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LETTER TO THE EDITOR

Trace Component Characteristic of Petroleum Ether Extracts from Different Camellia Seed Oil Products

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Camellia oleifera b is an evergreen tree that are widely planted in the subtropical region of southern China. The oil from *C. oleifera* seed is high-grade edible oil that is unique to China, with rich unsaturated fatty acids. *C. oleifera* can be obtained through a series of processing technology, such as hair oil, refined oil and so on. However, the trace active components vary in Camellia seed oil products at different processing stages, therefore, the trace components characteristic of petroleum ether extracts from 5 Camellia seed oil products (crude oil, first-grade finished oil, second-grade finished oil, refined oil, cold-pressed oil) were analyzed. The petroleum ether extract of first-grade finished oil is rich in Elaidic acid, while the contents in other 4 Camellia seed oil products are different distinctly, which ban be used to reduce cholesterol content and as food additive. The petroleum ether extracts from all 5 Camellia seed oil products have cis-11-octadecenoic acid, cis-9-Octadecenoic acid, octadec-9-enoic acid, and some components which can be developed into materials for cosmetics and biomedicine.

I Introduction

Camellia oleifera is a small evergreen tree of Camellia, is considered as one of four main woody oil trees in the world. *C. oleifera* is distributed in various provinces of China, such as Zhejiang, Henan, Jiangxi and so on (Feng et al. 2017). Changning of Hunan even also regarded as the country of Chinese oil tea. Because the seed can be squeezed oil, it is named *C. oleifera*. In recent years, the output and output value of *C. oleifera* in China has achieved double growth. The area of *C. oleifera* forest has developed from 45 million mu in 2008 to about 64000000 mu in 2016. The production of camellia seed has increased from 960 thousand tons to 2 million 170 thousand tons, and the production of tea oil has increased from about 200000 tons to 538 thousand and 600 tons; the output value of *C. oleifera* is increased from 11 billion yuan to 66 billion 100 million yuan (Xiao et al. 2017). The seeds contain more than 30% oil, which can be used for eating and moistening and adjusting medicines (Yang et al. 2017). It can make candles and soap, and can also be used as a substitute for oil (Lin et al. 2018). The content of unsaturated fatty acids in tea oil is up to 90%, far higher than that of vegetable oil, peanut oil and soybean oil (Di et al. 2017). The content of olive oil is twice as high as vitamin E, and contains specific physiological active substances such as camelliin, which has high nutritional value. *C. oleifera* has a high comprehensive utilization value (Gao et al. 2017). Tea seed meal contains tea saponin, tea seed polysaccharide, tea seed protein and so on. They are the raw materials of chemical, light industry, food and feed industry. (Kang et al. 2018)The tea seed shell can also be made into furfural and activated carbon. The grey shampoo of tea tree

can kill lice including insect eggs. It is the best material for making top and catapult (Lachmann et al. 2009). And because of its natural texture of tea tree, it is also a high grade material for making high quality wood buttons. *C. oleifera* is also a highly resistant tree species. It has strong resistance to sulfur dioxide, strong resistance to fluoride and chlorine. Therefore, scientific management of *C. oleifera* forests has the ecological benefits of soil and water conservation.

II Materials and Methods

(1) Materials

The fruits of the *C. oleifera* were collected in late October. The seeds were stripped from the fruit of *C. oleifera*. The seed of the *C. oleifera* was placed at room temperature (25°C) for 24 hours, then placed in a pulverizer (FW100). Then the sample was stored in dry conditions (Cheng et al. 2018). The crude oil is obtained by leaching process. Refined oil was obtained by high temperature pressed technology. Second-grade finished oil was obtained by pressed. After a series of technology such as deacidification, decolorization and so on, we can get first-grade finished oil. Cold-pressed oil was achieved by cold pressing technology.

(2) Methods

The crude oil, first-grade finished oil, refined oil, second-grade finished oil and cold-pressed oil were extracted by petroleum ether at ratio of Solvent: Oil=2:1. The samples were immersed for 8 h at room temperature; the mixed samples were fully extracted with an automatic FOSS Soxhlet Extracted apparatus (Agilent, USA) at 60°C for 4 hours, and then quickly filtrated with filter paper immersed in petroleum ether, for 24h. The filtrated extraction was evaporated between 45~50°C under 0.01 MPa vacuum, and finally concentrated to 20mL. The extracted residues were dried between 45~50°C. All extracts and extracted residues were stored at 4°C (Lam et al. 2019).

GC/MS determination: In the GC condition the quartz capillary column was 30 m x 250 μm x 0.25 μm, started at 150°C, without retention, and then was heated at a rate of 10°C/ min up to 300°C with run for 20 minutes. The temperature of the inlet was 150°C, the column flow was 1.0 ml/min, the split ratio was 10:1, and the carrier gas was high helium. In the S condition the ionization mode was EI, the electron energy was 70 eV, the ion source temperature was 230°C, the quadrupole temperature was 150°C, and scan the starting point was 150-600°C, on a wiley7n.1 standard spectrum and computer to search qualitative.

III Results and Analyses

(1) Trace component characteristic of petroleum ether extract from crude oil

The mixture of crude oil and petroleum ether has obvious stratification and faster speed. The other four oils are mixed with petroleum ether. These samples completely soluble in petroleum ether and can separate trace insoluble substances only at the bottom. 19 compounds were identified from 20 peaks from the petroleum ether extracted from crude oil. There were so many chemical raw materials in petroleum ether extracted from the crude oil. Cis-11-octadecenoic acid (14.43%) was mainly used for the production of stearate, stabilizer, surfactant, metal soap and softener. Cis-9-Octadecenoic acid (2.21%) can be as raw materials for the production of carbon paper, round bead oil and typewritten wax paper.

Rich biomedicine constituents were in the petroleum ether extracts of the crude oil. Cis-9-Octadecenoic acid can soften blood vessels and treat cholelithiasis (Liu et al. 2018). Elaidic acid (1.39%) can reduce the cholesterol content (Kishi et al. 2018). There were a few bio-energy constituents in the petroleum ether extracts of the crude oil. Ethyl oleate (0.70%) is combustible and can be used as a biofuel (Chen et al. 2018). 9-Hexadecenoic acid is the ideal raw material for biodiesel (Zariri et al. 2016).

A few aroma constituents, cosmetics, and food additives were in the petroleum ether extract of the crude oil. Cis-9-Octadecenoic acid can be used in sugar processing industry and spices. Trans-13-octadecenoic acid (41.86%) can improve the pregnancy rate of lactating dairy cows (Juchem et al. 2010). Many substances in crude oil can be used as cosmetic raw materials. Cis-11-octadecenoic acid (14.43%) is used for emulsifying the two kinds of skin care products, namely, the cream and the cold cream.

(2) Trace component characteristic of petroleum ether extract from first-grade finished oil

15 components were identified from the 15 peaks of petroleum ether extracted from the first-grade finished oil.

The chemical raw materials of the first-grade finished oil were rich in petroleum ether extract. The content of Cis-11-octadecenoic acid is 6.72% in the first-grade finished oil while 14.43% in crude oil. Oleamide (19.69%) can be used as antistatic agent, dispersant stabilizer, metal protector, additive for printing ink. Cis-13-docosenoamide (13.51%) is mainly used for the synthesis of photosensitive materials (Yu et al. 2017).

There were many biomedicine constituents in the petroleum ether extract of the first-grade finished oil. Octasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11 (0.88%) has the characteristics of moisturizing and promoting wound healing, and improves the appearance of scar (Martinez et al. 2017). Oleamide (19.69%) can be used as the raw material for emulsifier (Jeng et al. 2004).

The aroma constituents, the cosmetics were abundant in the petroleum ether extract of the first-grade finished oil. Elaidic acid (9.36%) can be added to food and drink. Cyclopentadecanone, 2-hydroxy (3.86%) is mainly used in beverages, sweets, gum and oral hygiene products. It is widely used in high grade flavor in the field of spice. Cis-13-Docosenoamide (13.51%) is used in food packaging materials as an opener for food packaging (Lago et al. 2016). There were a few bio-energy constituents of the first-grade finished oil in petroleum ether extract. 1-Hexadecanol is flammable (Peng et al. 2017).

(3) Trace component characteristic of petroleum ether extract from refined oil

21 components were identified from the 21 peaks in the petroleum ether extract from the refined oil.

The components of the refined oil are similar as the first-grade finished oil. Trans-13-docosenamide (4.54%) can be used as an opening agent, a smoothing agent and an anti scratch agent. Monoolein could be used as thickeners, surfactants and lubricants. There were a few biomedicine constitutes in the petroleum ether extract from the refined oil. Oleyl alcohol, trifluoroacetate can be used as a carrier for delivery of drugs through skin or mucous membrane, especially in the lungs (Nikkels et al. 2010).

(4) Trace component characteristic of petroleum ether extract from second-grade finished oil

17 components were identified from 17 peaks obtained from the petroleum ether extract of the second-grade finished oil. There were a few chemical raw materials in the petroleum ether extract of the the second-grade finished oil such as Octadec-9-enoic acid (4.55%), Monoolein (5.20%), Oleamide (12.14%) and so on. These can synthesize fluorine-containing compounds, pesticides and dyes (Kai et al. 2012). Cyclopentadecane is an expensive chemical raw material (Takahashi et al. 2018).

There were a small quantity of the biomedicine constitutes in the petroleum ether of the second-grade finished oil. Elaidic acid is used in medical research. Oleic acid synthesized by human body cannot meet the needs, and must be taken from food (Sauvat et al. 2018). The bio-energy is very scarce in the petroleum ether of the second-grade finished oil. 1-Hydroxyoctadecane is inflammable; combustion produces irritating smoke. Its dust can form explosive mixtures with air (Qin et al. 2017).

(5) Trace component characteristic of petroleum ether extract from cold-pressed oil

20 components were identified from 20 peaks from the petroleum ether extracted from cold-pressed oil.

Some chemical raw materials in the petroleum ether extract of the cold-pressed oil. 1-nonadecanol is fine

chemicals, which are often found in tobacco leaves. Oxacyclotridecan-2-one is a domestic chemical reagent, but it has irritation on eyes, respiratory tract and skin.

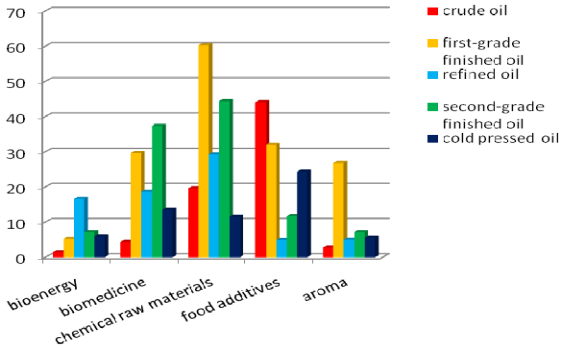

Figure 1: Classification of functions of five oils

The content of chemical raw materials in first-grade refined oil is the highest, followed by second-grade refined. The functional uses of the substances contained in first-grade and second-grade refined oils are extensive, but the content of each substance varies greatly. The highest content of food additives in crude oil decreases gradually with the refining process. Bioenergy substances are the most abundant in refined oils. Except for less than 5% in crude oil, there is little difference in other oils.

IV Conclusion

Crude oil contained a large number of components that are commonly used as raw chemical materials, such as cis-11-octadecenoic acid (14.43%), monoolein (1.56%) and 2-hydroxyethyl oleate (1.21%). Cis-11-octadecenoic acid can be used as surfactants and waterproofing agents. Monoolein is used as fabric finishing agent in textile industry. These three substances could also be used as intermediate. First-grade finished oil included many biomedicines, for example, octadec-9-enoic acid (5.80%), cis-11-octadecenoic acid (6.72%), and 1-hexadecanol (6.23%). The content of cyclopentadecanone, 2-hydroxy is 0.69% in the crude oil, 3.86% in the first-grade finished oil, 3.55% in the second-grade finished oil and 5.90% in the cold pressed oil. Cis-9-hexadecenoic acid has certain therapeutic effect on inflammation. It is also an ideal raw material for biodiesel, and can be used as a bio-energy. These findings suggested that the rich constitutes of five kinds oil could be used as raw chemical materials or developed to high value-added products for cosmetics, biomedicine aroma constituents and food additives via different solvent extraction ways.

References

Chen C, Cai D, Chen H, Cai J, Sun G, Qin P, Chen B, Zhen Y (2018) Tan Simultaneous acetone-butanol-ethanol fermentation, gas stripping, and full-cell-catalyzed esterification for effective production of butyl oleate. Bioprocess Biosyst Eng. 30.

Cheng X, Yang T, Wang Y, Zhou B, Yan L, Teng L, Wang F, Chen L, He Y, Guo K, Zhang D (2018) New method for effective identification of adulterated Camellia oil basing on Camellia oleifera-specific DNA. Arabian Journal of Chemistry 11(6): 815-826

Di TM, Yang SL, Du FY, Zhao L, Xia T, Zhang XF (2017) Cytotoxic and Hypoglycemic Activity of Triterpenoid Saponins from Camellia oleifera Abel. Seed Pomace. Molecules 22(10):1562.

Feng JL, Yang ZJ, Chen SP, El-Kassaby YA, Chen H (2017) High throughput sequencing of small RNAs reveals dynamic microRNAs expression of lipid metabolism during Camellia oleifera and C. meiocarpa seed natural

drying. BMC Genomics 18(1):546.

Gao, W., Wang, Y., Basavanagoud, B., & Jamil, M. K. (2017) Characteristics Studies of Molecular Structures in Drugs. Saudi Pharmaceutical Journal 25(4):580-586.

Jeng, WL, Huh (2004) Lipids in suspended matter and sediments from the East China Sea Shelf. Organic Geochemistry 35(5):647-660.

Juchem SO, Cerri RLA, Villaseñor M (2010) Supplementation with calcium salts of linoleic and trans-octadecenoic acids improves fertility of lactating dairy cows. Reproduction in Domestic Animals 45(1):55-62.

Kang, L, Du, HL, Du X, Wang HT, Ma WL, Wang ML, Zhang FB (2018) Study On Dye Wastewater Treatment of Tunable Conductivity Solid-Waste-Based Composite Cementitious Material Catalyst. Desalination and Water Treatment 125:296-301.

Kishi S, Fujiwara-Tani R, Luo Y, Kawahara I, Goto K, Fujii K, Ohmori H, Nakashima C, Sasaki T, Kuniyasu H (2018) Pro-metastatic signaling of the trans fatty acid elaidic acid is associated with lipid rafts. Oncol Lett 15(4):4423-4426.

Lachmann K, Eckert S, Vogel A (2009) Development of a multifunctional coating system for laser-induced material transport. Progress in Organic Coatings 64(2):294-299.

Lago MA, Ackerman LK (2016) Identification of print related contaminants in food packaging. Food Additives & Contaminants Part A Chemistry Analysis Control Exposure & Risk Assessment 33(3):518-529.

Lam SS, Mahari WAW, Ma NL, Azwar E, Kwon EE, Peng WX, Chong CT, Liu ZL, Park YK (2019) Microwave pyrolysis valorization of used baby diaper. Chemosphere 230: 294-302

Lin P, Wang K, Zhou C, Xie Y, Yao X, Yin H (2018) Seed Transcriptomics Analysis in Camellia oleifera Uncovers Genes Associated with Oil Content and Fatty Acid Composition. Int J Mol Sci 19(1):118.

Liu L, Cheng X, Zhao W, Wang Y, Dong X, Chen L, Zhang D, Peng W (2018) Systematic Characterization of Volatile Organic Components and Pyrolyzates from Camellia oleifera Seed Cake for Developing High Value-added Products. Arabian Journal of Chemistry 11(6): 802-814

Martinez-Pardo I, Shanks RA, Adhikari B, Adhikari R (2017). Thermoplastic starch-nanohybrid films with polyhedral oligomeric silsesquioxane. Carbohydr Polym 173:170-177.

Nikkels AF (2010) Vitamin D and the skin. Journal of Bone & Mineral Metabolism 28(2):117-130.

Peng WX, Wang LS, Mirzaee M (2017) Hydrogen and syngas production by catalytic biomass gasification. Energy Conversion & Management 135:270-273.

Qin J, Wang Y, He G, Chen L, He H, Cheng X, Xu K, Zhang D (2017) High-efficiency Micropropagation of dormant buds in spine base of red pitaya (Hylocereus polyrhizus) for industrial breeding. International Journal of Agriculture and Biology 19(1): 193-198.

Sauvat A, Chen G, Müller K, Tong M, Aprahamian F, Durand S, Cerrato G, Bezu L, Leduc M, Franz J, Rockenfeller P, Sadoshima J, Madeo F, Kepp O, Kroemer G (2018) Trans-Fats Inhibit Autophagy Induced by Saturated Fatty Acids. EBioMedicine 30:261-272.

Takahashi Y, Takuji N (2018) Actinomycetes, an Inexhaustible Source of Naturally Occurring Antibiotics. Antibiotics 7(2):45.

Xiao X, He L, Chen Y, Wu L, Wang L, Liu Z (2017) Anti-inflammatory and antioxidative effects of Camellia oleifera Abel components. Future Med Chem 9(17):2069-2079.

Yang Q, Fang F, Li Y, Ye Y (2017) Neuroprotective Effects of the Nanoparticles of Zinc Sapogenin from Seeds of Camellia oleifera. J Nanosci Nanotechnol 17(4):2394-400.

Yu M A, Yang CJ, Xia SF (2017) Metabolomics Study of Pinus massoniana Pollen Extract and its Preventive Effect on Benign Prostate Hypertrophy in Mice. Modern Food Science & Technology 33(3):8-13.

Zariri A, Pupo E, van Riet E, van Putten JP, van der Ley P (2016) Modulating endotoxin activity by combinatorial bioengineering of meningococcal lipopolysaccharide 14(6):36575