Physical Education, Health and Social Sciences

https://journal-of-social-education.org E-ISSN: 2958-

P-ISSN: 2958-

Medicinal and Pharmacological activities of Ginseng

Muhammad Yasin[1], Muhammad Talha Khalil[2], Momina Iftikhar[2], Muhammad Akram[2]

[1]Department of Biological Sciences, Superior University Lahore
[2]Department of Eastern Medicine, Government College University Faisalabad Pakistan

Corresponding Author: Dr. Muhammad Akram
Department of Eastern Medicine, Government College University Faisalabad, Pakistan
Email: muhammadakram@gcuf.edu.pk

DOI: https://doi.org/10.63163/jpehss.v3i3.552

Abstract:
Ginseng, a widely utilized medicinal herb in traditional Eastern medicine, is renowned for its diverse pharmacological properties. The primary phytoconstituents responsible for its therapeutic effects are ginsenosides, a class of triterpenoid saponins, along with polysaccharides, flavonoids, peptides, and polyacetylenes. These bioactive compounds contribute to ginseng's adaptogenic, antioxidant, anti-inflammatory, immunomodulatory, neuroprotective, and anticancer activities. Ginsenosides, particularly Rb1, Rg1, Rg3, and Rh1, interact with multiple cellular signaling pathways such as MAPK, PI3K/Akt, and NF-κB, influencing processes like apoptosis, cell proliferation, and cytokine production. Ginseng polysaccharides enhance immune function by stimulating macrophage activity and increasing the secretion of interleukins and interferons. Moreover, ginseng improves cognitive function, regulates blood glucose levels, supports cardiovascular health, and exhibits protective effects against neurodegenerative diseases. Its pharmacodynamics involve modulation of neurotransmitter release, receptor sensitivity, ion channel activity, and enzyme inhibition. The herb's multifaceted mechanisms of action reflect its potential as a complementary therapeutic agent in modern medicine. Current research supports its efficacy in managing conditions such as diabetes, cancer, cardiovascular disorders, and neurological dysfunctions. However, variations in ginseng species, extraction methods, and dosage necessitate further standardized studies to ensure its clinical safety and efficacy. Ginseng continues to be a focal point of phytopharmacological research with expanding global relevance.

Keywords: Ginsenosides, Pharmacodynamics, Neuroprotection, Immunomodulation, Antioxidant activity

Introduction

Ginseng has long been used as a medicinal herb in China, Korea, and Japan. Approximately 7000 logical papers in PUBMED attest to the fact that ginseng research is a hotspot in the field of examination. Ginseng is a deciduous plant in the Araliaceae family. (Farley et al.,2022)Quinquefolius panax and Panax ginseng are important varieties of ginseng, and the roots of this plant are used mostly for their healing properties. Many ginseng studies over the past few decades have focused on the metabolomics and digestion of ginseng or its active ingredients using the most recent advancements in bioanalysis. Up to now, over 200 ginsenosides and non-saponin components have been isolated and identified. (Han et al.,1992)

The development of ginseng analysis from a variety of perspectives has been aided in recent decades by the rapid advancement of logical advances. In several countries around the world, ginseng has been used as a dietary supplement. (Ichim et al.,2021)Ginseng is one of the top ten homegrown plants in the United States in 2003, and it's best utilized to improve nutrition. For instance, P. ginseng, also known as red Korean ginseng, is used mostly to make chocolate, tea granules, nectar with cut-protected roots, jam, and confections.

Similarly, ginseng that was under five years old was approved for use as a food source in China in 2012, which increased its production and uses. (Riaz et al.,2019)The two most generally recognized varieties of ginseng worldwide are Chinese ginseng (Panax notoginseng) and American ginseng (Panax quinquefolius). Instead than using whole ginseng extract to treat various ailments, several studies focus on analyzing specific ginsenosides.

Phytochemistry

Because ginsengs are so near to bioactive combinations, their wide variety and pharmacological properties are recognized. Vital ginsenosides, such as steroidal saponins that have conjugated with different sugar polysaccharides and moieties, make up around 10 to 20 percent of the weight of ginseng. Overall, ginseng's potential applications appear to be associated with immunostimulatory, calming, and cell-reinforcing exercises. Ginseng's therapeutic development and the effects of its ginsenosides on the cardiovascular, anti-diabetic, anti-cancer, and focused sensory systems, among other systems. There is evidence of the immune-modulatory and preventive benefits of American ginsengs on severe respiratory diseases.

for instance, the C-3 and C-20 locations are joined by glucose, rhamnose, xylose, and arabinose. Ginsenosides are referred to by the term Rx, where r stands for the plant's roots and X for the chromatographic extremities in a sequential order request. For example, the polar component of this plant is rb, and ra is less polar than rb. About 30 ginsenosides have been identified and classified into two classes: two-s protopanaxadiol, which includes rb1 to rb3 and additional compounds like Rs1, Rh2, Rg3, Rd, and Rc, and protopanaxatriol, which includes re, rg2, rg, rf, and rh1. The carboxyl grouping at the carbon 6 position in protopanaxadiol is what separates it from protopanaxatriol.

Additionally, certain rare ginsenosides have been identified, such as (3,28-o-bisdesmoside), the pentacyclic saponin oleanane ro, and f11 saponin ocotillol (r-24-pseudo-ginsenoside). It's still unclear how perfect and altered Gnsenosides are absorbed and transferred to the human body. Ginsenoside transport over the intestinal mucosa is non-saturable and vitality subordinate. Although the plant has a variety of fixes, ginsenosides play a more important role in the application of pharmacological activity than some of the other elements. Less than 10 records for the majority of the ginsenoside substances out of the astounding number of ginsenosides found in P. ginseng. In particular, the foundations of crude ginseng are often rich in ginsenosides rb1, rb2, rc, rd, re, rf, and rg1.

Oxidation, hydrolysis, and dehydration, for instance, result in the creation of artificial mixtures that frequently have improved natural workouts. Furthermore, ginsenosides that are taken orally undergo biotransformations in the gastrointestinal system, and certain metabolites that are produced by microbes differ structurally from ginsenosides that occur naturally. The auxiliary features of over 100 ginsenosides have been grouped here. C3 and C20 are the sugar moiety of dammarane-type ginsenosides found in proto-panaxadiols. The coupling between acylation and the glycosyl chains at the 6-hydroxyl group occurs in the terminal glucose of a 3-sugar chain. Among the structures identified in this group are rb1 through rb3 as well as rh2, rg3, rd, and rc.

Protopanaxadiol, which is characterized by the accumulation of Rb, is found in over thirty ginsenosides. Dammarane-type proto-panaxatriol ginsenosides combine with Rf, Re, Rg1, Rg2, Rh1, F1, and F3 ginsenosides but not with R1 ginsenoside. In any event, the protopanaxatriol moiety differs from protopanaxadiol due to a hydroxyl branch at carbon 6.

Two chains of glycosyl and a straight linking chain of saccharide are the two main features of protopanaxatriol structures. The ginsenosides Rb1, Re, Rd, Rg1, and Rb3 comprise more than 70% of the ginsenoside absolute content in AG and are regarded as the six major saponins. Another significant component is oleanolic corrosive, which has a penta-cyclic triterpene structure. Ginsenoside Ro is its subsidiary.

Finally, it is important to include ocotillol with a 5-membered epoxy ring at Carbon 20. The pseudo-ginsenoside f11 disconnected ocotillol type panaxoside is derived from AG's leaves and roots. AG includes A.A., phenolic mixtures, terpenes, nutrients, flavonoids, volatile oils, and minerals in addition to polysaccharides and saponins. According to a study led by Kochan et al., using trans-anethole as an elicitator can increase the amount of triterpene saponins in AG's shaggy root communities.

Pharmacology

The broad range of ginsengs and their pharmacological activities is acknowledged due to their close proximity to bioactive mixtures. Almost 10 to 20 percent of the weight of ginseng is made up of vital ginsenosides, such as steroidal saponins that have conjugated with various sugar polysaccharides and moieties. All things considered, the possible uses of ginseng seem to be linked to immunostimulatory, relaxing, and cell reinforcement workouts. The clinical development of ginseng and the impact of its ginsenosides on several systems, including the cardiovascular system, anti-diabetic, anti-cancer, and focused sensory system. American ginsengs' immune-modulatory and preventative effects on severe respiratory illnesses have been documented.

Focal sensory system & their impacts

Ginseng has a maturing effect on sickness associated with neuro-degenerative problems and issues connected to the focus sensory system. Ginsenosides are thought to have a significant influence on jobs. Numerous studies have looked at the protective effects of rb1 genocides, rg1, rg3, rd, and re on neuro-degeneration in both animals and cell neuronal communities. Further research reveals that the sublingual vein infusion of ginsenosides rg3 at a dose of 5 mg/kg had a significant neuro-protective effect on rodents with cerebral central ischemic demage-related issues, lowering neurological deficiency scores, reducing territory infarct, and improving cerebral blood flow.

At the same time, Rg3 may alleviate the declines in gsh, px, and SOD exercises as well as the rise in MDA levels brought on by cerebral ischemia. It is suggested that Rg3 functions by reducing peroxide lipids, scavenging free radicals, and enhancing mitochondrial vitality digestion (140005D).

Cardiovascular exercises

In the United States, American ginseng is a well-known home-grown remedy for cardiovascular disease sufferers. Following the use of ginseng American, certain anti-ischemic, antiarrhythmic, and anti-hypertensive effects have been seen. The pharmacological effects that may be obtained from the herb's cell-reinforcing properties might be Exercises for cancer prevention and the relationship between compound structure and cardiovascular-ensuring capabilities have been assessed. Compared to Asian ginseng root, American ginseng extracts had a more firmly established cancer preventive agent movement.

American ginseng root or berry has been shown to have both protective and cancer-preventive effects on purified cardiomyocytes by activating the Nrf2 pathway and upregulating peroxide detoxification mechanisms. One of the key experts in cell reinforcement, ginsenoside re, protected cardiomyocytes by looking for hydroxyl and hydrogen peroxide radicals.

Antidiabetic impacts

Type 2 diabetes, which accounts for over 90% of all instances of diabetes, is characterized by dispersed fat and carbohydrate breakdown brought on by insulin resistance and impaired insulin release. Both Asian and American ginseng are significant, and their roots have hypoglycemic effects in diabetic mouse models. We demonstrated that after twelve days of treatment with berries and ginseng American leaf, one of the key mice models used for ob/ob, decreased the level of fasting blood glucose, improved the transfer of glucose, and decreased body weight. When it came to suppressing the accelerated accumulation of glycation end products in the kidney of diabetic rodents, warmed American ginseng exhibited more established effects than natural ginseng.

Ginsenoside rh2 causes the expanded discharge of acetylcholine from nerve terminals, stimulating the muscarinic m3 receptors in the cells of the pancreas and lowering plasma glucose levels in wistar rats. By modifying the Akt/Foxo1/PDX-1 flagging pathway and regulating cell cycle proteins, Rh2 may restore the impaired cell's capacity for development and suppress its inclination for apoptosis. Rg3 enhanced islet cell function and reduced cytokine-induced damage associated with nitric oxide production and death in islets in a comparative study (129). Triglycerides, cholesterol, glucose plasma, and NEFA levels may all be reduced by 20.7%, 41.6%, 20.2%, and 24.6%, respectively, with an oral potassium dosage of 25 mg/kg.

Cancer& their chemoprevention

American ginseng and its key components have further pharmacological effect in malignant growth, chemoprevention, and tumor formation suppression. The American ginseng supplement enhanced the chemopreventive effect of fluorouracil-5 in human colon cells, suppressed the chromosomal variation in mice caused by mitomycin C, enhanced malignant growth-related fatigue in the laboratory, and provided radioprotective potential in healthy individuals' lymphocytes.

Anticarcinogenic Effects

Through a variety of components of action, ginsenosides, a significant and vital component of ginseng, have been shown to have anti-carcinogenic effects against a few malignant growth types when treated in vitro and in vivo. While some showed promising clinical results, others were used to combat malignant growth products on the market. Compared to ginseng red, ginseng's saponin rough portion demonstrated more robust in vitro cytotoxic activities against ACFIN, 15-HCT, and PC-3 cell lines, with IC50 values ranging from 60.3 to 90.8 g/mL.

Anti-Inflammatory& immune-modulatoryeffects:

According to a recent study, dark ginseng exhibited more calming, grounded effects than ginseng red in mice's xylene-induced ear oedema model and rodents' carrageenan-induced oedema; it inhibited the professional cytokines fiery, interleukin 1 & 6, and tumor rot factor (TNF-), as well as nitric oxide synthase inducible and two cyclo-oxygenase. Furthermore, following treatment with dark ginseng extract, the lipopolysaccharide-induced TNF-discharge was significantly reduced. Additionally, it has been shown that dark ginseng has a subordinate recouping effect against the induced cisplatin nephrotoxicity and the reduced reasonability of (pig cell LLC-PK1) cells. Furthermore, compound potassium may completely reverse the increased number of apoptotic LLC-PK1 cells in a test that is similar.

Hepato-protective Effect

Ginseng dark has a strong hepatoprotective effect on acetaminophen-actuated mice, as evidenced by the reduction of serum amino-transferase aspartate transaminase (AST) and lipid peroxidation alanine by liver damage item malondialdehyde (MDA) fundamentally, while increasing the levels of cell reinforcement in the liver tissues, including glutathione, p450 e1

cytochrome, and hydroxynonenal 4(4-HNE). Additionally, ginseng dark treatment separates ethanol, reduces the accumulation of lipid in the liver, and damages the muscle of diabetic mice by inducing AMP-enacted protein kinase.

Hostile to Obesity & Effects of anti-hyperlipidaemic:

Ginseng effectively removes and decreases the levels of complete cholesterol serum and low-density lipoprotein levels in the fat eating routine encouraged mice & in STZ-incited diabetic mice. Additionally, a significant reduction in triglyceride & non-esterified unsaturated fat (NEFA) levels with an expansion in high density level was observed in male hefty diabetic C57BLKS/J-db/db mice following treatment with ginseng. H2o and ethanol concentrates of ginseng dark reduce the accumulation of lipid through the guidelines of PPAR, C/EBP, and AMPK phosphorylation in 3T3-L1 cells with a more grounded movement for the ethanol extract. (Von et al.,2021)

Tonic Effect

The activity limit in rodents was increased by ginseng dark medications at a dose of 150 mg/kg. The amount of blood lactic acid was reduced, but the movement of citrate synthase in muscles was increased. Dark ginseng also increased muscle growth and could treat or reverse muscle misfortune associated with maturing by generating myoblasts with larger multinucleated myotubes and expanded breadth & thickness. The activity component is thought to be the initiation of Akt/mTOR/p70S6k hub. (Ugawa et al,1995)

Topical Uses

Dark-matured ginseng significantly reduced wrinkles in human fibroblasts at a 0.3g/ml convergence by increasing type I pro-collagen articulation levels and decreasing MMP-1 articulation levels. Additionally, it increased TIMP-2 outflow by up to 154.55% at 3 g/mL. However, it reduced MMP-2 and MMP-9 articulation levels to 45.15% and 66.65%, respectively, at 10 g/mL.

According to studies, Korean Red Ginseng (RG) protects skin from aging and wrinkles. It can also lessen the negative effects of sensitivity and atopic dermatitis. Privately owned ginseng radix rubra illustrated the reversal of diabetes and developing in mice in a creature model, exploring many rodent-related pathways and confirming

showed ginseng increased the skin's lipid and moisture content. Lipid and moisture content were greater in the oral controlled RGp group than in the benchmark group, and the differences were factually significant. Similarly, we could infer that on postoperative day 20, the lipid and moisture content as well as the skin's suppleness in wounded tissue were almost the same as those in normal skin by comparing it to normal skin tissue. On the other hand, there were no significant differences between the topically administered RGe bunch and those in the Vaseline group in terms of skin lipid, moisture content, or flexibility. It is believed that the moisture proportion was increased by the rapid effects of RG therapy on wound healing. (Buhse et al.,2005)

Gastrointestinal Systems

By reducing incendiary cells and oxidative burden in the throat, AG separate (fifty, hundred, and 200 mg/kg between) protected against oesophageal harm caused by reflux of oesophagitis; another study showed that AG (500 and 1250 mg/kg between) protected rodents from the mucosa of gastric harm caused by an incessant ethanol admission. (Li et al.,2020)

Hostile Properties of ageing

There were no controlled clinical preliminary studies on the effects of Ag in the future. Numerous investigations have been conducted on the ordered and natural aspects of maturing

and their relationship to the avoidance of AG's cancer agent features. 2.25g/kg for 14 days of AG is thought to protect against premature ovarian failure (POF), and the loss of ovarian capability before the age of 40 is a sign of accelerated maturation. According to that review, AG prevented POF via controlling prostaglandin production, ovulation, and ovarian maturation. (Demarble et al.,2014)

Conclusion

Ginseng has long been a pillar of herbal medicine, celebrated for a spectrum of health benefits linked to its complex chemistry. Key constituents such as ginsenosides, polysaccharides, peptides, and polyacetylenes underlie its adaptogenic, neuroprotective, immunomodulatory, antidiabetic, and anticancer actions. Evidence suggests that ginseng influences multiple molecular pathways, fine-tunes hormone secretion, and enhances antioxidant defenses. Growing scientific interest reinforces its candidacy for inclusion in contemporary therapies. Nonetheless, rigorous clinical and molecular investigations remain crucial to confirm its effects, establish safety parameters, and achieve consistent dosing guidelines. As research advances, ginseng stands out as a versatile, naturally derived resource for supporting health and managing diverse disease states.

Declarations

Availability of data and material: All data generated or analyzed during this study are included in this published article. Further information is available from the corresponding author upon reasonable request.

Competing interests: The author declares no competing interests.

Funding: No external funding was received for the preparation or publication of this manuscript.

Authors' contributions: Muhammad Akram conceived the study, conducted the literature review, and wrote the manuscript. The author read and approved the final version of the manuscript.

Acknowledgements: The author gratefully acknowledges the support of the Department of Eastern Medicine, Government College University Faisalabad, for providing academic resources and institutional guidance.

References

Buhse L, Kolinski R, Westenberger B, Wokovich A, Spencer J, Chen CW, Turujman S, Gautam-Basak M, Kang GJ, Kibbe A, Heintzelman B. Topical drug classification. International journal of pharmaceutics. 2005 May 13;295(1-2):101-12.

Demarble JB, Moskowitz DS, Tardif JC, D'Antono B. The relation between hostility and concurrent levels of inflammation is sex, age, and measure dependent. Journal of psychosomatic research. 2014 May 1;76(5):384-93.

Farley, K., 2022. Wild Roots: Ginseng, Conservation, and Nature in the Appalachian South (Doctoral dissertation, Washington University in St. Louis).

Han BH, Park MH, Han YN. Chemical and biochemical studies on non-saponin constituents of Korean ginseng. Journal of Ginseng Research. 1992;16(3):228-34.

Ichim MC, de Boer HJ. A review of authenticity and authentication of commercial ginseng herbal medicines and food supplements. Frontiers in Pharmacology. 2021 Jan 11;11:612071.

Li C, Yu W, Wu P, Chen XD. Current in vitro digestion systems for understanding food digestion in human upper gastrointestinal tract. Trends in Food Science & Technology. 2020 Feb 1;96:114-26.

Riaz M, Rahman NU, Zia-Ul-Haq M, Jaffar HZ, Manea R. Ginseng: A dietary supplement as immune-modulator in various diseases. Trends in Food Science & Technology. 2019 Jan 1;83:12-30.

Ugawa Y, Terao Y, Hanajima R, Sakai K, Kanazawa I. Facilitatory effect of tonic voluntary contraction on responses to motor cortex stimulation. Electroencephalography and

Clinical Neurophysiology/Electromyography and Motor Control. 1995 Dec 1;97(6):451-4.

Von Dentz M, Gambato G, Ferrari A, Fontana RC, Rodrigues E, Salvador M, Camassola M, Jahn MP. Antihyperlipidemic effect of the hydroalcoholic extract of Basidiomycete Pycnoporus sanguineus (Fr.) Murr. in streptozotocin-induced diabetic rats. Advances in Traditional Medicine. 2021 Sep;21(3):453-61.