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Antioxidant Effects of Raw Ginseng, Soft Red Ginseng, and Red Ginseng Sap

Man Kyu Huh[1]* and Kuk Hwan Kim[2]

[1]*Food Engineering and Technology Major, Dong-eui University, Busan 47340, Korea*
[2]*Hongsambonga Co. Ltd, Busan, Korea*

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Korean ginseng (*Panax ginseng*) generally has a good safety profile and contains many bioactive substances, such as ginsenosides or panaxosides. Korean red ginseng might help to stabilize the sympathetic nervous system and improve cognition in individuals. Soft red ginseng is produced by new processing technology. This study focused on investigating whether soft red ginseng produced under the new processing technology reduces or improves the existing antioxidant effects. No significant difference in 2,2′-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid) (ABTS) scavenging activity was found between soft red ginseng and ready-made red ginseng (p<0.05). Soft red ginseng extract showed higher 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) and hydroxyl radical (OH) scavenging activity than other ginseng extracts. OH scavenging activity was significantly different across three groups (raw ginseng, soft red ginseng, and red ginseng sap) (p<0.05). Nitric oxide (NO) scavenging activity was also significantly different among raw ginseng, soft red ginseng, and purchased red ginseng liquid products (p<0.05). Many calcium crystals appeared on the electron microscope in soft red ginseng. Magnesium and potassium showed no significant difference between soft red ginseng and hard red ginseng. The extract of soft red ginseng scavenged different free radicals efficiently due to the presence of DPPH and OH and may help treat free radical-induced diseases.

Key words : 2,2′-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid) (ABTS), 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH), ginseng, Hydroxyl radical (OH), Nitric oxide (NO)

Introduction

It is estimated that ginseng cultivation method was implemented in the mid-Goryeo period due to its excellent medicinal effects, and Korean specialty products called "Goryo Ginseng" were spread to China, Japan and other countries. Since then, Korea has established itself as a major ginseng plantation in the world. China has the most production with 44,749 tons (55.9%) in the world and Korea produces 27,480 tons (34.3%) based on 2008 China local and 2008 Ginseng Statistics Source Book by Korea [1]. Canada has 6,486 tons, the 3rd and the US 1,054 tons, etc. In addition, the scale of the Chinese pharmaceutical industry is increasing due to the development of ginseng cultivation and processing technology in China. Currently, ginseng consumption in Korea is divided into those directly made of raw ginseng and those made into related foods by processing raw ginseng, with a total of 46.2% of red ginseng, 7.9% of white ginseng, and 7.9% of Taegeuk ginseng, and 45.7% of them are used as raw ginseng. However, raw ginseng is almost limited to the domestic market and has no exports at all. Korea's domestic demand is very high at 87.6 percent in 2010, with exports standing at only 12.4%.

Ginseng has been in the spotlight as an herbal medicine and nourishing tonic for its healing effect and prevention of various diseases.

Various effects of ginseng increased significantly the physical and intellectual work capacities [22] such as anti-stress effect [19] and improvement on cognitive function [18]. Korean red ginseng might help to stabilize the sympathetic nervous system and improve cognition in individuals with high stress [2].

In traditional medicine it is perceived that the power of red ginseng is stronger than that of white ginseng in terms of invigorating. Therefore, it is known to use red ginseng when someone is in a very severe condition, or when it is judged that the use of white ginseng is not sufficient [21]. Ginseng is typically characterized by the presence of ginsenosides and gintonin.

Certain ingredients produced by heating the ginseng,

***Corresponding author**
Tel : +82-51-890-1592, Fax : +82-0505-182-6897
E-mail : mkhuh@deu.ac.kr

such as ginsenoside Rg2, Rg3, RH1, and RH2, are reported to prevent the cancer [10], cancer cell growth inhibition [14], and blood pressure drop action [15]. Red ginseng undergoes changes according to the variation of ingredients for manufacturing, extraction conditions, and components of red ginseng in accordance with storage [5]. The red ginseng by repeated heating and drying is effected saponin contents in accordance with the conditions of extraction [17], increased a phenolic acid such as syringic acid, ferric acid, and cinnamic acid by high temperature high pressure treatment [8], and the composition and content of ginsenosides [12]. Red ginseng products treated with high temperature and high pressure are accompanied by hardening after cooling down, adding to the burden on teeth and digestion. In this study, as soft red ginseng produced by new processing technology has been in soft condition for a considerable period of time, its use is expected to be expanded and varied. This study focused on investigating whether the antioxidant effects reduced or improved according to the new machining techniques.

Materials and Methods

Manufacture of experimental materials and extracts

Ginseng used in this experiment was limited to raw ginseng, soft red ginseng and red ginseng sap products. Raw ginseng and red ginseng sap were purchased on the market. Korean red ginseng was produced by the process of steaming and drying from fresh ginseng cultivated in Punggi-eup, Yeongju-ci, Korea. Soft red ginseng was personally made by steaming red ginseng and used as an experimental material.

To investigate the degree of antioxidation according to extraction solvents, we grinded raw ginseng and soft red ginseng after cleaning, added the extraction solvent (incremental water) of 10 times per weight so that the active ingredient could be extracted by stirring at 60℃ and 24 hr. Afterwards, it was stirred about an hr, at 60℃ with an ultrasonic bath (5510, Branson, USA) to extract the active ingredient. Extracts were filtered through the Whatman filter paper No. 1 (Toyo Roshi Kaisha, Ltd., Japan) and then depressurized and its solvents were eliminated by using a rotary vacuum evaporator (N-1001S-W, Eyella, Tokyo, Japan) and cooling down. Then, the sample was put in a vacuum chamber to obtain the dry powder and placed at low temperature. Powder samples were used in experiments after freezing and drying. As red ginseng sap products are in high concentration, they were diluted with distilled water so that the absorbance would be equal at 517 nm with previously extracted samples through Microplate Reader (VersaMax, California, USA) for DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate). Hydroxyl radical was also corrected by measuring absorbance at 532 nm. Other antioxidant experiments were also used after pre-calibration at wavelengths to be measured after reagent treatment. The concentration used was 0.25 mg/ml, 5.0 mg/ml, 0.75 mg/ml, and 1.0 mg/ml. The red ginseng sap products were used after adjusting the concentration to 1.0 mg/ml and being diluted according to the ratio.

ABTS free radical

The antioxidant activity of three ginseng extracts was measured on the basis of the scavenging activity of 2,2′-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid) (ABTS) free radical according to the method described by Brand-Williams et al. [4] with slight modifications. 1 ml of 0.1 mM ABTS solution in ethanol was mixed with 1 ml of the previous extracts of various concentrations (0.1, 0.5, and 1.0 mg/ml). ABTS was added to the solutions prepared with extracts and standard antioxidant substances and stirred. A solution of ABTS was prepared by dissolving 5 mg ABTS in 2 ml of ethanol, and the solution was kept in the dark at 4℃. A stock solution of the compounds was prepared at 1 mg/ml in DMSO. The stock solution was diluted to varying concentrations in 96-well microplates. Then, 5 μl of ethanol ABTS solution (final concentration 300 μM) was added to each well. The plate was shaken to ensure thorough mixing before being wrapped with aluminum foil and placed into the dark. The radical scavenging reaction was carried out at 37℃ in dark for 30 min. The optical density (OD) of the solution was read using the Microplate Reader at the wavelength 515 nm. Corresponding blank sample was prepared and Trolox (6-Hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid), a water-soluble vitamin E analog, serves as a positive control inhibiting the formation of the radical cation in a dose dependent manner. Relative inhibitor rate of raw materials and other samples for Trolox was calculated.

DPPH radical scavenging assay

DPPH is a dark, purple and stable free radical and decreases in antioxidants and turns colorless. The DPPH scavenging activity was measured by the method by Blois [3]. 0.3 ml of each sample was put into 2.7 ml of 0.1 mM DPPH

solution diluted with ethanol, being reacted at room temperature for 30 minutes. Afterwards, its absorption was measured at 517 nm. Corresponding blank sample was prepared and L-Ascorbic acid (0.1, 0.5, and 1.0 mg/ml) was used as reference standard (positive control).

Hydroxyl radical (OH) scavenging assay

The amount of malonaldehyde produced by disassembling deoxyribose from hydroxyl radiological by Fenton reaction was measured to check the hydroxyl radical scavenging ability of the samples [16]. The hydroxyl radical scavenging ability was measured in accordance with Chung et al. [7]. 0.2 ml of 10 mM $FeSO_4$, 0.2 ml $7H_2O$, 10 mM EDTA solution, 0.2 ml of 10 mM 2-deoxyribose, 1.0 ml of the 0.2 M phosphate buffer (pH 7.4) and 0.2 ml of various concentrations of extracts are mixed well. 0.2 ml of 10 mM H_2O_2 is put, mixed well and reacted for 3 hr at 37℃. After that, 1 ml of 2.8% TCA solution and 1 ml of 1.0% 2-thiobarbituric acid (TBA) solution are inserted in this mixed solution and boiled for 10 minutes. After the reactant was cooled completely, absorbance was measured at 532 nm. Ascorbic acid was taken as the positive control.

Nitric oxide (NO) scavenging assay

The nitric oxide scavenging activity was measured by the method described by Kato et al [9]. The final volume of the reactant was 1.2 ml for 1 mM $NaNO_2$ 120 ul, 0.1 N HCl 840 ul, and various concentrations of extracts. After the reaction for an hr at 37℃, 1 ml of the reactant was mixed with 3 ml of 2% acid and 400 μl of the Griess reagent and it was reacted for 15 minutes at room temperature. The amount of nitrite remaining was measured by checking the absorbance at 520 nm using a spectrophotometer. Catechin was used as a positive control.

Texture analysis using electron microscope

For the analysis of minerals and textures of soft red ginseng, raw, soft red, and red ginsengs were filmed and analyzed using FE-SEM (Field Emission Type Injection Electron Microscope) located in the Core Support Dynamic Center of Fusion Parts Materials in Dong-eui University. The magnification was 500 times, 1,000 times, and 2,000 times.

Statistical analysis

The following expression was used to calculate the total antioxidant activity, ABTS, DPPH, OH, and NO radical scavenging ability as percentages of the test material's discoloration.

Inhibition (%) = (IA-As) / IA ×100

IA in this expression is the absorbance of the sample-free group, and As is the absorbance of the specimen-free group.

EC50 is defined as the concentration of inhibitor necessary for 50% inhibition of the enzyme reaction of a maximum scavenging capacity. To determine the EC50 value of the active component, the technique using 96-well microplates was employed [23]. Regression analysis by a dose response curve was plotted to determine the EC50 values.

A variance analysis (ANOVA) was conducted for the effect on antioxidation by concentration of extracts, and the difference in average value by concentration was investigated for its significance in $p<0.05$, 0.01, or 0.001 by conducting Duncan's multi range test. All experimental results were marked with average standard deviation, and statistical analysis was analyzed using the SPSS (v18.0, SPSS Inc., Chicago, IL, USA), the statistical program.

Results

ABTS scavenging assay

ABTS scavenging activity of raw ginseng was evaluated 15.4% at 0.1 mg/ml and 46.8% at 1.0 mg/ml (Table 1). ABTS scavenging activity of soft red ginseng was evaluated 36.4% at 0.1 mg/ml and 70.5% at 1.0 mg/ml. ABTS scavenging activity of ready-made red ginseng was evaluated 39.9% at 0.1 mg/ml and 73.5% at 1.0 mg/ml. The all values of ABTS scavenging activity of two red ginseng products were higher than those of raw ginseng. However, ABTS scavenging activity of soft red ginseng and ready-made red ginseng did not show a statistically significant difference ($p<0.05$). When the L-Ascorbic acid used as a control, relative ABTS scavenging activities of raw ginseng, soft red ginseng, and ready-made red ginseng extracts were 53.1%, 79.9%, and 83.4%, respectively. The EC_{50} values of raw, soft red, and ready-made red ginsengs for ABTS were 108.9 ug/ml, 91.0 ug/ml, and 89.7 ug/ml, respectively (Table 2).

DPPH radical scavenging activity

Table 3 indicated DPPH radical scavenging ability of extracts. Scavenging activity of raw ginseng was 11.4% at 0.25 mg/ml concentration, 35.6% at 1.0 mg/ml, and relative radical scavenging activity with control group was 40.4% at

Table 1. The degree of inhibition (%) of ABTS properties for raw ginseng, soft red ginseng, and ready-made red ginseng gap at different concentrations

Ginseng	Concentration (mg/ml)	Inhibition ratio (%)		*t*-test
		Scavenging ability	Relative inhibition	
Raw ginseng	0.25	15.43±2.12	22.6	0.057
	0.50	28.74±3.27	37.5	
	0.75	40.91±1.04	49.6	
	1.00	46.77±2.86	53.1	
Soft red ginseng	0.25	36.42±3.07	53.5	0.012
	0.50	48.18±3.14	62.9	
	0.75	61.66±2.33	74.7	
	1.00	70.45±2.90	79.9	
Ready-made red ginseng gap	0.25	39.93±2.59	58.7	0.093
	0.50	50.55±2.63	65.9	
	0.75	64.78±4.41	78.4	
	1.00	73.51±3.53	83.4	
F-test		3.638	8.223*	

Data represented the mean ± SD from three replicates. * = $p<0.05$.

Table 2. The 50% inhibition (EC_{50}) of ABTS on 1.0 ug/ml

Ginseng	Value and repeat			
	1	2	3	Mean ± SD
Raw ginseng	112.233	105.632	108.815	108.893±3.301
Soft red ginseng	93.258	88.456	91.247	90.987±2.412
Ready-made red ginseng gap	91.468	87.249	90.447	89.721±2.201

Table 3. The degree of inhibition (%) of DPPH properties for raw ginseng, soft red ginseng, and ready-made red ginseng sap at different concentrations

Ginseng	Concentration (mg/ml)	Inhibition ratio (%)		*t*-test
		Scavenging ability	Relative inhibition	
Raw ginseng	0.25	11.40±4.62	16.7	0.338
	0.50	17.73±1.33	23.1	
	0.75	25.19±4.45	30.5	
	1.00	35.61±3.15	40.4	
Soft red ginseng	0.25	60.77±3.47	89.2	0.215
	0.50	71.80±5.22	93.5	
	0.75	77.65±4.28	94.1	
	1.00	86.17±2.05	97.8	
Ready-made red ginseng gap	0.25	32.46±3.81	47.6	0.023
	0.50	51.34±6.15	66.8	
	0.75	69.85±1.98	84.7	
	1.00	76.34±1.70	86.6	
F-test		15.102***	33.548***	

Data represented the mean ± SD from three replicates. *** = $p<0.001$.

1.0 mg/ml. The scavenging activity of soft red ginseng was 60.8% at 0.25 mg/ml concentration, 86.2% at 1.0 mg/ml, and the relative radical scavenging activity with control group was 97.8% at 1.0 mg/ml. The scavenging activity of the purchased red ginseng sap was 32.5% at 0.25 mg/ml concentration, 76.3% at 1.0 mg/ml, while the relative radical scavenging activity with control group was 86.6% at 1.0 mg/ml. DPPH radical scavenging activity was increased by concen-

Table 4. The 50% inhibition (EC_{50}) of DPPH on 1.0 ug/ml

Ginseng	Value and repeat			
	1	2	3	Mean ± SD
Raw ginseng	119.542	117.108	115.189	117.280±2.182
Soft red ginseng	71.663	65.656	65.493	67.604±3.516
Ready-made red ginseng sap	88.788	76.289	77.072	80.716±7.001

tration in all three types of ginseng. There were significant differences between raw ginseng, soft red ginseng and purchased red ginseng liquid products (p<0.05). As there was no significant difference between the three times iterated experimental groups, it was within the margin of error (p> 0.05). The values of EC_{50} for raw ginseng, soft red ginseng, ready-made red ginseng sap were 117.3 ug/ml, 67.6 ug/ml and 80.7 ug/ml, etc. (Table 4).

Hydroxyl radical (OH) scavenging activity

Table 5 showed the OH radical scavenging activity of extracts. OH scavenging activity of raw ginseng was 12.9% at 0.25 mg/ml concentration, 28.4% at 1.0 mg/ml, and relative radical scavenging with control was 43.1% at 1.0 mg/ml. The OH scavenging activity of soft red ginseng was 40.3% at 0.25 mg/ml concentration, 59.6% at 1.0 mg/ml, and 90.3% at 1.0 mg/ml for relative radical scavenging with control. The OH scavenging activity of the purchased red ginseng sap was 29.0% at 0.25 mg/ml concentration and 49.9% at 1.0 mg/ml, while the relative radical scavenging function with control group was 75.6% at 1.0 mg/ml. OH radical scavenging activity was increased by concentration in all three types of ginseng. There were significant differences among three groups (raw ginseng, soft red ginseng and red ginseng sap) (p<0.05). As there was no significant difference between the three times iterated experimental groups, it was within the margin of error (p>0.05). The values of EC50 for raw ginseng, soft red ginseng, and purchased red ginseng liquid products were 132.6 ug/ml, 88.2 ug/ml and 92.4 ug/ml, etc. (Table 6).

Nitric oxide (NO) scavenging activity

Table 7 showed the NO radical scavenging activity of extracts. NO scavenging activity of raw ginseng was 29.1% at 0.25 mg/ml concentration, 48.8% at 1.0 mg/ml, and relative radical scavenging with control group was 60.8% at 1.0 mg/ml. The NO scavenging activity of soft red ginseng was 57.0% at 0.25 mg/ml concentration, 76.8% at 1.0 mg/ml, while relative radical scavenging activity with the control group was 95.7% at 1.0 mg/ml. The NO scavenging activity of the purchased red ginseng sap was 46.9% at 0.25 mg/ml concentration and 64.3% at 1.0 mg/ml, while the relative

Table 5. The degree of inhibition (%) of OH radical scavenging activity of raw ginseng, soft red ginseng, and ready-made red ginseng sap at different concentrations

Ginseng	Concentration (mg/ml)	Inhibition ratio (%)		*t*-test
		Scavenging ability	Relative inhibition	
Raw ginseng	0.25	12.88±2.30	27.7	0.392
	0.50	19.28±0.55	31.7	
	0.75	23.47±2.47	36.6	
	1.00	28.44±2.69	43.1	
Soft red ginseng	0.25	40.30±2.84	86.6	0.111
	0.50	53.55±1.37	88.0	
	0.75	56.64±1.79	88.3	
	1.00	59.62±1.06	90.3	
Ready-made red ginseng gap	0.25	28.97±1.50	62.4	0.181
	0.50	38.86±0.87	63.8	
	0.75	44.31±1.61	69.1	
	1.00	49.91±3.25	75.6	
F-test		17.241***	119.408***	

Data represented the mean ± SD from three replicates. *** = p<0.001.

Table 6. The 50% inhibition (EC_{50}) of OH on 1.0 ug/ml

Ginseng	Value and repeat			
	1	2	3	Mean ± SD
Raw ginseng	133.403	132.069	132.389	132.620±0.696
Soft red ginseng	88.773	88.225	87.710	88.236±0.532
Ready-made red ginseng gap	92.339	92.386	92.560	92.428±0.116

Table 7. The degree of inhibition (%) of nitric oxide (NO) scavenging activity of raw ginseng, soft red ginseng, and ready-made red ginseng sap at different concentrations

Ginseng	Concentration (mg/ml)	Inhibition ratio (%)		*t*-test
		Scavenging ability	Relative inhibition	
Raw ginseng	0.25	29.17±1.50	16.7	0.444
	0.50	36.63±3.49	23.1	
	0.75	41.34±3.37	30.5	
	1.00	48.78±3.89	40.4	
Soft red ginseng	0.25	56.99±3.58	99.2	0.439
	0.50	63.23±3.34	93.1	
	0.75	68.20±4.78	90.4	
	1.00	76.77±1.85	95.7	
Ready-made red ginseng gap	0.25	46.86±2.17	81.6	0.004
	0.50	53.43±2.74	78.7	
	0.75	59.34±0.81	78.6	
	1.00	64.29±3.29	80.2	
F-test		13.060***	157.148***	

Data represented the mean ± SD from three replicates. *** = $p<0.001$.

radical scavenging activity with the control group was 80.2% at 1.0 mg/ml. NO radical scavenging activity was increased by concentration in all three types of ginseng. There were significant differences among raw ginseng, soft red ginseng and purchased red ginseng liquid products ($p<0.05$). As there was no significant difference between the three times iterated experimental groups, it was within the margin of error ($p>0.05$). The values of EC50 for raw ginseng, soft red ginseng, purchased red ginseng sap were 103.4 ug/ml, 87.1 ug/ml and 90.2 ug/ml, etc. (Table 8).

Inorganic analysis of soft red ginseng

There was a difference in calcium content between soft red ginseng and raw ginseng or hard red ginseng (Fig. 1). Many calcium crystals appeared on the microscope in soft red ginseng. Magnesium and potassium had no significant difference between soft red ginseng and hard red ginseng.

Discussion

Red ginseng which is made by steaming and drying raw ginseng is named for its red color after processing [19]. In fact, it is closer to reddish brown rather than 100 percent red, but it can be called red ginseng from various perspectives or convenience. The reason for the brownness of red ginseng is assumed to be a nonenzymatic browning reaction caused by the peculiarity of the steaming and drying, and Kim [11] estimated that the aminocarbonyl reaction and

Table 8. The 50% inhibition (EC_{50}) of NO on 1.0 ug/ml

Ginseng	Value and repeat			
	1	2	3	Mean ± SD
Raw ginseng	103.225	101.820	105.083	103.376±1.637
Soft red ginseng	88.455	86.039	86.687	87.060±1.251
Ready-made red ginseng gap	90.206	90.653	89.716	90.192±0.469

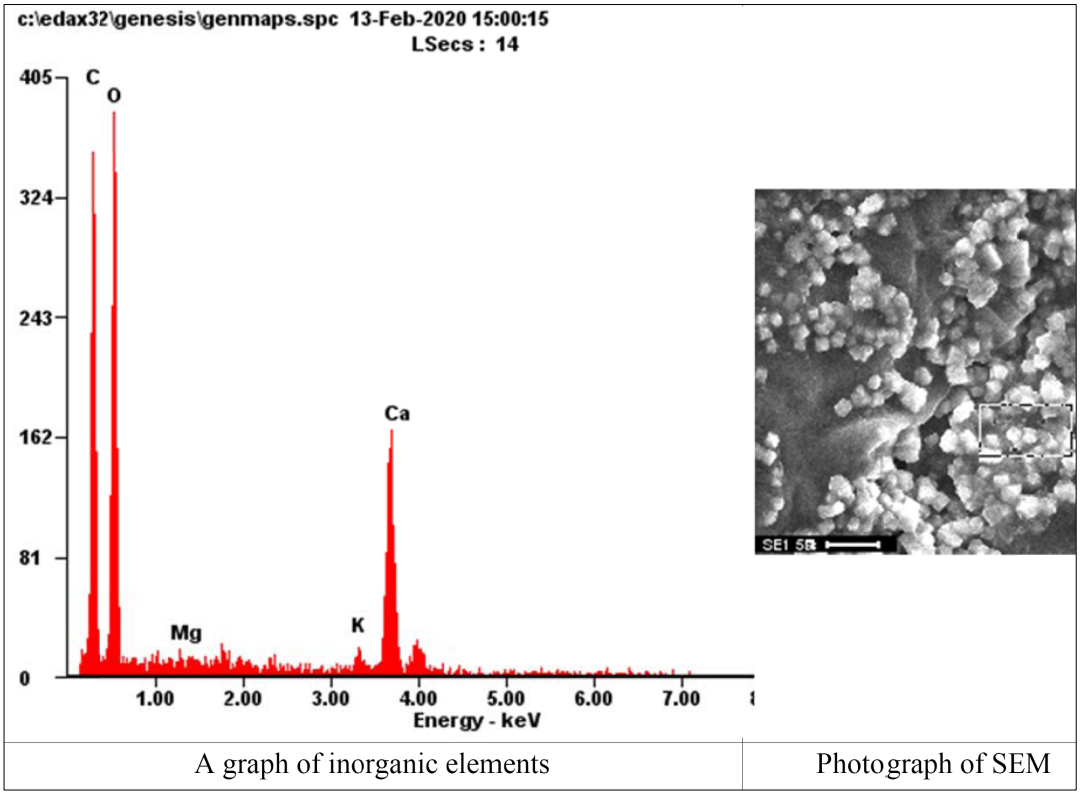

Fig. 1. Inorganic elements and texture analysis of soft red ginseng.

the automatic oxidation of polyphenol were the main causes of it [19]. One of the problems with red ginseng is hardening after drying. As red ginseng is difficult to eat directly because of its hardness after drying, it is generally a hassle for people to re-extract it with water and make it as small as grains so that it can be easily taken. Therefore, it is preferred to eat the form of extracts that are easy to drink and store. Soft red ginseng is a processed goods that does not require such a physical process. In terms of pharmacologic chemistry, a comparison between hard red ginseng and soft red ginseng is needed. As for antioxidant studies, the Superoxide dismutase (SOD) reported that Goryeo red ginseng significantly increased in activity [13]. This study found that antioxidant functions such as ABTS, DPPH, OH, and NO were significantly higher than raw ginseng by and large. Some anti-oxidant activities of soft red ginseng were also higher than products containing red ginseng sap. This was not an accurate comparison because the red ginseng sap content of the products was not high only with about 10%, with 90% of other ingredients, which resulted in offset or partial interaction effects. Although it was impossible to compare the results with hard red ginseng because no results were reported so far, the antioxidant function was not impaired but increased even if ginseng was manufactured as soft red ginseng.

Although we don't have any comparison targets as the results of various studies on red ginseng were conducted in different ways, reference from Cho et al. [6] presented that they were less than 0.24% in six types of ginseng. According to the reports from Han Bang Bio (China) commissioned by Ministry of Agriculture, it was analyzed that Korea Ginseng Products (white ginseng, red ginseng, X) and Chinese products (white ginseng, red ginseng, X) did not have higher calcium levels than other minerals [20]. The report showed that K (potassium) was the most (0.8 to 21 g/kg), followed by P (1.1 to 4.1 g/kg), and Ca (0.01 to 4.5 g/kg) (Table 9). We could see that soft red ginseng was much higher Ca. Magnesium (Mg) and potassium (K) had no significant difference between soft red ginseng and hard red ginseng based on the literature investigation. We usually eat a lot of anchovies and dairy products such as milk for calcium. Soft red ginseng can be suggested as an alternative.

Soft red ginseng had a high level of ABTS antioxidant function that was almost identical to red ginseng sap. The extract of soft red ginseng may be helpful in free radical-induced medicinal problems due to the presence of ABTs,

Table 9. Inorganic elements of several ginseng materials

Ginseng	C	O	Ca	K	Mg
Ginseng tail			0.147		
White ginseng			0.238		
Raw ginseng			0.126		
Ginseng tail extract			0.023		
White ginseng extract			0.011		
Raw ginseng extract			0.016		
Soft ginseng	50.84	43.18	5.28	0.45	0.24

Data excluding soft red ginseng: Cho et al. (1976).

DPPH, OH, and NO radical scavenging activity.

The Conflict of Interest Statement

The authors declare that they have no conflicts of interest with the contents of this article.

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초록 : 수삼, 연질 홍삼, 수액 홍삼의 항산화 효과

허만규[1]* · 김국환[2]
([1]동의대학교 식품공학과, [2]홍삼본가)

고려 인삼(*Panax ginseng*)은 일반적으로 안전성이 우수하고 ginsenosides or panaxosides 같은 많은 생활성적인 물질을 함유하고 있다. 특히 고려 홍삼은 교감 신경계를 안정시키고 인지력을 향상시키고 개인의 의학적 효과를 높이는 데 도움을 줄 수 있다. 새로운 가공 기술로 부드러운 홍삼을 생산하였다. 본 연구는 새로운 가공 기술에 따라 생산된 연질 홍삼이 항산화 효과를 감소시키거나 개선했는지 여부를 조사하는 데 초점을 맞췄다. 연질 홍삼과 시판 홍삼액은 2,2′-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid) (ABTS) 소거활성능에 있어 유의한 차이를 나타내지 않았다(p<0.05). 연질 홍삼은 수삼과 시판 홍삼액에 비해 DPPH (22-Diphenyl-1-pichrylic)와 OH (hydroxyl radical) 소거활성능이 높게 나타났다. OH 소거활성능은 세 그룹(수삼, 연질 홍삼과 시판 홍삼액) 간 유의한 차이를 나타내었다(p<0.05). NO (nitric oxide) 소거활성능 역시 수삼, 연질 홍삼, 홍삼 수액생산품 사이에 유의한 차이가 있었다(p<0.05). 연질 홍삼에서 많은 칼슘 결정체가 전자현미경상에서 관찰되었다. 마그네슘과 칼륨은 연질 홍상과 경질 홍삼 사이에 유의한 차이가 없었다. 연한 홍삼의 추출물은 DPPH와 OH의 존재로 인해 서로 다른 활성산소를 효율적으로 소거할 수 있어 자유 라디칼로 유도된 질환에 도움이 될 수 있다.