(6): 607-624.

Garcia-Salas, P.; Morales-Soto, A.; Segura-Carretero, A.; Fernández-Gutiérrez, A. Phenoliccompound-extraction systems for fruit and vegetable samples. Molecules 2010, 15, 8813±8826.

Gazzani, G., Papetti, A., Massolini, G. and Daglia, M. 1998. Anti- and Prooxidant Activity of Water Soluble Components of Some Common Diet Vegetables and the Effect of Thermal Treatment. Agriculture and Food Chemistry 46(10): 4118-4122.

Genova, G., Iacopini, P., Baldi, M., Ranieri, A., Storchi, P. and Sebastiani, L. 2012. Temperature and storage effects on antioxidant activity of juice from red and white grapes. International Journal of Food Science and Technology 47(1): 13-23.

Giergielewicz-Mozajska, H., Da Browski, L. and Amiesnik, J.N. 2001. Accelerated solvent extraction (ASE) in the analysis of environmental solid samples- some aspects of theory and practice. Critical Reviews in Analytical Chemistry 31(3): 149-165.

Girard, M., Turgeon, S.L. and Gauthier, S.F. 2002. Interbiopolymer complexing EHWZHHQactoglobulin and low- and high-methylated pectin measured by potentiometric titration and ultrafiltration. Food Hydrocolloids 16(6): 585-591.

Grigonisa, D., Venskutonisa, P.R., Sivik, B., Sandahl, M. and Eskilsson, C.S. 2005. Comparison of different extraction techniques for isolation of antioxidants from sweet grass (*Hierochloë Odorata*). Supercritical Fluids 33(3): 223-233.

Guinard, J., Wee, C., McSunas, A. and Fritter, D. 2002. Flavor release from salad dressing varying in fat and garlic flavor. Food Quality and Preference. 13(3): 129-137.

Guzman, G.J. and Murphy, P.A. 1986. Tocopherols of soybean seeds and soybean curd (tofu). Journal of Agricultural and Food Chemistry 34(5): 791-795.

Hamburger, M., Baumann, D. and Adler, S. 2004. Supercritical carbon dioxide extraction of selected medicinal plants-effects of high pressure and added ethanol on yield of extracted substances. Phytochemical Analysis 15(1): 46-54.

Hartel, R.W. and Heldman, D.R. 2012. Springer Science & Business Media, 6 Dec 2012-Technology & Engineering -288 pages

Hathcox, A.K., Beuchat, L.R. and Doyle M.P. 1995. American Society for Microbiology Death of Enterohemorrhagic Escherichia coli O157:H7 in Real Mayonnaise and Reduced-Calorie Mayonnaise Dressing as Influenced by Initial Population and Storage Temperature. Applied and Environmental Microbiology 61: 4172-4177.

Hennock, M., Rahalkar, R. R. and Richmond, P. 1984. Effect of xanthan gum upon the rheology and stability of oil-water emulsions. Journal of Food Science 49: 1271-1274.

Hsouna, A.B., Saoudi, M., Trigui, M., Jamoussi, K., Boudawara, T., Jaoua, S., and El Feki, A. 2011. Characterization of bioactive compounds and ameliorative effects of *Ceratonia Siliqua* leaf extract against CCl4 induced hepatic oxidative damage and renal failure in rats. Food and Chemical Toxicology 49: 3183-3191.

Hultin, H.O. 1994. Oxidation of lipids in seafoods. Seafoods. In *Chemistry, Processing Technology and Quality*. ed. F. Shahidi, and J.R. Botta, pp. 49-74. London: Chapman and Hall.

Ibrahim, G.E., Hassan, I.M., Abd-Elrashid, A.M., El-Massry, K.F., El-Ghorab, A.H., Manal, M.R. and Osman, F. 2011. Effect of clouding agents on the quality of apple juice during storage. Food Hydrocolloids 25(1): 91-99.

International Cocoa and Commodities Organisation (ICCO), 2014/2015. Quarterly Bulletin of Cocoa Statistics xxxvi(4).

Ismail, A., Marjan, Z.M. and Foong, C.W. 2004. Total antioxidant activity and phenolic content in selected vegetables. Journal of Food Chemistry 87: 581-586.

Jahurul, M.H.A., Zaidul, I.S.M., Norulaini, N.A.N., Sahena, F., Abedin, M. Z., Ghafoor, K. and Mohd Omar, A.K. 2014. Characterization of crystallization and melting profiles of blends of mango seed fat and palm oil mid-fraction as cocoa butter replacers using differential scanning calorimetry and pulse nuclear magnetic resonance. Food Research International 55: 103-109.

Jahurul, M.H.A., Zaidul, I.S.M., Norulaini, N.A.N., Sahena, F., Jinap, S., Azmir, J., Sharif, K.M. and Mohd Omar, A.K. 2013. Cocoa butter fats and possibilities of substitution in food products concerning cocoa varieties, alternative sources, extraction methods, composition, and characteristics. Journal of Food Engineering 117: 467-476.

Jekel, A.A., Vaessen, H.A.M.G., Schothorst, R.C. and Fresen. 1998. Capillary gas-chromatographic method for determining non-derivatized sterols-some results for duplicate 24 h diet samples collected in 1994. Journal of Analytical Chemistry 360(5): 595-600.

Johansson, D., Bergenstahl, B. and Lundgren, E. 1995. Wetting of fat crystals by WULJOFHULGHRLODQGZDWHU$HULFDQ2LO&KHPLVW6RFLHW\

Kamal-Eldin, A. and Moazzami, A. 2009. Plant Sterols and Stanols as Cholesterol-Lowering Ingredients in Functional Foods. Recent Patents on Food, Nutrition and Agriculture 1(1): 1-14.

Katalinic, V., Milos, M., Modun, D., Music, I. and Boban, M. 2004. Antioxidant effectiveness of selected wines in comparison with (+) catechin. Journal of Food Chemistry 86: 593-600.

Katan, M.B., Grundy, S.M., Jones, P., Law, M., Miettinen, T. and Paoletti, R. 2003. Efficacy and safety of plant stanols and sterols in the management of blood cholesterol levels. Mayo Clinic Proceedings Journal 78: 965-978.

Keen, C.L., Holt, R.R., Oteiza, P.I., Fraga, C.G. and Schmitz, H.H. 2005. Cocoa antioxidants and cardiovascular health. American Journal of Clinical Nutrition 81: 298-303.

Khraisha, Y.H. 2000. Retorting of oil shale followed by solvent extraction of spent shale: Experiment and kinetic analysis. Journal of Energy Sources. 22: 347-355.

Kilcast, D. and Subramaniam, P. 2011. Food and Beverage Stability and Shelf Life. Cambridge, UK: Woodhead Publicating Limited.

Kim, H. and Keeney, P. G. 1984. Epicatechin content in fermented and unfermented cocoa beans. Journal of Food Science 491090-1092.

King, J.W., 1993a. Analysis of fats and oils by SFE and SFC. INFORM 4(9): 1089-1090, 1092-1095, 1097-1098.

King, J.W., 1993b. Hazardous waste reduction in the development of analytical methods-supercritical fluid extraction. Symposium on new and emerging approaches to the development of methods in trace-level analytical chemistry, Berkeley Springs, WV.

.OLPFJDN,0DáHFND06ODFKWD0 and Gliszczyn´ska-6ZLJáR$ 2007. Effect of storage on the content of polyphenols, vitamin C and the antioxidant activity of orange juices. Journal of Food Composition and Analysis 20: 313-322.

Kochhar, S.P. 1983. Influence of processing on sterols of edible vegetable oils. Progress in Lipid Research 22: 161-188.

Koh, S.P., Arifin, N., Tan, C.P., Yusoff, M.S.A., Long, K., Idris N.A. and Lai, O.M. 2008. Rheological properties, oxidative stability and sensory evaluation of enzymatically synthesized medium- and long-chain triacylglycerol-based salad dressings. European Journal of Lipid Science and Technology 110: 1116-1126.

Kono, Y., Shibata, H., Kodama, Y. and Sawa, Y. 1995. The suppression of the N-mitrosating reaction by chlorogenic acid. Biochemistry 312: 947-953.

Kopcak, U. and Mohamed, R.S. 2005. Caffeine solubility in supercritical carbon dioxide/co-solvent mixtures. Journal of Supercritical Fluids 34(2): 209-214.

Korhonen, M., Hellen, L., Hirvonen, J. and Yliruus, J. 2001. Rheological properties of creams with four different surfactant combinations - effect of storage time and conditions. International Journal of Pharmaceutics 221: 187-196.

Kowalska, J. and Sidorczuk, A. 2007. Analysis of the effect of technological processing on changes in antioxidant properties of cocoa processed products. Polish Journal of Food and Nutrition Sciences 57(2A): 95-99.

© COPYRIGHT UPM

Kowalski, R. and Wawrzykowski, J. 2009. Effect of ultrasound assisted maceration on the quality of oil from the leaves of *Thyme thymus vulgaris L.* Flavour Fragrance Journal 24(2): 69-74.

Kritchevsky, D. and Chen, S.C. 2005. Phytosterols-health benefits and potential concerns: a review. Nutrition Research 25: 413-428.

Krysiak W. 2006. Influence of roasting conditions on coloration of roasted cocoa beans. Journal of Food Engineering 77(3): 449-453.

Kurosawa, T., Itoh, F., Nozaki, A., Nakano, Y., Katsuda, S.I., Osakabe, N. and Itakura, H. 2005. Suppressive effect of cocoa powder on atherosclerosis in kurosawa and kusanagi-hypercholesterolemic rabbits. Journal of Atherosclerosis and Thrombosis 12: 20-28.

Laca, A., Sáenz, M.C., Paredes, B. and Díaz, M. 2010. Rheological properties, stability and sensory evaluation of low-cholesterol mayonnaises prepared using egg yolk granules as emulsifying agent. Journal of Food Engineering 97(2): 243-252.

Lagarda, M.J., García-Llatas, G. and Farré, R. 2006. Analysis of phytosterols in foods. Journal of Pharmaceutical and Biomedical Analysis 41(5): 1486-1496.

Lampe, M.A., Burlingame, A.L., Whitney, J., Williams, M.L., Brown, B.E., Roitman, E. and Elias, P.M. 1983. Human stratum corneum lipids: characterization and regional variations. Journal of Lipid Research 24: 120-30.

Lang, Q. and Wai, C.M. 2001. Supercritical fluid extraction in herbal and natural product studies-a practical review. Journal of Talanta 53: 771-782.

Lee, B.L., New, A.L. and Ong, C.N. 2003. Simultaneous determination of tocotrienols, tocopherols, retinol, and major carotenoids in human plasma. Clinical Chemistry 49: 2056-2066.

Lee, S., Biresaw, G., Kinney, M.P. and Inglett, G.E. 2009. Effect of cocoa butter replacement with a -glucan-rich hydrocolloid (C-Trim30) on the rheological and tribological properties of chocolates. Journal of the Science of Food and Agriculture 89(1): 163-167.

Lerchenfeld, E.P. and Striegel, D.E. 2008. Beverages containing plant sterols (US 7335389 B2).

Leroux, J., Langendorff, V., Schick, G., Vaishnav, V. and Mazoyer, J. 2003. Emulsion stabilizing properties of pectin. Food Hydrocolloids 17: 455-462.

Li, S. and Hartland, S. 1996. A new industrial process for extracting cocoa butter and [DQWKLQHVZLWKVXSHUFULWLFDOFDUERQGLR[LGH-RXUQDORI3HULFDQ2LO&K Society 73(4): 423-429.

© COPYRIGHT UPM

Liauw, M.Y., Natan, F.A., Widiyanti, P., Ikasari, D., Indraswati, N. and Soetaredjo, F.E. 2008. Extraction of neem oil (A*zadirachta indica A. Juss*) using n-hexane and ethanol: studies of oil quality, kinetic and thermodynamic. ARPN Journal of Engineering and Applied Sciences 3(3): 49-54

Lipp, M., Simoneau, C., Ulberth, F., Anklam, E., Crews, C., Brereton, P., de Greyt, W., Schwack, W. and Wiedmaier, C. 2001. Composition of genuine cocoa butter and cocoabutter equivalents. Journal of Food Composition and Analysis 14: 399-408.

Lu, F.S.H., Bruheim, I., Haugsgjerd, B.O. and Jacobsen, C. 2014. Effect of temperature towards lipid oxidation and non-enzymatic browning reactions in krill oil upon storage. Food Chemistry 157: 398-407.

Luque de Castro, M.D. and Garcia-Ayuso, L.E. 1998. Soxhlet extraction of solid materials: An outdated technique with a promising innovative future. Analytica Chimica Acta 369:1-10.

Ma, Z., Boye, J.I., Fortin, J., Simpson, B.K. and Prasher S.O. 2013. Rheological, physical stability, microstructural and sensory properties of salad dressing supplemented with raw and thermally treated lentil flours. Journal of Food Engineering 116: 862-872.

Maerker, G., Nungesser, E.H. and Bunick, F.J. 1988. Reaction of cholesterol 5,6-epoxides ZLWK VLPXODWHG JDVWULF MXLFH -RXUQDO RI 6HULFDQ 2LO &KHPL Society 23: 761-765.

0DOLüDQLQ05DF9$QWLü9$QWLü03DOGH/0.HIDODV3DQG5DNLü9 2014. Content of antioxidants, antioxidant capacity and oxidative stability of grape seed oil obtained by ultra sound assisted extraction, Journal of the American Oil ChHPLVWV¶6RFLHW\989-999.

Mamidipally, P.K. and Liu, S.X. 2004. First Approach On Rice Bran Oil Extraction Using Limonene. European Journal Of Lipid Science And Technology 106: 122-125.

Mariod, A.A, Matthäus, B. and Ismail M. 2011. Comparison of supercritical fluid and hexane extraction methods in extracting kenaf (*Hibiscus cannabinus*) seed oil lipids. American Oil Chemists' Society 88(7): 931-935.

Marquand, C. and Croft, D. 1994. Thermofluids: an integrated approach to thermodynamics and fluid mechanics principles. Chichester, New York, Brisbane, Toronto, Singapore: John Wiley and Sons Ltd.

Masmoudi, H., Piccerelle, P., Dréau, Y. L. and Kister, J. 2006. A Rheological Method to Evaluate the Physical Stability of Highly Viscous Pharmaceutical Oil-in-Water Emulsions. Pharmaceutical Research 23(8): 1937-1947

© COPYRIGHT UPM

Mason, T.J., Paniwnyk, L. and Lorimer, J.P. 1996. The uses of ultrasound in food technology. Ultrasonics Sonochemistry 3: 253-260.

Matsumura, Y., Egami, M., Satake, C., Maeda, Y., Takahashi, T., Nakamura, A. and Mori, T. 2003. Inhibitory effects of peptide-bound polysaccharide on lipid oxidation in emulsions. Food Chemistry 83: 107-119.

McClements, D.J. 2005. Food Emulsions: Principles, Practices and TechniquesSSÅ 338. Boca Raton, FL, USA: CRC Press

Melecchi, M.I.S., Martinez, M.M., Abad, F.C., Zini, P.P., Filho, I.N. and Caramao, E.B. 2002. Chemical composition of Hibiscus tiliaceus L. flowers: A study of extraction methods. Journal of Separation Science 25: 86-90.

Michiels, J.A., Kevers, C., Pincemail, J., Defraigne, J.O. and Dommes, J. 2012. Extraction Conditions Can Greatly Influence Antioxidant Capacity Assays In Plant Food Matrices. Journal of Food Chemistry 130(4): 986-993.

Mittelbach, M. and Gangl, S. 2001. Long storage stability of biodiesel made from rapeseed and used frying oil. Journal of the American Oil Chemists' Society78(6): 573-577.

Moghadasian, M.H. and Frohlich, J.J. 1999. Effects of Dietary Phytosterols on Cholesterol Metabolism and Atherosclerosis: Clinical and Experimental Evidence. American Journal of Medicine 107: 588-594.

Morley, W. and Varona, B. 2002. Dressing or marinade (US20020064588 A1).

Morris, V.J. 2006. Bacterial polysaccharides. In *Food Polysaccharides and Their Applications*, ed. M.S. Alistair, and O.P. Glyn, pp. USA: CRC Press.

Morton, G.M., Lee, S.M., Buss, D.H. and Lawrence, P. 1995. Intakes and Major Dietary Sources of Cholesterol and Phytosterols in the British Diet. Journal of Human Nutrition and Dietetics 8: 429-440.

Mun, S., Kim, Y.L., Kang, C.G., Park, K.H., Shim, J.Y. and Kim, Y.R. 2009. Development of reduced-fat mayonnaise using 4_GTase-modified rice starch and xanthan gum. International Journal of Biological Macromolecules 44: 400-407.

Murphy, K.J., Singh, A.K.I., Francis, M.A., Moriarty, H., Pike M. . and Sinclair, A.J. 2003. Dietary Flavanols And Procyanidin Oligomers From Cocoa (*Theobroma Cacao*) Inhibit Platelet Function. The American Journal Of Clinical Nutrition 77(6): 1466-1473.

Naczk, M. and Shahidi, F. 2006. Phenolics in Cereals, Fruits and Vegetables: Occurrence, Extraction and Analysis. Journal of Pharmaceutical and Biomedical Analysis 41: 1523-1542.

© COPYRIGHT UPM

Nair, P.K.P. 2010. 5-Cocoa (*Theobroma Cacao L.*). In *The Agronomy and Economy of Important Tree Crops of the Developing World*, ed. P.K.P. Nair, pp. 131-180. London, UK: Elsevier.

Natsume, M., Osakabe, N., Yamagishi, M., Takizawa, T., Nakamura, T., Miyatake, H. 2000. Analyses of polyphenols in caco liquor, cocoa and chocolate by Normal-Phase and Reversed-Phase HPLC. Bioscience, Biotechnology and Biochemistry 64:2581-2587.

Neukam, K., Stahl, W., Tronnier, H., Sies, H. and Heinrich, U. 2007. Consumption of Flavanol-Rich Cocoa Acutely Increases Microcirculation In Human Skin. European Journal of Nutrition 46(1): 53-56.

Niüiforoviü N., Mihailoviü 9DNRYL ü P., Solujiü S., Stojkoviü A. and Pavloviü M. D. 2010. Antioxidant Activity of Selected Plant Species; Potential New Sources of Natural Antioxidants. Food and Chemical Toxicology 48: 3125-3130.

Norton, J.E., Fryer, P.J., Parkinson, J. and Cox, P.W. 2009. Development and characterisation of tempered cocoa butter emulsions containing up to 60% water. Journal of Food Engineering Salad Dressing Emulsions Supplemented with Various Pulse Flours. Journal of Food Research 2(2): 167-181.

Norulaini, N.A.N., Setianto, W.B., Zaidul, I.S.M., Nawi, A.H., Azizi, C.Y.M., Mohd Omar, A.K. 2009. Effects of supercritical carbon dioxide extraction parameters on virgin coconut oil yield and medium-chain triglyceride content. Food Chemistry 116: 193-197.

Nourooz-Zadeh, J. and Appelqvist, L.Å. 1992. Isolation and quantitative determination of sterol oxides in plant-based foods: soybean oil and wheat flour. Journal of $PHULFDQ2LO&KHPLVWV¶6RFLHW\ 293.

Ntanios, F.Y. 2001. Plant Sterol-Ester-Enriched Spreads as an Example of a New Functional Food. European Journal Lipid Science and Technology 103:1 02-106.

Ntanios, F.Y., Homma, Y. and Ushiro, S. 2002. A Spread Enriched With Plant Sterol-Esters Lowers Blood Cholesterol And Lipoproteins Without Affecting Vitamins A And E In Normal And Hypercholesterolemic Japanese Men And Women[1,2]. The Journal of Nutrition 132(12): 3650-3655.

Okogeri, O. and Tasioula-Margari, M. 2002. Changes Occuring in Phenolic &RPSRXQGV DQG7RFopherol of Virgin Olive Oil during Storage. Journal of Agriculture and Food Chemistry 50: 1077-1080.

Oktay, M., Gulcin, I. and Kufrevioglu, O.I. 2003. Determination of in Vitro Antioxidant Activity of Fennel (*Foeniculum vulgare*) Seed Extracts. Food Science and Technology 36: 263-271.

© COPYRIGHT UPM

Osada, K., Kodama, T., Yamada, K. and Sugano, M. 1993. Oxidation of cholesterol by heating. Journal of Agriculture and Food Chemistry 41: 1198-1202.

Ostlund Jr, R.E., Racette, S.B., and Stenson, W.F. 2003. Inhibition of cholesterol absorption by phytosterol-replete wheat germ compared with phytosterol-depleted wheat germ[1,2,3]. American Society for Clinical Nutrition 77(6): 1385-1389.

Othman, A., Ismail, A. Abdul Ghani, N. and Adenan I. 2007. Antioxidant capacity and phenolic content of cocoa beans. Food Chemistry 100(4): 1523-1530.

Pangborn, R.M., Gibbs, Z.M. and Tassan, C. 1978. Effect of hydrocolloids on apparent viscosity and sensory properties of selected beverages. Journal of Texture Studies 9: 415-436.

Paraskevopoulou, A., Athanasiadis, I., Blekas, G., Koutinas, A.A., Kanellaki, M. and Kiosseoglou, V. 2003. Influence of polysaccharide addition on stability of a cheese whey kefir±milk mixture. Food Hydrocolloids 17(5): 615-620.

Paraskevopoulou, A., Boskou, D. and Kiosseoglou, V. 2005. Stabilization of olive oil-lemon juice emulsion with polysaccharides. Journal of Food Chemistry 90(4): 627-634.

Paraskevopoulou, D., Boskou, D., Paraskevopoulou, A. 2007. Oxidative stability of olive oil-lemon juice salad dressings stabilized with polysaccharides. Journal of Food Chemistry 101: 1197-1204.

Paredes, M.D.C., Rao, M.A. and Bourne, M.C. 1989. Rheological characterization of salad dressings. 1. Steady shear thixotropy and effect of temperature. Journal of Texture Studies 19: 247-258.

Paviani L. C., Dariva C., Marcucci M. C., Cabral F. A. 2009. Supercritical carbon dioxide selectivity to fractionate phenolic compounds from dry ethanolic extract of propolis. Journal of Food Engineering 33:15-27.

Pereira, C.G. and Meireles, M.A.A. 2010. Supercritical Fluid Extraction of Bioactive Compounds: Fundamentals, Applications and Economic Perspectives, Food and Bioprocess Technology 3: 340-372.

Péres, V.F., Saffi, J., Melecchi, M.I.S., Abad, F.C., Jacques, R.A., Martinez, M.M., Oliveira, E.C. and Caramáo, E.B. 2006. Comparison of soxhlet, ultrasound-assisted and pressurized liquid extraction of terpenes, fatty acids and Vitamin E from *Piper gaudichaudianum* Kunth. Journal of Chromatography A 1105: 115-118.

Phillips, K.M., Ruggio, D.M., Toivo, J.I., Swank, M.A. and Simpkins, A.H. 2002. Free and esterified sterol composition of edible oils determined by solid-phase extraction and gas-liquid chromatography. Journal of Food Component and Analytical 15: 123-142.

Phuah, E.T., Beh, B.K., Lim, C.S.Y., Tang, T.K., Lee, Y.Y. and Lai, O.M. 2015. Rheologicalproperties, textural properties, andstorage stability of palm kernel-based diacylglycerol-enriched mayonnaise. European Journal of Lipid and Science Technolology 117: 1-10.

Piironen, V., Lindsay, D.G., Miettinen, T.A., Toivo, J. and Lampi, A. 2000. Review 3ODQW6WHUROV%LRVQWKHVLVELRORJLFDOIXQFWLRQDQGWKHLULPSRUWDQ nutrition. Journal of the Science of Food and Agriculture 80(7): 939-966.

Plat, J. and Mensink, R.P. 2005. Plant stanol and sterol esters in the control of blood cholesterol levels: mechanism and safety aspects. The American Journal of Cardiology 96(1): 15-22.

Polagruto J.A., Wang-Polagruto, J.F., Braun, M.M. and Lee, L. 2006. Cocoa Flavanol-Enriched Snack Bars Containing Phytosterols Effectively Lower Total And Low-Density Lipoprotein Cholesterol Levels. Journal of the American Dietetic Association 106: 1804-1813.

Pollak, O.J. 1953. Reduction of blood cholesterol in man. The Circulation Journal 7: 702-706.

Przybylski, R., Zambiazi, R. and Li, W. 1999. Kinetics of sterols changes during storage and frying of canola oils. Proceedings of the 10th International Rapeseed Congress, Canberra, Australia.

Ramadan, M.F. and Moersel, J.T. 2004. Oxidative Stability of Black Cumin (*Nigella sativa L.*), Coriander (*Coriandrum sativum L.*) and Niger (*Guizotia abyssinica Cass.*) crude seed oils upon stripping. European Journal of Lipid Science Technology 10635-10643.

Ramezani, R. 2004. The Effect Stability of Packaging Materials and Refined Sunflower Oil Storage Condition on the Oxidative. Food Science and Technology Research Journal 10(3): 350-354.

Ramljak, D., Romanczyk, L.J., Metheny-Barlow, L.J., Thompson, N., Knezevic, V., Galperin, M. and Dickson, R.B. 2005. Pentameric procyanidin from *Theobroma cacao* selectively inhibits growth of human breast cancer cells. American Association for Cancer Research Journal 4(4): 537-546.

Ramsay, M.E., Hsu, J.T., Novak, R.A. and Reightler, W.J. 1991. Processing rice bran by supercritical fluid extraction. Journal of Food Technology 30: 98-104.

Reverchon, E. and de Marco, I. 2006. Supercritical fluid extraction and fractionation of natural matter. Jounal of Supercritical Fluids 38: 146-166.

Rodríguez. O., Ortuño, C., Simal, S., Benedito, J., Femenia, A. and Rosselló, C. 2014. Acoustically assisted supercritical CO_2 extraction of cocoa butter: Effects on kinetics and quality. Journal of Supercritical Fluids 94: 30-37.

Rudrappa, U., 2009. Soybean Oil Nutrition Facts. Retrieved from www.Nutrition-And-You.Com

Ruzaidi, A., Amin, I., Nawalyah, A.G., Hamid, M. and Faizul, H.A. 2005. The effect of Malaysian cocoa extract on glucose levels and lipid profiles in diabetic rats. Journal of Ethnopharmacology 98: 55-60

Ryan, E., McCarthy, F.O., Maguire, A.R. and O'Brien, N.M. 2009. Phytosterol Oxidation Products: Their Formation, Occurrence, and Biological Effects: Food Reviews International, 25(2): 157-174.

Salajegheh, D., Vaziri, A. and Bastani, D. 2013. Supercritical extraction of cocoa butter from cocoa seed, using pure carbon dioxide, carbon dioxide with ethanol as co-solvent and ethane. Middle East Journal of Scientific Research 13(8): 1010-1015.

Saldana, M.D.A., Mohamed, R.S. and Mazzafera, P. 2002. Extraction of cocoa butter from Brazilian cocoa beans using supercritical CO_2 and ethane. Fluid Phase Equilibria 194-197: 885-894.

Salisova, M., Toma, S. and Mason, T.J. 1997. Comparison of conventional and ultrasonically assisted extractions of pharmaceutically active compounds from *Salvia officinalis*. Ultrasonics Sonochemistry 4: 131-134.

Sang, S., Hou, Z., Lambert, J.D. and Yang, C.S. 2005. Redox Properties of Tea Polyphenols and Related Biological Activities. Antioxidants and Redox Signalling 7(11-12): 1704-1714.

Schinor, E.C., Salvador, M.J., Turatti, I.C.C., Zucchi, O.L.A.D. and Dias, D.A. 2004. Comparison of classical and ultrasound assisted extractions of steroids and triterpenoids from three *Chresta spp*. Ultrasonics Sonochemistry 11: 415-421.

Schlichter-Aronhime, J. and Garti, N. 1988. Solidification and Polymorphism in Cocoa Butter and the Blooming Problems. In *Crytallization and Polymorphism of Fats and Fatty Acids*, ed. N. Garti and K. Sato, pp. 363-393. New York, US: Marcel Dekker Inc.

Seeton, C.J. 2006. Viscosity-temperature correlation for liquids. Tribology Letters 22(1):67-78.

Sengar, G., Sharma, H.K. and Kaur, M. 2014. Effect of Storage Conditions on Physico-Chemical Properties and Fatty Acid Ratio, C18:2/C16:1 of Blended Fat.
International Journal of Postharvest Technology and Innovation 4(1).

Serjouie, A., Tan, C.P., Hamed, M., Che Man, Y.B. 2010. Effect of frying process on fatty acid composition and iodine value of selected vegetable oils and their blends. International Food Research Journal 17: 295-30.

Shahidi, F. 2000. Antioxidants in food and food antioxidants. Journal of Nahrung, 44: 158-163.

Shen, J. and Shao, X. 2005. A Comparison of Accelerated Solvent Extraction, Soxhlet Extraction, and Ultrasonic-Assisted Extraction for Analysis of Terpenoids and Sterols in Tobacco. Analytical and Bioanalytical Chemistry 383: 1003±1008.

Shi, J., Yi, C., Xue, S. J., Jiang, Y., Ma, Y. and Li, D. 2009. Effects of modifiers on the profile of lycopene extracted fromtomato skins by supercritical CO_2. Journal of Food Engineering 93:431-436.

Shukla, V.K.S. %DLOH¶V,Q dustrial Oil and Fat Products, ed. F.Shahidi, pp. 159± 173. USA: John Wiley and Sons, Inc.

Siddique, Y.H., Ara, G. and Afzal, M. 2012. Estimation of lipid peroxidation induced by hydrogen peroxide in cultured human lymphocytes. Dose-Response Journal 10.

Sihvonen, M., Jarvenpaa, E., Hietaniemi, V. and Huopalahti, R. 1999. Advances in supercritical carbon dioxide technologies. Trends in Food Science and Technology 10: 217-222.

Singleton, V.L. and Rossi, J.A. 1965. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. American Journal of Enology and Viticulture 16: 144-158.

Smittle, R.B. 2000. Microbiological Safety of Mayonnaise, Salad Dressings, and Sauces Produced in The United States: a review. Journal of Food Protection 10(8): 1015-1153.

Snyder, J.M., King, J.W., Taylor, S.L. and Neese, A.L. 1999. Concentration of phytosterols for analysis by supercritical fluid extraction. Journal of the $PHULFDQ2LO&KHPLVWV¶6RFLHW\ 76(6): 717-721.

Soupas, L., Huikko, L., Lampi, A.M., Piironen, V., 2006. Oxidative stability of phytosterols in some food applications. European Food Research and Technology 222(3-4): 266-273.

Soupas, L., Huikko, L., Lampi, A. and Piironen, V. 2007. Pan-frying may induce phytosterol oxidation. Journal of Food Chemistry 101(1): 286-297.

Soupas, L., Juntunen, L., Lampi, A.M. and Piironen, V. 2004. Effects of sterol structure, temperature, and lipid medium on phytosterol oxidation. Journal of Agriculture and Food Chemistry 52(21):6485-6491.

Staphylakis, K. and Gegiou, D. 1985. Free, esterified and glucosidic sterols in cocoa. Journal of Lipids 11: 723-728.

Steinburg, F.M., Bearden, M.M. and Keen, C.L. 2003. Cocoa and chocolate flavonoids: implications for cardiovascular health. Journal of American Dietetic Association 103: 2125-2223.

Sun, C., Gunasekaran, S. and Richards, M.P. 2007. Effect of xanthan gum on physicochemical properties of whey protein isolate stabilized oil-in-water emulsions. Food Hydrocolloids 21: 555-564.

Sun, T. and Ho, C.T. 2005. Antioxidant activities of buckwheat extracts. Journal of Food Chemistry 90: 743-749.

Swern, D. 1982. Cooking oils, salad oils, and salad dressings. In "*Bailey's Industrial Oil and Fat Prod*uction, ed. D. Swern, pp. 315. New York: John Wiley.

Tamine, A. and Deeth, H. 1980. Yogurt: Technology and Biochemistry. Journal of Food Protection 43: 939-977.

Tapiero, H., Towsend, D.M. and Tew, K.D. 2003. Phytosterols in the Prevention of Human Pathologies. Biomedical and Pharmacology Journal 57: 321-325.

Taylor, M.K., Young, T.M., Butzke, C.E. and Ebeler, S.E. 2000. Supercritical Fluid Extraction of 2, 4, 6-Trichloroanisole from Cork Stoppers. Agricultural and Food Chemistry 48 (6): 2208-2211.

Tomaru, M., Takano, H., Osakabe, N., Yasuda, A., Inoue, K., Yanagisawa, R. and Uematsu, H. 2007. Dietary supplementation with cacao liquor proanthocyanidins prevents elevation of blood glucose levels in diabetic obese mice. Journal of Nutrition 23(4): 351-355.

Tomas-Barberan, F.A., Cienfuegos-Jovellanos, E., Marin, A., Muguerza, B., Gil-Izquierdo, A., Cerdaa, B., Zafrilla, P., Morillas, J., Mulero, J., Ibarra, A. 2007. A new process to develop a cocoa powder with higher flavonoid monomer content and enhanced bioavailability in healthy humans. Journal of Agriculture and Food Chemistry 55: 3926-3935.

Tomsone, L., Kruma, Z. and Galoburda, R. 2012. Comparison of different solvents and extraction methods for isolation of phenolic compounds from horseradish roots (*Armoracia rusticana*). World Academy Of Science, Engineering And Technology 6(4): 1155-1160.

Torres-Arreola, W., Soto-Valdez, H., Peralta, E., Cardenas-Lopez, J.L. and Ezquerra-Brauer, J.M. 2007. Effect of a low-density polyethylene film containing butylated hydroxytoluene on lipid oxidation and protein quality of sierra fish (*Scomberomorus sierra*) muscle during frozen storage. Journal of Agriculture and Food Chemistry 55(15): 6140-6146.

Tsimidou, M.Z., Georgiou, A., Koidis, A. and Boskou, D. 2005. Loss of Stability of µµ9HLOHG´&ORXG9LUJLQ2OLYH2LOVLQ6WRUDJH-RXUQDORI9RO 77-383.

Turkmen, N., Sari, F. and Velioglu, Y.S. 2006. Effects of extraction solvents on concentration and antioxidant activity of black and black mate tea polyphenols determined by ferrous tartrate and FolineCiocalteu methods. Journal of Food Chemistry 99:835-841.

USDA. Database for the Flavanoid Content of Selected Foods, 2003. Retrieved from http://www.nal.usda.gov/fnic/foodcomp/Data/Flav/flav.pdf.

Van Beek, T.A. 2002. Chemical analysis of Ginkgo biloba leaves and extracts. Journal of Chromatography A 967(1): 21-55.

Van Ruth, S.M., Shaker, E.S. and Morrissey, P.A. 2001. Influence of methanolic extracts of soybean seeds and soybean oil on lipid oxidation in linseed oil. Journal of Food Chemistry 75: 177-184.

Velez-Ruitz, J.F. and Barbosa-Canovas, G.V. 1998. Rheological properties of concentrated milk as a function of concentration, temperature and storage time. Journal of Food Engineering 35: 177-190.

Vessby, B. 1994. Implications of long-chain fatty acid studies. INFORM 5(2): 182-185.

Vilegas, J.H.Y., de Marchi, E. and Lancas, F.M. 1997. Extraction of low-polarity compounds (with emphasis on coumarin and kaurenoic acid) from Mikania JORPHUDWDµ;XDFR¶DHDYHVolkswical Analysis 8: 266-270.

Vilkhu K., Mawson R., Simons L., Bates D. 2008. Applications and opportunities for ultrasound assisted extraction in the food industry-a review. Innovative Food Science and Emerging 9: 161-169.

Vinson, J.A. and Hontz, B.A. 1995. Phenol Antioxidant Index: Comparative Antioxidant Effectiveness of Red and White Wines. Journal of Agriculture and Food Chemistry 43(2): 401-403.

Wan, P.J. and Wakelyn, P.J. 1997. Technology and solvents for extracting oilseeds and nonpetroleum oils. pp. 186, 189, 192, 193, 1997. Champaign, USA: AOCS Press.

Wan, Y., Vinson, J.A., Etherton, T.D., Proch, J., Lazarus, S.A. and Kris-Etherton, P.M. 2001. Effects of cocoa powder and dark chocolate on LDL oxidative susceptibility and prostaglandin concentration in humans. The American Journal of Clinical Nutrition 74: 596-602.

Wang, L. and Weller, C.L. 2006. Recent advances in extraction of nutraceuticals from plants. Trends in Food Science and Technology 17(6): 300-312.

Warner, K., Frankel, E.N., Snyder, J.M. and Porter, W.L. 1986. Storage stability of soybean oil-based salad dressings: effects of antioxidants and hydrogenation. Journal of Food Science 51(3): 703-708.

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Weiss, T.J. 1981. Food Oils and Their Uses. pp. xi-310. Westport, Connecticut, USA; AVI Publishing Co. Inc., and Chichester, W. Sussex.

Wendin, K. and Hall, G. 2001. Influences of fat, thickener and emulsifier contents on salad dressing; static and dynamic sensory and rheological analyses. Lebensmittel-Wissenschaft and Technology 34: 222-233.

Weststrate, J.A. and Meijer, G.W. 1998. Plant sterol-enriched margarines and reduction of plasma total- and ldl-cholesterol concentrations in normocholesterolaemic and mildly hypercholesterolaemic subjects. European Journal of Clinical Nutrition 52: 334-343.

Wu, J., Lin, L. and Chau, F. 2001. Ultrasound-assisted extraction of ginseng saponins from ginseng roots and cultured ginseng cells. Ultrasonics Sonochemistry 8: 347-352.

Wu, X., Beecher, G.R., Holden, J.M., Haytowicz, D.B., Gebhardt, S.E. and Prior, R. 2004. Lipophilic and hydrophilic antioxidant capacities of common foods in the United States. Journal of Agriculture and Food Chemistry 52: 4026-4037.

Yackinous, C., Wee, C. and Guinard, J.X. 1999. Internal preference mapping of hedonic ratings for ranch salad dressing varying in fat and garlic flavor. Food Quality and Preference 10(4-5): 401-409.

Yang, C.M., Luedecke, L.O., Swanson, B.G. and Davidson, P.M. 2003. Inhibition of microorganisms in salad dressing by sucrose and methylglucose fatty acid monoesters. Journal of Food Processing and Preservation 27: 285-298.

Young, S. 1950. Research on Mayonnaise and Salad Dressings. Food in Canada 10:20-25.

Zaidul, I.S.M., Norulaini, N.A.N., Mohd Omar, A.K. and Smith Jr. R.L. 2007c. Blending of Supercritical Carbon Dioxide (SC-CO_2) extracted palm kernel oil fractions and palm oil to obtain cocoa butter replacers. Journal of Food Engineering 78: 1397-1409.

Zarnowski, R. and Suzuki, Y. 2004. Expedient Soxhlet extraction of resorcinolic lipids from wheat grains. Journal of Food Composition and Analysis 17(5): 649±663.

Zhang, H., Jiang, L., Ye, S., Ye, Y. and Ren, F. 2010. Systematic evaluation of antioxidant capacities of the ethanolic extract of different tissues of jujube (*Ziziphus jujuba* Mill.) from China. Journal of Food Chemistry and Toxicology 48: 1461±1465.

Zhou, K. and Yu, L. 2004. Effects of extraction solvent on wheat bran antioxidant activity estimation. Journal of Food Science and Technology 37(7): 717-721.

© COPYRIGHT UPM

Zhu, Q.Y., Holt, R.R., Lazarus, S.A., Ensunsa, J.L., Hammerstone, J.F., Schmitz, H.H. and Keen, C L. 2002a. Stability of the flavan-3-ols epicatechin and catechin and related dimeric procyanidins derived from cocoa. Journal of Agriculture and Food Chemistry 50: 1700-1705.

)ŧHOHZLF] %XGUQ *UVLDN : 2UDF] J., Nebesny, E. and Bojczuk, M. 2014. Influence of roasting conditions on fatty acid composition and oxidative changes of cocoa butter extracted from cocoa bean of Forastero variety cultivated in Togo. Food Research International 63: 328-343.

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