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Essential oil extracted from peach (*Prunus persica*) kernel and its physicochemical and antioxidant properties

Hao Wu [a,c], John Shi [a,*], Sophia Xue [a], Yukio Kakuda [b], Dongfeng Wang [a,c], Yueming Jiang [d], Xingqian Ye [e], Yanjun Li [f], Jayasankar Subramanian [g]

[a] Guelph Food Research Center, Agriculture and Agri-Food Canada, Ontario N1G 5C9, Canada
[b] Department of Food Science, University of Guelph, Ontario N1G 2W0, Canada
[c] College of Food Science and Technology, Ocean University of China, Qingdao, Shandong 266003, China
[d] South China Botanical Garden, The Chinese Academy of Sciences, Guangzhou 510650, China
[e] Department of Food Science and Nutrition, School of Biosystems Engineering and Food Science, Zhejiang University, Hangzhou 310029, China
[f] Hangzhou Wahaha Group Co., Hangzhou 310018, China
[g] Department of Plant Agriculture, University of Guelph, Vineland Station, Ontario L0R 2E0, Canada

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ABSTRACT

Peach kernel oil was extracted using Soxhlet extraction with different solvents (petroleum ether, ethyl ether, chloroform and hexane). The physicochemical properties (acid value, iodine value, peroxide value and saponification value), the fatty acid composition, phenolic constituents and contents, and antioxidant activities of peach kernel oil were examined. As per our results, oil extracted with hexane has better overall quality. Its acid, peroxide, iodine and saponification values were 0.895 mg KOH/g oil, 0.916 mg/g oil, 36.328 mg/100 g oil and 101.836 mg KOH/g oil, respectively. Large proportions of unsaturated fatty acid (91.27%) and high content of phenolic compounds (4.1593 mg GAE/g), which contribute to considerably strong antioxidant activity, were found in oil. The main fatty acids found in the peach kernel oil were oleic acid (61.87 g/100 g oil) and linoleic acid (29.07 g/100 g oil). The HPLC analysis of phenolic compounds showed that rutin, (-)-epicatechin gallate, hydrocinnamic acid, sinopinic acid, dithiothreitol and caffeic acid were major constituents. The results suggested that peach kernel oil is a good source of the unsaturated fatty acid, phenolic compounds with strong antioxidant activity, and has the potential to be used as nutrient rich food oil. The results also verified that peach kernel meals contained higher amounts of total phenolic and stronger antioxidant activities than oils, enabling their application as ingredients for functional or enriched foods.

1. Introduction

Peach is the third most important deciduous tree fruits worldwide, ranking after apples and pears. A significant part of the harvested peaches is processed resulting in a substantial amount of waste stones. Peach kernel contain almost 50 wt% of oils (Yolanda, Albertina, Juan & Pando, 2009). The peach kernel has slightly toxic effects when used excessively due to its content of hydrogen cyanide (prussic acid). Hydrogen cyanide is a chemical compound with extremely poisonous, because it binds irreversibly to the iron atom in hemoglobin, making it unavailable to transport the vital O_2 to the body's cells and tissues. The dose should not be excessive and any excessive dose may cause headache, blurred vision, palpitations, or even death from respiratory failure. However, since the concentration of hydrogen cyanide in peach kernel is small (0.45–2.6 mg/g) and can be detected in the processed peach products (Barceloux, 2008, chap. 5).

Peach kernel oil has been widely used in the cosmetics industry as an ingredient in soaps, shampoos, lotions, creams, and shampoos because it is a light, penetrating oil, and absorbs easily and does not leave a greasy feeling. Peach kernel oil is nutritionally attractive and has an opportunity of producing high value products from the biowaste in peach industry due to their unsaturated fatty acid and antioxidant constituents (Saadany, Kalaf, & Soliman, 2004). Therefore, peach kernel can be considered as an important source of essential oil for the food and nutraceutical supplement industries.

Fatty acids, especially, unsaturated fatty acids, are important as nutritional substances and metabolites in living organisms. Many

* Corresponding author. Tel.: +1 519 780 8035; fax: +1 519 829 2602.
E-mail address: john.shi@agr.gc.ca (J. Shi).

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kinds of fatty acids play an important role in the regulation of a variety of physiological and biological functions (Zhao, Wang, You, & Suo, 2007). The main fatty acids found in peach kernel oil are about 58% oleic acid and 32% linoleic acid (Kamel & Kakuda, 1992). Oleic acid is an 18-carbon monounsaturated fatty acid, essential in human nutrition and helps reducing triglycerides, LDL-cholesterol, total cholesterol and glycemic index (Eduardo, 2010). Also, the increase in stability over oxidation of vegetable oil is attributed to oleic acid (Abdulkarim, Long, Lai, Muhammad, & Ghazali, 2007). The linoleic acid is an essential fatty acid from omega-6 group (18:2(n-6).) and very important for development and maintenance of the nervous system and the physiological functions in humans, since it reduces total and LDL-cholesterol levels. Phenolic composition of food materials such as phenolic acids, flavonoids and tannins have been the scope of many studies lately due to their antioxidant effects.

Phenolic compounds make important contributions to the nutritional properties, sensory characteristics and the shelf life of peach kernel oil. However, the fate of individual phenolic compounds in the course of peach kernel oil extraction as well as their contribution to the overall antioxidant properties of oils has not yet been investigated.

The extraction technique used to obtain high aggregate value compounds from natural products is crucial for product quality. Soxhlet extraction is a standard technique and is the main reference to which other extraction methods are compared. The advantage of conventional Soxhlet is that the sample is repeatedly brought into contact with the fresh portions of the solvent, thereby helping to displace the transfer equilibrium. There is a wide variety of official methods involving a sample preparation step based on Soxhlet extraction (US EPA Method 3540, 1995; AOAC Method 963.15, 1990; British Standard, BS 4267, 1994, 8 p.). In short, Soxhlet extraction is a general, well-established technique which clearly surpasses in performance other conventional extraction techniques.

However, there are only few studies on the extraction of peach kernel oil (Yolanda, Albertina, Juan & Pando, 2009), and the fatty acid profile, polyphenolic compound, physicochemical properties and antioxidative properties of peach kernel oil were not well established yet. Therefore, the objectives of this study were to compare the efficiency of the extraction solvents; evaluate the quality of peach kernel oil through the physicochemical properties, fatty acid composition, profile of phenolic compounds and antioxidant activity; and at last define the most effective solvent that can be used in the extraction of peach kernel oil with Soxhlet.

2. Materials and methods

2.1. Materials

Peaches (*Prunus persica*) were harvested from orchard of Vineland Research Centre (Ontario, Canada). Peach pits were collected and cracked to obtain the kernel. The kernel were then ground in a food grinder (Waring commercial Co. Ltd., USA) to reduce the particle size to a maximum diameter of 500 μm as measured by a sieve (The W.S. Tyler Company of Canada Ltd., Canada), sealed in a plastic container and stored in a refrigerator until extraction. The storage conditions assured eliminating effects of oxygen and humidity and to avoid oxidation of the dried peach pit powder during storage time.

Folin–Ciocalteu reagent and 2, 2′-Diphenyl-β-picrylhydrazyl (DPPH) were supplied by Sigma (St. Louis, MO, USA). Standards of fatty acid methyl esters (FAME) (mixture 463) were obtained from Nu-Chek-Prep, Inc. (Elysian, MN, USA). Polyphenol standards for HPLC analysis were supplied as follows: keracyanin chloride, (+)-catechin, (-)-epicatechin gallate, 3,4-dihydroxybenzoic acid, rutin hydrate, procyanidin B2, ellagic acid, caffeic acid, DL-dithiothreitol, protocatechinic acid, procatechol, gentisics acid, kuromanin chloride, vanillic acid, myricetin, hydrocinnamic acid, sinopinic acid, and obtained from Sigma (St. Louis, MO, USA). KI, $Na_2S_2O_3$, KOH, phenolphthalein, HCl, starch indicator, I_2, Br_2 were from Fisher Chemicals (Fair Lawn, NJ, U.S.A). The solvents employed for extraction and HPLC performance were all obtained from Caledon Laboratories LTD (Georgetown, ON, Canada).

2.2. Methods

2.2.1. Oil extraction

Soxhlet extraction was performed according to Campos, Leimann, Pedrosa, and Ferreira (2008). The extractions were performed at least in duplicate, with different solvents: petroleum ether, hexane, ethyl ether and chloroform, with polarities of 0.01, 0.06, 2.9 and 4.4, respectively. The solvents chosen for present study are normally used to extract oil from plant kernel. Thirty grams of ground peach kernel was extracted in a soxhlet-extractor with 200 mL solvents for 24 h at 50 °C. This mild extraction temperature of 50 °C was chosen to avoid thermal degradation on bioactive compounds in the extracts. Also the temperate is in the range of boiling temperature of these solvent. The resulting extracts, obtained by the different methods were separated by evaporating the solvents used in a rotary evaporator under reduced pressure and at temperature of 50 °C. The obtaining the fractions were weighted, and then filtered through 0.45um membranes and oil physicochemical properties were determined. The meals were also collected after extracting oils, and weighted after evaporating excess solvent under nitrogen. The total yield of extracted oil for each method was obtained by the mean value of extracted oil mass divided by mass of raw material used (30 g), on dry weight base (d.b).

The Oils and their meals were evaluated to compare their total phenolic content, phenolic profiles and antioxidant capacity.

2.2.2. Physicochemical properties of peach kernel oils

Acid value, iodine value, peroxide value and saponification value of the extracted peach kernel oils were determined using AOAC (1990) methods. The hydrocyanic acid content of the extracted oil was determined by the method of Blinn and Boyd (1964).

2.2.3. Fatty acid (FA) analyses

The fatty acid profile was determined as fatty acid methyl esters (FAME) by gas chromatography. The methyl esters were prepared by following produces. Oils (50 mg) were dissolved in sodium dried diethyl ether (1 mL) and methyl acetate (50 μL). Then 1 mol/L sodium methoxide in dry methanol (20 μL) was added, and the solution was agitated briefly to ensure thorough mixing. The solution immediately becomes cloudy as sodium-glycerol derivatives were precipitated. After set for 5 min at room temperature, the reaction was stopped by adding a saturated solution of oxalic acid in diethyl ether (30 μL) with brief agitation. The mixture was centrifuged at about 1500 g for 4 min to precipitate sodium oxalate, and the solvent was removed in a gentle stream of nitrogen at room temperature. Fresh diethyl ether (1 mL) or hexane was added, and an aliquot of this was taken directly for GC analysis.

A gas chromatographic (GC) (model 5890; Hewlett–Packard, Palo Alto, CA, USA) equipped with a flame ionisation detector and an auto sampler (model 7673, Hewlett–Packard, Palo Alto, CA, USA), a 100 m CP-Sil 88 fused capillary column (Varian Inc., Mississauga, ON, Canada), and ChemStation software system (version A.09, Hewlett–Packard, Palo Alto, CA, USA) were used for analysing FAME. The injector and detector temperatures were 250 °C. The temperature programme for the column was: hold at 45 °C for