

Ginseng In Dentistry

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ABSTRACT

Ginseng is quite possibly the most broadly sold medicinal plant in the world, having been used for almost 2000 years in Asian nations, primarily as a general tonic and adaptogen to preserve the body's resilience to unfavorable conditions and homeostasis, as well as to improve physical functions. Researchers believe that ginsenosides found in ginseng, are responsible for any clinical effects of the herb. *Ginsenosides* are the most extensive components of panax ginseng, that are extracted through various methods and used in production of different ginseng products. Ginseng products may vary in their potential medicinal properties so ingredients of the ginseng product must be checked before purchasing. Ginseng is popular because it boosts immunological function, reduces weariness, improves cognitive functioning and also plays a role in dentistry. This article will provide a basic overview of all accessible knowledge about the ginseng plant, with a focus on the plant's uses in general and in dentistry to date.

Keywords: Panax ginseng, sources, ginsenosides, bioactivity, dentistry uses.

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INTRODUCTION

For about two thousand years, ginseng has been used as natural product for different medical purposes.¹ Being a sensitive plant, it must be treated with caution from seed to mature plant.¹ Panax ginseng is a perpetual shrub that grows up to 50–80 cm.² It features inconspicuous blossoms that grow into red berries, and a root that resembles a human figure due to the way it branches.² The root is the part of the plant that has the most therapeutic value because it contains the majority of the key components and "active" substances.² Only the genus "Panax" contains true ginseng plants.³ Several additional plants are mistakenly called ginseng, though they belong to a different subdivision or group.^{3,4} True ginseng belongs to a family that is similar to the Siberian ginseng, but Serbian ginseng does not have the same genus. Eleutherosides, excluding ginsenosides, are the active components in it. Siberian ginseng has a wood-like root rather than a fleshy one.³

History

Shen Nong Pharmacopoeia was the initial documented course regarding the therapeutic uses of Ginseng plant.⁵ Li Shizhen had cataloged the ginseng plant as a "magnificent tonic" in 1596.⁵ The herb became employed as a cure for individuals with persistent illnesses and people that were recuperating, instead of an "all-remedy" treatment.⁶ In the 16th century, ginseng plantations in China and Korea became a source of contention.⁶

Common morphological features

It is usually yellowish brown in color and the leaves of ginseng are palm-shaped.¹ Every year the stipe lengthens one by one and has a distinctive odor and sour taste. Per root, one stem is usually generated. It is made up of rhizome, main root, lateral roots and fine roots.¹

Table 1: Various species that are put up for sale as ginseng plants but they are not actual ginseng plants.⁴

Common Names	Latin binomial (Family)	Incorrect names given to species
California Spikenard	Aralia californica (Araliaceae)	California ginseng
Small spikenard	A.nudicaulis (Araliaceae)	Wild ginseng
Suma	Hebanthe eriantha, syn. Pfaffia paniculate (Amaranthaceae)	Brazilian ginseng
Maca	Lepidium meyenii(Brassicaceae)	Peruvian ginseng
Devil's club	Oploppanax horridus (Araliaceae)	Pacific ginseng
Gynostemma	Gynostemma pentaphyllum (Cucurbitaceae)	Blue ginseng
Eleuthero	E.senticosus (Araliaceae)	Serbian ginseng

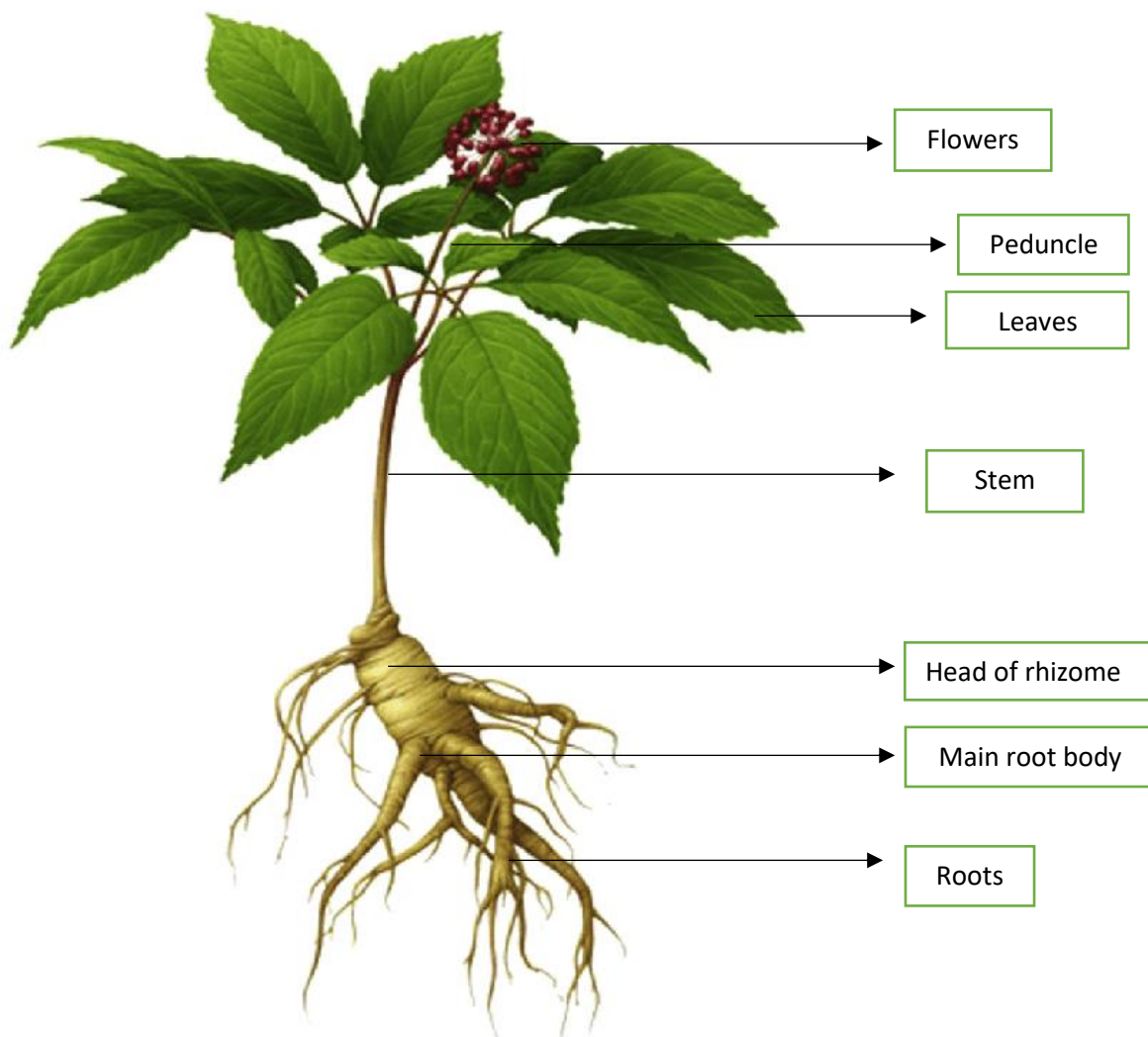


Figure 1: Morphological structure of ginseng plant [7]

Types

- a. Wild ginseng plant
- b. Cultivated ginseng plant
- c. Red ginseng plant
- d. White ginseng plant

Wild ginseng versus cultivated ginseng

The roots of wild ginseng are dark brown and twisted.⁸ They consist of many coextensive growth rings, are frequently bifurcated and they are often small in size in addition to not being very heavy in weight.⁹ The lengthy neck of a wild root is one of its distinguishing features.⁸ The roots of grown ginseng appear as off-white, simple, soft and plump, with few growth rings.⁸ On the other hand, the roots of cultivated ginseng are frequently hefty.⁹ The most common shape is that of a carrot.⁹

Species

Red ginseng versus white ginseng

Red ginseng is simply white ginseng that has gone through additional processing, resulting in a price increase. White ginseng, on the other hand, is dried as soon as it is harvested and sold as a dry root or powder.¹⁰ The shade variation depends on treatment of ginseng through various processes. ‘White’ ginseng as maybe expected, is sun- baked. While ‘Red’ ginseng is steam heated between 100–110°C for about two-three hours.¹⁰ This procedure terminates any infectious agents that may be present on the roots of the plant. The drawback includes the degradation of numerous active ingredients positioned inside the bark’s outer layers.¹⁰ G115, a Panax ginseng extract, is made using a unique procedure that maintains the active ingredients while removing undesirable impurities.¹¹

Table 2: Different species of ginseng⁷

#	Common name	Cultivation region	Morphological characteristics
1	Panax ginseng	Korea, China	Lateral root is well developed, human shaped roots
2.	Panax quinquefolium L	US, Canada, Ontario	Short tap root and lateral root, weak growth of fine root
3.	Panax notoginseng Burk	China, Guangxi	Rugged and black roots
4.	Panax Japonicus C. A. Meyer	Japan	Bamboo shaped uneven

Chemical composition and structure

Ginseng's dried roots and rhizomes contain a variety of medically important components such as Saponins, oils, phytosterol, carbohydrates, organic acids, nitrogenous compounds, amino acids, peptides, vitamins, minerals and specific enzymes.¹² Saponins from ginseng have been found to be the most active and essential components.¹² Up till now 13 saponins have been discovered and those called ginsenosides or panaxosides, are triterpenes of dammarane and oleanane systems.¹³ Majority of the saponins, that are usually found in the roots of ginseng plants can also be found in the leaves.¹³

The fundamental structure of saponins consists of a hydrophobic, steroidal four-ring system with a trans connection and various carbohydrate moieties (i.e glucose [glc], rhamnose [rha], xylose [xyl], and arabinose [ara]) linked to the carbon-3 (C3), carbon-6 (C6), and carbon-20 (C20) locations.¹⁴ Each ginseng saponin could be further subdivided into dammarane type, including the panaxadiol-type (PPD) group, which contains a hydrogen atom at C6 (i.e., Rb1, Rb2, Rb3, Rc, Rd, Rg3, Rh2, Rs); the panaxatriol-type (PPT) group, which contains a C6 sugar side-chain (i.e. Re, Rf, Rg1, Rg2, Rh); or the oleanane type, which has two minor classes, the oleanolic acid group (i.e Ro) and ocotillol group (i.e. F11), based on their chemical structures.¹⁴ All of the metabolites are nonpolar compared to the parental components, that are absorbed easily in the gastrointestinal system.¹⁴

Synthesis of Ginseng

Synthesis of ginseng starts with seeds or roots. It requires precise environmental conditions. It needs at least 70% shade. The soil should be moist and have at least 15-20% base nutrients and the pH should not exceed 6.0. Seeds are planted in fall and germinate in spring. Before planting the rough organic matter and rocks have to be removed first. Dig the soil 12 inch deep for root plantation and 8-10 inch deep for seed plantation. Space between planting seed or roots should be kept 6 to 12 inches apart because wide space is better. Horizontal plantation of roots is to be done. Water them regularly so that they do not get dry. Time for seed germination starts at 18th month. Only one compound leaf is formed in first year of plantation which is about 1 to 2 inch in height and is just above the ground. The prominent circular ridges on roots also appears. More and more leaves formed till the coming few years. Finally, a mature plant is formed which is about 12 to 24 inch long. Greenish-yellow clustered flowers are visible in midsummer. The formed fruit is a like the size of pea having 2 seeds.^{15,16} Ginseng can also be planted indoors with proper required conditions. Need of containers with drainage facility and sunlight should be under observation. In fall season seeds are planted, while roots should be planted in spring.¹⁷

Extraction of ginseng

Extraction is the first step to study and analyze the chemical composition and other properties of the herbs. The roots of ginseng contain six ginsenosides which are of utmost importance. Most abundant among them is Rg1 and Rb1. There

are different methods used for extraction. It includes conventional/traditional and advanced methods.

A. Traditional method includes:

- *Soxhlet method*
- *Heat reflux extraction*
- *Ultrasound assisted extraction*

B. Advanced method includes:

- *Pressurized liquid extraction*
- *High pressure microwave assisted extraction*
- *Supercritical fluid extraction*
- *Pulsed electric field extraction*

Traditional methods

• *Soxhlet method*

This method was discovered by Franz von Soxhlet in 1879 that uses repeated filtration process of organic solvent for separation purpose.¹⁸ It is still used despite of its disadvantage, which is that it takes longer time to be extracted with less efficiency.¹⁹ Percent content of Ginsenoside depends on different time which is 1, 2 and 8 hours, and different solvents used which are MeOH, water-saturated n-BuOH, and water with 10% MeOH.²⁰

• *Heat reflux extraction*

This method includes solid solvent extraction. By giving specific temperature, duration and concentration of solvent, the solvent evaporates leaving behind components of ginseng. Kim et al did experiment on these effects over extraction quality.¹⁹ According to their study, solvent with unlike concentration (0%, 10%, 30%, 50%, 70%, and 100% EtOH), temperatures (40°C, 60°C, and 80°C), and durations (2, 4, 6, and 8 hours) were determined for ginseng extraction. It was concluded that 70% EtOH was the best solvent for extraction of ginsenosides from ginseng powder.¹⁹

• *Ultrasound assisted extraction:*

This method uses mechanical action of ultra sound, both rate and solvent are the useful agents in extraction of ginsenosides from P. ginseng through this method.¹⁹ By rising rate, amount of extraction increases (11.2 mg/g ginseng after 30 minutes, 13.0 mg/g ginseng after 1 hour, 13.7 mg/g ginseng after 2 hours, and 14.5 mg/g after 3 hours).²¹ Similarly solvent also effects extraction amount. Maximum ginsenoside is extracted through n-BuOH-saturated water UAE compared to when solely using water.²¹

Advanced methods

• *Pressurized liquid extraction:*

This method uses extremely heated liquids at very high pressures and enhance speed.²² The extraction efficacy is much better than Soxhlet method.²³ Solvent MeOH, with a temperature of 140°C, time of twenty minutes and pressure of 3 MPa were used for ginsenosides extraction in both P. ginseng and P. quinquefolius.²¹

• **High pressure microwave assisted extraction:**

Shi et al discovered that this technique takes much less time over extraction and also less amount of solvent is needed as compared to other methods.²⁴ The seven major components from *P. ginseng* are extracted through this method are Rg1, Re, Rb1, Rc, Rb2, Rb3, and Rd, of more yield (43.3 ± 1.5 mg/g ginseng) as compared to Soxhlet extraction method (37.1 ± 2.0 mg/g ginseng).^{24,25} Extraction efficiency also dependent on irradiation time and microwave power. Time of 1-15 min and power of 30-150W make the extraction of Rg1 and Rb1 from root of *P. ginseng*.²⁶

• **Supercritical fluid extraction:**

This technique uses supercritical fluid instead of organic solvent.¹⁹ There are several different supercritical fluids used

but most effective one is supercritical CO₂ because it is neither toxic nor inflammable, also has low critical pressure and temperature.²⁷ But the problem is its high polarity towards natural material like saponins, flavones, and alkaloids which can be overcome by adding modifiers.²⁷ Extraction from *P. ginseng* by ultrasound-assisted supercritical CO₂ reverse microemulsion extraction (USCRME) is 3.2 times greater than with traditional supercritical fluid extraction.²⁸

• **Pulsed electric field extraction:**

This method uses high electric field voltage for extraction purpose.²⁹ Electric field of 20 kV/cm, 6 μs pulse duration, 70% EtOH, and 150 L/h velocity was used due to which a better class of ginsenoside (12.7 ± 0.1 mg/g ginseng) was extracted when it was compared to traditional methods.¹⁹

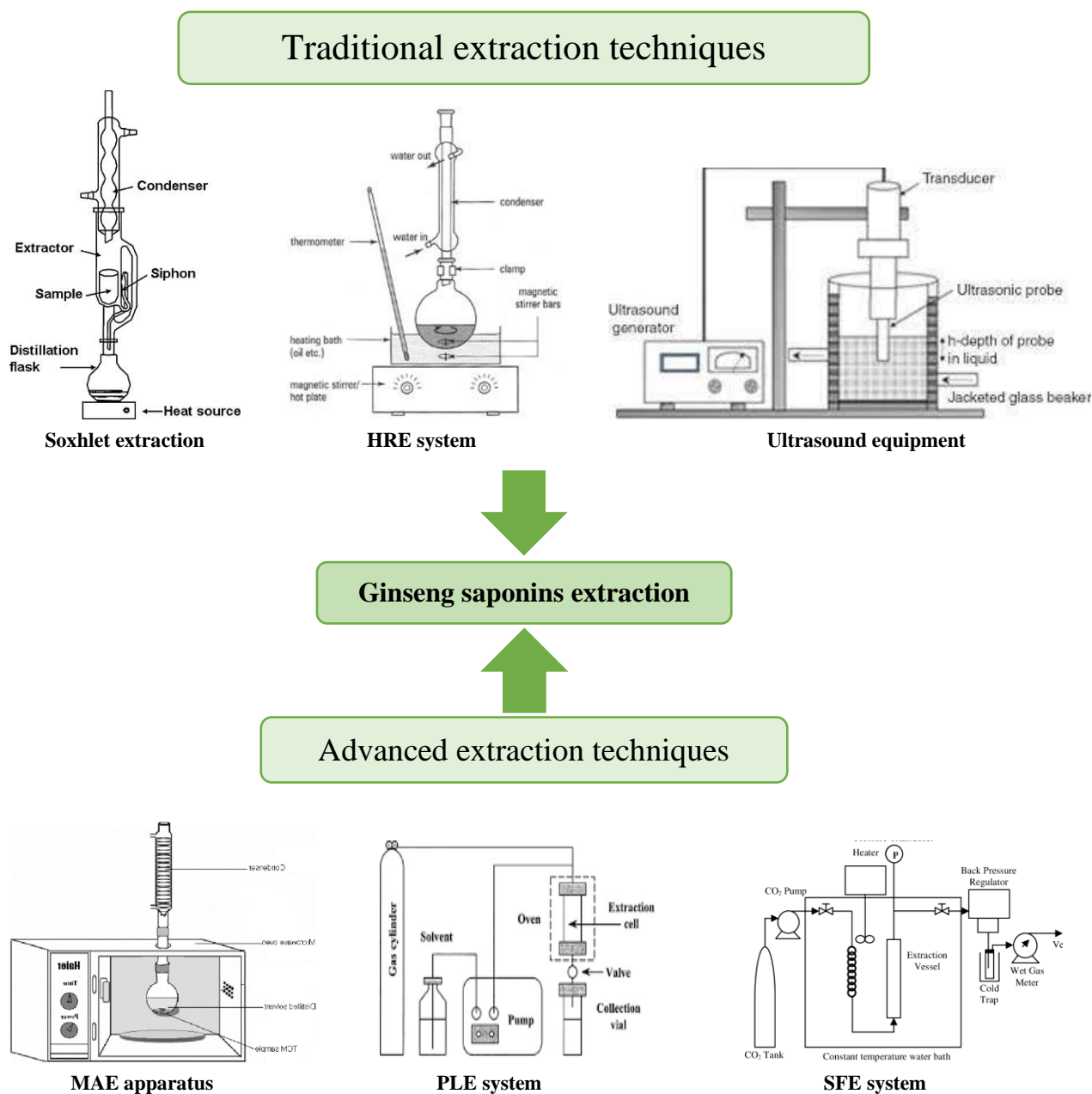


Figure 3: Traditional and advanced extraction methods for ginseng saponins extraction.¹⁹

General uses of ginseng

1. Anti-inflammatory and antioxidant effects

According to some experimental studies, ginseng extracts reduce inflammation and boost antioxidant ability of the cells.^{30,31} Korean red ginseng extracts showed anti-inflammatory activity in skin cells of individuals with eczema.³² Another study was conducted which showed 18 young male athletes who took 2 grams of Korean red ginseng extracts three times per day for one week. The levels of inflammatory markers were checked and measured in both the test group and the placebo group. Decreased amounts were shown in the test group compared to the placebo group.^{33,34}

2. Good brain activity

Ginseng has shown results to help with memory, behavior, and mood.^{35,36} In one study, 30 healthy participants were given 200 mg of Panax ginseng every day for one month. Improvements were seen in the mental health, social functioning, and mood of the participants at the end of the trial. However, after 8 weeks, these benefits were no longer substantial, implying that the advantages of ginseng may diminish with continued use.³⁷ In another study, 30 healthy adults were given single doses of 200 or 400 mg of Panax ginseng before and after a 10-minute mental test to see how it influenced their mental function, mental weariness, and blood sugar levels. The 200-mg dose was more beneficial in enhancing mental performance and weariness.³⁸ Furthermore, several studies have discovered favorable benefits regarding brain activity and Alzheimer's patients.^{39,40}

3. Improvement of erectile dysfunction

Studies have shown that ginseng could be helpful in treating erectile dysfunction in males.^{41,42} Korean red ginseng showed 60 percent improvement in ED symptoms when compared to actual ED medication.⁴³ Furthermore, another study found that ingesting 1,000 mg of aged ginseng extract for two months improved erectile function.⁴⁴ More research is needed, however, concerning the impact of ginseng on erectile dysfunction.^{45,46}

4. Boosting of immune system

Ginseng may help in substantiating the immune system.⁴⁷ According to one study, individuals who use ginseng as a therapeutic herb might have 35% more chance of living a life that is disease-free for five years after curative surgery.⁴⁸

5. Benefits against cancer

Ginseng helps in the preclusion of several malignancies.⁴⁹ Ginsenosides may help to break irregular cell division by preventing aberrant cell growth and production in case of malignancies.⁵⁰ According to a study, people who use ginseng might have 16% decreased cancer risk.⁵¹ Furthermore, another study found that individuals who take ginseng as a medication are less likely to have cancers of lip, mouth, esophagus, stomach, colon, liver, and lung cancer.⁵² Ginseng may also help individuals undergoing chemotherapy improve their health, lessen adverse effects, and boost the effectiveness of some treatment medications.^{50,53}

6. Fight against fatigue and increase of energy levels

A study showed the influence of giving 1 or 2 grams of Panax ginseng and a placebo to 90 people with chronic fatigue.⁵⁴ People who were administered ginseng had reduced physical and mental weariness in addition to lower oxidative stress when compared to those who were given a placebo.⁵⁴

7. Lower blood sugar level

Ginseng appears to help individuals, with and without diabetes, control their blood glucose levels.^{55,56} In one study, 19 persons having type 2 diabetes were given 6 grams of Korean red ginseng along with anti-diabetic medicine. Good blood pressure control was maintained by the patients. They also exhibited 11% reduction in blood sugar levels, 38% reduction in fasting insulin, and 33% increase in insulin sensitivity.⁵⁷

Uses of ginseng in dentistry

1. The process of development and reconstruction of dentin is carried out by the human dental pulp stem cell (hDPSC). A study was carried out in Chongqing Medical University, China to know the possible effects of ginsenoside (RG1) on the stem cells of pulp. The investigation was initiated by collection of fifty nine impacted third molars from individuals aged nineteen and twenty years. The pulp of the individual tooth was taken out from the crown and root portion of the tooth. The segregated pulp was then treated with ginsenoside Rg1 and cell cycle analysis were performed. Results showed that ginsenoside (RG1) stimulated multiplication and reproduction of DPSCs to odontoblastic type cells. This mechanism was brought about by regulation of related genes along with their pathways. This information indicates that ginseng might be helpful in endodontic biotherapy, reparative dentin formation and tooth tissue engineering.⁵⁸

2. The Korean red ginseng helps and promotes bone remodelling. A Study was conducted by Myong-Hun-Kang in which cells from the Korean red ginseng were loaded onto the surface of titanium miniplate and then the cells were cultured to make a titanium nanotube. The titanium nanotube implants were then eventually placed on the mandibular edentulous area of a rat. After 1-4 weeks, the edentulous area around the peri-implant tissue showed new bone formation and increased differentiation and proliferation of cells. Thus, the implantation of Korean red ginseng cells on titanium nanoplate promoted osteogenesis and osteointegration.⁵⁹

3. Another important use of ginseng in dentistry is that it helps in minimizing the number of bacteria in oral cavity. A study was performed in which a mouthwash containing red ginseng extract was given to 15 individuals in a sample group of 60 healthy individuals aged 18-24 years. The remaining three groups containing 15 people each, were given other mouthwashes and were instructed to use it two times a day for five days. Salivary sample test was performed before and five days after the utilization of mouthwashes. From this study, it was proved that the mouthwash containing red ginseng extract is a blessing for Dentistry because it helped in eliminating most of the harmful bacteria as compared to the other chemical mouthwashes.⁶⁰

4. An organic dental powder is available in the market which could be used as an alternative to natural tooth paste. It basically contains ginseng as an active ingredient. This special blend of the root and plant extract of ginseng cleans the teeth gently yet thoroughly. It tranquilizes and makes the gingiva strong and is also acceptable in children.⁶¹

Disadvantages of ginseng

1. There are some possible side effects of ginseng that include difficulty in sleeping which is one of the common one.
2. Due of its stimulant property, it may cause restlessness among some people, along with nervousness and agitation.⁶²
3. There is difficulty to concentrate and experience of headache.⁶³
4. Consuming large amount of ginseng makes the heart to palpate irregularly or beat either fast or slow.⁶⁴
5. The natural balance of intestine may get disturbed causing diarrhea, inability to control bowel and urinary functions, Nausea and vomiting and stomach ache.⁶⁵
6. Panax family of ginseng has shown some results in which there is increase in blood pressure in some patients. Female may experience breast pain, vaginal bleeding and breast tenderness.⁶⁶
7. Asian ginseng is contraindicated in pregnant females, cause birth defects but not sure whether it is safe during breastfeeding.⁶⁷

8. Special attention is required before using ginseng in case of people who take medication such as calcium channel blockers (Nifedipine) and other high blood pressure medications, as well as statin medications like anticoagulant Aspirin, warfarin and phenelzine.⁶⁸

CONCLUSION

Ginseng has been utilized in the field of medical sciences in different eras. It is usually sold as a good source to maintain a balanced diet, as a medicament which helps in maintenance of many bodily functions like boosting of immunity, in maintenance of good blood pressure control, as a treatment for erectile dysfunction and so forth, however modern clinical research is indecisive about its therapeutic effectiveness and its overuse may have harmful effects and may lead to interaction with prescription drugs so more research needs to be done in this case. Apart from bodily functions, ginseng has also shown some promising dental purposes such as osteointegration, reparative dentine formation, antibacterial effects and maintaining healthy oral flora but still more research work needs to be done on ginseng plant in field of dentistry as well.

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