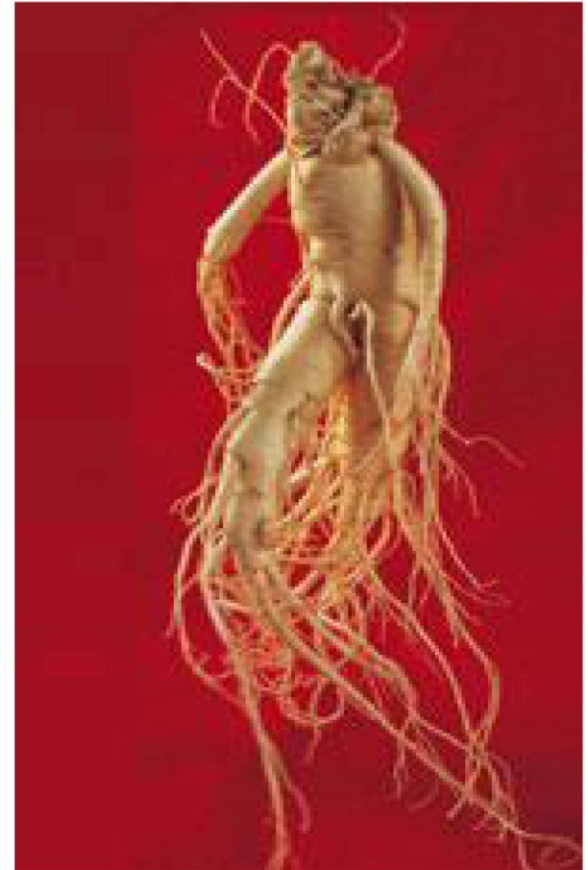


## 1.Introduction

Korean ginseng is well known for its superior quality and health enhancing effects in the world, as one of Korean specialty products. It has been recognized as a cure-all and very reliable plant in traditional oriental medicine.

In these health-oriented days, more people pay much attention to diseases and ginseng.

Therefore, we will take a look at how people become interested in ginseng, what is the trend of ginseng and finally what are the effects of black-red ginseng.



## 2. Definition of ginseng



### 2-1. Origin of the word, Korean ginseng

Korean ginseng is a shade perennial plant belonging to the family Araliaceae of the order Apiales. Its scientific name is *panax ginseng*. It grows in cool, temperate climates containing hardwood forests of mountainous regions. Due to the high demand of ginseng for medicinal purposes, it has been cultivated. It can grow up to 60cm and has a single erect or slant stem which terminates in a whorl of about 3–4 leaves on long petioles. Each compound leaf is palmate with 5 widely spreading leaflets. It bears almost spherical (small and wide), reddish purple fruits in autumn, which are about 5–9mm in diameter and drupe with two semicircular kernels. Each kernel contains a single seed called “seng-berry”, like a strawberry.

Ginseng root is white or yellow in color and grows up to 10–20cm with 2–3cm thickness within a few years. The root resembles the form of a human body. This is why ginseng called ginseng (人蔘: human body-shaped root).



Now, there are many types of herbs called as ginseng, though they belong to other genus than panax outside the Korea. This is why we call Korean ginseng as

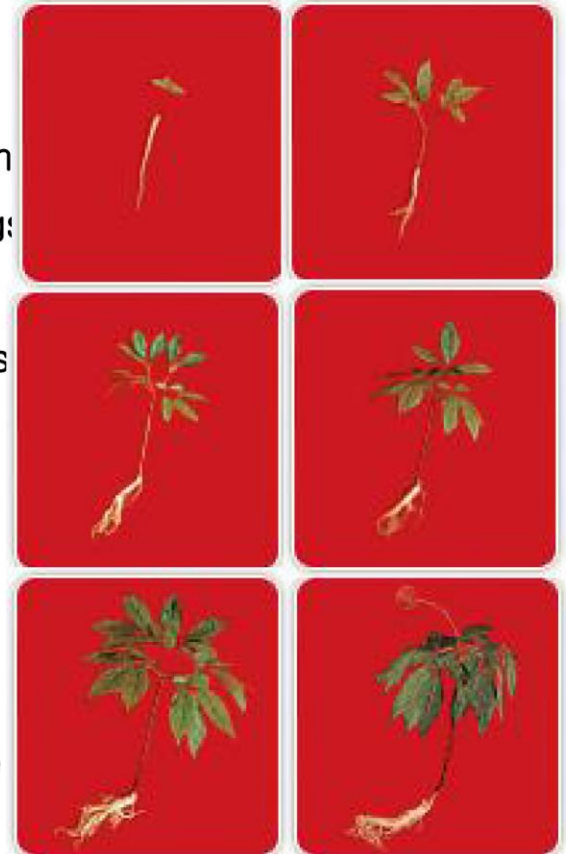
“Korean panax ginseng”. Further, Korean ginseng can be written in 蔘 (meaning ginseng), while ginseng from other countries is written in 参 (meaning ginseng).

In a narrow sense, ginseng means Korean ginseng. However, in a broad sense, ginseng includes the ginsengs from America, China and Japan (American ginseng, Chinese ginseng called 三七人蔘 (the species: *Panax notoginseng*) and Japanese ginseng called 竹節人蔘 (the species: *Panax japonicas*).

The scientific name of Korean panax ginseng has been named by C.A. Meyer, a Russian botanist in 1894. As the generic name *Panax* is a compound word of ‘Pan’ meaning all and ‘Axos’ meaning cure, panax ginseng means ‘a cure for all diseases’. The species name ‘ginseng’ is an English spelling for 人蔘 in Chinese pronunciation.

## 2-2. Growing Korean Ginseng

Ginseng can grow up to 60cm and has a single erect stem which terminates in a whorl of about 3–4 petioles. Each compound leaf is palmate with 5 widely spreading leaflets. The outer leaf is small and three leaves in the center are 4.5–15cm in length and 3–5.5cm in width with sharp, saw-tooth edges. First-year ginseng seedlings produce only one compound leaf with three leaflets. As the plant ages and grows more leaves, it typically has 5 leaves and develops into two-prong stage, three-prong stage, four-prong stage, five-prong stage, six-prong stage and seven-prong stage. In summer, a single flower stalk comes out and terminates in about 4–40 light yellow to green blossoms in umbel (upper mapping and binding exchange layer). Ginseng has 5 petals and 5 stamens with 1 pistil. Ginseng fruit is drupe in flat sphere shape with 5–9mm long diameter. When it ages, it turns into scarlet in color with two semicircular kernels in the center. Ginseng root is used for medicines and resembles the form of a human body. This is the reason why it is called Ginseng (meaning a human body-shaped root).

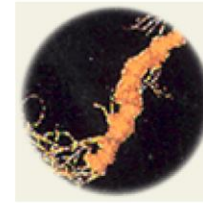


Ginseng originally grows deep in the mountains. It was first collected for medicinal purposes. Due to increasing demands and limited yield of natural ginseng, ginseng was first grown on the fields in Korea in the 16<sup>th</sup> century. Cultivation of high-quality ginseng is suitable for most areas of Korea, due to perfect climate of four distinct seasons, ideal soil conditions, enough annual precipitation, and unique traditional cultivation skill.



### 3. Types of ginseng

#### 3-1. Ginseng types by environmental conditions for growth



Type	Growth environment
Field-cultivated ginseng	Ginsengs are artificially cultivated in the field.
Wild-simulated ginseng	The seeds of wild ginsengs are sown in natural mountains but artificially cultivated
Wild ginseng	Ginsengs naturally grow deep in the mountains

### 3-2 Ginseng types by production areas



There are 6–7 species belonging to ginseng in the world. In general, however, there are mainly three types of ginseng commercially distributed in the ginseng market. The ginseng with the botanical name “*Panax ginseng* C.A. Meyer” grown in the Far East has been traditionally used as an important invigorant in Chinese medicine. In recent years, the production of American ginseng (*Panax quinquefolius*), which is different from panax ginseng from Asia, has gradually increased.

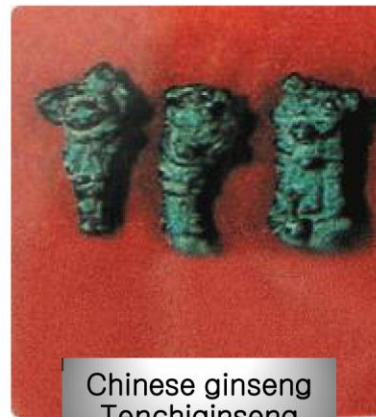
Ginseng Types	Scientific Name	Number of Foliole	Root Shape	Distribution	remark
Korean ginseng	<i>Panax ginseng</i> C.A. Meyer	5	Human body	Korea, China (Northeast area), Japan, and Russia (Primorsky Krai)	
American ginseng	<i>Panax quinquefolius</i> L.	5	Column	USA, Canada, China (Recently cultivated in China)	Also called as western ginseng, huaqishen.
Nepal ginseng	<i>Panax. pseudoginseng</i>	5	Bulb	Eastern north America	
Three leaf ginseng	<i>Panax.trifolium</i>	3	Sphere	Eastern north America	
Japan ginseng	<i>Panax.japonicum</i>	5	Bamboo root	Japan and China (Yunnan province)	
Chinese ginseng Tenchiginseng	<i>Panax notoginseng</i> (Bruk) F.H.Chen	5~7	small carrot	China (Yunnan province and Guangxi province)	Also called as Sanchiginseng



American ginseng



American wild ginseng



Chinese ginseng  
Tenchiginseng



Canadian ginseng

In addition, there are other types of ginseng such as *Panax japonicas* C. A. Meyer (Japan ginseng in bamboo root shape), *Panax trigolium* C.A. Meyer also called dwarf ginseng growing in Eastern North America (in a very small bulb shape), and *Panax pseudoginseng* also called Himalayan ginseng (in a corn shape with many adventitious roots). However, these are not cultivated for medicine.

Meanwhile, recently many products are misunderstood by consumers as ginseng products because they use ginseng in their brand names by following the reputation of Korean ginseng, all though they belong to different species from ginseng species.

For example, *Eleutherococcus senticosus* is called Siberian ginseng and *Pfaffia paniculata* is called Brazilian ginseng. However, these plants belong to different species from ginseng and don't contain even saponins.

“Korean ginseng” has been considered to be the most precious medicinal herb among Asian ginsengs. This has strong and firm head part, fat main root in column shape and healthy rootlets, which is commonly shaped like human body in appearance. This external appearance of Korean ginseng is generally understood as the expression of Korean climate, soil conditions and well-developed growing method.

### 3-3. Ginseng types by processing methods

Ginseng is divided into fresh ginseng, white ginseng, taegeuk ginseng, red ginseng, black ginseng and black-red ginseng, based on its processing methods and maintenance of ginseng's original shape.

Fresh ginseng is a raw ginseng which is not processed after being collected from fields.

#### Fresh ginseng (raw ginseng)

	Definition	Remark
Fresh ginseng (raw ginseng)	<p>This is a fresh ginseng naturally collected from fields. It is very popular, due to its 70–80% water content and fresh effects of medicinal properties.</p> <p>However, it deteriorates and gets damaged so easily during transportation and distribution. Therefore, it is kept in specially designed conditions and packing for long term storage.</p>	



## White ginseng



type	Processing method	Ginseng types after processing
<b>White ginseng</b>	<p>It commonly uses 4-year-old fresh ginseng roots.</p> <p>It is sun-dried or heat-dried with or without barks. It is milky white or light yellow in color.</p> <p>According to the external appearance by processing, it is divided into straight ginseng (upright-shaped ginseng), half-curved ginseng (by bending ginseng rootlets) and curved ginseng (by bending entire rootlets and some parts of main roots).</p> <p>Half-curved ginseng and curved ginseng are processed after barks are peeled off.</p>	<ul style="list-style-type: none"> <li>– Straight ginseng (upright-shaped ginseng): It has been mainly processed in Kaesong province since the Goryeo Dynasty. It features soft texture and mild medicinal properties by carefully trimming and making dried roots straight.</li> <li>– Curved ginseng: It has been mainly processed in Geumsan area since the Baekje Dynasty. It features hard texture and strong medicinal properties by partially or wholly bending ginseng roots for easy storage and transportation.</li> <li>– Half-curved ginseng: It is processed by allowing the main body roots to straight and bending other rootlets.</li> <li>– Fresh-dried ginseng: It is dried without peeling barks off. Due to its strong medicinal properties, it is used for commercial purposes. That is, it mainly uses fresh ginseng roots including its bark and head part.</li> <li>– Dried ginseng rootlets: It is dried from fresh ginseng rootlets or the rootlets from white ginseng processing. It has three sizes as small, medium and large. Due to its strong medicinal properties, it is used for tea.</li> <li>– Dried young ginseng: It uses young ginseng roots.</li> <li>– Broken ginseng: It is named after the ginseng with poor shape or over 2/3 damaged portion of whole ginseng.</li> <li>– Skin white ginseng: It is processed like straight ginseng but barks are not peeled off.</li> </ul>



- Straight (upright-shaped) ginseng:  
It is processed in standing position.



- Fresh-dried ginseng:  
It uses over 3-year-old fresh ginseng roots including barks and head part. It is sized below 7mm in diameter and 5.0g in weight



- Curved ginseng:  
It is processed by bending some parts of main roots and entire rootlets.



- Skin straight ginseng:  
It is processed almost like white straight ginseng but barks are not peeled off, unlike red ginseng.



- **Half-curved ginseng:**  
It is processed by allowing the main roots to stand upright and other rootlets to be bent down.



- **Broken ginseng:**  
It includes the ginseng roots having poor shape or over 2/3 damaged portion of whole ginseng.



- **Dried ginseng rootlet:**  
It is named after the ginseng dried with fresh ginseng rootlets only. It has three sizes as small, medium and large.



## Red ginseng

Ginseng type	Processing method	Ginseng types after processing
Red ginseng	<p>It is steamed and dried with fresh ginseng roots for long-term storage. It is red brown in color.</p> <p>It is processed to reduce moisture below 14%, which promotes non-enzymatic browning reaction to create deep brown color with hard texture. It can be stored for long time with maintaining its original form.</p> <p>It is divided into chunsam (meaning: sky-grade red ginseng), jisam (meaning: earth-grade red ginseng) and yangsam (meaning: good-grade red ginseng).</p> <p>It mainly uses 4~6-year-old fresh ginseng roots including barks to steam and dry. After processing, it turns into brownish red.</p>	<p>-Chunsam (sky-grade red ginseng): It refers to top-quality red ginseng with high-density tissues and good appearance</p> <p>-Jisam (earth-grade red ginseng): It refers to the red ginseng with lower quality and appearance than chunsam.</p> <p>-Yangsam (good-grade red ginseng): It refers to the red ginseng with lower quality and appearance than jisam.</p> <p>-Julsam (cut-off red ginseng): It refers to the red ginseng cut into two pieces</p> <p>- Red ginseng rootlets : It refers to good-quality red ginseng rootlets without main roots. It is divided into large rootlets, medium rootlets and fine rootlets.</p>



## Monopoly laws for red ginseng



In Korea, red ginseng has been made over last 1,000 years. It was recorded in the book titled Gotyeo Dokyung(written in 1123, the first year of the king Injong in Goryeo Dynasty) that ginseng was steamed (red ginseng) or dried in raw (white ginseng).

In 1895(the 32<sup>nd</sup> year of the king Kojong in Goryeo Dynasty), red ginseng monopoly law and related acts were announced and established by government. In 1908, red ginseng monopoly law and related acts had been established and handed down through many modifications and complements.

Until 1995, red ginseng could be made by the Korean government only. In 1996, however, red ginseng manufacturing, processing and sale were allowed for anybody with certain facilities. According to the current law, red ginseng is defined as 'steamed ginseng or alphasized ginseng starch'.

## Taegeuk ginseng

	Processing Method	Remark
Taegeuk ginseng	<p>Fresh ginseng roots including barks are cleaned to steam, dry and process.</p> <p>It turns into yellowish brown or red between red ginseng and white ginseng</p>	



## Black Red Ginseng



	Processing Method
Black Red Ginseng	<p>Blackred ginseng is firstly selected from high quality 6-year-old ginseng roots.</p> <p>They are cleaned and then steamed for 12 hours at below 130°C, using a pressure steam cooker made with our own know-how. Pressure steaming allows ginseng in vacuum condition to send out water deep from the ginseng and, at the same time, fibers and other nutrients more active.</p> <p>Steamed ginseng is now naturally shadedried below 15% moisture content for about 7 days for the highest medicinal value.</p> <p>This ginseng is again steamed for 1.5 hours at below 90°C.</p> <p>These are the steps to make high quality 6-year-old Korean red ginseng.</p> <p>Then, the repetition of steaming, pressuring and drying for 1.5 hours at below 100°C up to 9 times lead to Korean black red ginseng.</p>



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#### 4. Differences & Superiority of Korean ginseng from other ginseng types

4-1. Korean ginseng has a long medicinal history and widely used for medicines with many clinical applications.



In the historical records over 2,000 years, Korean ginseng was described as a top-quality harmless elixir of life in the Chinese medical books such as 急就章 (BC 33–48), 傷寒論 (AD 196–220) and 新農本草經 (AD 483–496).

In 本草綱目 (AD 1598), Chinese ginseng called 田七參 (the species: *Panax notoginseng*) is mainly used to stop bleeding. Western ginseng has been firstly discovered in Canada in 1716 and known to Chinese merchants.

As ginseng was so rare and expensive in China at that time, Canada ginseng has been used as a medicinal substitute for Chinese ginseng for last 250 years so far. As described in Chinese medical books, Korean ginseng has been widely used for medicines with many clinical applications and proved to be effective with the support of many scientific researches. In particular, many studies supported by clinical trials proved that ginseng is effective for enhancing health, longevity or used as an alternative medicine.

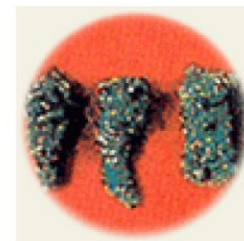
By the way, there are very few studies that prove the medicinal effects of 田七參 (the species: *Panax notoginseng*) or western ginseng.

4-2. Korean ginseng contains more types of ginsenosides having medicinal activities than 田七参 (the species: *Panax notoginseng*) and western ginseng (the species: *Panax quinquefolium*) belonging to same genus.

In terms of total ginsenoside content as one of active ingredients in ginseng, though there are some differences from researchers, Korean ginseng contains 3-4% ginsenosides and many other non-saponin active ingredients while western ginseng (the species: *Panax quinquefolium*) and 田七参 (the species: *Panax notoginseng*) contain 4-5% ginsenosides. Ginsenosides are also found in stems and leaves of ginseng, as well as in roots but most abundant in leaves. But, oriental medicine has customarily used thick ginseng roots only, instead of saponin-rich rootlets. Considering the traditional quality standard of ginseng, this indicates that ginseng's medicinal value is focused more on other factors than ginsenosides content. Compared to western ginsengs from American or Canada and 田七参 (the species: *Panax notoginseng*) from China belonging to same genus, Korean ginseng contains more types of ginsenosides having medicinal activities



Table 1. : Comparison of ginsenosides content in Black ginseng, Red ginseng, White ginseng, Western ginseng, Chinese ginseng and Japanese ginseng .



	Korean Ginseng			Western ginseng: Panax quinquefolium	Chinese ginseng : Panax notoginseng	Japanese ginseng: Panax japonicas
	Black ginseng	Red ginseng	White ginseng			
Total	70	32	22	14	15	8
PD	35	19	14	9	6	6
PT	25	12	7	4	9	4
Oleanone	1	1	1	1	—	1

Table 2. : Ginsenosides types in Korean ginseng, Western ginseng and Chinese ginseng.

	Ginsenosides
Korean ginseng (36types)	<ul style="list-style-type: none"> <li>- PD (23) Ra<sub>1</sub>, Ra<sub>2</sub>, Ra<sub>3</sub>, Rb<sub>1</sub>, Rb<sub>2</sub>, Rb<sub>3</sub>, Rc, Rd, MG-Rb<sub>1</sub>*, MG-Rb<sub>2</sub>*, MG-Rc*, MG-Rd*, Rg<sub>3</sub>, 20(s)-Rg<sub>3</sub>**, Rh<sub>2</sub>**, Rs<sub>1</sub>**, Rs<sub>2</sub>**, Q-R<sub>1</sub>, N-R<sub>4</sub>**, Rg<sub>5</sub>**, Rs<sub>3</sub>**, Rs<sub>4</sub>**, Rg<sub>6</sub>**</li> <li>- PT (12) Re, Rf, 20-GLc-Rf, Rg<sub>1</sub>, Rg<sub>2</sub>, 20(R)-Rg<sub>2</sub>**, Rh<sub>1</sub>, 20(R)-Rh<sub>1</sub>**, Rh<sub>4</sub>**, N-R<sub>1</sub>, F<sub>4</sub>**, Rf<sub>2</sub>**</li> <li>- Oleanane : Ro</li> </ul>
Western ginseng (14types)	<ul style="list-style-type: none"> <li>- PD (9) Rb<sub>1</sub>, Rb<sub>2</sub>, Rb<sub>3</sub>, Rc, Rd, MG-Rb<sub>1</sub>, F<sub>2</sub>, Q-R<sub>1</sub>, Gy-XVII</li> <li>- PT (4) Re, Rg<sub>1</sub>, Rg<sub>2</sub>, P-F11</li> <li>- Oleanane (1) : Ro</li> </ul>
Chinese ginseng (15types)	<ul style="list-style-type: none"> <li>- PD (6) Rb<sub>1</sub>, Rc, Rd, Gy-XVII, N-R<sub>4</sub>, N-Fa</li> <li>- PT (9) Re, 20-GLc-Rf, Rg<sub>1</sub>, Rg<sub>2</sub>, Rh<sub>1</sub>, N-R<sub>1</sub>, N-R<sub>2</sub>, N-R<sub>3</sub>, N-R<sub>6</sub></li> <li>- Oleanane : -</li> </ul>



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\* Abbreviations => PD: Protopanaxadiol, PT: Protopanaxatriol, G: Ginsenoside,  
MG: Malonyl-Ginsenoside, Q: quinquenoside, N: Notoginsenoside,  
P: Pseudoginsenoside, Gy: Gypenoside

In particular, red ginseng contains BRMs (biologic response modifiers) in very small amounts which are not found in western ginseng (*Panax quinquefolium*) or 田七参 (*Panax notoginseng*)

**Table 3: Ginsenosides in very small amounts in red ginseng**

Ginsenosides	Medicinal activities	Remark
Ginsenoside-Rh <sub>2</sub>	<ul style="list-style-type: none"> <li>– Inhibition of cancer cell proliferation</li> <li>– Promotion of cancer cell re-differentiation (induced by normal cells)</li> <li>– Inducement of active death (apoptosis) in cancer cells</li> </ul>	<p>No found</p> <p>in western ginseng or Chinese ginseng</p>
Ginsenoside-Rg <sub>3</sub>	<ul style="list-style-type: none"> <li>– Inhibition of anti-cancer drug resistance</li> <li>– Inhibition of vasodilation or platelet cohesion</li> <li>– Protection of brain cells</li> </ul>	<p>No found</p> <p>in western ginseng or Chinese ginseng</p>
Ginsenoside-Rf	<ul style="list-style-type: none"> <li>– Calcium channel block in sensory neurons for pain relief</li> </ul>	<p>No found</p> <p>in western ginseng or Chinese ginseng</p>
Ginsenoside-Ro	<ul style="list-style-type: none"> <li>– Anti-platelet and anti-inflammation</li> </ul>	<p>No found</p> <p>in Chinese ginseng.</p>



Recently, ginsenoside-Rh2 and ginsenoside-Rg3 in red ginseng as microelements receive attention from academia. Ginsenoside-Rh2 is proven that it strongly inhibits the proliferation of cancer cells (Kitagawa et al. 1993, Kikuchi et al. 1991, Ota et al. 1991) and that it converts cancer cells into normal cells by promoting re-differentiation of cancer cells (Odashima et al. 1979, Lee et al. 1993). Ginsenoside-Rg3 is also proven that it inhibits the transformation of normal cells into cancer cells (Kitagawa et al., 1993) and anti-cancer drug resistance (Park et al. 1996), and platelet cohesion (Tamura et al. 1992).

However, there is no report yet that these ginsenosides as microelements are found in western ginseng (*Panax quinquefolium*) or Chinese ginseng (*Panax notoginseng*). In vitro testing shows that ginsenoside-Rf blocks out the calcium channels in sensory neurons to strongly inhibit pain, which is almost equivalent to morphine (Nah et al. 1995) and that it strongly defend against alcohol-induced developmental brain disorder (Okamura et al. 1994).

However, this ginsenoside-Rf is not found in western ginseng (*Panax quinquefolium*) yet (Cheung et al. 1994). It is also reported that ginsenoside-Ro responsible for anti-platelet and anti-inflammation is not found in Chinese ginseng (*Panax notoginseng*).



#### 4-3. Korean ginseng shows uniform distribution of various ginsenosides

According to individual ginsenoside composition for total ginsenosides contents in western ginseng and Korean ginseng, western ginseng contains 49% of G-Rb-1 and 26% of G-Re that consist of about 75% ginsenosides, which are quite predominant. However, Korean ginseng contains 23% of Rb1, 19% of Rg1, 15% of Re, 12% of Rc and 11% of Rb2, which shows very uniform distribution of individual ginsenoside. (Table 4)



Table 4. Comparison of important ginsenosides in Korean ginseng and western ginseng

구 분	Ginsenosides(%)											
	Ra	Rb <sub>1</sub>	Rb <sub>2</sub>	Rc	Rd	Rh <sub>2</sub>	Re	Rf	Rg <sub>1</sub>	Rg <sub>2</sub>	Rg <sub>3</sub>	Ro
Korean (100%)	3.33	22.9	10.9	11.9	6.67	0.09	14.7 6	4.28	18.5 7	3.33	0.95	2.3 2
Western(100%)	*	49.1	1.32	6.86	8.76	*	25.8 6	*	4.34	0.53	*	1.8 3

- A few ginsenosides are not found in western ginseng.  
(Written based on the reports by 田中 (1995) and 高 (1994).)

4-4. Ginsenosides composition in western ginseng is similar to that of Korean ginseng rootlets.



If we take a look at the ginsenosides content by region, Korean ginseng's ginsenosides are found more in rootlets and fine rootlets than in main roots. That is, it is understood that ginsenosides are more abundant in rootlets than in thick roots and ginsenosides composition shows non-uniform distribution. (Table 5)

In particular, Table 4 shows that western ginseng contains very small amount of Rg1 but much more Rb1, which is quite similar to ginsenosides distribution in Korean ginseng rootlets.

Therefore, in aspect of to analytical chemistry, if high contents of ginsenosides and Rb1 are preferred, fine rootlets of Korean ginseng can also be used instead. However, it shouldn't also be underestimated that oriental medicine considers thick main ginseng roots more medicinally effective than ginseng rootlets, considering empirical and traditional quality standards and expensive price of main roots.

Table 5. The saponin content and the ratio of PD/PT, Rb1/Rg1 in various parts of raw red ginseng(Nam et al. 1998)



Sources of material	Crude saponin (%)	Total <sup>a)</sup> ginsenosides(%)	PD*/PT**	Rb <sub>1</sub> / Rg <sub>1</sub>
Main body <sup>1)</sup>	4.30±0.094	2.08±0.077	1.15±0.050	1.12±0.039
Big tail root <sup>2)</sup>	5.59±0.135	2.69±0.100	1.32±0.036	1.40±0.040
Mid tail root <sup>3)</sup>	7.01±0.561	3.55±0.086	1.46±0.048	1.73±0.075
Fine root <sup>4)</sup>	10.31±0.445	5.62±0.080	1.89±0.033	2.35±0.041
Fine hair root <sup>5)</sup>	15.46±0.768	8.43±0.123	2.30±0.074	2.97±0.124

1) : 13.79±2.59mm,

2) : 8.27±0.80mm,

3) : 5.42±0.73mm,

4) : 2.83±0.45mm,

5) : below 1.5mm

\* PD saponins : Rb1 + Rb2 + Rc + Rd, \*\* PT saponins : Re + Rf + Rg1 + Rg2

a) Total ginsenosides : PD+PT saponins

4–5. Korean ginseng contains higher contents of non-saponins BRMs than western ginseng or Chinese ginseng 田七参 (Panax notoginseng).

Various medicinal effects of Korean ginseng cannot be understood by ginsenosides only. Recently, many studies proved that Korean ginseng contains many other active ingredients than ginsenosides. Non-saponins of Korean ginseng include polyacetylenes responsible for inhibiting cancer cell proliferation and stimulating anti-tumor actions, acidic polysaccharides and protein fractionation which are more abundant in Korean ginseng than in western ginseng or Chinese ginseng . (Table 6–7)



Table 6: Comparison of polyacetylenes by ginseng species (고 1994)(Unit: mg/g dry weight)

Polyacetylene	<i>P. ginseng</i>		<i>P. quinquefolius</i>		<i>P. notoginseng</i>	
	K.R.	C.R.	J.R.	A.W.	C.W.	S.G.
Panaxynol	0.18	0.07	0.09	0.13	0.15	0.08
Panaxydol	0.55	0.21	0.37	0.47	0.56	0.53
Panaxytriol	0.16	0.12	0.12	0.04	0.05	0.14
Total	0.89	0.40	0.58	0.64	0.76	0.75

- K.R: Korean Red ginseng, C.R:Chinese Red ginseng, J.R:Japanese Red ginseng ,
- A.W: American Western C.W: Canadian Western, S.G: Chinese ginseng 田七参 (Panax notoginseng).

In the table, Korean red ginseng shows higher yields of acidic polysaccharides associated with increase of cancer–immunity, and the inhibition of lypolysis and prevention of obesity and high cholesterol by lowering the absorption of cholesterols and fats in the guts, than Korean white ginseng and three times higher than western ginseng or 田七参 (Panax notoginseng). (Table 7)



They are recently reported that polysaccharides have antagonistic effect against toxohormone–L that induces weight loss and poor appetite in cancer patients (Okuda et al. 1984, 1989) and boost immunity (Yun et al. 1993, Tomoda et al. 1993, Lee et al. 1997, Kim et al. 1998).

Table 7: Comparison of acidic polysaccharides contents in Korean ginseng, western ginseng and Chinese ginseng.

	acidic polysaccharides fraction (w/w, %)	
	content(w/w, %)	relative ratio (%)
Korean ginseng	4.9 ± 0.6	59.3
Western ginseng	4.4 ± 0.8	53.5
Chinese ginseng	3.7 ± 0.2	44.6

According to the comparison of protein contents, Korean ginseng contains 2–3 times more water–soluble and thermo–stable proteins and free amino acids than western ginseng or Chinese ginseng(Park et al. 1998). (Table 7). In particular, thermo–stable proteins are known as BRMs that defend against the radiations such as X or gamma rays (Yonezawa et al. 1984). In addition, as shown in the ginsenosides distribution table by root regions (Table 8), ginsenosides are found more in thick roots (main body root) than in fine rootlets.

More specifically in root regions, ginsenosides are found more in cortex areas, while acidic polysaccharides and proteins are found more in the center.

From ancient times, Korean ginseng’s main roots are commonly used for medicine in oriental medicine.

Korean Red ginseng is also made mainly by main roots without fine rootlets. It can be understood that non–saponin BRMs abundant in main roots are in line with main root–centered quality value of Korean red ginseng.

Table 8: Comparison of proteins and free amino acids in Korean ginseng and western ginseng (Park et al.1988) (unit: mg/g dry weight )

	Korean Ginseng			Western	Chinese
	Main roots	Rootlets	Fine rootlets		
Water-soluble proteins	38.0*(17.9)#	29.5	19.6	11.4*(3.8)#	17.0*(12.2)#
Thermo-stable proteins	28.1 (14.7)	22.3	12.8	10.1(3.3)	7.3(3.9)
Free amino acids	73.7 (34.1)	54.9	14.8	32.8(23.7)	24.7(27.0)

\*:Center part(xylem + pith), #:periderm(cortex + epidermis)

Table 9: Arginine and its derivatives contents in Korean ginseng

	contents (%)			
	Free arginine	Arg-Fru-Glc <sup>a)</sup>	The others	Total
white ginseng (L)	2.61	0.61	0.40	3.62
white ginseng (S)	2.53	0.28	0.52	3.33

#### a) Amino acid derivatives as BRMs

Ginseng's quality is closely related with not only ginsenosides content but their quality, that is, composition of individual ginsenoside and non-saponin BRMs. Therefore, it should be understood that medicinal effects of ginseng can be achieved by the synergistic effects among non-saponin compounds, as well as specific saponin compounds.



#### 4-6. Superiority of Korean ginseng has been historically recognized in literature.

Natural medicinal plants have different effects and properties, depending on their origins, habitat and refining process. Therefore, these points are mainly considered for clinical applications.

In Chinese medical books titled 本草書 and 本草綱目 (草部 第 12 卷), ginseng from Baekje country and then Korea country were considered as the best quality. At that time, Korea indicated Liaodong province which is now equivalent to Manchuria, the main production center of Chinese ginseng.

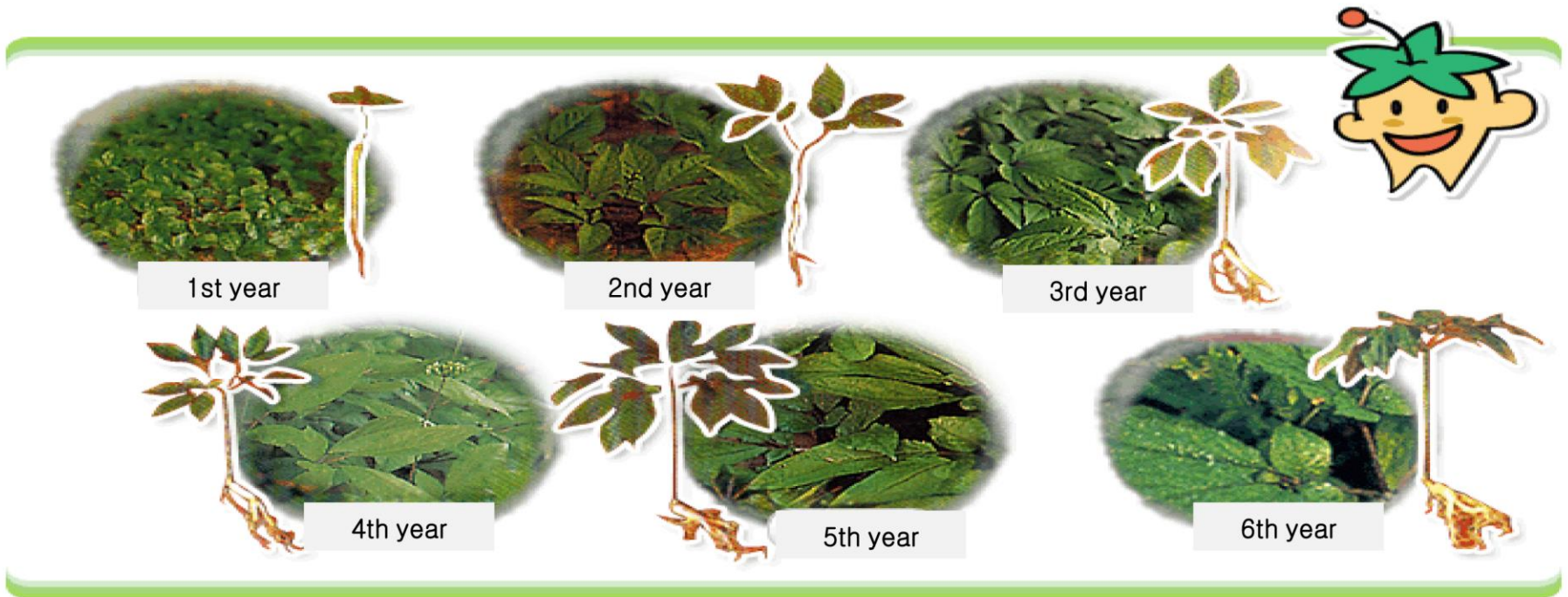
Baekje indicated the current Gyeonggi and Chungcheong provinces as the main production centers of ginseng roots for red ginseng. While the ginseng from Baekje is thin but hard and white, the ginseng from Korea is big and empty. Korean ginseng was no match for Baekje ginseng. Like this, Korean ginseng has been historically considered as the best quality.

For reference, a Japanese professor called 久保 (近畿大學 藥學部) reported the inner structure of 6-year-old ginsengs from different origins (久保, 1983).

Table 1: Comparison of the number of vascular bundles of 6-year-old ginseng's main roots from different origins (Kubo 1983)

	the number of vascular bundles			average
Republic of Korea	348	295	287	310
Shinshu, Japan	216	214	214	215
Daikon-jima, Japan	234	229	234	232
North Korea	180	173	178	177
Kirin, China	189	202	193	195

It is reported that ginsenosides in transverse cuttings of Korean ginseng are mainly found in the periderm and cortex (Kubo et al. 1980, Tadato Tani et. al., 1981). According to the study on ginseng's transverse cuttings by production location, the numbers of vascular bundles in woody rays of Korean red ginseng and white ginseng and the numbers of oil canal in phloem are all higher than in other production locations. In addition, it is observed that Korean-origin ginseng is dense, due to less number of cells and less number per unit volume. All these results support that Korean-origin ginseng is excellent in quality.



4-7. Chinese medicine recognizes the powerful effects of Korean panax ginseng in aspects of applications.

According to the clinical applicatin, a Chinese medicinal book published by 中國 中山醫學院, Korean ginseng has more powerful medicinal effects than Chinese ginseng (origin from Jilin province). For example, when it used as an invigorant, Korean ginseng requires less dosage (1.5–3g) than Chinese ginseng (2.5–5g). And also, when it used as a heart medicine, Korean ginseng requires less dosage (3–6g) than Chinese ginseng (9–15g). In conclusion, Korean ginseng provides more powerful medicinal activities than Chinese ginseng does.

Table 4: Clinical applications of Korean ginseng and Chinese ginseng (裴 1993)

	Korean ginseng	Chinese ginseng (from Jilin province)	Remark
Medicinal properties	strong	weak	Korean ginseng has more invigorating ability
Applications	<ul style="list-style-type: none"> <li>– Weak symptoms</li> <li>– More effective on shock or state of lethargy</li> </ul>	<ul style="list-style-type: none"> <li>– For dehydration and physical weakness</li> </ul>	
<Dosage> <ul style="list-style-type: none"> <li>– Invigorant</li> <li>– Heart medicine</li> <li>– First-ad treatment</li> </ul>	1.5–3g 3–6g 15–24g	2.5–5g 9–15g 15–30g	<ul style="list-style-type: none"> <li>– Anemia, weak spleen and stomach and low qui (energy)</li> <li>– Dehydration and heart failure</li> <li>– Excessive bleeding and shock</li> </ul>

In the book titled 本草書 in China, there are the comparisons of medicinal properties between Korean ginseng and Chinese ginseng and Korean ginseng is more effective on low energy and dizziness.

#### 4–8. Korean ginseng is evaluated as superior for inhibition of cancer cell proliferation.

According to some papers, Hwang et al. 1978 reported that petroleum ether is a non-saponin anti-cancer fraction and Hwang et al. 1993 reported that Korean red ginseng(good-grade) showed higher content (0.64%) of petroleum ether Extract than 0.47% of Chinese red ginseng (origin: Jilin province, grade: 3). These fractions are also sub-divided by each solvent to compare anti-cancer activities of Korean red ginseng and Chinese red ginseng.

According to the testing result, Korean red ginseng showed more powerful anti-cancer activities on mouse leukemic cell (P388), human colon cancer cell (HT-29) and human rectal cancer cell (HRT-18) than Chinese ginseng. (Cancer cell proliferation rate= proliferated cell number of testing group by culture time– cell number at starting stage/ proliferated cell number of control group by culture time– cell number at starting stage x 100) (Hwang et al. 1993)

The active ingredients for inhibiting cancer cell proliferation in these fractions are proved to be polyacetylenes such as panaxynol, panaxydol and panaxytriol. These polyacetylenes are found more in Korean red ginseng than Chinese or Japanese ginseng (Table 5) (Go 1994).

Table 5. Comparison of polyacetylene compounds in ginseng by producing locationss  
(Go 1994) (Unit: mg/g dry weight)

Polyacetylene	<i>Panax ginseng</i> C.A. Meyer		
	Korean (red ginseng)	Chinese (red ginseng)	Japanese (red ginseng)
Panaxynol	0.18	0.07	0.09
Panaxydol	0.55	0.21	0.37
Panaxytriol	0.16	0.12	0.12
Total	0.89	0.40	0.58

4-9. Animal testing showed that red ginseng extract boosted the immune response of the mice transplanted with tumor cells.

Testing mice are hypodermically injected with Sarcoma-180 tumor cells ( $1 \times 10^6$  cells/ mouse) and then orally administered with ginseng extract every day to find the influences on leukocyte chemotaxis, competence for MIF (migration inhibitory factor), the ability of natural killer cells to destroy tumor cells and tumor cell cytotoxicity of lymphokine-activated killer cells.



As a result, the test group medicated with ginseng-extract improved chemotactic ability of leukocytes, macrophage migration inhibition, NK cells & LAK cells activation, tumor (weight) growth inhibition and blood circulation. In terms of strength of effects of ginseng extract, Korean ginseng showed superior effects than Chinese ginseng and American ginseng. (Lee et al. 1992, 1993).

4-10. It is reported that Korean panax ginseng and Chinese ginseng show relatively long genetic distance.

Recently, there was a test to find out the genetic relationship among panax ginsengs from Korea (17 types), Japan (1 type) and China (6 types), using RAPD (random amplified polymorphic DNA) fingerprinting method. According to the result, it is reported that Korean panax ginseng and Chinese ginseng (from Jian (集安), Wusong (霧淞), Xizhou (錫州) and Jingyu (靖宇)) show relatively long genetic distance (Lim et al. 1996 and Choi 1995). In terms of geography, there are considerable differences in ecosystems including sunshine, precipitation and soil conditions belonging to growth conditions for ginseng. In general, it can be understood that the characteristics of differentiated Korean panax ginseng are mainly caused by production area (growing environment) and processing method of ginseng, which are taken seriously in natural medicine.

## 5. Ginseng cultivation in Korea



### 5-1. History & methods of ginseng cultivation

Before ginseng has been cultivated, ginseng generally referred to natural or wild ginseng in most cases.

Ginseng has been cultivated to cope with the increased demand and excessive collection of ginseng. In the beginning, the seeds or seedlings of ginseng were sprayed over mountains to cultivate ginseng, which is called wild-simulated ginseng. This pattern recently develops into the cultivation under artificial shade. It was recorded that wild-simulated ginseng has been cultivated over 1,000 years, since the King Sunjo (AD 1567–1608) in Chosun Dynasty.

All areas of Korea were the best places to cultivate top-quality ginseng, because of four distinct seasons, soil conditions, annual precipitation and even long-standing unique traditional skills of cultivation.

Ginseng is naturally found between 33 and 43 degrees latitude north in the Far East. In Korea, ginseng is cultivated between 36 and 38 degrees latitude north with other natural advantages including soil conditions, sunshine, climate and annual precipitation.

Ginseng is one of the most fastidious plants to grow, as it has quite different physiological characteristics from other plants. Since it is a shade loving plant, it is currently cultivated under artificial shade. Therefore, it grows very slow on a low level of photosynthesis, compared to other field-grown plants.

Ginseng roots cultivated for about 6 years generally weigh about 90g only.

As its roots also have low absorption rate of nutrients, it cannot be cultivated with high-concentration chemical fertilizers. Instead of abundant fertilizing properties, ginseng requires organic compounds like compost as a slow-acting fertilizer which improves soil conditions. In particular, growth in diameter and production yield of ginseng roots are mainly influenced by soil and landform. First, land should be suitable for growing ginseng. Before ginseng seeds are sown, soil should be taken care for with oak leaves as a natural fertilizer and plowed many times..



## How to grow Korean ginseng

01.



seed

02.



Testa of seed is peeled off.

03.



Seeds are sown and covered with straw.

04.



Ginseng seeds spout.

05.



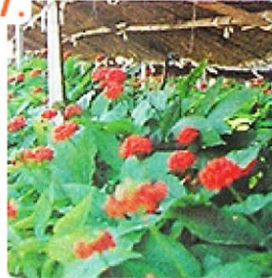
Ginseng leaves come out.

06.



Ginseng leaves

07.



Ginseng seeds ripen on the field.

08.



Ginseng produces fruit called seng berry.

09.



A photo that shows growing environment of ginseng

### Comparison of fresh-weight of ginseng roots by year (1996)

By year	1	2	3	4	5	6
Fresh-weight of ginseng roots (g) <sup>a)</sup>	0.83±0.05	4.73±0.91	19.90±5.3 9	41.27±7.9 7	62.43±17. 45	87.63±16. 05
Index <sup>b)</sup> (%) <sup>c)</sup>	100 0.95	570 5.40	2,271 22.71	5,024 47.10	7,522 71.24	10,558 100

Ginseng can be divided into red ginseng and white ginseng, depending on processing method. In the beginning, red ginseng was developed mainly to store for long time. Development of scientific explanation on refining process of natural herbal medicine as traditional pharmaceutical skills have revealed the differences of white ginseng, red ginseng, teageuk ginseng and red-black ginseng.

a) Fresh-weight of ginseng root: average value +/- average derivation

b) Index: The index 100 indicates the fresh-weight of root of ginseng's young seedling.

c) %: The percentage 100 indicates the percentage of fresh-weight of one-year-old ginseng root.

Once a field is sown with ginseng seeds, it cannot be used for ginseng cultivation again within 10 years. This is because harmful insects cause damage and soil conditions worsen. Some mitigating measures can be developed but fundamental and practical measures have not been found yet. Land conditions for growing ginseng should be checked for the status of soil contamination by chemical fertilizers or organic pollutants. Harmful pesticides are strictly prohibited to cultivate ginseng. For ginseng cultivation, organic and traditional farming methods have been maintained. In particular, Koreans have been growing young seedlings from seedbeds and then selected good quality young ginseng roots to transplant to main fields. Korean panax ginseng is differentiated from the ginsengs from other areas, due to the development of soil management and transplantation.

04.



Ginseng seeds  
spout.

05.



Ginseng leaves come  
out.

06.



Ginseng leaves

07.



Ginseng seeds  
ripen on the field.

08.



Ginseng produces  
fruit called seng  
berry.

## 5-2. Conditions for growing ginseng



Ginseng really needs time and efforts for cultivation. Ginseng cultivation periods can be divided into preparation stage, seedling stage and main cultivation stage. Preparation stage is the process to select the field and prepare for cultivation. In seedling stage, the field is sown with ginseng seeds to grow seedlings from seedbeds. Main cultivation includes from transplantation of young roots into main fields to collection

	conditions
temperature	Average temperature for ginseng cultivation is about 0.9°C to 13.8°C. In summer, 20–25°C is fine but the temperature exceeds 35°C, it causes many problems in cultivation. 700–2,000mm of rainfall is acceptable but 1,100–1,300mm is suitable. The less snowing, the better.
Sunshine	Ginseng is a shade plant and prefers half sunshine and half shade. Direct sunlight is not good. Dispersed sunlight is suitable with 1/8–1/13 of outdoor sunshine.
Soil	Good soil for growing ginseng needs abundant nutrients available from the soil. For topsoil, sandy loam soil is better and, for subsoil, clay is preferred. Uncontaminated mature (paddy) field in pH 5.5–6.0 is fine. Chemical fertilizers or quick-acting high concentration fertilizers worsen natural soil conditions.
Landform	Slanted land toward the north or northeast at 8–15 degrees is suitable for growing ginseng. If well-irrigated, even or flat land is also acceptable. Humus soil with broadleaf trees, similar to natural environment, or artificially provided same landform is acceptable. In particular, Geumsan area has a lot of mountains (71.5%) which is most suitable for cultivating ginseng.

## 6. Ingredients in Korea ginseng

Ginseng contains a variety of the ingredients such as saponin as glycosides, protein, amino acids, nucleic acids and alkaloid as nitrogen-containing compounds, fatty acids, essential oil, polyacetylene, phenolic compounds, phytosterols and terpenoids as fat-soluble compounds, monosaccharides, oligosaccharides, polysaccharides as sugars, and others including pectin, vitamins and minerals. (Table 1)

Ginseng cannot be compared to other medicinal plants, as far as it contains a variety of chemicals.

Table1. Chemical constituents in Korean ginseng

Organic	Saponin (3-6%)	<ul style="list-style-type: none"> <li>- Protopanaxadiol(22)</li> <li>- Protopanaxatriol(11)</li> <li>- Oleanolic acid(1)</li> </ul>
	N-compounds (12-16%)	<ul style="list-style-type: none"> <li>- Protein, Amino acid(16)</li> <li>- Peptide, Nucleic acid(9)</li> <li>- Alkaloids(11)</li> </ul>
	Lipid-solubles (1-2%)	<ul style="list-style-type: none"> <li>- Fats, Fatty acid</li> <li>- Essential oils</li> <li>- Phytosterol</li> <li>- Organic acid</li> <li>- Phenolic compounds(15)</li> <li>- Polyacetylenes(20)</li> <li>- Terpenoids</li> </ul>
	Vitamins (0.05%)	- Water-soluble vitamin(8)
	Carbohydrates (60-70%)	<ul style="list-style-type: none"> <li>- Polysaccharide</li> <li>- Oligosaccharide</li> <li>- Sugar, Fiber, Pectin</li> </ul>
Inorganic	Ash (4-6%)	- Mineral

△ water content : 9-11%

## 6-1.Saponin

Saponin is the most well-known active ingredient in ginseng. Saponin is sometimes considered as the index for ginseng quality.

However, saponins are important in the types and composition ratio of ginsenosides, that is, saponins in ginseng. Ginsenosides have pain-relieving PD ginsenosides and stimulating PT ginsenosides. Korean ginseng contains more types of ginsenosides and balanced proportions between PD and PT compounds, than other ginsengs from China, Japan or America. This means Korean ginseng performs well-balanced regulation of blood pressure and body temperature.

In general, saponins are commonly found in plants (about 750 plants).

Saponins are easily found in beans, *Codonopsis lanceolata* (bonnet bellflower), buckwheat, balloon flower, water parsley, mung bean, garlic, onion, ginkgo and arrowroot even in a small amount. Saponins are named from lathering like soap. In general, as saponins lower surface tension of water, saponins lather easily and hemolytic. However, ginseng saponins are reported to have mild medicinal properties without toxins and hemolysis. In addition, ginseng saponins have different structures from the saponins found in other plants.

Therefore, in order to distinguish ginseng saponins from the saponins in other plants, ginseng saponins are specially called ginsenosides (ginseng + glycoside).

The chemical structures of ginsenosides are divided into three groups. That is, there are PD (protopanaxadiol), PT (protopanaxatriol) and Oleanolic acid. Most saponins found in other plants are oleananes but ginseng saponins are known as dammarane-based triterpenoid saponins which are not commonly found in other plants.

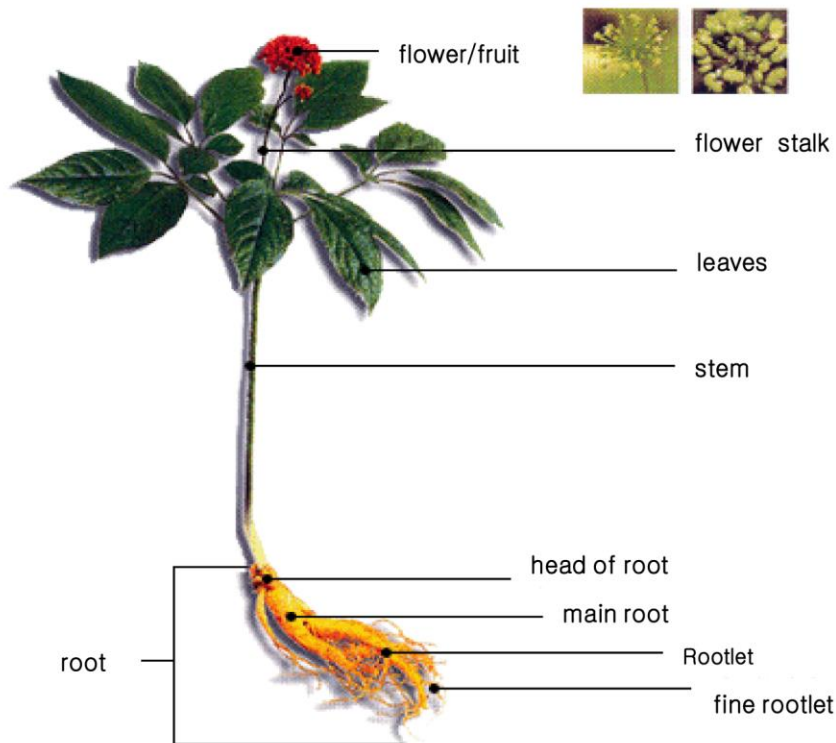
Ginsenosides are effective in regulating physical activities by influencing central nerves, endocrine systems, immune systems and metabolic systems. About 10 types from 30 types of ginsenosides in Korean ginseng are reported to have medicinal activities. These ginsenosides perform similar or opposite functions. For example, ginsenoside-Rb1, a typical ginsenoside of PD saponins, is known to have an inhibitory activity against central nerve systems and ginsenoside-Rg1, a typical ginsenoside of PT saponins, has stimulant effect.

However, these ginsenosides are known to display no antagonistic effects. They are also found in the head part, stems and leaves of ginseng, as well as in roots. Among these, ginsenosides are most abundant in leaves. However, peoples have mainly used thick main roots, instead of saponin-rich leaves and rootlets in oriental medicine.

Considering the traditional quality standards of ginseng, ginseng's medicinal values are not mainly on saponins.

It is proved that ginseng contains a variety of active ingredients, as well as saponins.

In recent research, red ginseng contains saponins but also many other active ingredients such as polyacetylenes responsible for inhibiting cancer cell proliferation and stimulating anti-cancer activities, acidic polysaccharides, essential oil, phytosterol, phenols, proteins, peptides, alkaloid, amino acids, nucleic acid, vitamins, lignan and minerals. Saponins are mainly contained in main roots (2.5%), rootlets (4.0%) and fine rootlets (8.8%), though there may be slight difference of results.



## 6-2. Saponin distribution by ginseng parts

	PD Saponin(%)	PT Saponin(%)	Total
Head of root	3.2	3	6.2
Outer bark	3.2	2.1	5.3
Central part	0.07	0.05	0.12
White ginseng	1.6	0.6	2.2

Ginsenosides are found in stems and leaves, as well as roots. Even in the root, saponin contents are different in outer bark, cortex and central part.

Saponins are rich in the order: periderm > phloem > xylem.

Saponins are more abundant in the cortex than in central part (xylem).

However, ginsenoside-Ro is found more in the xylem.

### Saponin distribution in root areas

Area	Weight ratio	P. D saponin (%)	P.T saponin (%)
Outer bark	1	1.5	0.9
Cortex	6	4.6	2.4
Central part	12	0	0

<Comparison of saponin content in ginseng parts (standard: 10 for large ginseng root)>

Ginseng parts	L Ginseng	S Ginseng	White Skin ginseng	Head part	leaves	Outer bark	flower	Rootlet	Ginseng Tea	Ginseng extract
saponin	10	12	16	28	30	35	50	55	11	30

<Saponin distribution by harvesting season>

- More powerful remedial results in the roots harvested in summer than in the winter .

<Fluctuation of amount of ginseng extract and saponin content by time>

	Ginseng extract amount(%)	Saponin content (%) from entire ginseng	Saponin content(%) from ginseng extract
Feb.	34.1	2.7	7.8
Apr.	29.3	2.9	10.1
Jun.	20.9	4.2	20.3
Aug.	16.8	3.8	22.6
Oct.	15.4	2.5	16.2
Dec.	43.6	2.5	7.1

<Comparison of ginseng ingredients between summer and winter>

Ingredient type	Water-soluble ingredients(%)	Ether-soluble ingredients(%)	Total (%)	Sugar content(%)	Amid acid(%)
summer	17.3	1.9	5.2	4.5	1.2
겨울인삼	43.6	1.6	3.4	25.8	2.4

In oriental medicine, ginseng is warm in nature which associated with promotion of blood circulation.

When a large amount of red ginseng is taken in a short period of time, this may lead to facial flushing, sweating, a taker may have red or sweaty skin, or warmth on hands or feet. These symptoms are usually similar to the responses of vasodilator. These subjective experiences are the indirect evidences of ginseng's vasodilator (Jayin Kim, 1994).

Both in oriental and western medicines, ginseng has been considered a tonic or invigorant. It is understood that this invigorant warms your body to promote blood circulation and metabolism and maintain homeostasis.

In addition, it was clinically proven that ginseng improved peripheral nerve microcirculation of women with menopausal disorder, since it increases erythrocyte deformability as a vascular factors (the sizes of a red blood cell and peripheral capillary are about  $7\mu\text{m}$  and  $3\mu\text{m}$ , respectively. When a red blood cell passes through capillary vessel, its size is reduced) (Ogita 1990). Like this, ginseng keeps your body warm by improving blood circulation. If there is a poor blood circulation, your body feels cold.

Ginseng has a biphasic activity of both a stimulating and a calming effect.

It contains specific ingredients responsible for both calming and stimulating the central nerve systems (Takagi K. et al. 1972). It is known that PPD-type saponins provide a calming effect on the central nerve systems and PPT-type saponins show slow stimulation. Ginseng has uniform composition (about 1:1 ratio) between ginsenoside-Rb1, as a representative of PPT-type saponins, and ginsenoside-Rg1, a predominant compound of PPD-type saponins. By the way, western ginseng shows about 1:4 ratio of ginsenoside Rg1 and ginsenoside-Rb1. In the animal experimentation with mice and rats on voluntary exercise, small amounts of ginsenosides (2.5mg/kg or 5.0mg/kg, oral medications) showed a stimulating effect and large amounts of ginsenosides (50mg/kg or 100mg/kg, oral medications) showed a calming effect (Hong et al. 1974). It is misunderstood that Korean ginseng's strong potent action or relatively high content of ginsenoside-Rg1 than western ginsengs lead to a unilateral stimulation on the central nerve system.

In the experimentations on disturbed sleep/ wakefulness by physical or mental stresses such as moderation in eating, compulsory exercise and short sleep, ginseng stabilizes sleep (Lee et al. 1990; Rhee et al. 1990; Shimizu et al. 1992) and shows psychotropic effects such as anti-depression or anti-anxiety (Yoshimura et al. 1988, 1989, 1991 and 1994). It is reported that the medication of ginseng, together with strychnine, picrotoxin and caffeine as central nerve system stimulants, reduces the risk of fatal toxicity (LD50) of central nerve system stimulants (Kim 1967). In particular, ginsenosides, as a strong central nerve system stimulant, are known to inhibit cocaine-induced excited delirium, and to reduce psychological dependence and toxicity (Kim et al, 1987, 1993, 1995, Tokuyama et al. 1992).

### **\*Effects on central nerve system**

Ginseng has a biphasic activity of both a stimulating and a calming effect on the central nerve system, and shows different effects, depending on the amount of medication.

Ginseng provides anti-depression, anti-anxiety, anti-pain and sleep stabilization.

Ginseng is effective on the central nerve systems by influencing neurotransmitter metabolism.

### **\* Improving your brain functions**

Ginseng improves learning ability and memory.

Ginseng increases intellectual performance.

Ginseng activates the effects of choline involved in memory and learning and boosts brain metabolism.

Ginseng acts as an active ingredient that improves memory and promotes the formation of LTP (long-term potentiation) that plays an important role in memory and learning.

Ginseng restores brain cells by promoting the differentiation and growth of nerve cells cultivated.

Red ginseng (saponins) is effective in preventing nerve cell damage accompanying cerebral ischemia and learning disability & behavioral disorder.

### **\* Enhancement of anti-carcinogenesis and anti-cancer activity**

Ginseng contains the active ingredients that inhibit cancer cell proliferation and induces normal-shaped cells.

Ginseng shows the increases in anti-carcinogenesis and anti-cancer activity.

Red ginseng contains the active ingredients that inhibit the spread of cancer cells and anti-cancer drug resistance.

Ginsenoside-Rh2 in red ginseng induces apoptosis that kills cancer cells by themselves.

It is proved in an epidemiological survey on anti-carcinogenesis using animal testing that ginseng is effective on primary prevention of cancer.

Ginseng reduces immune toxicity, one of side effects of anti-cancer drugs.

### **\* Regulation of immune response**

Ginseng activates natural killer cells and promotes the production of gamma-interferon.

Red ginseng extract activates macrophage in the reticuloendothelial system and influences the production of anti-bodies.

Ginseng regulates the immune response by stimulating or inhibiting mitosis of lymphocytes cultivated.

Ginseng increases anticancer drug-induced low immune functions.

### **\*Anti-diabetic activity**

Ginseng is playing a key role as an anti-diabetic drug in oriental medicine.

Ginseng lowers experimental hyperglycemia and improves diabetes-induced metabolic disorder.

Korean ginseng stimulates insulin release and contains the ingredient responsible for insulin-like activity.

Ginseng improves subjective symptoms of diabetic patients and prevents diabetes complications.

### **\* Enhancing liver functions**

Ginseng promotes protein synthesis and sugar & fat metabolism.

Ginseng stimulates detoxification and liver regeneration and protects against liver damage.

Ginseng stimulates alcohol detoxification to cure hangover.

Ginseng activates anti-hepatitis activity and treats hepatitis.

### **\* Improving cardiovascular disorder and anti-arteriosclerosis**

Saponins in red ginseng stimulate vasorelaxation to improve blood circulation.

Red ginseng saponins promote the vasorelaxation responsible for inhibiting arteriosclerosis and regulating blood pressure and protect endothelial cells against damage.

Ginseng protects cardiac muscle cells and strengthens cardiac functions.

Ginseng inhibits platelet cohesion and regulates the ratio of PGI<sub>2</sub> (responsible for inhibiting platelet cohesion) and TXA<sub>2</sub> (responsible for inducing platelet cohesion).

Red ginseng improves erythrocyte deformability and peripheral circulation.

Red ginseng saponins inhibit the proliferation of vascular smooth muscle cells.

Red ginseng improves cholesterol metabolism.

### **\* Regulation of blood pressure**

Ginseng has a biphasic activity on blood pressure.

Red ginseng saponins lower blood pressure, which is associated with stimulation of vasorelaxation.

Red ginseng improves life quality of those with hypertension and is useful as an assistant curing agent together with hypotensor.

### **\* Improving menopausal disorder and osteoporosis**

Red ginseng improves microcirculation and restores ovarian functions.

Red ginseng improves menopausal disorder.

Red ginseng is effective in increasing bone formation and density on experimental osteoporosis induced animals.

### **\* Anti-stress, anti-fatigue and improving sexual behavior disorder**

Ginseng enhances physically adaptive capacity to harmful environment and stimulates recovery from fatigue.

The result of in vivo testing shows that ginseng stimulates the ability to perform exercise and fatigue recovery.

Ginseng defends against heat or cold environmental stresses.

Ginseng inhibits stress-induced low immunity.

Ginseng stimulates the release of adrenocorticotrophic hormone to give anti-stress effect.

Ginseng has a psychotropic activity that improves sexual behavior disorders induced by social or psychological stresses.

### **\* Anti-gastric ulcer and anti-inflammatory activity**

The result of many animal experimentations show that ginseng enhances digestion and prevents or treats gastric ulcer.

Red ginseng (saponin fractions) inhibits the occurrence of stress-induced ulcer and treats the symptoms of gastric ulcer.

Ginseng (extract and ingredients) has anti-inflammatory and skin-softening activities.

### **\* Effects on kidney (renal) diseases**

Ginseng has anti-nephritis and inhibits the progress of kidney diseases.  
Ginseng saponins remove free radicals involved in occurrence and progress of kidney diseases.

### **\* Anti-oxidant and anti-aging activities**

Ginseng inhibits the production of free radicals and lipid peroxidation.  
Ginseng extract and saponins defend against oxidative stress by activating the enzymes including SOD (superoxide dismutase) that remove free radicals.  
The results of animal experimentations show that long-term intake of ginseng extends life.

### **\* Protection against radiation hazard**

Ginseng contains the active ingredient responsible for defending against radiation hazard.  
Ginseng stimulates the recovery of damaged chromosomes and hemopoiesis caused by radiation.

### **\* Drug detoxification**

Korean ginseng extract and saponins inhibit the formation of morphine resistance and dependence.  
Ginsenosides inhibit reverse tolerance and mental toxicity to cocaine and methamphetamine.

## 7. Safety of Korean ginseng

### 7-1. Ginseng's safety



a. In traditional oriental medicine, ginseng is considered almost non-toxic (it is reported in an ancient Chinese medical book titled 新農本草經 that ginseng is classified into a non-toxic folk medicine that can be taken for long period) (Hyo 1987). The test results conducted so far show that ginseng causes no acute or chronic poisoning with almost no side effects (Ivan M, Popov et al. 1973).

b. According to the result of animal (mice and rats) experiment on ginseng's toxicity, there is almost no possibility of acute poisoning (LD50: lethal dose 50%) with oral medications (over 5g/ kg) of ginseng (red ginseng) powder, ginseng extract and crude saponins (Hyo 1978; Yoshio Takino et al. 1984; Kaku et al. 1975). In particular, it is reported that the mice were medicated with over 10–30g/kg of ginseng roots (Brekman II and Dardymov IV, 1969).

c. In the teratological test on pregnant mice and rats orally medicated with ginseng extract containing 45% ginsenosides (dose: 4g, 1g, 0.01g/kg/day, 14 days), there was no external deformation or abnormal skeletal muscle in the mother's body and embryo) (Eiichi Hayashi et al. 1977).

d. It was proved that white mice medicated with red ginseng powder mixed into feed for 1–6 months (0.625g, 1.25g and 2.5g of ginseng powder mixed into 1kg feed) were safe on toxicity (Hong et al. 1984) and the rats medicated for 6 weeks with ginseng jelly and candy containing ginseng extract showed no abnormal symptoms or lesions (Kim Hyung Soo et al. 1978), compared to control group (Kim et al. 1978).

- e. The studies of ginseng's (G115) toxicity on tetragenecity, carcinogenesis and cardiovascular system with the animals such as mice, rats, rabbits and dogs showed no acute, subacute or chronic poisoning (F.G. Hess et al. 1982, 1993; F. Soldati 1984).
- f. The Ames test, a short-term mutagenicity assay of red ginseng extract using salmonella typhimurium tester strain TA 100 and V-79 Chinese hamster cell line to evaluate the safety of red ginseng extract, confirmed its safety with the result of "negative" in all items (Lee I. P. et al. 1984).

## 7-2. A rare side effects of Korean ginseng

a. It is reported that long-term excessive ginseng intake (15g/ day) should be avoided, as the long-term takers (133 persons) with ginseng products in U.S. market show the symptoms of ginseng abuse syndromes such as high blood pressure, dizziness, insomnia, skin rashes and diarrhea caused (Siegel R. K. 1979). However, an objection was raised that those ginseng takers actually took American ginseng or other species such as *Eleutherococcus senticosus* and *Rumex hymenosepalus*, instead of *panax ginseng* and it is doubtful that those symptoms were directly from *panax ginseng* or are related to dose or quality problem (C. Norman Gillis, 1997). Siegel R.K (1980) reported that intake of standard ginseng products and proper dose of ginseng don't lead to any side effect.

b. There was a case that a person had a severe headache and vomited after taking ginseng and then cerebral arteritis was observed, which was assumed that it may be associated with excessive intake of alcohol from ginseng (equivalent to 25g of dry ginseng). However, it is still doubtful that this case was from excessive intake of ginseng or the side effects of ginseng, and what type of ginseng was really taken (Ryu S. J. et al. 1995).

c. It was hard to evaluate the cases of ginseng's toxicity and side effects, due to insufficient information about the content of ginseng, manufacturing types and quality. According to the investigation on the quality of ginseng products in overseas markets, some products didn't contain ginsenosides at all. It is important to be aware of fake ginseng products (Cui J. et al. 1994).

### 7-3. Side effects and precautions of ginseng in Chinese or Korean traditional medicine

- a. Successive scholars of oriental medicine have classified ginseng into folk medicine, as it is non-toxic and causes no side effects (Lee et al. 1984; Toshihiro Fujibayashi 1997).
- b. It is common in the recent Chinese medicine that ginseng is used for weakness and not for excessive or heat syndromes (Yuk et al. 1992). For example, ginseng is usually avoided by those with hypertension. In particular, ginseng is prohibited by those over 180mmHg of systolic pressure. In addition, ginseng is generally prohibited by those with hypohidrosis, dyschezia, heat syndrome, cold or inflammation-induced high fever (Hukki Junmi et al. 1994; Lee et al. 1993; Yuk et al. 1992).
- c. Lee and Ahn 1993; Hukki and Kulwol 1994; Yuk 1992 reported that there are the side effects of ginseng such as fever, nose bleeding, breathing difficulty, skin rashes or mild abdominal (stomach) pain. Lee and Ahn 1993; Hukki and Kulwol 1994 reported that there are sometimes the symptoms like headache, sleeplessness or palpitation, high blood pressure but these symptoms disappeared when they stop taking ginseng.
- d. According to Sasang Constitutional medicine, one of main streams of oriental medicine, ginseng is most suitable for the lesser Yin person (少陰人, Soeumin) who has innate weak spleen and stomach, among four sasang constitutional types. Ginseng can cause itching or skin rashes in other sasang constitutional types (Lee 1992). However, if there is no specification for ginseng types, it generally means white ginseng (plain ginseng). This means red ginseng having different processing method may give different results.

e. Song (1998) conducted a clinical trial and physio-chemical testing (in both western medicine and oriental medicine) with 188 healthy persons around the age 30 (male 107, female 81) who are classified into the lesser yin person (少陰人, Soeumin), the lesser yang person (少陽人, Soyangin) and the greater yin person (太陰人, Taeumin) by sasang constitution, and medicated with 3g/day of red ginseng powder to one group (130 persons; brand name: Cheong-Kwan-Jang) and placebo as corn starch powder in same amount to other group (58 persons). The symptoms such as physical fatigue or mental depression have been clinically improved but there was no distinct difference in sasang constitutional types. Subjective symptoms like upper body fever, indigestion, heavy weight feeling on chest, facial flushing and itching were observed. There were 11 cases which stopped intake due to side effects but there were no significant difference between red ginseng group (6.2%) and placebo group (5.2%). This indicates that ginseng doesn't cause any specific side effects.

f. In China, Taiwan and Hong Kong which countries are confident in the efficacy of ginseng, the scholars of Chinese medicine recognized that ginseng can cause the side effects such as nose bleeding or body temperature increase, due to its strong nature, but these are mainly caused by the differences in eating habits, climate conditions and physical constitutions between Chinese and Koreans. Jin et al. (1997, 1998) conducted a clinical trial with 86 persons (66 persons: hypertension and 20 persons: normal in health) at 中日友好醫院 and dose of 3g Cheong-Kwan-Jang red ginseng powder/ day for 6 weeks. The result showed that red ginseng lowered blood pressure of those with hypertension by average 60% and improved many subjective symptoms without any serious side effects. It was also reported that those with high cholesterol (79 persons) didn't show any significant side effect with Cheong-Kwan-Jang red ginseng powder.

## Misunderstanding on Ginseng

<The recognition that ginseng can increase fever (heat) or body temperature is mainly on the misunderstanding of ginseng's nature.>

There is a paper that Korean ginseng belongs to Yang and western ginseng belongs to Yin and the latter reduces heat and the former raises heat. Further, it claims that western ginseng is more effective for those in the South East Asia where the weather is hot and humid year around (Hsu 1979).

In Chinese medicine, western ginseng is classified into 涼 (cool) in nature and mainly used as an invigorant for weakness, unlike Korean ginseng (Bae 1993).

In Chinese medicine, western ginseng is understood to lower fever (reduce heat), like the plants such as 沙參 (*Codonopsis lanceolata*), 天門冬 (*Asparagus cochinchinensis* MERR) and 麥門冬 (broadleaf Liriodie) as an invigorant. However, there is no verified experimental or scientific basis that western ginseng is good for those who live in hot weather, which is a method of symptomatic therapy. As western ginseng belongs to different species, they cannot be identified with Korean ginseng. In the past, Korean ginseng has been substituted by western ginseng, as it was very rare. Western ginseng is used for weakness but its invigorating ability is weaker than Korean ginseng (Wong 1994).

In these days, there are many reports that the experiments with ginseng, ginseng extract or its ingredients on the human body showed that ginseng doesn't increase body temperature in all cases. It is a misunderstanding that ginseng unconditionally raises body temperature under normal conditions, as it is warm in nature.

► The thicker, 6-year-old ginseng collected in autumn, the better?

Due to the misperception of consumers, all ginsengs are selling as 6-year-old ginseng roots. However, the quality of ginseng is determined as the content of saponins. Sometimes, 4-year-old or 5-year-old ginsengs contain more saponins than 6-year-old ginseng roots. It is also wrong that thicker ginseng roots in good shape have more nutrients. On the contrary, thicker ginseng roots have high possibility of empty inside. It is the best to choose the ginseng in proper thickness that goes well with its age. Ginseng is effective when its leaves and stems start dry. This is why ginseng is collected at the end of September and early October. It is true that ginseng collected in autumn is better.



Fresh ginseng

#### 7-4 Healing Crisis (暈眩 phenomenon)



暈眩 means 'sand blind' and 'dizzy or faint', respectively.

That is, it means literally 'dizzy and struck blind' in Chinese.

It is the phenomenon when people experience temporary worsening after intake of a medicine. This is totally different from side effects of a medicine. Instead, it is a process of recovery from a disease. This 暈眩 phenomenon is also called 好戰反應 which means the temporary reaction to get recovery. This phenomenon is actually good news. People need to consider changing a current therapy or treatment when there is no healing crisis.

In western medicine, this is called a crisis for healing, that is, a crisis that makes a patient give up treatment, since most people feel severe pain. This occurs when healthy blood is supplied every corner of the body to nourish and clean the body at the same time, and finally to get better health. That is, it is the process when toxins are removed from the body.

To get recovery from diseases in latency for long time, some symptoms including severe pain appear again. Those with chronic adult diseases may have severe healing crisis. According to Hering's Law of Cure, "all cure starts from within out, from the head down, and in reverse order as the symptoms have appeared or been suppressed.

That is, healing crisis starts from the interior of the body toward the skin, from the top of the body downward, and from the most recent illness to the oldest.

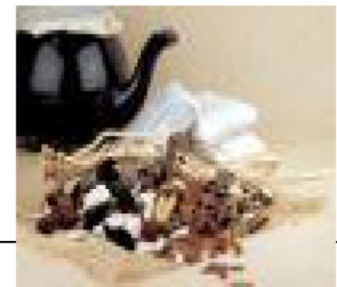
For mild illness, healing crisis starts faster and ends even faster. For severe illness, healing crisis starts later and lasts longer. For long-standing illness, healing crisis may be painful.

In the beginning of healing crisis, people experience very mild symptoms. Then they have severe symptoms which gradually disappear with times. Healing crisis lasts about 3 days in shortest but sometimes last about 3 months. More toxins in the body, longer the healing crisis lasts.

After a healing crisis, your body begins to feel better with clear mind.

You have to overcome the pain of healing crisis but, for too much pain, you can stop taking medication till the healing crisis disappears. The repetition of starting and stopping medication gradually leads to self-adaptive ability of your body with lesser pain. If it is more bearable, then you can start taking medication again. Healing crisis includes the symptoms such as headache, dazedness, swelling in entire or parts of your body, or neuralgia and pain from arthritis. In addition, there are tiredness, fatigue, palpitation, nose bleeding, vomiting, cold or general fatigue, itching, skin rashes, fecal stasis, coated tongue, fever or coldness, sand blind and dizziness, cloudy urine, toothache, ear pain.

These symptoms appear in different ways, depending on the types and conditions of diseases.



## Healing Crisis



- Body acidification

There are the symptoms such as severe fatigue, sleepiness, pain in tongue end or neck, and frequent urination and farting. In case of hypertension, there may be heavy feeling in the head or dizziness for 1–2 weeks or enervation.

Women with anemia may have a little nose bleeding, thirst, too much dreaming at night, or stomach discomfort.

Those with indigestion may have stifling or fever in the pit of the stomach, or difficulty in eating. In case of gastric ulcer or erosion, stomach can be inflamed or blistered with pain or heavy feeling.

Gastric ptosis has heavy feeling in the chest or vomiting, with downward displacement of stomach.

Frequent diarrhea may occur.

- Chronic fatigue

Liver dysfunction: there are the symptoms such as vomiting, itching, blistering or bleeding feces.

Liver cirrhosis: Mild bleeding feces can occur.

### \* Digestion & menstruation disorder

Kidney disease: There are the symptoms such as facial swelling, blisters or acne, slight swelling in the legs,

### \* Relaxation

It includes feeling tired, sleepy or absentminded.

About 1 out of 3 persons has this symptom.

When an organ in illness starts to recover its own function, other organs which were adaptive to former ill condition show temporary unbalance or worsening with low spirit, dizziness and enervation.

### \* Over-sensitiveness

It includes too much sensitiveness in the intestines or nerves, due to constipation, pain, diarrhea, itching, swelling or sweating.

When a disease progresses from acute to chronic, it starts to get recovery in stable condition but shows temporary acute symptoms. About 1 out of 5 persons has these symptoms.

### \* Excretion or Discharge

This is the phenomenon that your body excretes the toxins such as pus, whit (eye discharge) or coated tongue from the body. About 1 out of 10 persons have these symptoms. This is the process of detoxification of waste or heavy metal toxins. It appears on congestion, urine or skin.

Stomachache, abdominal pain, vomiting and fever are the symptoms when cells are regenerated and unhealthy tissues disappear.

### \* Signs of recovery

Fever or considerable pain appears when poor circulation induced blood clots are contaminated and temporarily travel your body.

In most cases, these disappear within 3–4 days.



## 8. Conclusion

a. In oriental medicine, ginseng has been considered non-toxic and proved to be safe in the animal testing. Many clinical tests also showed no significant side effects. However, very few studies reported the symptoms of side effects by ginseng. They are considered transient and will disappear right away with stopping medication of ginseng.



b. In oriental medicine, it is known that ginseng has been mainly used to invigorate weakness and prohibited to use for excessive or heat syndromes. According to the results of many animal experiments and clinical trials on ginseng's homeostasis, above practice is not absolute. However, since food also sometimes causes allergic reactions with individual variations, ginseng should avoid abuse or misuse. In general, red ginseng manufactured under strict quality management can be evaluated as a healthy food within recommended dose.