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Original article

Chemical composition characteristics of Korean straight ginseng products

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ABSTRACT

Background: The present study was conducted to provide basic data for standard quality characteristics by grade, and for the establishment of new grading criteria for Korean straight ginseng (SG).
Methods: The major constituents (moisture, total sugar, acidic polysaccharide, phenolic compound, crude saponin, and ginsenosides) in SG with skin products were analyzed to examine the standard quality characteristics.
Results: Five-year-old first-grade 15- and 25-piece grade SG products were collected over a period of 5 years and analyzed. The total water-soluble sugar content was 35.2% and 35.4% for the 15- and 25-piece grades, respectively, and the acidic polysaccharide content was 4.1% for the 15-piece grade and 4.6% for the 25-piece grade. Both the 15- and 25-piece grade products had 0.5% total phenolic compounds. The amount of crude saponin was 3.2–5.5% in all samples. The amounts of the major ginsenosides Rb_1, Rf, and Rg_1 were 4.7, 1.1, and 3.6 mg/g, respectively, in the 15-piece grade and 3.6, 1.0, and 3.0 mg/g, respectively, in the 25-piece grade.
Conclusion: Overall, the coefficient of variation was over 15% for the major constituent contents, indicating that it was difficult to standardize the constituent contents using the mean value.

1. Introduction

Korean ginseng, *Panax ginseng* Meyer, named by Carl Anton Meyer of Russia in 1843, is a plant in the Araliaceae family and is one of the major representative medicinal herbs in Korea [1]. "Panax" means cure for all diseases, as it combines the Greek words *pan* meaning "all" and *axos* meaning "medicine" [2]. In Korea, red ginseng and various processed ginseng products—in addition to fresh ginseng and primary ginseng products, such as root ginseng—are used as health foods. Korean ginseng is known to have many health benefits, such as immune function improvement, antifatigue, blood circulation improvement, blood cholesterol improvement, antidiabetic, memory improvement, endurance improvement, anticancer activity, antistress effects, depression improvement, and antiaging effects. Accordingly, studies on the various physiologically active constituents responsible for these effects, including ginsenosides, acidic polysaccharides, and peptides, have been actively conducted [3–9].

The chemical composition of ginseng includes carbohydrates, nitrogen-containing compounds, fat-soluble substances, minerals, and ginseng saponin (ginsenoside), and the chemical structure of approximately 30 types of ginsenosides has been determined. Ginseng saponin is present in the form of a glycoside, a combined aglycone and sugar—hence, its name ginsenoside. Ginseng saponin is divided into a four-ring structure triterpenoid dammarane-type saponin, including protopanaxadiol- and protopanaxatriol-type saponins, and a five-ring structure oleanane-type saponin. As the major active component of Korean ginseng, ginsenoside has predominantly been used to establish the quality specifications of ginseng. Moreover, Korean ginseng contains various functional constituents in addition to saponin, such as phenolic compounds with antioxidant activity, polyacetylene, which exhibits cytotoxicity to cancer cells, sesquiterpene, an essential oil, and acidic

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polysaccharides, which are currently studied actively in relation to immune responses [10]. To date, studies on the function of the major active constituents, such as ginsenosides, and on the improvement of the constituent content and functionality through puffing, acid treatment, and high-heat treatment have been actively conducted. However, these studies have concentrated mainly on red ginseng and its specific constituents [11–13].

Currently, the ginseng products distributed on the domestic market can be largely classified as fresh ginseng and its primary processing products in its original shape, red ginseng, and dried ginseng (DG). DG is a fresh ginseng product that is not cooked but dried by sunlight, hot wind, or other methods. Considering the fact that most foreign ginseng products are sold on the international market in a similar shape as DG, efforts should be made to conduct studies on the functionality of DG and for the standardization of the quality and specification of domestic DG products. A review of the previous literature showed that some studies on the quality and physicochemical properties of DG have been conducted [14,15]. Nonetheless, it was difficult to determine the physicochemical quality characteristics of DG products because most of the research consisted of one-time studies or their ranges of sample selection and quality evaluation items were narrow. As of 2011, DG accounted for approximately 30% of the total ginseng distribution [16]. DG is classified as 4-, 5-, and 6-year-old roots according to the cultivation period; by shape, DG is largely categorized into straight ginseng (SG) and curved ginseng, which are distributed at a ratio of approximately 4:6. Ginseng is also classified as first, second, and third grade according to the quality characteristics, which include the appearance and package, and is sold in various piece-grade sets from five to 75 pieces based on the number of pieces per package unit. However, studies on the chemical properties by the grade and piece grade of DG are rare. The present study was conducted to provide basic data for the standard quality characteristics by grade and the establishment of new grading criteria for DG. Our experiments included samples of 15- and 25-piece grades of first-grade SG (5-year-old) products that were selected from the DG products distributed in Korea, and a specific quantity of samples was collected annually for 5 years. The moisture, water-saturated butanol extract, ginsenoside, total phenolic compound, and acidic polysaccharide contents were then measured and statistically analyzed.

2. Materials and methods

2.1. Sample

Among the major DG products produced between 2006 and 2010, 5-year-old 15- and 25-piece grade SG with skin were selected as the target samples. A total of 80 products—40 of the 15-piece grade and 40 of the 25-piece grade (5–10 products per year for 5 years)—were collected from major domestic DG markets, such as Gyeongdong Market (Seoul, Korea) and Geumsan Market (Geumsan, Korea). The collected samples were then used for chemical analyses after even pulverization to a 60-mesh size and storage at −60°C. All samples of SG products were finished products, and only products that passed the quality test by the inspection office of the National Agricultural Cooperative Federation (Geumsan, Korea) or self-inspection and were packaged and sold in the market were used as samples.

2.2. Moisture content

The moisture content was determined according to the Association of Official Analytical Chemists method 925.45 [17].

2.3. Water-soluble total sugar content

The total sugar content was quantified using a phenol–sulfuric acid method with glucose as the reference [18].

2.4. Acidic polysaccharide content

The acidic polysaccharide content was quantified using a carbazole–sulfuric acid method with β-D-galacturonic acid as the reference [19].

2.5. Phenolic compound content

The total phenolic compound content was measured according to the Folin–Ciocalteu method with gallic acid as the reference [20].

2.6. Water-saturated 1-butanol extracts (crude saponin) content

The water-saturated 1-butanol extractcontent was determined according to the CODEX official method [21].

2.7. High-performance liquid chromatography analysis of ginsenoside content

The ginsenoside content was measured using high-performance liquid chromatography according to a previously described method [22].

2.8. Statistical analysis

A basic statistical analysis was performed for the results of the chemical analysis between the SG products and among the piece grades for each sample. The mean, standard deviation, minimum, maximum, and coefficients of variation (CVs, %) values were calculated.

3. Results and discussion

3.1. Moisture content

Table 1 shows the results of the moisture content by piece grade of the SG products on the market. The moisture content of SG with skin was 8.6–11.6% for the 15-piece grade and 8.6–13.4% for the 25-piece grade; the average moisture content was 10.2% and 10.8%, respectively. The CV, which shows the differences among individuals, was approximately 11.1%. Such a difference among the individual samples was believed to be the difference in the degree of drying during the manufacturing process and natural drying during the distribution period after manufacturing. Overall, the

Table 1
Moisture Content of Korean Straight Ginseng Products.

	Moisture content (%)		
	15-piece grade* ($n = 40$)	25-piece grade ($n = 40$)	Total ($n = 80$)
Mean	10.2	10.8	10.4
SD	0.8	1.4	1.2
MAX	11.6	13.4	13.4
MIN	8.6	8.6	8.6
CV (%)†	8.2	13.2	11.1

SD, standard deviation.
* Piece grade refers to the number of pieces per 300 g package for each straight ginseng products.
† CV (%): coefficient of variance, (SD/Mean) × 100.