台灣農業研究 (J. Taiwan Agric. Res.) 62(3):249–258 (2013)
DOI: 10.6156/JTAR/2013.06203.05

Effects of Roasting Prior to Pressing on the Camellia Oil Quality

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Abstract

Hsieh, C. M., J. C. Yang, Y. C. Chuang, E. I. C. Wang, and Y. L. Lee. 2013. Effects of roasting prior to pressing on the camellia oil quality. J. Taiwan Agric. Res. 62(3):249–258.

Oil tea camellia seed oil serves as a culinary oil in China for over two thousand years. It has many remedial functions as described in ancient Chinese medicine books, such as mitigating blood circulation, nourishing gastrointestinal tract, improving eyesight and detoxification. Camellia oils sold in Taiwan are manufactured by traditional pressing methods and without refining. Standard processing procedures include dehulling, milling and pressing. A roasting treatment can be added between the dehulling and milling stages, but little is scientifically known about its advantages or disadvantages. In this study three camellia seeds, *Camellia oleifera*, *Camellia tenuifolia* and *Camellia sinensis*, were treated to different roasting conditions at various temperatures and times. The resulting oils were analyzed with respects to acid value, peroxide value, fatty acid composition, and phenols content to investigate their quality and characteristics. Our results suggested that with adequate roasting treatments the camellia oil quality can be improved and become oxidatively more stable.

Key words: Oil tea camellia seed oil, Roasting, Oil quality, Oil oxidative stability, *Camellia oleifera*.

INTRODUCTION

Oil tea camellia seed oil, namely camellia oil, has been used as a culinary oil in Chinese family for over two thousand years. In the 'Compendium of Materia Medica' written by Shizhen Li (1518–1593 AD) the camellia oil has been touted to have functions of mitigating circulation, nourishing gastrointestinal tract, improving eyesight and detoxification (Shen *et al*. 2012). A review by Li *et al*. (2011) provided bioactivity information of camellia oils to include functions of reducing oxidation, inflammation, neoplasma, hyperlipidermia, protecting heart and liver, and improving human immunity. Camellia oils have a similar fatty acid composition as that of olive oil, high in oleic acid (C18 : 1) which could reach over 80% (Zhong *et al*. 2007). The oleic acid-rich oils have been proven to reduce blood cholesterol and the risk of cardiovascular disease (Kris-Etherton 1999). In addition to the fatty acid compositions the camellia oils possess several active ingredients other than those of olive oil, such as tea polyphenols and tea saponins (Li *et al*. 2011). So far, the most emphasized benefit of consuming camellia oils is on their ideal fatty acid composition. Whereas in a more sophisticated experiment, two lignans (one of which was sesamin) showed good anti-oxidation activities for the *Camel-*

Received: April 23, 2013; Accepted: July 22, 2013.
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lia oleifera oil (Lee & Yen 2006). There are still many unidentified active ingredients in the oil remain to be explored.

In Taiwan there are three categories of camellia oils in the commercial market, *Camellia oleifera*, *Camellia tenuifolia* and *Camellia sinensis*; the former two have the bioactivities described as above, the third is a byproduct of green tea plantation. *C. oleifera* is the major species of cultivation in China. *C. tenuifolia*, on the other hand, is a unique species distributed in broadleaf forests of north Taiwan, and its seed oils are considered more valuable than that of the *C. oleifera*. All three camellia oils are sold in organic shops and command substantially higher prices than other vegetable oils offered in supermarkets. The main reason people are willing to buy them is that they are claimed to have biological activities and low herbicides/artificial-chemicals contaminations. In general, all commercial camellia oils are sold as unrefined crude oils in Taiwan.

Pursuing high quality and healthy food is always the prime objective of food manufacturers. For good quality, manufacturers generally focus on good material sources which are the root of all, and then followed by good producing processes. In camellia oils production, three steps, dehulling, milling and pressing, are applied to dry camellia seeds to obtain crude oils. In order to increase yield, most manufacturers resort to steam the milled seed meals before pressing. The effect of steaming is thought to allow hot water vapor to enhance aggregation of oil droplets, expel them from tissues, and thus increase the yield. However, water content is conceivably also an acidification factor of oils as it reacts with triacylglycerols (TGs, neutral lipid, the main component of oil) to produce free fatty acids. Therefore, conversely, some manufacturers instead apply a roasting treatment after dehulling to reduce the moisture content in camellia seeds.

In this study, roasting treatment was applied at different temperatures and times to seeds. The resulting oils were analyzed with respect to their acid value (AV), peroxide value (POV), fatty acid composition, and phenols content to investigate their quality and characteristics. Oil stability was measured by the oil Rancimat method (Lampert 1999) which helps gauging the oil's resistance to oxidation and predicting oil shelf life/stability at different temperatures.

MATERIALS AND METHODS

Camellia seeds and oil pressing process

The *C. tenuifolia* and *C. sinensis* seeds were harvested from trees grown in northern Taiwan, and *C. oleifera* seeds were harvested at the same time from a Mainland China source. The seeds were dried in a shade at room temperature, and the hulls and kernel shells were then removed. The kernels were roasted with a coffee bean roaster (ET-2, Xiong-Bang Ltd., Taoyuan, Taiwan) at temperatures of 110, 120 and 130℃ for 5, 10 or 15 min. Briefly, each roasting treated about 300 g kernels which were placed into the roaster when the pre-set temperature was reached. The temperature would decrease temporarily because of the kernel loading, but return to the pre-set temperature within 3 min, and then the timer started the countdown. The unroasted kernels served as the control set. After cooling to room temperature, the kernels were pulverized with a pulverizing machine (RT-08, Rong Tsong Precision Technology Co., Taichung, Taiwan). The pulverized meals were sieved with a 10 mesh sieve and then wrapped in two layers of cloth. An oil presser (Golden Flower Tea Oil Production Co., Miaoli, Taiwan) was used following a pressure program of 600 psi for 11 min, 1,000 psi for 40 min, and 2,800 psi for 15 min. Pressing was done at room temperature. Each pressing treated about 1 kg of kernel meals, and the yield was calculated by subtracting the weight of oil cake (including the cloth) after pressing from the original weight and dividing by the latter.

Acid value and peroxide value

Acid value is the amount of carboxylic acid in oil which can be neutralized with potassium hydroxide (KOH). An autotitrator 785 DMP Trino (Metrohm, Switzerland) was used to determine the acid value of the oils following the instruction of the instrument. In which, about 2 g of oil dissolved in 50 mL of solvent (toluene : isopropanol : dd H_2O = 500 : 495 : 5) was titrated with tetrabutylammonium hydroxide (0.1 M in isopropanol : methanol = 2 : 1, v/v, 35435 Fluka, Sigma-Aldrich, Saint Louis, MO). Oil peroxide value (POV) was determined according to the AOCS Official Method 965.33, but the oils weights were reduced to 2.50 g, a half of the standard method.

Fatty acid composition

The oil samples were first derived with methanol to form fatty acid methyl esters (FAME). In which, one drop of oil (ca. 0.015 g) was dissolved in 1 mL *n*-hexane (containing internal standard 3.0 mg methyl heptadecanoate, Sigma-Aldrich), added with 60 μL of 2 N KOH (in methanol), vigorously shaking for 10 min on a Vortex shaker. The reaction was stopped by adding 0.4 mL saturated sodium chloride solution (36 g dissolved in 100 mL dd H_2O). The mix-

ture was then centrifuged at 12,000 × *g* for 2 min to separate the *n*-hexane and aqueous (containing methanol) layers. The *n*-hexane layer was filtered with 0.45 μm PVDF filter (Millex-HV, Millipore, Darmstadt, Germany) and diluted 100 folds and then injected to a gas chromatography coupled to a mass spectrometry (GC-MS) analysis (Varian CP-3800 GC, MS 4000, Palo Alto, CA). The separation column was CP8822 (Vf-23ms 30 M × 0.25 mm, ID DF = 0.25, Varian), and the injector temperature was set at 240℃, the helium carrier gas flow rate was set at 1 mL min^{-1}, with a split ratio of 100 : 1. The oven temperature program was as follows: 1 min at 100℃, 15℃ min^{-1} to 185℃, and 8 min at 185℃. One μL of the sample was injected. The standards references were the Supelco FAME Chemical Standards (Sigma-Aldrich).

Total phenols

The method of Singleton & Rossi (1965) was modified for the oil samples. Firstly, the samples were mixed with isopropanol (1 : 1, v/v), and then a 15-μL of the mixture was added to 240 μL distilled water, 15 μL Folin-Ciocalteau's phenol reagent (Sigma Co.) and 30 μL 35% $Na_2CO_{3(aq)}$ (Sigma Co.). After vigorous vortexing, and centrifuging at 13,000 rpm for 2 min, undissolved oil floating to the meniscus was withdrawn, and a 200-μL aliquot was used for the absorbance measurement at 750 nm, each sample in triplicates. Gallic acid (GA) (Sigma Co.) as a standard was dissolved in distilled water at concentrations of 0, 0.1, 0.2, 0.3, 0.4 and 0.5 mg mL^{-1}.

Oil stability

Oil stability index (OSI) assay was conducted to measure the oil stability. OSI is the time in hours of an oil sample reaching maximum change in conductivity during oxidation at 110 or 130℃. The change was caused by the production of deteriorated, volatile organic compounds (Lampert 1999). This method can be applied for comparing stabilities of parallel oil samples and predicting their stable periods at various temperatures. The oil deteriorating reaction can deduce the equation $t = A \times e^{(B \times T)}$ (where t is heating temperature, T is time of OSI, A and B are derived from experimental data). With continuous aeration, oil oxidation is accelerated, and the predicted stable periods can be considered as the 'shortest' ones, since ordinarily oil is not aerated in usage.

A Rancimat apparatus (873 Biodiesel Rancimat, Metrohm AG, Switzerland) was used for the analysis. Each 3.00 g of oil sample was tested at a set of testing temperatures of 120, 130 and 140℃, with continuous aeration at 10-L h^{-1} air flow. The effluent gas led into a test cup containing 60 mL of distilled water was monitored for electrical conductivity (EC) during the entire process. To predict oil stable period at different temperatures, a line equation was deduced from the temperature set (120, 130 and 140℃). Its regression coefficient r must be higher than 0.9 for the predicted stable period to be considered reliable.

RESULTS

Roasting of camellia seeds—observation and yield

Seeds of the three kinds of camellia, *C. tenuifolia*, *C. oleifera* and *C. sinensis*, were subjected to different roasting temperatures (110, 120 or 130℃) and times (5, 10 or 15 min) combinations. The roasting treatment slightly reduced their water contents. The most vigorous treatment (130℃ for 15 min) reduced the water content the most, about 5% (data not shown), and its resultant oil was the most viscous one compared to the others. Their oil yields are shown in Fig. 1. The roasting characteristics of the former two camellia oils were similar, and their yields were markedly higher than the last. The roasting treatments slightly reduced the yield of *C. tenuifolia* and *C. oleifera* oils; with about a 4% decrease in samples roasted at the highest temperature. The *C. sinensis* showed a gradual and marked decreasing trend with the roasting temperature and the yields decreased from unroasted 20% to only 9%. The average yields of *C. tenuifolia*, *C. oleifera* and *C. sinensis* were 35.6, 33.6 and 12.4 g 100 g^{-1} of kernels, respectively (Table 1).

Acid value and peroxide value

Acid value (AV) is an important indicator of oil quality, and it is defined as the amount of mg KOH used to neutralize free fatty acids in 1 g of oil. Water, acid and base in the oil and ambient temperature are the main factors in oil deterioration, known as 'rancid', which can occur in the processes of manufacturing, storage and cooking. Many countries have their own regulations for edible oil merchandise. For refined oils the regulation is much more restrict than those directly pressed (crude oils). In Taiwan, acid values of refined oils are varied but all must be lower than 0.6 (mg KOH g^{-1} oil); and for pressed oils, the values for peanut oil is 2.0, and the sesame oil is 4.0. All the assayed oil samples were less than 1.0, except for unroasted *C. oleifera* oil (AV 1.2, Fig. 2). Comparatively, the AV variations in *C. oleifera* oils were larger than those in the other two camellia oils. The average AVs of *C. tenuifolia*, *C. oleifera* and *C. sinensis* were 0.50, 0.78 and 0.66, respectively (Table 1).

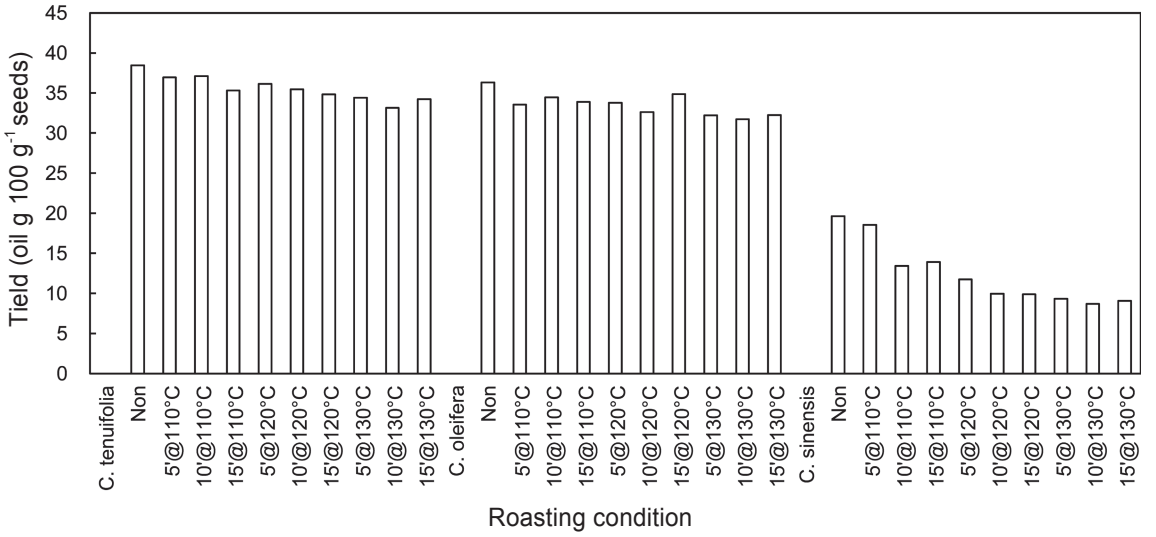

Fig. 1. Yields of three kinds of camellia oils with different roasting conditions.

Table 1. Comparison of three kinds of camellia oils on yields and some characteristics.

AVG ± SD[z]	*Camellia tenuifolia*	*Camellia oleifera*	*Camellia sinensis*
Yield	35.61 ± 1.57	33.57 ± 1.42	12.42 ± 3.95
AV	0.50 ± 0.05	0.78 ± 0.21	0.66 ± 0.03
POV-1	9.42 ± 2.67	4.32 ± 0.92	2.72 ± 3.03
Roasted only	9.77 ± 2.57	4.31 ± 0.98	1.83 ± 1.21
POV-2	10.04 ± 3.01	4.83 ± 1.08	3.13 ± 4.31
Roasted only	10.34 ± 3.04	4.77 ± 1.12	1.77 ± 1.50

[z] AVG ± standard deviation. Units: yield, g oil 100 g^{-1} kernels; AV, mg KOH g^{-1} oil; POV, meq peroxide kg^{-1} oil.

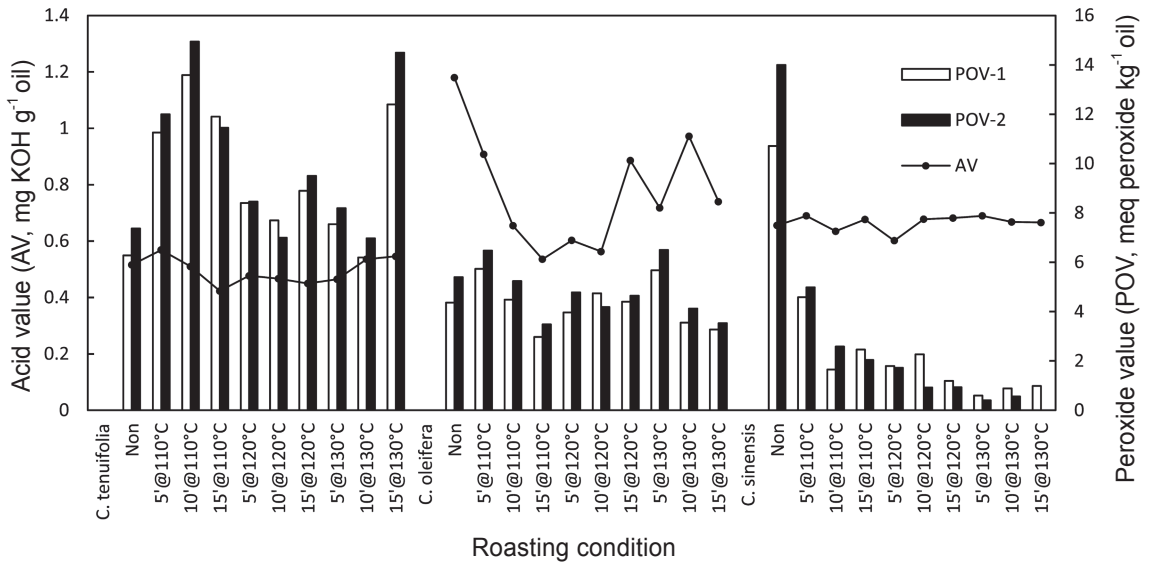

Fig. 2. Acid values (AV) and peroxide values (POV) of three kinds of camellia oils with different roasting conditions.

Peroxide value (POV) is another important indicator of oil quality. In Taiwan the POVs of some refined vegetable oils, such as peanut oil and rice bran oil, are limited to below 20 meq peroxide kg^{-1} oil. All the tested oils were below the limit (Fig. 2). The camellia oil samples were stored at 4℃ for indefinite periods. The POV-1 was determined after 5 months storage and POV-2 after 7 months. Roasting treatment effectively improved the quality of *C. sinensis* oils. The condition of roasting at 110℃ for 5 min produced POV-1 and -2 of 4.6 and 5.0, respectively; less than halves of the unroasted oils (10.7 and 14.0, respectively). At the highest treatment temperature of 130℃ for 5–15 min, their POVs were decreased to less than 1.0. For *C. oleifera* oils, their POVs (Fig. 2) were very consistent with different roasting conditions including the unroasted. On the contrary, *C. tenuifolia*'s POVs were quite fluctuant, initially increasing and later decreasing with the intensity of the roasting conditions, but at the highest and longest treatment, sharply increased (130℃ for 15 min, POV-1 and -2, 12.4 and 14.5, respectively). Therefore, the roasting treatments did not show a conclusively good influence on *C. tenuifolia* and *C. oleifera* oils. For the three camellia oils, their average POVs (POV-1 and -2) sequence were *C. tenuifolia* (9.42 and 10.04) > *C. oleifera* (4.32 and 4.83) > *C. sinensis* (2.72 and 3.13) (Table 1). All were substantially less than the requirement of 20, and the 2-month storage period tended to increase the POV by about 0.5–0.6.

Fatty acid composition

Fatty acid compositions of the three camellia oils roasted at different conditions are shown in Fig. 3. Table 2 shows their average and standard deviation values calculated from all conditions including the unroasted. Most of the standard deviations were less than or close to 10% of the averages, except for the plamitic acid (C16 : 0, 13% ± 3.0%) in the *C. sinensis* oils. The palmitic content of this oil can be separated into two groups: one with ca. 16% for treatment intensity of < 120℃ for 5 min; and the other with ca. 10% for treatment intensity > 120℃ for 10 min. This indicated that the roasting treatment did not affect the fatty acid compositions of *C. tenuifolia* and *C. oleif-*

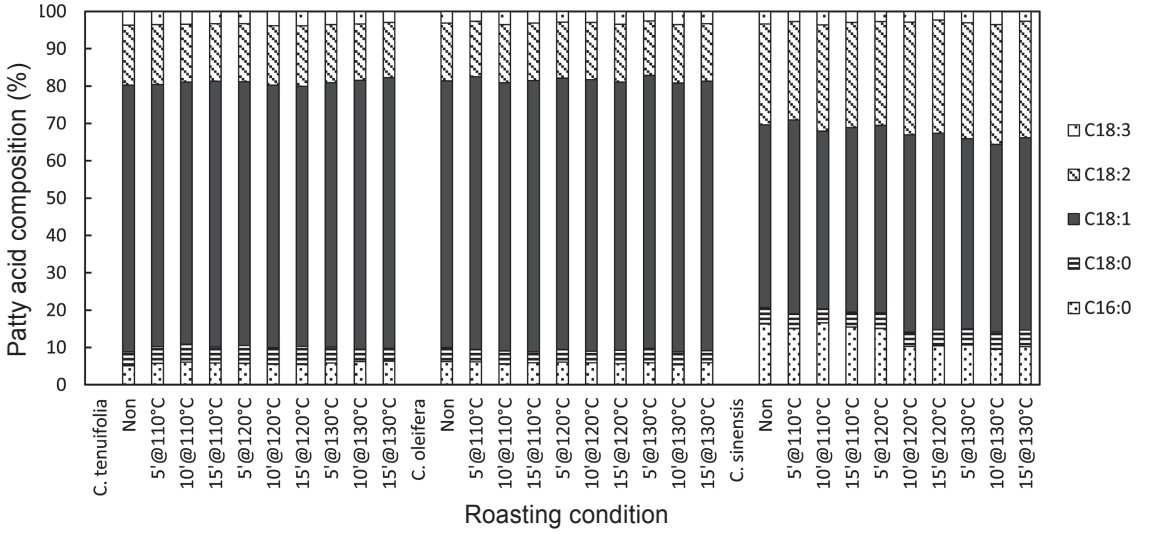

Fig. 3. Fatty acid compositions of three kinds of camellia oils with different roasting conditions.

Table 2. Average fatty acid composition of three kinds of camellia oils[z].

FA (%)	C16 : 0	C18 : 0	C18 : 1	C18 : 2	C18 : 3
Camellia tenuifolia	5.8 ± 0.4	4.3 ± 0.5	70.9 ± 0.9	15.6 ± 0.5	3.4 ± 0.3
Camellia oleifera	5.9 ± 0.3	3.4 ± 0.3	72.4 ± 0.6	15.3 ± 0.4	3.1 ± 0.4
Camellia sinensis	13.0 ± 3.0	4.2 ± 0.3	50.6 ± 1.7	29.3 ± 2.0	2.9 ± 0.4

[z] Value of fatty acid composition is mean ± standard deviation, calculated from all data including roasted sample.

era, but slightly altered the *C. sinensis* oil. The compositions of *C. tenuifolia* and *C. oleifera* were similar, having oleic acid content of 70.9% and 72.4%, respectively. Oleic acid content of *C. sinensis* oil was comparatively less, only 50.6%. The second main oil component was linoleic acid (C18 : 2), accounting for 15.6, 15.3 and 29% in the oils of *C. tenuifolia*, *C. oleifera* and *C. sinensis*, respectively. All three oils had about 3% linolenic acid (C18 : 3).

Phenols contents

Phenols are a structural category of chemical molecules bearing aromatic group(s) and having at least one hydroxyl group bonded to the benzene ring. Phenols contents of the three oils increased following the intensity of roasting conditions. At the most intense treatment (130℃ for 15 min), the phenols contents of *C. tenuifolia*, *C. oleifera* and *C. sinensis* were 3.1, 1.7 and 2.7 times of those unroasted counterparts, respectively (Fig. 4).

Oil stability index

Oil stability index (OSI, t, in h) follows the changes of tested temperature (T, in ℃) with an equation $T = \ln(t)/B - \ln(A)/B$, A and B coefficients resulted from the experimental data. Samples from the three camellia oils roasted at 110, 120 and 130℃ for 10 min and 130℃ for 15 min were analyzed (Fig. 5). The OSI approximately follows a Q_{10} temperature coefficient, i.e., the oxidation rate doubles at every 10℃ increment. Semi-logarithmic plots of all samples were prepared by setting ln(t) (x-axis, logarithmic scale) and T (y-axis), which produced linear regression lines with $r > 0.99$ (data not shown).

Comparing all unroasted samples, the *C. oleifera*'s oil was the most stable one, with OSIs of 8.0, 4.4 and 2.4 h at 110, 120 and 130℃, respectively (the data below follow the same sequence). The OSIs of *C. tenuifolia* (5.6, 3.2 and 1.9 h) and *C. sinensis* (5.8, 2.9 and 1.5 h) were quite similar.

Compared to the unroasted, the OSIs of *C. tenuifolia* oil roasted at 110℃ for 10 min decreased (4.7, 2.7, 1.6 h), but increased for roasting at 120℃ (6.7, 3.7, 2.2 h) and 130℃ (6.6, 4.2, 2.2 h) for 10 min; however, the one roasted at 130℃ for 15 min again decreased (4.9, 2.8, 1.4 h) to similar values of that at 110℃ for 10 min. For the oils of *C. oleifera*, the OSIs increased following the roasting intensity to reach the highest values (13.5, 7.0, 3.6 h), which were also the highest among all the tested samples. For *C. sinensis* oils the best roasting condition was observed at 130℃ for 10 min (OSIs 10.8, 5.3, 2.6 h). These results indicated that the roasting treatments effectively improved oil oxidative stability, except in the case of *C. tenuifolia* oil roasted at 110℃ for 10 min.

Stable periods of the oils predicted with OSIs

The predicted stable periods of camellia oils at 4 and 25℃ are shown in Fig. 6. The roasting treat-

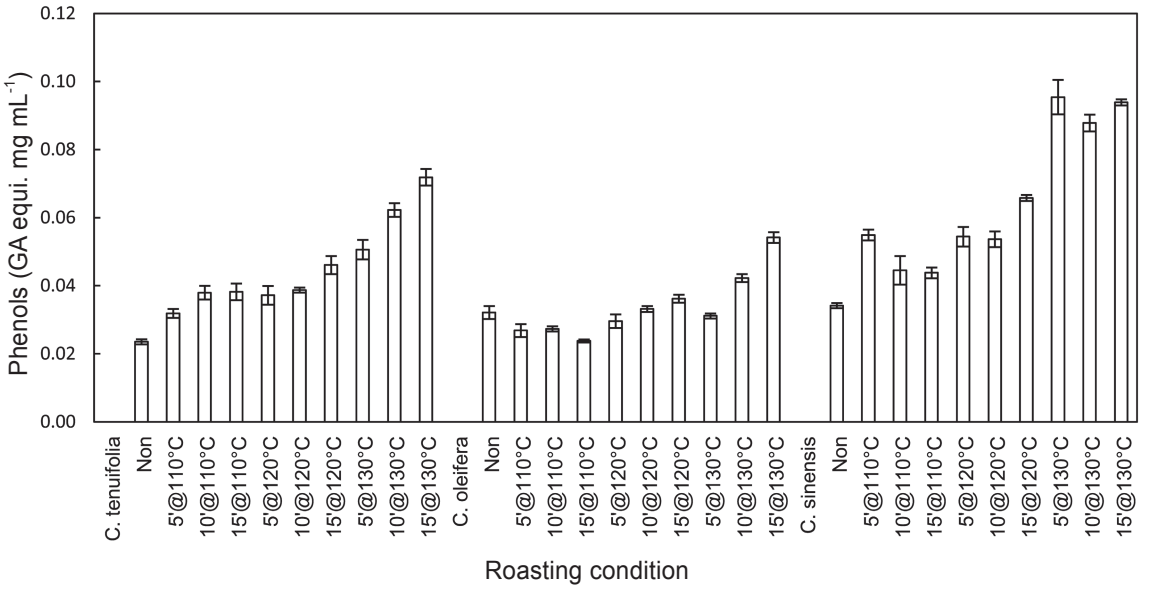

Fig. 4. Phenols contents of three kinds of camellia oils with different roasting conditions.

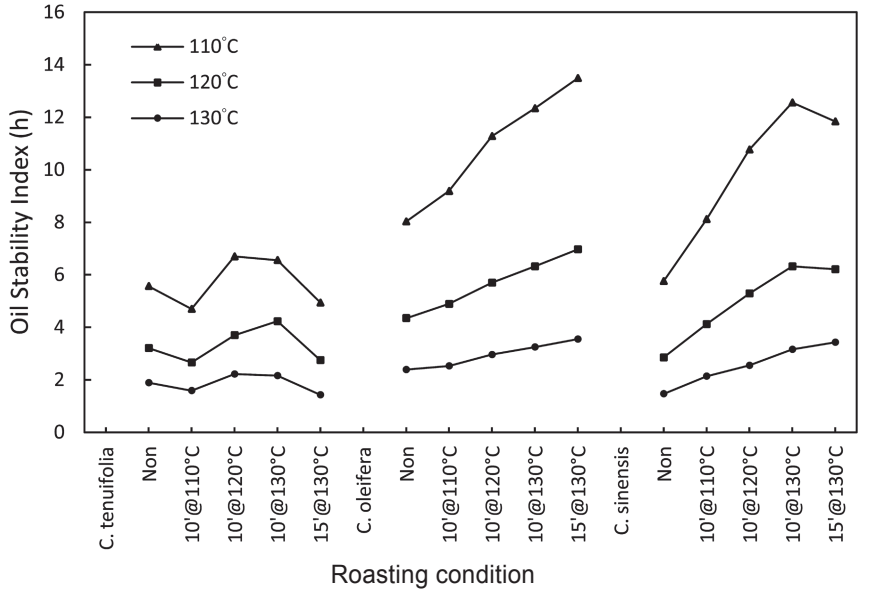

Fig. 5. Oil stability index (OSIs) of three kinds of camellia oils with different roasting conditions.

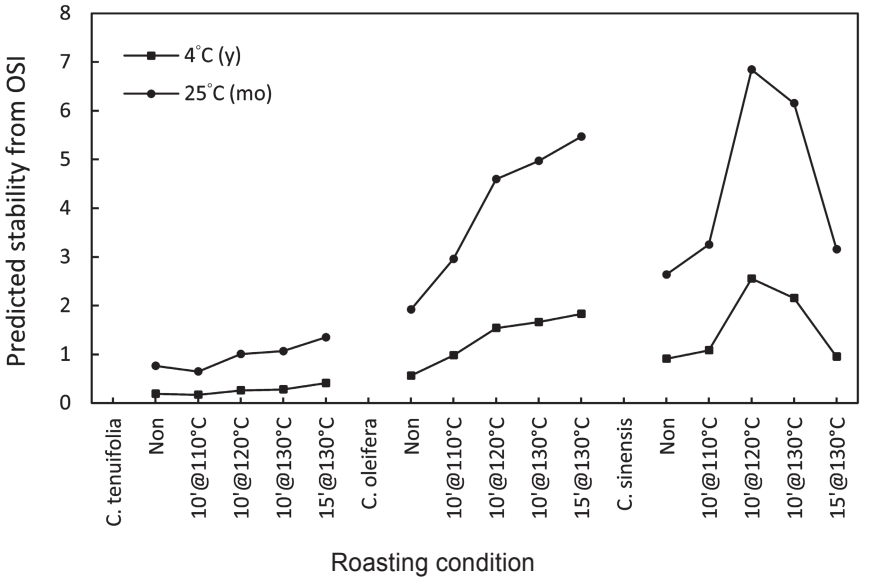

Fig. 6. Predicted oil stability of three kinds of camellia oils with different roasting conditions at temperatures 4℃ (year) and 25℃ (month).

ments exhibit good influences on the *C. tenuifolia* and *C. oleifera* oils, as all OSIs are higher than those of unroasted. Conversely, in *C. sinensis* oil, the longest stable period was obtained at the treatment of 120℃ for 10 min (the longest among all the samples), but the periods slightly decreased at 130℃ for 10 min and dramatically decreased at 130℃ for 15 min.

DISCUSSION

Roasting effects on oil yield and quality

The reasons of yield decreases may be compli-

cated. In plant seeds, TGs (oil) is stored in oil bodies enclosed by a layer composed of phospholipids and protein oleosin (Tzen & Huang 1992). The roasting process provided heat to denature protein, change TGs polymorphism (Murano 2003), and possibly resulted in reduced oil yields. The viscosity of oils increased with increasing intensities of roasting. This suggested that some alterations or interactions of ingredients occurring during the roasting process. Yield decrease by one-half in the *C. sinensis* oils suggested that there were alterations inside the tissue to hamper oil out-flow. Therefore, roasting treatment is not recommended in handling the *C. sinensis* seeds.

On the other hand, the roasting treatment did not conclusively affect the AV and POV of *C. tenuifolia* and *C. oleifera* oils, while it reduced the POV of *C. sinensis* oil. This indicated that roasting induced some physiochemical changes in *C. sinensis* oil which are beneficial to oxidation resistance. Another important indicator for oil utilization is smoke point (SP). Oils with high SP means their TGs are not degraded and have low contaminants. All the tested camellia oils bearing high SPs (avg. > 200℃ , data not shown) were not affected by the roasting treatments, and are considered as stable oils and suitable for cooking, especially when compared to many unrefined vegetable oils (such as corn, soybean and safflower oils). All the tested oil samples had AVs and POVs less than the general regulation limit for vegetable oils. These suggest that proper selection of camellia seeds materials and good processing procedures are the key to produce high quality oils.

Roasting effects on oil characteristics —FA composition and phenols contents

Roasting treatments did not affect the FA compositions of *C. tenuifolia* and *C. oleifera*. Their oleic acid (C18：1) content were less than 75%, slightly less than that reported (ca. 80%, Zhong *et al*. 2007). A possible reason is that the seeds might not be fully mature when harvested (Luo *et al*. 2012). The decrease in palmitic acid (C16：0) content of *C. sinensis* oils (from 16% decreased to 10%), however, may in part due to the roasting treatment (Fig. 3). Saturated fatty acids (such as plamitic acid) generally have higher melting points and are prone to form lipid crystals in bulk oil. Heating melts lipid crystals and may form new crystal forms after cooling which is related to the polymorphism of the TGs (Nawar 1996). Plausibly, the roasting procedure provided the melting energy, and upon recooling, the *C. sinensis* oil formed more new lipid crystals than did the other two camellia oils. Because our pressing system did not introduce heat (cold pressing), the lipid crystals in the *C. sinensis* thus were trapped in tissues and the oil yields significantly decreased, and the pressed oil contained less palmitic acid as a consequence.

Phenol contents in the three oils increased after roasting. In the *C. tenuifolia* and *C. sinensis* oils the increases were more notable than that did in the *C. oleifera* oil. Heat treatments have been reported to increase the phenols content of citrus peel extract, with an accompanying improvement in the antioxidant activities (Xu *et al*. 2007). Therefore, it is suggested that roasting treatments of the camellia oil seeds might augment detectable phenols which exerted their antioxidant activities on oils and thus increased their stability. The mechanism may be that some simpler phenols were derived from cleavage of the larger polyphenols (such as lignin) and bore more functional groups, such as hydroxyl groups on the aromatic rings, which displayed higher antioxidant activity. In a nutritional perspective, plant polyphenols have been proven to be a good source of human diet that is healthful and help prevent disease (Scalbert *et al*. 2005; Pandey & Rizvi 2009). This suggests that suitable roasting treatments of the camellia oil seeds may yield higher health values to humans.

Roasting effects on oil stability

In the OSI analyses, *C. oleifera* oils exhibited increased stability with the increasing roasting intensities (Fig. 5). The *C. sinensis* oils showed a similar trend except at the most intense roasting condition (130℃ for 15 min). On the contrary, the oils of *C. tenuifolia* were more stable at treatment temperatures of 120 and 130℃ for 10 min, which was inconsistent to the phenols content, but rather akin to the inverse POVs pattern (Fig. 2). Oil with higher POV is deemed to be of lower quality. The highest POVs were observed in the *C. tenuifolia* oil roasted at 110℃ for 10 min and 130℃ for 15 min. These were the same samples with the lowest OSIs. Possibly, there is a relationship between POV and OSI values; however, this relationship eludes observed on the oils of *C. oleifera* and *C. sinensis*.

Fig. 6 shows the predicted oil stability that is applicable to oil storage. The improvements exerted by the roasting treatment on oil stability were most notable in the *C. oleifera* oil, and followed by the *C. sinensis* and *C. tenuifolia* in a decreasing order. Different conditions of the roasting treatment appeared to produce different results for the oil samples. The treatment at 130℃ for 10 min increased twice the stable periods of the unroasted oils of *C. oleifera* and

C. sinensis. This condition could be the best treatment for the camellia oils (the stability of *C. tenuifolia* oil also improved with this treatment).

Possible reasons for the oil stability increases with roasting treatment might involve augmentation of phenolic content, as mentioned above, and the inhibition of enzymes in the seeds. Lipase, peroxidase (POD) and lipoxygenase (LOX) might be the three key enzymes affecting stability of pressed oil. Megahed (2011) found wheat lipases could be inhibited by 70℃ heating for 30 min and that AV of the resulting oil reduced. Rodriguez-Saona *et al*. (1995) inactivated the POD and LOX enzymes of sweet corn by steam blanching and found that the polyunsaturated fatty acids did not change during 9 month of storage at -20℃ but those in the control sets showed reductions. Therefore, roasting treatments of the camellia oil seeds might inactivate these enzymes and stabilize the oil.

CONCLUSIONS

The roasting treatments in this study increased the phenols contents and oil stability, but did not conclusively alter the oils' acid value and peroxide value. As for FA compositions, only palmitic acid contents in the *C. sinensis* oils slightly decreased. The oil yields decreased to different extents depending on the intensity of the roasting treatments. Therefore, we suggest that a best roasting condition shall be determined before undertaking mass production to obtain optimal results for both oil quality and quantity.

ACKNOWLEDGEMENT

This study was supported by the Council of Agriculture (101AS-1.1.2-FI-G1), Taiwan, ROC.

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茶籽榨油前炒培處理對油品之影響

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摘要

謝靜敏、楊正釧、莊曜駿、王益真、李雅琳。2013。茶籽榨油前炒培處理對油品之影響。台灣農業研究 62(3):249–258。

中國使用茶籽油作為食用油，已經超過 2000 年的歷史了，許多古代藥典中均有記載茶籽油的功效，例如幫助血氣運行、滋養胃腸、改善視力以及解毒等等。台灣茶籽油的製程，是使用傳統壓榨法、沒有經過精煉，其標準製程包括去殼、磨碎及壓榨。在去殼與磨碎之間，可以加入炒培處理，但是其優缺點並無科學實證。本研究使用三種茶籽，大果油茶 (*Camellia oleifera*)、小果油茶 (*Camellia tenuifolia*) 及一般茶樹 (*Camellia sinensis*)，以不同的炒培溫度與時間處理，研究其榨出油的品質與特徵。分析酸價、過氧化價、脂肪酸組成，以及酚類化合物的含量，並且分析其油脂氧化安定性。結果顯示，運用合宜的炒培處理，可以有效提高油脂的品質與氧化安定性。

關鍵詞：茶籽油、炒培、油脂品質、油脂氧化安定性、大果油茶。

投稿日期：2013 年 4 月 23 日；接受日期：2013 年 7 月 22 日。
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