



# Pharmacological Viewpoint Concerns and Phytochemical Components of Ginseng

Anvi RANA<sup>1</sup>

1. First Author & Corresponding author M.Sc. student, Department of Food Technology and Nutrition, Lovely Professional University, India. Email: [anvirana001@gmail.com](mailto:anvirana001@gmail.com)

Received: September 26, 2022. Revised: September 27, 2022. Accepted: November 18, 2022.

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## Abstract

Ginseng is described as the "King of all herbs," "Man-root" or "Root of heaven" and regarded as the most powerful herbal remedy, particularly grown in Korea, China, Japan, Vietnam, and North America. It has been in existence for a long time. The most demanded herbal cure, Ginseng, principally the root, has long been employed in traditional Asian medicine. The extent of availability of bioactive combinations and their impact on the body differs between American and Asian ginseng. Asian ginseng, also known as *Panax ginseng*, has a more calming influence and is more advantageous than American ginseng, such as *Panax quinquefolius*. The pharmaceutical aspect of development and extraction with diverse morphological properties is examined. Saponins, glycosides, carbohydrates, polyacetylenes, amino acids, vitamins, volatile oil, enzymes are all present in the Phyto-content of Ginseng. Ginsenosides are saponins that are constituents of the triterpenoid dammarane and have anticancer, anti-cardiovascular, anti-microbial, anti-obesity, anti-inflammatory, and antioxidant properties. Ginseng, in particular, has the possibility to help with microbial invasion, inflammatory processes, oxidative stress, and diabetes. It developed nanoparticles and nanocomposite film technologies as novel drug delivery platforms for cancer, inflammation, and neurological illnesses. Furthermore, it offers a range of applications that will be vital for future growth.

**Keywords:** Ginseng, Remedial, Phytonutrients, Health benefits, Pharmacological

**Major classifications:** Health Science, Public Health

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## 1. Introduction

Ginseng has emerged as one of the most well-known herbs. Ginsenosides, which have been saponins and triterpenes, are the primary bioactive elements of ginseng. Many saponins have been identified as constituents of *Panax ginseng*, often marketed as Korean ginseng. It is a herb that has been employed for a range of medicinal uses. It is classified as an antidepressant, which are natural chemicals that are thought to increase the body's resilience to stress. Numerous active compounds can be found in *Panax ginseng*. Ginsenosides and panaxosides represent the most significant. *Panax ginseng* and other plants known as ginseng, such as American ginseng or *Panax Notoginseng*. All of those are distinct plants with differing

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characteristics. However, traditional herbs are mostly used for health promotion and rehabilitation of chronic, rather than life-threatening, illnesses. Medicinal plants possess bioactive chemicals including flavonoids, phenolic acids, tannins, stilbenes, and lignans which can be used therapeutically. These botanicals are adopted in indigenous medicine without the lack of research to justify their therapeutic effects. Every medicinal herb possesses a number of qualities that facilitate the creation and manufacturing of innovative and diverse kinds of medical medicines (Kiefer & Pantuso, 2003). Ginsenosides have been the focus of the major of ginseng pharmacologic and therapeutic study. They have anti-inflammatory, antibacterial, antiviral, and antifungal properties. They have also been proven to have therapeutic potential for hypertension, anxiousness, and a variety of neurodegenerative conditions (Shi et al., 2019). Saponins, ginseng oils, carbohydrates, sugar content, organic acids, amino acids (AA), peptides, vitamins, and minerals are among the chemical active compounds found in ginseng roots. Ginseng saponins have been shown to be one of the significant and efficient constituents. As a necessary consequence, chemical research has concentrated on these saponins and 14 saponins have been discovered and identified, and they have been termed ginsenosides (Sook et al., 2010).

Ginseng, also described as Jen Sheng (The root of heaven), is rooted in a Chinese word that means "man-herb," whereas Panax means "full healer" and refers to a power plant that can alleviate practically every disease condition. Additionally, Siberia, China, and Korea have been the largest consumers of ginseng as natural herbal medicine, with only a minor amount of commercial operations in Germany.

**Table 1:** Taxonomic classification of Ginseng

Kingdom	Plantae
Scientific name	Panax Ginseng
Division	Tracheophyta – vascular plants, tracheophytes
Class	Magnoliopsida
Order	Apiales
Family	Araliaceae
Genus	Panax L.
Species	Panax ginseng C.A. Mey.

Moreover, because of its resemblance to a human, it is characterized as a "man-root". When tried compared to certain other medicinal herbs, ginseng was regarded as a "strong and good tonic" because of its multiple health characteristics. It is referred to as the most extensively utilized herbal treatment across the entire globe (Baeg & So, 2013). Ginsenosides constitute the most effective primary constituents of ginseng. Moreover, various non-saponins have been extracted from ginseng, such as glycoproteins, peptides, polysaccharides, polyamines, polyacetylenes, etc. (Baek et al., 2012). *Panax quinquefolius* (American Ginseng), *Panax ginseng* (Korean Ginseng), *Panax notoginseng* (China Ginseng) *Panax vietnamensis* (Vietnamese Ginseng), and *Panax pseudoginseng* are among the other species. Each of these species is considered rare in regions wherein Panax ginseng is the most common and widely grown (Coon & Emst, 2002).

## 2. Crop Production and Management of Ginseng

Ginseng can only be identified in the Northern Hemisphere, where it is developed in North America, Korea, and China (Manchuria). American ginseng is remarkably similar to Chinese ginseng in that both have high quantities of ginsenosides and are much desired in China. They require a relatively fairly mild climate with temperatures ranging from 0 to 26°C, loamy rich soil, well-drained land, and no sunlight contact, the use of shelter is highly recommended. Ginseng plants adapt for winter hibernation when the weather cools they usually grow in soil that is cool (in a shaded place/cold-weather climate), moist, well-drained, and nutrient (calcium-rich). It grows to a maximum height of 14 inches and has greenish-yellow corollas. It will have two to four prongs (a fork-like narrow point), each one with five leaves. Every prong develops from the same spot on the plant's primary stem. It will have red flowers in the middle once it is prepared to be grown. The roots expand and fill out while drying, typically 9.84 inches long and 0.27-0.98 inches, with 2-6 big branches and an external spiraling pattern split longitudinally with root scarring (Saldanha et al., 2012).

The coloration of the outer surface varies depending on the variety; it is white or yellow in color when it is in the rawest aspect. White ginseng is referred to as dry and unpeeled. Black ginseng, on the other hand, is manufactured in China or Korea and originated from *Panax ginseng*. The roots of the *Panax* plant are peeled, cooked, and then processed to generate a red pigment. Ginseng is well-known for providing a sour taste with a little sweetness (similar to carrots) and has a mildly scented aroma. The frequency of ginseng leaf scars in the rhizome has the ability to estimate a plant's age and growth. The interior surface of ginseng is yellowish-brown in appearance covered with oil-storing dark red bark and wood fibers (Rokot et al., 2016).

## 2.1 Ginseng plantation practices

Every four to six years, roots are effectively eliminated from plants, generally in the fall or summer season. The roots are cleansed and sterilized to prevent insect development (Lee et al., 2013). Large-scale ginseng production increased requirements for the long-term preservation of harvested organic material, precipitating the creation of post-harvesting techniques. The two most commonly used conventional post-harvest methods are white ginseng (dried form) and processed (steamed procedure) red ginseng. In Korea, red ginseng is purified for roughly 3-3.5 hours at a temperature of 120-130°C, as a necessary consequence of which Saponins content is changed for the better, and can be preserved for 24-36 months (2-3 years) with no dramatic reduction in Phyto-content nutrients, while white ginseng in China has its exterior skin removed by peeling, dried, and protected from exposure for 12-15 months (1-1.25 year) (Hankins, 2000).

## 2.2 Components of Ginseng

Flower bud, Fruit, Seed, Stem, Leaves, Rhizomes, and Roots (Main root and Lateral root). Root hairs are long, thin outgrowths (Kang & Kim, 2016).

## 2.3 Traditional applications of Ginseng

Ginseng has been used for a long time as a traditional herbal therapy to address a variety of diseases. Ginseng root is defined as the ability to provide energy, decrease cholesterol, increase strength, promote the immune system and alleviate stress. It is claimed to be the most effective treatment for general fatigue and provides energy (Kim, 2018). It is commonly used in traditional Chinese medicine to treat heart and blood vessel diseases, enhance strength, and blood volume, promote vitality and appetite, and soothe patients. It has also been given for tiredness, anemia, and dysfunction, as well as to relax patients. Ginseng has been taken in Ayurvedic medicine for centuries for its antioxidant, anticancer, and cardioprotective properties (Dharmananda, 2002).

## 3. Varieties of Ginseng

The features of the various varieties vary. Ginseng is divided into two main categories as Asian or Korean ginseng which is referred to as *Panax ginseng* and American ginseng as *Panax quinquefolius*. The *Panax quinquefolius* (American ginseng) is regarded as less powerful and milder in character than Korean ginseng in traditional Chinese medicine. It is appropriate for young and middle-aged persons and may be used for a long period of time. Additionally, American ginseng is taken as an opportunity to enhance immune function and regulate blood glucose levels. On the other side, Korean ginseng (*Panax ginseng*) since this includes ginsenosides, the active elements of this root, is regarded as real ginseng. It is much more suited to the old aged person and may be used for a short period of time (11-12 weeks). The root of Korean ginseng properties is known to boost physical stamina, decrease tiredness, and improve stress tolerance (Park et al., 2014).

## 4. The Phytochemical Constituents of Ginseng Plants

It comprises several therapeutically essential ingredients and thus more than 100 elemental compositions derived from various ginseng cultivars. The basic phytochemical constituents of Ginseng include Volatile oil, Polyacetylenes, Amino acids, Carbohydrates, Saponins, and Vitamins.

#### **4.1 Volatile oil**

Based on the ginseng variety, volatile oils contain a variety of pharmacological capabilities, characteristics, and chemical components. They emit a distinct smell and are frequently liquid at room temperature. Ginseng volatile oil is a ginseng constituent that possesses antibacterial and anti-inflammatory capabilities. In ginseng varieties, there are roughly 369 known volatile oil components. These constituents include aldehydes, fatty acids, sesquiterpenoids (made up of three isoprene units), sesquiterpene hydrocarbons, and heterocycles (Qiu et al., 2008).

#### **4.2 Polyacetylenes**

Polyacetylene is a natural polymer having an acetylene repeating monomer Polyacetylene was found in ginseng at various levels from 0.08 to 0.079%. MTT test viability assay was used to determine the chemotherapy impact of the bioactive polyacetylenes panaxynol and panaxydol discovered in Panax Ginseng Meyer roots (for evaluating cell metabolic activity) (Yeo et al., 2017).

#### **4.3 Amino acids**

Amino acids are molecules that include both carboxyl and amine groups. White Korean ginseng root comprises at least 15 various free amino acids, a few of which are needed and others that are not. Ginseng includes a significant quantity of amino acids that appear to be advantageous to human health, including valine, histidine, phenylalanine, leucine, theonine, arginine, and lysine (Cho et al., 2008).

#### **4.4 Carbohydrates**

Ginseng has the highest proportion of polysaccharides (acid), which are classified into two categories based on the structure of its monosaccharide, ginseng starch with glucans, and ginseng pectin. Ginseng root also produces ginseng pectin, a crude carbohydrate. Ginseng pectin is made up of numerous distinct types of sugars. Ginseng polysaccharides, the primary physiologically active ingredient in ginseng, have a range of biological functions including immunological modulation, biological activities, and anti-inflammation (Jung et al., 2004).

#### **4.5 Saponins**

Ginsenosides are the saponins found in ginseng. Ginseng saponins are classified as Rb1, Rb2, Rc, Rd, Re, and Rl depending on their composition. Out of these compositions, Ginsenoside Rb2 is a powerful protopanaxadiols (PPD) type of saponin, largely occurring in the leaf and stem of ginseng. Ginsenoside concentration varies across varieties of ginseng as well as between plant segments. In P. ginseng, 38 ginsenosides have been discovered (Choi, 2008). Because of the high concentration of Ginsenosides in ginseng. Ginsenosides have anti-inflammatory, antioxidant, and antiapoptotic properties, as well as impacts on the immunological and neurological systems (Wu et al., 2001).

#### **4.6 Vitamins**

Ginseng includes a trace of vitamin C around (7.7 mg per 100 gm). Ginseng root is high in important vitamins. Vitamin B complex, biotin, niacin, niacinamide, and pantothenic acid have all been found. It has also been documented that vitamin B, nicotinic acid, and folic acid are present. Vitamin content was found to vary based on the origin and condition of the ginseng plant. These micronutrients are certainly significant components of ginseng (Kim, 2016).

### **5. Pharmacological Properties of Ginseng**

Ginseng has been consumed as a traditional herb in Asian countries for a long time due to its antioxidant properties and anticancer properties. Its implications for improving immunity, and energy, as well as overcoming cardiovascular diseases, diabetes mellitus, and neurological diseases, have all been acknowledged (Lum et al., 2002).

### 5.1 Anti-cancer activity

When compared to white ginseng, red ginseng has much higher anticancer effectiveness because of the production of active anticancer ginsenosides during steaming treatment (Kim et al., 2013). Ginseng is commonly used by people with cancer to promote clinical results, enhance their quality of life, alleviate cancer-related illnesses, lessen chemotherapy adverse reactions, and perhaps boost the effectiveness of chemotherapeutic medications (Chong-Zhi et al., 2016).

When contrast to white ginseng, red ginseng has much higher anticancer action because of the formation of active anticancer ginsenosides through the steaming procedure. An investigation of 909 cases of cancer and 909 subjects in Korea found that ginseng consumption decreased substantially cancer risk, with ginseng extracts and powder being more effective than fresh slices, juice, or tea (Fan et al., 2012).

Cell proliferation mediators, growth regulators, tumor suppressors, inflammatory response molecules, and protein kinase are all instances of transcription factors that are altered to create anticancer activity. Moreover, it inhibits the tumor by controlling cellular proliferation, reducing angiogenesis, and blocking invasion using a variety of strategies that target the tumor's cellular and molecular features (Li et al., 2020).

As per Hong, The extract of Ginseng can make an anticancer medicine chemosensitized by inducing MDR-1-related protein (It is a component of the C family of a class of proteins termed ATP-binding cassette exporters). In addition, Ginseng has also been demonstrated to alleviate medication-induced adverse reactions when used in conjunction with cancer chemotherapy. Ginsenosides Rh4 (Rh4 is a ginseng saponin with anti-diabetic characteristics) and Rk3, in specific, lessen the daily dosage nephrotoxicity manufactured by cisplatin which induces nuclear and mitochondrial DNA destruction and the formation of reactive oxygen species (ROS), through the mechanism and structure-activity connection with other. Furthermore, Ginsenoside Rk3 and ginsenoside Rh4 have been revealed to have medicinal impacts on a variety of illnesses including several hematological diseases mainly anemia, sickle cell disease, and rare genetic disorders (Hong et al., 2021).

Ginseng has been studied as a chemotherapeutic stimulant, and it has been established that when combined with other chemotherapeutic medications, such as navebine and vinorelbine, ginseng boosts the efficacy of lung cancer therapies in the short to medium period of time. One of the studies was carried out, with 78 patients participating. In accordance with the findings, the patient's life satisfaction has been enhanced. Rather than employing ginseng extract, experts are focused on purified ginsenosides because they provide a speedy and precise method of action (Lee et al., 2009).

### 5.2 Anti-inflammatory activity

Inflammation is an uncontrollable process caused by situations such as metabolic abnormalities, inflammatory diseases, cardiovascular problems, or allergies; on the other side, it is our body's way of responding to highly unsafe triggers including tissue damage (Lee et al., 2021).

The anti-inflammatory properties of ginsenosides (the active ingredient of ginseng) are associated with the inhibition of pro-inflammatory cytokines and enzymes in M1-polarized macrophages. Whereas ginsenoside Rc (a dammarane-derived ginsenoside found in Korean ginseng that is replaced by hydroxyl groups only at 3beta, 12beta, and 20 pro-S sites) defeats the macrophage cytokines. Also, the ginsenosides (Re) and (Rp1) can suppress the Nuclear factor – B cells (NF-B) signaling pathway transcription factor. Individuals who took ginseng had a 60% better likelihood of survival than those who did not take ginseng, according to clinical trials. (Baek et al., 2016). Cyclooxygenase (COX-2), Inducible nitric oxide synthase (iNOS), Tumor necrosis factor (TNF), and inflammatory signaling mechanisms, are increased in lipopolysaccharide-activated macrophages, and the extract of Korean ginseng proved anti-inflammatory effectiveness via Nitric oxide (NO) synthase (Hofseth et al., 2007).

### 5.3 Anti-microbial activity

Antimicrobial activity is characterized by actions made to hinder the growth or destruction of microorganisms.

A number of investigations have found that extracts of ginseng or their compounds, alone or in combination, have strong and powerful antimicrobial activities. The extracts of Korean red ginseng extract inhibited respiratory syncytial virus-induced inflammatory cytokines and reduced lung damage. Furthermore, Panax notoginseng referred to as the plant of the ginseng was analyzed in vitro and in vivo to construct a new vaccine and antiviral pharmaceuticals against influenza viruses, and it was discovered that the Panax notoginseng expanded mouse splenocyte Natural Killer (NK) cell activity and reduced influenza virus infection mortality by 85% when the trial was undertaken (Wang et al., 2020).

The ginseng root, Notoginseng, was investigated for antifungal activity against the fungi *Epidermophyton floccosum*, *Trichophyton Rubrum*, and *Trichophyton mentagrophytes*. The antimicrobial properties method must be investigated to determine whether the antifungal activity was caused by contact with the fungal cell membrane, which impaired membrane consistency. The preliminary investigation concluded that notoginseng saponin can be helpful to treat ringworm (Xu et al., 2009).

#### 5.4 Antioxidant activity

Ginsenosides, which have been demonstrated to have a number of positive properties, particularly antioxidant activity, are the main bioactive compounds of *Panax ginseng*. Ginseng contains powerful antioxidants, Fine roots had the strongest 2,2-diphenyl-1-picrylhydrazyl radical scavenging activity and ferric reducing antioxidant ability, after by lateral and then major roots. However, the quantities vary depending on the kind and manner of preparations. Antioxidants promote the body's battle with free radicals, which might harm cell development and progression (Kitts et al., 2000).

#### 5.5 Anti-obesity activity

Obesity has become an important public health concern in the current era. Ginseng has an anti-obesogenic impact, although its anti-obesity processes are not well understood. Ginsenosides have been shown in both Vitro and in vivo to enhance calorie expenditure through activating the adenosine monophosphate-activated kinase route and to decrease energy consumption in a comparable way. According to Zheng, after 2 months of ginseng extract treatment, blood levels of total cholesterol, triacylglycerol, and Low-density lipoprotein (Bad cholesterol) diminished while those of high-density lipoprotein (Good cholesterol) improved (Zheng et al., 2020).

#### 5.6 Anti-cardiovascular activity

A cardiovascular disease is a group of illnesses that affect the heart or blood arteries and is among the main contributors to death worldwide. Ginseng's active ingredients (Ginsenosides) can boost nitric oxide generation, suppress reactive oxygen species formation, enhance blood circulation, and improve lipid profile normalization. *Panax ginseng* has been shown in experiments to assist maintain healthy blood circulation and to increase vascular endothelial cell-derived nitric oxide release, which lowers blood pressure. Ginseng's constituents can act as anticoagulants in blood circulation. The root of ginseng assists in controlling total cholesterol, triglycerides (TG), and low-density lipoprotein (LDL) referred to as "Bad cholesterol" (Yang et al., 2017).

### 6. Worldwide Demand for Ginseng in Economic Development

Because of its growing global demand for health, the whole food sector, which focuses on organic food, medicines, and other byproducts of chemical processing of health food, is fast increasing. Although ginseng has the main focus within organic health foods, medicinal items with many purposes that contain this element might considerably improve a person's living standard and become a worldwide bestseller. Derived from traditional effectiveness, the ginseng industry retained its value across Asia. Moreover, if a range of goods and promotions adapted to the global marketplace and clients, as well as scientific studies on effectiveness, are produced, the value might spread throughout Asia and into the rest of the globe in the future. Based on the rapid distribution of ginseng usage, a marketing plan including such innovative distribution advancement, products, layout, packaged foods, cost, product diversification, and so on should indeed be followed by significant investments in ginseng cultivation, new material improvement, safety and effectiveness, and development of new products.

### 7. Conclusion and Future Possibilities

Korean and American ginseng referred to as one of the most important Ayurvedic remedies in the United States (U.S), has been shown to increase energy, decreased blood sugar and cholesterol levels, relieve stress, induce relaxation, prevent diabetes (Type-2), and assist in the treatment of cancer, anorexia, hypertension, and sleeping problems (insomnia) according to traditional medicinal systems including such Chinese and Ayurvedic healthcare. Asian ginseng, also known as *Panax ginseng* or Korean ginseng, is the most widely typically consumed kind of ginseng. Different innovations and collection

procedures are being explored. Among the approximately 200 phytochemicals discovered are saponins, glycosides, polysaccharides, polyacetylenes, phytosterols, amino acids, vitamins, volatile oils, and enzymes. The most advanced anticancer, anti-inflammatory, antibacterial, and antioxidant pharmacological activities, and clinical studies, are addressed. Ginseng has anti-inflammatory, anti-obesity, antifungal, antibacterial, antiviral, immune-boosting, and antioxidant properties. To improve bioavailability and concentrate drug administration, a novel formulation of phytosome nanocapsule particles for cancer, inflammation, and neurological illnesses was established. It may be determined that emphasizing the herb in current pharmaceutical companies' research and manufacturing in both national and international agencies would be advantageous and successful in reducing the detrimental effects of supertonic ginseng.

The major purpose of this review was to understand the concept and to summarize the content analysis of ginseng varietal variations in terms of their beneficial properties. The primary purpose of *Panax ginseng* cultivar categorization has been to place a greater focus on those with red ginseng dependability, adequate health features, disease resistance, and high saponin content. As an outcome, various cultivars have been created that address common concerns faced during ginseng root growth, reduce biological effects, and reinforce important active components. Furthermore, this study will assist viewers in identifying and comprehending the varieties of ginseng that are most appropriate for a better quality of life. Existing cultivars' characteristics can be improved in the future, and new *Panax* varieties can be developed by inter- or intraspecific hybridization.

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