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Research Note

Quality Evaluation on Use of Camellia Oil as an Alternative Method in Dried Seaweed Preparation

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ABSTRACT: The fatty acid and volatile compound compositions of camellia oil were analyzed in this study. The impacts of the replacement of conventional vegetable oil with camellia oil on the sensory attributes of dried seaweed were also determined. C18:1 (83.59%), followed by C16:0 and C18:2, were the most abundant fatty acids in camellia oil. A total of 11 and 32 volatile compounds were identified in camellia oil and sesame oil, respectively. In the preference test, the camellia oil samples received a higher, although insignificant, liking rating in overall acceptability of appearance. Overall, there were no differences between the sensory attributes of camellia oil and sesame oil. This finding, combined with the unique fatty acid composition, thermal stability, and health benefits of camellia oil indicate that further study into the use of camellia oil in foods is warranted.

Keywords: camellia oil, dried laver, nori, fatty acid composition, volatile compounds

INTRODUCTION

Camellia japonica belongs to the *Theaceae* family and is known as the tea seed plant. It has been cultivated as an ornamental plant in China and in other Western cultures (1). Camellia oil is mainly composed of neutral lipids, especially oleic acid (<85%). The high oleic acid concentration of camellia oil is similar to that of olive oil (2). Oleic acid has been shown to exert multiple health-promoting effects, including anti-atherogenic effects (3), plasma fatty acid-lowering effects (4), high density lipoprotein cholesterol-increasing effects (5), and an anti-inflammatory effect (6).

The red algae genus, *Porphyra yezoensis* (i.e., nori), is one of the most commonly consumed seaweeds in East and Southeast Asia, and its consumption is rapidly spreading throughout the world. In Japan, approximately nine billion nori sheets are produced per year and utilized for various culinary purposes (e.g., sushi, soups, and salads) (7). Nori has been gaining a great deal of attention due to its various biological activities (e.g., anti-allergic activity, chemoprotective activity, anti-inflammatory activity, and detoxification activity) (8-11). Nori is also known as a good source of polysaccharides, minerals, vitamins, and chlorophyll (10).

The steps used to cook nori vary by culture. Typically, a sheet of dried nori is lightly roasted after applying oil and salt. Sesame oil (or another type of vegetables oil) is often used for this preparation step. However, because plant oils are a rich source of polyunsaturated fatty acids (PUFA), these preparation methods may result in thermal oxidation of the PUFA. In fact, it is well known that the high temperatures and oxidative conditions that occur while cooking result in the development of short chain aldehyde, hydroperoxide, and keto derivatives that may generate undesirable flavors (12). In contrast, oleic acid vegetable oils (e.g., high oleic safflower oil) have greater heat-stability than conventional oils due to the stability of monounsaturated fatty acids (i.e., oleic acid) (13). Thus, given the stability and health benefits of camellia oil, a logical next step is to test whether the preparation of nori with camellia oil as an alternative to conventional oils (e.g., sesame oil) affects the sensory characteristics of the prepared nori.

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MATERIALS AND METHODS

Materials

Unseasoned dried nori and sample oils were purchased from local grocery stores (Jinju, Korea). To prevent nori quality from influencing the results of this study, one kind of nori was used throughout the study. Upon receipt, oil samples (i.e., camellia oil and sesame oil) were flushed with nitrogen and stored at −40°C to prevent oxidation prior to analysis. HPLC-grade methanol, hexane, boron trifluoride in methanol, anhydrous sodium sulfate, and sodium chloride were purchased from Fisher Scientific (Suwanee, GA, USA). Heptadecanoic acid (98% purity), diethyl ether, potassium hydroxide, 1% phenolphthalein in ethanol (v/v), pentadecane, *n*-alkanes (C8-C20), and a lipid standard mixture of 37 fatty acid methyl esters (FAMEs) were acquired from Sigma-Aldrich (St. Louis, MO, USA). Other chemicals were of analytical grade.

Extraction and quantification of FAMEs

The FAMEs present in the oils were prepared according to Ngeh-Nawainbi's method with slight modifications (14). Briefly, each sample (up to 25 mg) was transferred into a 5 mL reaction vial and weighed. Heptadecanoic acid was used as an internal standard (IS) for this assay. One mL of the IS (1 mg heptadecanoic acid/mL hexane) was added to each reaction vial. Samples were mixed with 0.5 N sodium hydroxide in methanol and flushed with nitrogen. The mixtures were incubated at 100°C for 5 min. After cooling, 2 mL of boron trifluoride in methanol was added to each vial with stirring with a Reacti-vial™ magnetic stirrer, and the solution was mixed for 1 min. Then each vial was placed in a Reacti-Block™ B-1 aluminum block within a Reacti-Therm III™ heating/stirring module (Thermo Fisher Scientific, Rockford, IL, USA) and incubated at 100°C for 30 min. Once derivatized, samples were allowed to cool at room temperature, and 5 mL of saturated sodium chloride solution was added to each vial. To extract the FAMEs, 1.5 mL of hexane was added to each sample. Then the hexane layer was transferred to a 2 mL, wide-opening, crimp-top vial. The vial was then capped with an 11 mm silver aluminum cap with a clear polytetrafluoroethylene/red rubber septa and then crimped with a crimper.

An Agilent 6890N Network Gas Chromatograph (Agilent Technologies, Palo Alto, CA, USA) interfaced with a flame ionization detector (FID) was used for fatty acid analysis. A SP-2560 capillary column (100 m×0.25 mm inner diameter, 0.25 μm film thickness; Sigma-Aldrich) was used to separate the FAMEs. Ultra-high purity nitrogen was used as the carrier gas at a flow rate of 1 mL/min. Analyses were performed in constant flow mode. A split liner with glass wool was installed in the injector, and the injector temperature was set to 220°C for split injection at a split ratio of 10:1. The FID temperature was set to 240°C. Ultra-high purity hydrogen (40 mL/min) and scientific-grade air (450 mL/min) were the fuel gases for the FID. The initial oven temperature was set to 140°C and held for 5 min before ramping up (4°C/min) to 230°C. The temperature was maintained at 230°C for an additional 35 min. All analyses were performed in triplicate.

The Supelco® 37 component FAME mix reference standard was used to identify and quantify individual FAMEs. A relative response factor was calculated for each FAME using methyl heptadecanoate as an IS. Each FAME yields a unique response depending on its chain length, saturation, and *cis/trans* configuration. This response is defined by the following equation:

$$R_i = (Ps_i \times Ws_{C17:0}) / (Ps_{C17:0} \times Ws_{is})$$

where R_i is the relative response factor for fatty acid *i*, Ps_i is the peak area of an individual FAME, *i*, in the FAME standard solution, $Ws_{C17:0}$ is the mg of C17:0 FAME in the injected FAME standard solution, $Ps_{C17:0}$ is peak area of C17:0 FAME in the FAME standard solution, and Ws_{is} is the mg of individual FAME, *i*, in the injected FAME standard solution.

Measurement of acid value (AV)

To evaluate the stability of camellia oil and sesame oil against thermal oxidation, the AVs of the oils were determined utilizing a method described elsewhere (15). In brief, sample oils were incubated at 180°C for 3 h. Then, 10 g of each oil was mixed with 100 mL of a diethyl ether : ethanol (1:1, v/v) solution with 1% phenolphthalein in ethanol (v/v). This mixture was titrated with 0.1 N potassium hydroxide.

Measurement of *p*-anisidine acid value (*p*-AV)

The *p*-AVs of camellia oil and sesame oil were analyzed by the American Oil Chemists' Society method (16,17). In brief, 100 mg of sample was dissolved in 25 mL of isooctane. Then, 2.5 mL of each sample was mixed with 0.5 mL of 5% *p*-anisidine solution in acetic acid and incubated at 25°C for 10 min. The sample mixture was spectrophotometrically measured at 350 nm using a Synergy HT UV-Vis spectrometer (BioTek Instrument, Winooski, VT, USA). The assay was performed in triplicate and the *p*-AV was calculated as follows:

$$p\text{-AV} = 25 \times (1.2 \times A_2 - A_1) / W$$

where A_1 is the absorbance (at 350 nm) of the solution before the addition of *p*-anisidine, A_2 is the absorbance (at 350 nm) after the addition of *p*-anisidine, and W is the amount of sample (g).

Determination of the iodine value (IV)

The degree of unsaturation of fatty acids in camellia oil and sesame oil was expressed as the IV. The IV was calculated by the following formula based on Ham et al. (18):

$$IV = (0.8599 \times \%\ \text{oleic acid}) + (1.7316 \times \%\ \text{linoleic acid}) + (2.6154 \times \%\ \text{linolenic acid}) + (0.7853 \times \%\ \text{eicosenoic acid})$$

Extraction of volatile compounds from the oil samples

Solid phase microextraction (SPME) was used to extract the volatile compounds from camellia oil and sesame oil. Polydimethylsiloxane fibers (film thickness 100 μM; Supelco Co., Belafonte, PA, USA) were conditioned at 250°C for 30 min prior to each measurement. The volatile compounds present in the oils were extracted according to the optimum conditions determined in our preliminary work (data not shown). Briefly, 5 g of each oil sample was added to a 50 mL glass vial sealed with an aluminum cover and Teflon septum. Then, 10 μL of pentadecane was added as an IS. The sample was incubated in a water bath with continuous stirring with a magnetic stirrer for 10 min at 60°C to allow for the equilibration of the volatiles in the headspace. After the equilibration, a manual SPME holder containing a preconditioned polydimethylsiloxane fiber was inserted into the vial and the fiber was exposed to the headspace for 30 min. The exposed fiber was then inserted into the injector port of a gas chromatograph-mass spectrometer. The volatiles were thermally desorbed in the hot injection port of the gas chromatograph for 5 min at 250°C in splitless mode and then cryo-focused on the head of the analytical column.

Chromatographic analysis

Chromatographic analyses were performed on an Agilent 7890 Gas Chromatograph (Agilent Technologies, Santa Clara, CA, USA) equipped with an Agilent 5975C inert XL MSD with Triple-Axis Detector (Agilent Technologies). An HP-5 capillary column (30 m×0.25 mm, 0.25 μm film thickness) was used for the separation of analytes, and the detector was operated in electron impact ionization mode (70 eV), scanning a mass range (m/z) from 30 amu to 550 amu. The analysis was carried out in splitless mode, using helium as the carrier gas (1.3 mL/min flow rate). The injector temperature was set to 250°C. The column was maintained at an initial temperature of 40°C for 4 min and then programmed to increase at a rate of 5°C/min until the final temperature, 200°C, was reached. Then, the column was maintained at 200°C for 20 min.

The volatile compounds were primarily identified by comparison of the mass spectra with data from commercially available mass spectral databases (i.e., WILEY and NIST). In addition, the volatiles were identified by matching the retention indices (RI) with data from published literature (19-21). The RI for each sample was calculated based on a series of *n*-alkanes (C8-C20) according to the formula (22) below:

$$RI_s = 100z + 100(\log X_s - \log X_z)/(\log X_{(z+1)} - \log X_z)$$

where RI_s is the retention index of the compound of interest, z and z+1 are *n*-alkanes, X_s is the retention time of the compound of interest, X_z is the retention time of the *n*-alkane compound, and $X_{(z+1)}$ is the retention time of the *n*+1-alkane compound; the retention time (X_s) of the compound of interest is between X_z and $X_{(z+1)}$ (*n*= number of carbon atoms).

Preparation of seaweed samples for sensory evaluation

Dried and unseasoned nori was prepared by a professional cook. Briefly, camellia oil or sesame oil was applied to a sheet of nori (approximately 22×32 cm). The oil sample was spread to completely cover one side of a nori sheet and then the coated nori sheet was lightly salted with 20 mg of salt per sheet. The seasoned nori was roasted in a cooking oven at 200°C for 30 s and cooled at room temperature. All seaweed preparation steps were done by a single person and all samples were prepared less than 1 h prior to the sensory evaluation.

Study participants

Forty subjects performed a sensory evaluation of the seasoned and roasted nori samples. All subjects were recruited from the Gyeongnam National University of Science and Technology through fliers and were paid a with a gift card incentive for their participation. People who were allergic to the food items tested in the study were screened prior to the sensory evaluation. The study was approved by the University Institutional Review Board and consent forms were provided to study participants in advance. The demographic characteristics are summarized in Table 1.

Table 1. Demographic information of study participants and the frequency of nori consumption

		Percentage (n)
Gender	Male	25 (10)
	Female	75 (30)
Age	19~29	97.5 (39)
	30~40	2.5 (1)
	≤40	0
Frequency of nori consumption (per month)	Never	5 (2)
	≥ 5 times	40 (16)
	≥ 10 times	32.5 (13)
	≥ 20 times	12.5 (5)
	Daily	10 (4)

Sensory evaluation

Participants used labeled affective magnitude (LAM) scales to evaluate the seasoned, roasted nori for perceived intensities of overall appearance, overall preference, crispiness, roasting-flavor, saltiness, sweetness, bitterness, greasiness, and aftertaste. The LAM scales were labeled with the phrases 'greatest imaginable like', 'like extremely', 'like very much', 'like moderately', 'like', 'neither like nor dislike', 'dislike moderately', 'dislike very much', 'dislike extremely', and 'greatest imaginable dislike'. The preference scales ranged from 0 (greatest imaginable dislike) to 15 (greatest imaginable like) (23).

Statistical analysis

The fatty acid composition and acid values of the sample oils were expressed as the mean±standard deviation. The sensory evaluation results were expressed as the mean±standard error of the mean. The statistical significance between groups was calculated by one-way analysis of variance followed by Scheffe's multiple range tests utilizing the Statistical Analysis System (SAS, Cary, NC, USA). *P*-values less than 0.05 were considered statistically significant.

RESULTS AND DISCUSSION

The fatty acid compositions of camellia oil and sesame oil were analyzed, and the results are shown in Table 2. Nine fatty acids, ranging from C16 to C24, were identified based on retention mapping with external standards. The fatty acids were quantified relative to the internal standard. In the camellia oil, C18:1 was by far the most abundant fatty acid (83.59%), followed by C16:0 (8.50%) and C18:2 (4.58%). The concentrations of saturated fatty acids, monounsaturated fatty acids, and PUFA in the camellia oil were 10.71%, 83.72%, and 5.57%, respectively. These results are in agreement with previous studies (2,24). Haiyan et al. reported that C18:1 was the most prevalent fatty acid in camellia oil, comprising about 84% of the total fatty acid profile (24). Similarly, in another study, C18:1 accounted for about 85% of the total lipid content and 86% of the neutral lipid content of camellia oil (2).

The fatty acid profile of each oil sample was used to calculate the IV. The IVs for camellia oil and sesame oil were 82 and 195, respectively. Ham et al. noted that the agreement between the IV calculated from the fatty acid profile of a sample and the IV obtained by the conventional titration method is satisfactory. In the present study, the IV of camellia oil was lower than that of sesame oil (82±1 vs. 195±1; Table 2). In oils, a lower IV is associated with better stability against rancidity. This is thought to be due to a decrease in the production of aldehydes from unsaturated fatty acids in low IV oils.

The *p*-AV of camellia oil and sesame oil were measured by determining the amount of aldehyde (principally 2-alkenals and 2,4-alkadienals) present in each sample. During this determination, the aldehydes present in the oils were reacted with the *p*-anisidine reagent under acidic conditions to form yellowish products (25). List et al. reported a strong correlation between the *p*-AV and flavor acceptability scores of salad oils (26). In our study, the *p*-AV of camellia oil and sesame oil were 9.13 and 22.26, respectively.

To compare the thermal stability of camellia oil and sesame oil, samples of each type of oil were heated at 180°C for 3 h, and then the acid values of the heated samples were measured. The acid values of camellia oil were lower than those of sesame oil before (1.33±0.11 vs. 1.95±0.16) and after (1.77±0.22 vs. 2.42±0.12) heating. In oils, a high acid value is proportional to the presence of free fatty acids. In this regard, the present data indicate that camellia oil should be more stable against thermal oxidation than sesame oil. This notion is in agreement with the fatty acid profiles of the oils.

As previously mentioned, the fat frying cooking method develops desirable characteristics in food but also degrades oils via multiple processes, including oxidation, polymerization, and isomerization (12,27). These chemical processes are known to impact food quality. To be specific, the oxidation of fats and oils is known to result in an unpleasant off-taste, unpleasant odors, undesirable flavors, and a loss of nutritive value (i.e., reduction in essential fatty acid and vitamin concentrations) (27). Furthermore, the oxidation products of lipids may be ab-

Table 2. Fatty acid composition and iodine values of camellia oil and sesame oil

	Fatty acid composition (weight %)[1]									Iodine value
	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:1	C22:0	C24:0	
Camellia oil	8.50±0.11	0.11±0.02	2.11±0.07	83.59±1.21	4.58±0.06	1.00±0.02	0.01±0.00	0.06±0.01	0.04±0.01	82±1
Sesame oil	6.31±0.08	ND[2]	2.96±0.08	15.74±0.22	16.17±0.10	58.78±0.38	ND	0.04±0.02	ND	195±1

Data are the mean±standard deviation (n=3).
[1]Weight % indicates that the oils were weighed and values are expressed as the amount of each fatty acid relative to the total fatty acid amount.
[2]ND: not detected.

sorbed and metabolized by the body, resulting in toxicity (e.g., reactive aldehydes) (28). Because of their increased stability, high oleic oils have improved technological applications (13). Thus, camellia oil could be used as an alternate to saturated fats and oxidation-prone oils, especially when heating or frying foods such as nori.

SPME analysis revealed that camellia oil and sesame oil contain 11 and 32 volatile compounds, respectively. Hydrocarbons were the predominant volatile compounds in both oils (Table 3 and Table 4). The peak area of

Table 3. Volatile compounds present in camellia oil

Peak number[1)]	RT[2)]	Retention indices[3)]	Compound[4)]	Peak area×10^5
1	12.84	962	2,2,4,6,6-Pentamethylheptane	8.1
2	16.56	1,091	Nonanal	5.2
3	24.46	1,363	Cinnamic acid methyl ester	3.6
4	26.06	1,418	1-Hexacosanol	18.8
5	26.41	1,430	3,8-Dimethyldecane	136.2
6	26.59	1,436	Methoxyacetic acid	42.8
7	26.72	1,441	2-Methylpentadec-1-ene	20.3
8	27.59	1,471	Cyclopentadecane	12.3
9	28.45	1,501	5,5,7,7-Tetraethylundecane	16.6
10	29.26	1,528	2-Furancarboxylic acid, octyl ester	4.1
11	29.62	1,541	1-Methylpyrrolidine	5.4

[1)]Peaknumbering was determined by the order of elution through the column.
[2)]RT: retention time (min).
[3)]Retention indices were determined using C8-C20 as external references.
[4)]The gas chromatographic retention data and mass spectral data were compared to those of authentic samples and library compounds, respectively.

Table 4. Volatile compounds present in sesame oil

Peak number[1)]	RT[2)]	Retention indices[3)]	Compound[4)]	Peak area×10^3
1	7.51	778	Methylpyrazine	1.4
2	10.29	874	2,5-Dimethylpyrazine	15.8
3	13.23	976	2-Ethyl-6-methylpyrazine	9.6
4	13.33	979	Trimethylpyrazine	40.1
5	13.60	988	2,4-Heptadienal	22.4
6	14.00	1,002	2,2,11,11-Tetramethyl-dodecane	6.2
7	14.94	1,035	2,2-Dimethyleicosane	9.4
8	15.26	1,046	2,6-Dimethyloctane	6.4
9	15.79	1,064	2-Ethyl-3,6-dimethylpyrazine	29.3
10	16.56	1,091	Nonanal	12.0
11	16.69	1,095	6,7-Dihydro-5H-cyclopentapyrazine	4.1
12	19.14	1,179	1-Dodecene	24.5
13	19.58	1,195	*n*-Decanal	3.4
14	20.84	1,238	1-Methylbicycloheptane	69.2
15	23.63	1,334	1,3-Diisocyanato-1-methylbenzene	5.9
16	23.67	1,336	2,4-Diisocyanato-1-methylbenzene	18.7
17	24.61	1,368	1-Tetradecene	6.1
18	25.46	1,382	Caryophyllene	13.8
19	25.53	1,400	Tetradecane	27.3
20	28.41	1,499	1-Chlorohexadecane	3.2
21	28.96	1,518	1-Chloroheptacosane	5.2
22	31.34	1,600	Hexadecane	47.9
23	31.38	1,602	Oxirane	20.4
24	31.92	1,620	3-Cyclohexyltridecane	23.7
25	32.06	1,625	1-Bromooctadecane	14.5
26	32.20	1,630	2-Hexadecanone	66.0
27	34.25	1,700	Heptadecane	56.8
28	37.14	1,800	Octadecane	50.6
29	38.54	1,848	Octacosyl trifluoroacetate	11.2
30	40.03	1,900	*n*-Nonadecane	32.3
31	42.51	1,985	Eutanol	10.5
32	45.25	2,080	Undecanoic acid, methyl ester	59.5

[1)]Peak numbering was determined by the order of elution through the column.
[2)]RT: retention time (min).
[3)]Retention indices were determined using C8-C20 as external references.
[4)]The gas chromatographic retention data and mass spectral data were compared to those of authentic samples and library compounds, respectively.

nonanal in camellia oil was half that of sesame oil. Decanal was found in the sesame oil sample but was not detected in the camellia oil sample. Notably, five pyrazine compounds, methylpyrazine, 2,5-dimethylpyrazine, 2-ethyl-6-methylpryazine, trimethylpyrazine, and 2-ethyl-3,6-dimethylpyrazine, were identified in the sesame oil sample but not in the camellia oil. This may be because sesame seeds are generally roasted prior to oil pressing. Pyrazine compounds are known to be greatly influenced by degree of roasting and represent roast flavor (29).

To determine whether camellia oil is suitable as an alternative to conventional vegetable oils, we carried out a preference test between camellia oil and sesame oil, which is one of the most widely utilized vegetable oils for seasoning nori. As previously mentioned, participants were asked to evaluate their perceived intensities of preference for items derived from nori. Subjects evaluated the overall appearance of the nori samples prior to consumption. The rest of the perceived intensities were evaluated with LAM scales after sample consumption. There were no differences noted in any of the tested sensory attributes of sesame oil and camellia oil (Fig. 1). Although it was not statistically significant, it should be noted that the overall appearance of the nori prepared with camellia oil received a higher liking rating than the nori prepared with sesame oil (P=0.08). In contrast, the roasting-flavor and bitterness of the nori sample seasoned with sesame oil were preferred over those of the nori sample prepared with camellia oil. The latter two results were somewhat expected, as sesame seeds are known for their bitter taste and are normally toasted to increase their roasting-flavor and mask their bitter taste (30). There was no significant correlation between the sensory attributes tested and the frequency of nori consumption or the gender of the study participants (data not shown). The similarities in the liking/disliking ratings of sesame oil and camellia oil in the sensory evaluation indicate that further studies about the practical uses of camellia oil in various culinary applications are warranted.

One of the limitations of the present study was that most of the subjects we recruited were between 19 years old and 29 years old. While we would have liked to include subjects with a wider range of ages, because the study was performed in a university setting the subjects were mainly students. Thus, the results obtained in the present study may not predict preferences between camellia oil and sesame oil in older age groups. Another limitation of this study is that the sensory panelists were not trained to conduct the descriptive sensory analysis that would have made it possible for us to find relationship between a subject's preference and sensory data (i.e., description of product) (31). Nonetheless, the present study included a relatively large number of subjects (n=40) and utilized LAM scales, which are reported to allow for greater discrimination of preference compared to other methods (e.g., 9-point hedonic scale) (23).

While high oleic acid oils are more stable than conventional vegetable oils during frying (13), there are other factors (e.g., presence of antioxidants) that impact stability during frying (32). Thus, the extent to which lipid oxidation occurs during the frying of these oils should be characterized and compared in future studies. Our research team is currently investigating the effects of frying conditions on the quality of camellia oil.

In summary, the fatty acid profile of camellia oil was analyzed in this study. As reported in other studies, nine fatty acids, ranging from C16 to C24, were detected in camellia oil (1,2,24). Oleic acid (i.e., C18:1) was by far the most prevalent fatty acid, indicating that camellia oil

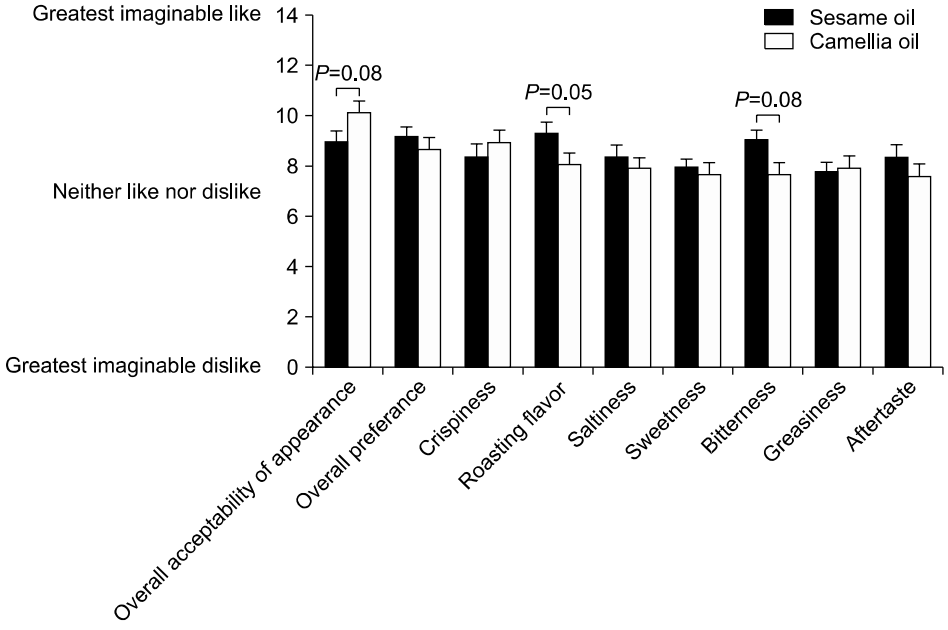

Fig. 1. Sensory evaluation of nori samples seasoned with either camellia oil or sesame oil. Participants used LAM scales to evaluate prepared nori for perceived intensities of overall appearance, overall preference, crispiness, roasting-flavor, saltiness, sweetness, bitterness, greasiness, and aftertaste. The preference scales ranged from 0 (greatest imaginable dislike) to 15 (greatest imaginable like). Data represent the mean±standard error of the mean (n=40). P-values less than 0.05 were considered significantly different (Scheffe's test). No differences between the sensory attributes of sesame oil and camellia oil were noted.

may be a rational alternative to oxidation-prone oils (e.g., vegetable oils). We also compared the sensory attributes of nori that had been prepared with camellia oil to those of nori that had been prepared with sesame oil. Nori was selected for this comparison because its preparation is likely to induce thermal oxidation of the oil used for seasoning. There were no differences between the sensory attributes of the camellia oil and the sesame oil, indicating that further studies regarding the culinary uses of camellia oil are warranted, especially considering the unique fatty acid composition and the previously reported health benefits of camellia oil.

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AUTHOR DISCLOSURE STATEMENT

The authors declare no conflict of interest.

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