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学 位 論 文 要 旨

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学位論文題目

Lipid characteristics and physiological functions of *Camellia oleifera* seed

学位論文の要旨

Camellia oleifera is an important oil crop, cultivated in East Asia. *C. oleifera* is one of the four major woody oil trees (palm, coconut, and olive) in the world and has been cultivated for more than 2300 years in China, as described in *Classic of Mountains and Seas* in BC. *C. oleifera* seeds consist of a black hard shell and a yellow kernel; the dried kernel contains about 50% oil. Therefore, *C. oleifera* seeds are mainly used for the production of *C. oleifera* seed oil. *C. oleifera* seed oil often substitutes for olive oil, because it is from a woody plant and is rich in oleic acid. Previous studies have shown that 54.1-75.5% of the fatty acids in olive oil are oleic acid, while 76.0-81.4% of the fatty acids in *C. oleifera* seed oil are oleic acid. In addition, *C. oleifera* seed oil contains many bioactive substances, such as polyphenol, flavonoid, squalene and sesamin. *C. oleifera* seed oils were also reported to have antioxidant, anti-inflammatory, antimicrobial, hepatoprotective and gastroprotective properties.

C. oleifera tree can be planted on barren hills and lands for preventing soil erosion and protecting the ecological environment. Furthermore, *C. oleifera* tree can be cultivated in the mountains for providing income to the farmers. Thus, the Chinese government formulated a medium- and long-term development plan for *C. oleifera* and decided to vigorous develop the *C.oleifera* industry in 2009.

However, compared with the olive oil, consumers have a lower overall awareness of *C. oleifera* seed oil, so vigorously carry out the basic characteristics of *C. oleifera* seed oil are needed to provide the basic theoretical basis and scientific basis for improving the market influence of *C. oleifera* seed oil. Furthermore, most countries in the world have not yet formulate the standard for *C. oleifera* seed oil because of the lack of basic data. Thus, in this study, the lipid characteristics and physiological functions of *C. oleifera* and *C. oleifera* seed oil were studied in detail.

First, 3 types of camellia (*C. oleifera*, *C. japonica*, *C. sinensis*) seed oils were systematically compared for their chemical and physical characteristics in Chapter 2. The results indicated significant differences in acid value, peroxide value, iodine value, saponification value and relative density of the above-mentioned camellia seed oils. The *C. japonica* seed oils showed the highest acid value (1.7 mg/g), while the *C. sinensis* seed oils showed the highest peroxide value (17.4 meq/kg). The *C. japonica* seed oils showed the lowest iodine value (79.9 g/100 g), saponification value (192.7 mg/g) and refractive index (1.4633) of all the oils, while the *C. sinensis* seed oils showed the lowest relative density (0.911 g/cm^3). The major fatty acids in the camellia seed oils were palmitic acid, oleic acid and linoleic acid; the oleic acid in *C. oleifera* and *C. japonica* seed oils accounted for more than 80% of the total fatty acids. The oleic acid levels in the *C. oleifera* and *C. japonica* oils were higher than those in the *C. sinensis* seed oils, while the linoleic acid levels in the former were lower than those in the latter one. The triacylglycerol composition was different among camellia seed oils, although the most abundant triacylglycerol molecular species in the camellia seed oils was trioleoylglycerol. Seven sterol species,

squalene and α-tocopherol were detected in the camellia seed oils, however, the contents of tocopherol and unsaponifiable molecules in the *C. oleifera* and *C. japonica* seed oils were significantly lower than those in the C. *sinensis* seed oil. These results demonstrate that the varieties of Camellia affected characteristics of the seed oils.

Next, the lipid characteristics of *C. oleifera* seeds from different cultivar and planting location were compared in Chapter 3. The oil content, fatty acid composition, triacylglycerol composition, tocopherol content and sterol composition were investigated for these seed oils. The oil content in Yuekexia-2 was the lowest (11.6%), while those in other cultivars ranged from 22.3% to 29.6%. Like the Chapter 2, the major fatty acids of *C. oleifera* seed oils were palmitic acid (8.4~11.5%), oleic acid (76.3~80.5%), and linoleic acid (7.9~12.2%), respectively. Trioleoylglycerol was the most abundant triacylglycerol specie (more than 50%) in the *C. oleifera* seed oils. *C. oleifera* seed oils contained 21.2~36.4 mg/100g of α-tocopherol. Seven sterols and squalene were found in all *C. oleifera* seed oils, while the *C. oleifera* seed oils showed significant differences in their contents of unsaponifiable matters. The planting location and the cultivar type significantly affected some of the lipid characteristics with the *C. oleifera* seeds.

In Chapter 4, polyphenols, which were bioactive components contained in *C. oleifera* seeds, were qualified and quantified. Compared with the other oil crops, *C. oleifera* seeds contained more polyphenols and showed strong antioxidant ability. On the other hand, it was suggested that cultivars and planting location of *C. oleifera* could affect the polyphenol content and antioxidant capacity. In addition, kaempferol, as a flavonoid, with the form of glycosides was identified as the main component of polyphenols contained in *C. oleifera* seeds.

Since *C. oleifera* seed oil is mainly used for cook, its oxidation stability and thermal stability were evaluated in Chapter 5. In this study, four oils, including soybean oil, rapeseed oil, olive oil, and *C. oleifera* seed oil, were oxidized or heated. The results showed that the oxidation stability and thermal stability of *C. oleifera* seed oil were similar to olive oil, significantly better than soybean oil and rapeseed oil. Thus, the effects of unsaponifiables in olive oil and *C. oleifera* seed oil such as squalene, lanosterol and β-amylin on the deterioration of the oil during frying were investigated. It was found that these unsaponifiables did not affect the oxidation of oils.

Finally, the effects of dietary *C. oleifera* seed oil on lipid metabolism in rats were investigated in Chapter 6. The results showed that *C. oleifera* seed oil and olive oil did not lower the plasma total cholesterol in rats fed a high cholesterol diet. However, *C. oleifera* seed oil lowered the plasma triacylglycerol concentration.

These studies concerning with the lipid characteristics and physiological functions of *C. oleifera* seeds from several angles provide basic data for the future development of the *C. oleifera* industry. *C. oleifera* seeds are expected to be widely applied in the fields of food, industrial products, cosmetics, and pharmaceuticals in the future.