

Research Note

백삼 및 홍삼 농축액의 사포닌 분석

고성권* 이충렬 최응의 임병옥 성종환 윤광로

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Analysis of Ginsenosides of White and Red Ginseng Concentrates

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Commercial white and red ginseng concentrates were analysed for total ginsenoside contents, and compositions of ginsenosides Rb₁, Rb₂, Rc, Rd, Re, Rf, Rg₁, 20(S) Rg₃, 20(R) Rg₃, 20(S) Rb₁ and 20(R) Rb₁. The content of crude saponin and total ginsenosides of white ginseng concentrates (WGC) were about 2-3 times higher than those of red ginseng concentrates (RGC). HPLC showed that each ginsenoside content was higher in WGC, with those of Rb₁, Rg₁, and Rb, being over three times higher than that of RGC. 20(S)- and 20(R)-ginsenoside Rg₃, specific artifacts found only in red ginseng, were detected both in WGC and RGC by HPLC. Differences in the contents of these specific ginsenosides between WGC and RGC were not significant. The contents of 20(S)-ginsenoside Rg, determined by HPLC were 0.40 and 0.53 in WGC, whereas 0.48% and 0.47%, and those of 20(R)-ginsenoside Rg₃ were 0.14 and 0.22% in WGC, and 0.10 and 0.11 % in RGC using the methods of shibata and Food Code, respectively.

Key words: ginsenoside content, commercial white and red ginseng concentrates, ginsenoside Rg₃

Introduction

As the Panax ginseng is widely used as functional food or food supplement with its effects scientifically certified, the amount of ginseng distributed around global markets is drastically on the rise. In addition, the cultivation of ginseng is expanded throughout the world with production in China, North America, Chile, Australia and New Zealand showing a remarkable growth. China, in particular, has increased production of ginseng by as much as five folds for the past 10 years from 1600 tons in 8000 tons in 1995 while Korea, the place of origin for ginseng, has long lost the reputation as the suzerain of ginseng as well as the competitiveness in global market and has fallen into an uncertain circumstance even in domestic market as well under the WTO system. . Under this circumstance have specific plans to restore the previous reputation regarding ginseng been sought, one of which is the rigorous research into producing quality Korean ginseng as differentiated functional food and pharmaceutical product.

The new ginseng products developed and introduced in the market recently are likely to focus on red ginseng. As the ginsenoside Rg₃ contained in red ginseng turns out to have anti-cancer effect, the preference to the red ginseng process products with has dramatically increased. However, the popular trend of developing red ginseng process products can cause the adverse effect of relatively or erroneously undermining the competitiveness of white ginseng process products. The differentiated features of red ginseng are likely to be highlighted in the process of placing emphasis on the efficacy of red ginseng process products while the white ginseng may be underestimated by consumers although there is no fundamental difference between red ginseng and white ginseng in terms of the effectiveness as health food supplement except the heat processing is applied to red ginseng as opposed to white ginseng. Since, however, the white ginseng process products also go through a heat treatment during the process of producing the white ginseng products, a number of heat products including ginsenoside Rg₃ are definitely created in white ginseng process products as well. In conclusion, the differentiation between the red ginseng and the white ginseng can be identified by comparing the content of effective components rather than whether or not the effective components exist.

Against this backdrop, this research is aimed to provide the basic information to support the additional benefits of white as well as red ginseng products by comparing and analyzing individual ginseng saponins including the total content of saponin and ginsenoside Rg₃ extracted from one of the red ginseng concentrate products of the company A and from one of the white ginseng concentrate products of the company B that are widely available in consumer market.

Method of Test

Test Material

One type of red ginseng concentrate products made by company A and one type of white ginseng concentrate products made by company B have been purchased to use them as test materials. The specimen of each product is stored at Natural Product Research Lab of Chungang University Ginseng Research Institute.

Manufacturing of crude saponin

The crude saponin has been manufactured as described below in accordance with the Shibata or red ginseng component method published in Food Code to determine the content and to use this crude saponin as specimen for analysis.

Shibata method:

50g of each specimen has been taken and processed with ethylether for three times to eliminate the fat-soluble materials and then has been processed again with water-saturated n-butanol for three

times to obtain the n-BuOH layer, which has been added to be vacuum concentrated along with the specimen. All manipulations have been conducted in a quantitative manner and the content of the vacuum concentration product has been designated with the amount of crude saponin.

Food Code Method:

The extract obtained by repeating manipulation of 7.0g of specimen twice at the temperature of 70 to 80°C for approximately one hour using water-saturated n-butanol in accordance with the red ginseng component method mentioned in Food Code has been vacuum concentrated. This extract has been heated for about 30 minutes with ethylether to remove fat from it. The content of residue has been measured and then the content of crude saponin has been calculated in accordance with the formula of the Food Code.

Analysis of HPLC and Ginseng saponin

The HPLC has been conducted by applying the condition of the Kim, et. al. crude saponin and has been directly compared with the specimen in accordance with the Commercial Law to analyze the content and composition of ginseng saponin. The specimens used were the genuine saponin refined in Ginseng Research Institute of Chungang University and the ginsenoside with 95% or more purity obtained from the Ilhwa Co. Ltd. Central Research Institute.

The HPLC device used was the Gilson 305 system(Gilson, France) and the column used was the μ -Bondapak C₁₈ (Waters, 3.9 X 150mm, US). The moving phase was acetonitrile(HPLC level, Sigma, US) and distilled water for HPLC with the ratio of acetonitrile steadily increased from 17% to 33%, 60% and to 80% before decreasing back to 17%. The experiment was conducted at room temperature with the flow rate of 1.0mL per minute. The chromatogram has been detected at 210nm using the uv/vis detector(Gilson 118, France).

Result and Implication

Each one of the red ginseng concentrates and of the white ginseng concentrates widely available in domestic market has been selected, respectively, to examine and compare the amount of crude saponin in it as well as the content distribution of individual ginsenosides in order to find out the difference between red ginseng process products and white ginseng process products in terms of the pattern of containing saponin. As illustrated in Table 1, the amount of crude saponin measured in Shibata method and in Food Code method has been 10.65% and 21.77%, respectively for WGC(white ginseng concentrate), which is higher than 5.80% and 10.94%, respectively, for RGC(red ginseng concentrate). WGC has also shown 7.40% and 10.64% as the amount of total ginsenosides content (Table 2) calculated based on the HPLC method, which is more than twice as much as that of RGC with 3.31% and 3.13%. Meanwhile, in terms of the difference in value between the Shibata method and the Food Code method, the value obtained through the Food Code method has been greater than that of the Shibata method in general although the content of total ginsenosides(Table 2) of RGC was similar with 3.31 and 3.13%, respectively. Soldati and Sticher have maintained that the

total ginsenosides of standard ginseng extracts they manufactured was approximately 4.15 through 7.95%, which is extremely similar to the outcome for WGC in this study in that d ginseng extracts use white ginsengs as raw material.

Table 1. Content of Crude Saponins in the Commercial White and Red Ginseng concentrates (%)

Commercial concentrates	Shibata method	Korean food code method
WGC ¹⁾	10.65	21.77
RGC ²⁾	5.80	10.94

¹⁾WGC; white ginseng concentrates.

²⁾RGC; red ginseng concentrates.

Table 2. Composition of ginsenosides of white and red concentrates prepared from the commercial ginseng concentrates (% w/w)

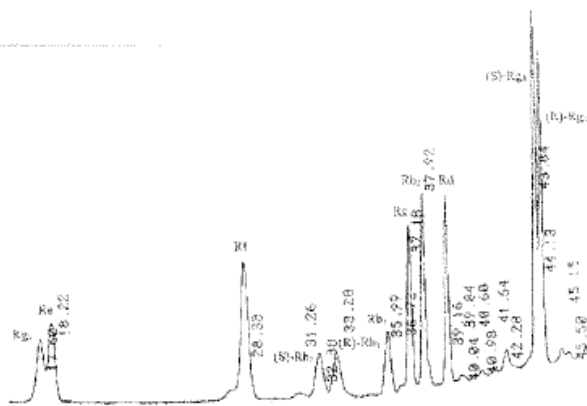
Ginsenosides	WGC ¹⁾		RGC ²⁾	
	Shibata ³⁾	Food Code	Shibata	Food Code
Rb ₁	1.55	2.28	0.48	0.50
Rb ₂	0.91	1.39	0.27	0.38
Rc	1.11	1.69	0.32	0.47
Rd	0.68	1.00	0.23	0.29
Re	0.32	0.43	0.09	0.09
Rf	0.12	0.15	0.06	0.06
Rg ₁	0.16	0.21	0.06	0.07
20(S) Rg ₃	0.40	0.53	0.48	0.47
20(R) Rg ₃	0.14	0.22	0.10	0.11
20(S) Rh ₁	1.80	2.39	1.06	0.58
20(R) Rh ₁	0.21	0.35	0.16	0.11
Total ginsenosides ⁴⁾	7.40	10.64	3.31	3.13
Diol/Triol	1.84	2.01	1.32	2.44

¹⁾WGC; a commercial white ginseng concentrates.

²⁾RGC; a commercial red ginseng concentrates.

³⁾means the preparation methods of saponin fractions.

⁴⁾sum of individual ginsenosides content.



[Standard]

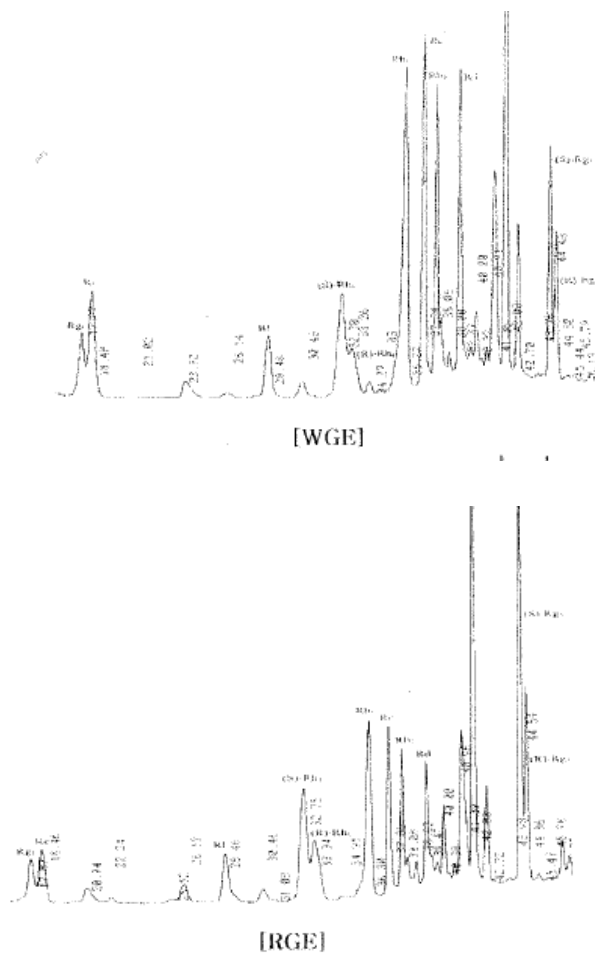


Fig 1. HPLC profiles of ginsenosides detected from the commercial concentrates, RGC (red ginseng concentrates) and WGC (White ginseng concentrates), and compared with chromatograms of the standard authenties.

The ginseng saponins under the analysis if this study include ginsenoside Rb1, Rb2, Rc, Rd, Re, Rf, Rg, 20(S), 20(R), Rg3, 20(S) Rh1 and 20(R) Rh1, whose content has been calculated by directly comparing with the specimen through HPLC as illustrated in Fig. 1. When it comes to the content distribution of ginseng saponins, as illustrated in Table 2, most individual saponins including ginsenoside Rb1 have been evaluated more favorably towards WGC than RGC regardless of the crude saponin producing conditions. In addition, the ratio of protopanaxadiol group over protopanaxatriol group (PD/PT) of crude saponin obtained based on the Shibata method has been 1.84 for WGC, which is also higher than 1.32 for RGC while the PD/PT of crude saponin based on the Food Code method has been 2.01 for WGC, higher than 2.44 for RGC but no substantial difference between concentrates.

In addition, the ginsenoside Rb1, the indicator of sedative effect imposed on central nervous system has been 1.55 and 2.28% for WGC three or four times higher than that of RGC with 0.48 and 0.50% while ginsenoside Rg1, the indicator of anti-fatigue activity, has been 0.91 and 1.39%, again three or

four times higher than that of RGC with 0.27, 0.38% and ginsenoside Rb₂, the indicator of anti-diabetic activity, has also turned out to be approximately three times higher for WGC with 0.91 and 1.39% than that for RGC with 0.27 and 0.38%. In particular, 20(S) and 20(R)-ginsenoside Rg₃, which are known as the unique saponin of red ginseng has turned out to be contained in similar amount both in WGC and RGC. That is, the content of 20(S)-ginsenoside Rg₃ has been found more in crude saponin of RGC with 0.48% than in WGC with 0.40% based on the Shibata but has been higher in crude saponin of WGC with 0.53 than in RGC with 0.47. The same has been true with 20(R)-ginsenoside Rg₃ that has shown 0.14 and 0.22% for WGC, again slightly higher than 0.10 and 0.11% for RGC.

Korean red ginseng, which is obtained by evaporating and drying green ginseng has been highly acknowledged as one of the best natural medicines and health supplements in Korea for a long time. As the refined heat products such as ginsenoside Rg₃ produced during the red ginseng manufacturing process are becoming known to have anti-cancer effect as well as the cancer-inhibitory activity, its superiority has been remarkably recognized and reaffirmed. Meanwhile, as ginsenoside Rg₃ is recognized as the unique component found in red ginseng only, unnecessary differentiation and incorrect fact about red ginseng as opposed to white ginseng and relevant process products have come to the surface although it is a clear fact that white ginseng also creates a number of second-tier products by heat with a high possibility of creating ginsenoside Rg₃ as well because its process products undergo the process of extraction and condensation before released as completed products. Therefore, the outcome of this study that 20(S)-ginsenoside Rg₃ and 20(R)-ginsenoside Rg₃, formerly known as the unique products of red ginseng, have been found in WGC just as much is not a surprise at all. Moreover, ginseng process products, whether they originate from red or white ginseng, can create a large amount of ginsenosides depending on the processing condition, which supports the assertion that all ginseng process products should be compared and contrasted under the assumption that new-concept ginsenosides can be created in all ginsengs regardless of the type.

Summary

One type of WGC and one type of white RGC that are currently available in market have been selected as specimen to obtain the saponin distribution and content in them, including the content of crude saponin as well as individual ginsenosides for comparison purpose. The specimen of each product is stored at Natural Product Research Lab of Chungang University Ginseng Research Institute. The amount of total ginsenosides measured based on the Shibata method and domestic Food Code method has shown to be 10.65 and 21.77%, respectively for WGC and to be 5.80 and 10.94% respectively for RGC while the amount of total ginsenosides measured based on the HPLC method has shown to be 7.40 and 10.64%, respectively for WGC and to be 3.31 and 3.13% respectively for RGC, indicating that the overall amount of saponin contained in WGC is larger than that of RGC. Most ginsenosides including Rb₁₊, Rb₂₊, Rc, Rd, Re, Rf, Rg₁, 20(S) Rg₃, 20(S) Rh₁ and 20(R) Rh₁ based on the analysis of HPLC have shown to be greater in WGC than in RGC with

ginsenoside Rb₁+ Rg₁ and Rb₂, in particular, contained in WGC three times more than that in RGC. In addition, there has been no significant difference in the ratio of protopanaxadiol group to protopanaxatriol group (PD/PT) between the red and white ginseng concentrates. What's noticeable is that the 20(S)- and 20(R)-ginsenoside Rg₃, which has been preciously known to be a unique saponin of red ginseng, has turned out to be contained both in WGC and RGC with its amount comparable to each other. The amount of 20(R)-ginsenoside Rg₃ contained in RGC has been 0.48 and 0.47% based on crude saponin manufacturing method while that of 20(R)-ginsenoside Rg₃ contained in WGC has been 0.40 and 0.53%. In addition, the amount of 20(R)- ginsenoside Rg₃ contained in RGC has been 0.10 and 0.11% while that of 20(R)- ginsenoside Rg₃ contained in WGC has been 0.14 and 0.22%

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