Journal of Medicinal Plants Research Vol. 5(4), pp. 485-489, 18 February, 2011
Available online at http://www.academicjournals.org/JMPR
ISSN 1996-0875 ©2011 Academic Journals

Review

Research progress on the health function of tea oil

Li He*, Zhou Guo-ying, Zhang Huai-yun and Liu Jun-ang

Central South University of Forestry and Technology, Forestry biotechnology key laboratories, Biotechnology Core Facilities, College of Forestry, Changsha, Hunan, 410004, China.

Accepted 7 December, 2010

Tea oil comes from unique woody oil trees in South China and is one of the four woody edible oils in the world. Tea oil is the edible oil obtained by squeezing mature seeds of oil tea. The unsaturated fatty acid content in tea oil can reach as much as 90%, which is the highest amount so far for unsaturated fatty acid in edible oil. The content of catechin in oil tea is about 80%, which have good whitening and anti-oxidation effects. Tea polyphenol is a natural antioxidant with significant antioxidation, which can eliminate free radicals, protect cell membrane structures, etc. Camellia saponin has many functions: Anti-permeability, anti-inflammatory, analgesic, anticancer, etc. Squalene is a kind of polyphenolic active composition with good oxygen-enriched capacity in oil tea. This paper summarizes the fatty acid composition and some functional components of tea oil, and its functions of anti-tumor, lipid-lowering, liver and heart protection, antisepsis and anti-inflammation, coronary heart disease prevention, delay of atherosclerosis, anti-oxidation, and regulation of the immune function. This paper aims to lay the foundation for further study and use of the medicine and health functions of tea oil.

Key words: Oil tea, tea oil, health function.

INTRODUCTION

Oil tea (*Camellia oleifera*), the camellia of theaceae, is classified as perennial woody plants (Figure 1). It comes from unique woody oil trees in South China, and is one of the four woody edible oils in the world. Tea oil is the edible oil obtained by squeezing mature seeds of oil tea. Tea oil is a kind of high quality edible oil with clear color, pure quality, and rich nutrients. Its fatty acid composition is similar to the best vegetable olive oil, and is even well known around the world as “oriental olive oil.” Oil tea contains a variety of functional components. Long-term intake of oil tea can significantly prevent cardiovascular sclerosis, lower blood pressure, lower blood lipid, delay atherosclerosis (AS), increase gastrointestinal absorption function, promote hormone secretion of endocrine glands, prevent decline of neurological function, improve human immunity, and prevent cancer (Wu et al., 2005).

THE FATTY ACID COMPOSITION OF TEA OIL

Qualitative analysis of the fatty acid composition of tea oil shows that the main fatty acid compositions are relatively stable. It is mainly composed of oleic acid (C18:1, 78 to 86%), linoleic acid (C18:2, 8.6%), linolenic acid (C18:3, 0.8 to 1.6%), palmitic acid (C16:0, 8.8%), and stearic acid (C18:0, 2.0%). Its monounsaturated fatty acids (MUFA) content is greater than that of olive oil (80%), while its unsaturated fatty acids completely comply with international nutritional standards of “Omega meals.” It is rich in higher vitamin E (that is, twice as much as olive oil); contains squalene and flavonoids which has better anti-cancer and anti-inflammatory functions; and can be produced without pollution from any pesticide and chemical fertilizers (Liao et al., 2005; Lai et al., 2007).

THE OTHER FUNCTIONAL COMPONENTS OF TEA OIL

Camellia saponins

Camellia saponin has many functions: Sterilization, bactericidal, anti-permeability, anti-inflammatory, phlegm reduction, anti-itching, anti-cough, analgesic, anticancer, insecticidal, deworming, etc. Camellia saponin belongs to the saponin of triterpene glycosides. It is a better natural

*Corresponding author. E-mail: csuftlihe@163.com.

Figure 1. Tea oil tree.

surfactant with surface activities with high efficient emulsification, dispersion, wetting, etc. It is one of the main ingredients of the new type pesticide with low toxicity and high efficiency; can be used widely in insecticide, fungicide, and clinical preventive and treatment of the skin disease infected by bacteria and fungi (Jiang et al., 2003).

Tea polyphenol

Tea polyphenol is the mixture of catechin S, flavonol, phenolic acid and depside, and other polyphenols. The content of catechin in oil tea is about 80%. Tea polyphenol is a natural antioxidant with significant antioxidation, which can eliminate free radicals, protect cell membrane structures, inhibit histamine from releasing mast cells, reduce the amount of cytokine formation, and then to facilitate anti-allergy or similar functions to reduce inflammation, slow down human aging, prolong human life, and fight tumor (An et al., 2006). The study of Liu Lingang et al. (2005) has confirmed that tea polyphenol can significantly inhibit tyrosinase. It can also inhibit tyrosinase activity, possibly through antioxidant functions and the clearing of free radical activities. Tea polyphenol has inhibitive and killing effects on proteus vulgaris, staphylococcus infection, staphylococcus epidermidis, streptococcus mutans, clostridium botulinum, lactobacillus, vibrio cholerae, and other pathogenic bacteria in different degrees, thus effectively preventing staphylococcus infection of antibiotic-resistance and inhibiting hemolysin activity (Liang et al., 2004; Zhao et al., 2005). In addition, tea polyphenol can lead to pathogenic fungi of human skin diseases with stronger inhibitory effect (Chen, 1998); protect, restore, and treat damages from ionizing radiation for hematopoiesis and the immune system (Cao, 1998); and promote growth of skin keratinocytes cells, maintain proliferation of cell cycles, and inhibit normal skin from having keratinocytes (Fu et al., 2000). The pharmacological action of tea polyphenol can be explained by the unique protection and treatment function of the skin, as it can effectively prevent UV damage, aging, wrinkling. It can also promote skin whitening while preventing acne, edema, and allergies.

Squalene

Squalene is a kind of polyphenolic active composition with good oxygen-enriched capacity. This means that it has anti-hypoxia and anti-fatigue abilities, and can improve human immunity and increase gastrointestinal absorption (Zhao et al., 2004).

The bioactive compound squalene was detected in seed oil of *Camellia oleifera*. Squalene in the seed oil is on relative high level (Li et al., 2006). Squalene has been proposed to be an important part of the mediterranean diet as it may be a chemopreventative substance that protects people from cancer (Smith et al., 2000; Owen et al., 2004). Squalene is a hydrocarbon and a triterpene, and is a natural and vital part of the synthesis of

cholesterol, steroid hormones, and vitamin D in the human body (www.rpi.edu). Squalene is used in cosmetics, and more recently as an immunologic adjuvant in vaccines.

Squalene is used in cosmetics as a natural moisturizer. It penetrates the skin quickly, does not leave a greasy feeling on the skin and blends well with other oils and vitamins. Squalane is a saturated form of squalene in which the double bonds have been eliminated by hydrogenation. Because squalane is less susceptible to oxidation than squalene, it is more commonly used in personal care products. Toxicology studies have determined that in the concentrations used in cosmetics, both squalene and squalane have low acute toxicity, and are not significant human skin irritants or sensitizers (Christian, 1982).

THE BIOACTIVE FUNCTION OF TEA OIL

Anti-tumor

Unsaturated fatty acid, especially essential fatty acid, has significant anti-tumor effects. Biological membrane plays a very important role in various metabolisms of the human body. It also offers a series of biochemical reactions carried in the membrane. When membrane phospholipid is undersupplied and oxidized by unsaturated fatty acid, it will result in cell dysfunction, abnormal structures of the cell membrane and mitochondria, and cell carcinogenesis. Siegel (1987) studied a variety of free fatty acids and their effects on the ascites tumor cell of rats, and reported that unsaturated fatty acids could kill tumor cells *in vitro.* When linoleic acid (that is, linolenic acid complex) was injected in rats suffering from cancer, it significantly improves their survival time. According to statistics, cancer is minimal for Eskimos, as they typically ingest plenty of essential fatty acids. In addition, according to a survey on epidemics in Mediterranean coast countries, fat supply take up 40% of total energy, but the mortality of coronary heart disease (CHD) and tumor is very low; this may be related to the consumption of olive oil, which is rich in oleic acid (Matton, 1985; Barradas, 1990).

Reducing blood lipid

Too much fat in one's diet can adversely affect the lipid metabolism of the body (Wang et al., 2007). This is the reason why in the early periods, people would reduce their intake of dietary fats, as doing so would decrease blood lipid. Deng Ping et al. (1993) studied the effects of tea oil intake on the blood lipids of normal adults by randomly dividing 120 test objects into 3 groups: Edible tea oil, blend oil, and market oil (50 g/d). Based on required dietary measures, the recommended energy intake should correspond to daily energy allowance (RDA) of above 90%, in which fat energy supply should about 30% of total energy. After consuming 40 g/d, the test objects of blood three acids glyceride (TG), blood cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) decreased by 15.9, 9.6, and 13%, respectively. The difference is highly significant at $P<0.01$. Blood high-density lipoprotein cholesterol (HDL-C) also increased slightly. These comprehensive effects are most favorable in preventing cardiovascular diseases (e.g., CHD), as tea oil is rich with MUFA. Subsequently, Wang Ping et al. (1993) studied the effects of tea oil on animal blood lipids and platelet functions. Their study results showed that tea oil reduces blood platelet aggregation rate of rats and the TXB2/6-Keto-PGF1α ratio; increases MUFA content in blood platelet membranes; and decreases the content of polyunsaturated fatty acids (FUFA). Deng Xiaolian et al. (2002) selected common medicine, food, and Chinese herbs as excipient, and then utilized these for health care-related tea oil while maintaining their original flavor. Wistar male white rats were used as test object species. Health tea oil fed through the mouth was administered to rats from each test group. Results showed that health tea oil could lower both TC and TG serums of rats. Moreover, no significant effect was observed on the weight of rats.

Protecting liver and heart

Zhou et al. (2000) used adult SD rats as study objects on the protective effect of tea oil (with unsaturated fatty acid) on obstructive liver jaundice. Rats divided into sham-operation, bile duct ligated, and bile duct ligated groups were fed with tea oil. Two weeks later, after surgery, the serum levels of total bilirubin (TB), direct bilirubin (DB), glutamic pyruvic transaminase (GPT), glutamic oxaloacetic transaminase (GOT), and succinate dehydmgenase (SDH) were checked in the liver tissue. The pathological changes of the liver tissues were also observed by light and electron microscopy. The results showed that tea oil could significantly improve the nutritional status of obstructive jaundice rats and lower the serum levels of TB, DB, GPT, GOT, as well as enhance SDH activity in the liver mitochondria to a certain extent. It can also maintain the structural integrity of liver mitochondria, endoplasmic reticulum, and nuclear membranes. They believed that tea oil could protect the rat livers from obstructive jaundice, either in form or in function.

Zhou et al. (2000) studied the heart protective function of tea oil rich with MUFA for obstructive jaundice in rats. Results showed that tea oil could significantly improve the nutritional status of obstructive jaundice. It could also significantly decrease the serum levels of TB, DB, GPT, and GOT; enhance SDH activity in the cardiac muscle mitochondria; and, to a certain extent, maintain the structural integrity of the mitochondria membrane,

nuclear membrane, and myofilament of the cardiac muscle. They believed that tea oil could protect the rat hearts from obstructive jaundice, either in form or in function.

Antisepsis and anti-inflammation

Tea oil takes the form of a colorless to light yellow liquid, and is an excellent oil used for skincare. It can effectively prevent skin infections, and is widely used as an antibacterial for gram-positive bacteria, gram-negative bacteria, and fungi. It attaches on the skin surface and can penetrate deep into the skin for efficacy purposes, directly affecting the sources of infection, as well as to maintain and promote normal metabolism of healthy skin. Feng (2001) mainly used tea oil to treat herpes zoster, soft tissue contusion, and water and fire scald. Yuan et al. (2005) treated 45 cases of perianal friction erythema by external application of tea oil and achieved satisfactory result with quick erythema regression. Zhu et al. (2005) treated 60 cases of infant diaper dermatitis by external washing of Chinese herbal medicine and eternal application of tea oil, consequently demonstrating curative effects.

Coronary heart disease prevention

Health and vegetable oil corresponds to the fatty acid composition of oil and its fat-soluble active substances. Many studies have shown that tea oil can effectively prevent cardiovascular disease because it is rich in unsaturated fatty acids. Oleic acid tea oil minimal influence on body tissue, but it can significantly maintain body health, as well as inhibit and prevent hypertension, cardio-cerebrovascular diseases, etc. Results from investigation on the Chinese population and the epidemic disease of 65 counties showed that the oleic acid content of erythrocyte lecithin among individuals is correlated significantly and negatively with mortality from CHD (Chen et al., 1991). The study of Deng et al. (1993) showed that TG, TC, and LDL-C decreased by 15.9, 9.6, and 13%, respectively, after consuming tea oil, unlike for HDL-C, indicating ability to prevent CHD.

Delaying atherosclerosis

Tea oil can delay the formation of AS. Chen et al. (1996) used Japanese big ear male rabbits and Wistar male rats as test objects and divided them into tea oil (TO), safflower oil (SO), and lard oil (L) groups. Results showed that tea oil can significantly delay AS formation, and its mechanism might have been affected after the inclusion of tea oil MUFA into the tissue. Such takes effect with decreased blood and liver lipids, increased HDL-C/TC ratio, inhibited thromboxane (TXB2) release, increased body antioxidant enzyme SOD and GSH-Px activity, and lowered regeneration of plasma and liver lipid peroxide (LPO).

Anti-oxidation

Zhang (2006) showed higher antioxidant enzyme (SOD) activity. Results showed that tea oil served as anti-active oxygen species in body tissues. To some extent, tea oil can increase antioxidant enzyme activity.

The antioxidant poperties of tea oil were evaluated by scavenging ·OH produced by Vc-Cu^{2+}-H_20_2-yeast polysaccharides system and the stable DPPH free radical. Zhang (2006) showed that the refined tea oil is capable to scavenge the ·OH free radicals with an IC_{50} of 0.7165 µg/ml equivalent to that of 5.31 µg/ml quercetin. Methanol exhibited pronounced radical scavenging activity against the stable DPPH radical (with antioxidant capacity IC_{50} value of 52.37 µg/ml). The presence of phenolic compounds and flavonoids in each extracts may be responsible for its individual antioxidant activity, and the lipophilic phenolic fractions would likely account for a great part of the antioxidant properties of the oil (Zhang, 2006).

Immune function regulation

Tea oil can regulate the functions of the immune system. Feng et al. (1996) studied three kinds of unsaturated oil and fat with different kinds of oil (e.g. tea oil, corn oil and fish oil), as well as their effects on the immune function of mice and the function of LPO in the body. Clearly, the effects of the three kinds of unsaturated fats on the immune system of mice were different. Based on all immune indexes, the positive regulatory immunological function of tea oil was the strongest, possibly because it presented the most MUFA content, while the highest content of n-3PUFA was for fish oil, as this is prone to LPO and immune function prevention.

Conclusions

Based on extant literature, the 90% content of unsaturated fatty acids in tea oil is thus far the highest among edible oils. In the body, unsaturated fatty acids are essential substances, but it cannot be synthesized and must be first supplied with food. An undersupply of unsaturated fatty acids will result in dry skin and hair loss. The health function of tea oils is mainly embodied in their “non-polyester” components. In tea oil, the content of unsaturated fatty acid is high, and hence, can be easily absorbed and digested, while unlike general edible oil, which will change into fat after consuming if it is not digested, and it will accumulate in viscera and subcutaneous tissue, and be prone to cause obesity or

other diseases. In this sense, tea oil can be used for weight loss. Tea oil is also a well-known tonic for pregnant women; by consuming it, women after childbirth can eliminate abdominal fat accumulated during pregnancy and can help ensure rapid recovery. As for the human body, consuming tea oil can improve human enzyme activities, increase metabolic rate, improve constitutes, strengthen bidirectional regulation, and maintain high energy.

With a deepened understanding of tea oil, its medical mechanism can be clarified gradually. However, current studies are mostly limited to the tea oil itself, but the kind(s) of components of tea oil (that is, main functions) remain(s) largely speculative. Therefore, further identification and application of the medicinal and health care components of tea oil are important directions for future studies.

ACKNOWLEDGEMENT

The research of this dissertation is supported by The National Eleventh Five-Year Program on Science and Technology in China (No. 2009BADB1B0204).

REFERENCES

An Z, Zhou JY (2006). Tea polyphenols induces cell apoptosis of highly metastatic human lung cancer *in vitro*. Zhejiang Med. J., 28(7): 523-525.

Barradas MA (1990).The effect of oil supplementation on human platelet function, serum cholesterol related variblesand plasma fibrinogen concentration. Nutr. Res., 10: 403.

Chen JS (1991).Diet Life style and mortality in China,a study of the characteristics of 65 chinese counties. Oxford Univ.Press, Comell Univ. Press, People's Med. Pub. House, pp. 391-397.

Chen MF, Gu JF, Sun MT, Yang HB, Zhang SQ, Liu YJ (1996). Effect of tea-seed oil on the atheromatic formation and its mechanism. Acta. Nutrimenta. Sinica., 18(1): 13-19.

Chen QY (1998). Inhibition of tea to harmful bacteria. Tea Commun., (4): 32-36.

Cao MF (1998). Tea polyphenols protective effect of radiation damage to mice. J. Tea Sci., 18: 139-144.

Christian MS (1982). Final report on the safety assessment of squalane and squalene". J. Am. College Toxicol., 1(2): 37-56.

Deng JR (1993). Study on the influence of normal blood of Oil tea. Acta. Nutrimenta. Sinica., 15(3): 289-291.

Deng PJ, Zhang YH, Huang JX (1993). A study of the effect of tea seed oil on serum lipid in normal adults. Acta. Nutrimenta. Sinica., 3: 289-292.

Deng XL, Xie GS, Huang SG (2002). Study on the health care oil tea and just the function of lipid. China Oils and Fats, 5: 96-98.

Fu YC, Wei SM, Lin HF, Zhang Y (2000). Effects of tea polyphenols on cell kinetics and apoptosis of primary cultured rat skin keratinocytes. J. Hyg. Res., 29(2): 94-96.

Feng X, Zhou YZ (1996). Influences of feeding tea seed oil, corn oil and fish oil on immune status in mice. Acta Nutrimenta Sinica, 18(4): 412-417.

Feng PG (2001). Application of Oil tea. China's Naturopathy, 9(10): 59.

Jiang HP, Sun LF (2003). Extraction and its application research progress of tea saponin. Jiangxi Chem., 4: 52-57.

http://www.rpi.edu/dept/bcbp/molbiochem/MBWeb/mb2/part1/cholesterol.htm#prenyl.

Liao SJ, Ji DL, Tong HR (2005). Study on fatty acid compostion and nutrition health protection function of the Oil tea Camellia Seed Oil. Food oil, 6: 7-9.

Lai MS, Yang L (2007). Pharmacology and clinical application research progress of tea Oil. J. External Ther. T.C.M., 16(3): 6-7.

Liu LG, Yan YJ, Wu XZ (2005). The inhibitory effect of green tea polyphenols on tyrosinase. China J. Leprosy Skin Dis., 21(2): 103-104.

Liang WH, Liu JG, Wu JY, Wang K, He QM (2004). Antibacterial activities of tea polyphenols to streptococcus mutans *in vitro*. Acta. Acad. Med. Zunyi, 27(3): 230-231.

Li Dong M, Wang J, Liang W, Zhao ZD (2006). Influence of Extraction Method on Content of B ioactive Component Squalene in Seed Oil of Camellia Oleifera Abel. Biomass Chem. Eng., 40(1): 9-12.

Matton F (1985). Comparison oil effects of dietary SFA, MUFA and PUFA on plasma lipids in man. J. Lipid Res., 26: 194.

Owen RW, Haubner R, Würtele G, Hull E, Spiegelhalder B, Bartsch H (2004). Olives and olive oil in cancer prevention. Eur. J. Cancer Prev., 13(4): 319-326.

Siegel I, Liu TL, Yaghoubzadeh E, Keskey TS, Gleicher N (1987). Cytotoxic effects of free fatty acids on ascites tumor cells. J. Natl Cancer Inst., 78(2): 271-277.

Smith TJ (2000). Squalene: potential chemopreventive agent. Expert. Opin. Investig. Drugs, 9(8): 1841.

Wang WJ, Chen CG, Chen J (2007). The positive role of medical care of Oil tea. Food Nutr. China, 9: 48-51.

Wang P, Wang C, Zhang J (1993). Effect of tea seed oil on blood lipids and platelet function in animals**.** Acta. Nutrimenta. Sinica., 4: 377-384.

Yuan Q, Li LS, Su XM (2005). Observation and care of treatment of friction use raw oil tea. Modern J. Integr. Trad. Chin. Western Med., 12(3): 336.

Zhu MZ, Zhu SH, Huang RL (2005). Effect analysis of herbal treatment outside washed diapers dermatitis. Nurs. Foreign Med. Sci., 24(7): 360-361.

Wu XH, Huang YF, Xie ZF (2005). Health functions and prospective of Camellia oil. Food Sci. Technol., 5: 94-96.

Zhang B, Zhou YZ (1995). Effects of tea seed oil and soybean oil on free oxygen radical and activities of antioxidative enzymes in rats. Acta. Nutrimenta. Sinica., 6: 199-203.

ZHOU B, Peng SY, MOU YP (2000). Experimental study on the protective effect of tea oil on the liver with obstructive jaundice. J. Wen zhou Med. College. 3:193-195.

Zhou B, Peng SY, Mou YP (2000). Experimental study on the protective effect of tea oil on the heart in obstructive jaundice, 4: 308-410.

Zhao A Y (2005). Development of natural antioxidant tea polyphenol. China Food Additives, 5: 78-80.

Zhao ZD, Sun Z (2004). Research progress on natural resources and application of the bioactive substance--Squalene. Chem. Ind. For. Prod., 24(3): 107-112.

Zhang ZY (2006). Study on the radiation activity of antioxidant ingredients and mechanism of Tea Oil. Zhejiang University Press, p. 1-36.