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Therapeutic Roles of Goji Berry and Ginseng in Traditional Chinese

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ABSTRACT

Background: Goji berries (Lycium barbarum), widely used in traditional Chinese medicine, can be applied as a dietary supplement. They are classified as nutraceutical food due to their long and safe traditional use. Ginseng has been increasingly used in the last decades and has become well known for its significant role in preventing and treating many diseases. **Methods:** The keywords of Goji berry, Ginseng, Traditional Chinese medicine were searched in Google Scholar, Scopus, Research Gate, and PubMed in both English and Chinese languages. **Results:** Goji berry significantly inhibited the generation and spread of cancer cells, improved eyesight, and increased reserves of muscle glycogen and liver glycogen, which may increase human energy and has anti-fatigue effect. Usage of Goji berries improved brain function and enhanced learning and memory. It had positive effects on anti-cancer, anti-oxidant activities, retinal function preservation, anti-diabetes, immune function, and anti-fatigue. Pharmacological activities of ginseng extracts affected the central nervous system, antipsychotic action, tranquilizing effects, protection from stress ulcers, increase of gastrointestinal motility, anti-fatigue action, endocrinological effects, enhancement of sexual behavior, acceleration of metabolism, or synthesis of carbohydrates, lipids, RNA, and proteins. In Traditional Chinese Medicine, ginseng helps to maintain a healthy immune system. **Conclusions:** In this review article we found that Goji berries and Ginseng were sources of compounds with valuable nutritional and bioactive properties. Therefore, they could be incorporated into foods with functional properties. More clinical studies are necessary to uncover the numerous substances and their effects in goji berries and ginseng that contribute to public health.

Keywords: *Goji berry; Ginseng; Traditional Chinese medicine*

Introduction

Goji, also called wolfberry, has been used as traditional medicinal foods in China and other Asian countries for centuries (Potterat, 2010). They are very hard, spiny, and shrubby vines in the tomato-nightshade family *Solanacaea*. Goji berry has different vernacular names; its most common name is wolfberry, which comes from “gou” meaning wolf. The name "goji" is an extrapolation

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of a number of native words, originally coined in 1973 by researchers at the Tanaduk Botanical Research Institute (Amagase and Farnsworth, 2011). Goji plants are native to China, where they are grown from the subtropics in the South to the cold dry climate on Inner Mongolia. Commercial fruit production is concentrated near Inner Mongolia. The fruits are red like a tomato with a green calyx near the stem. Seeds are small and edible, similar to tomato seeds. Flowers have a purple color, which fades to yellow (Amagase, 2014, Amagase and Farnsworth, 2011). Goji berry belongs to division of Magnoliophyta, class of Magnoliopsida, order of Solanales, family of *Solanaceae*, and Genus of *Lycium*. Goji berry or wolf berry is the common name of the fruits *Lycium barbarum* or *Lycium chinese*, which are two closely related species (Redgwell *et al.*, 2011). The genus *Lycium* (*Solanaceae*) consists of about 80 species found worldwide in arid to semi-arid environmental conditions (Huang *et al.*, 2015). The main centers of diversity for this genus are distributed between Argentina and Chile, Southern Africa and Southwestern North America (Miller *et al.*, 2008). *L. barbarum* and *L. chinese* have been domesticated and widely cultivated in Northwest China for more than 600 years. *L. ruthenicu* is endemic to northwestern China and is regarded as a potential plant to control erosion because of its high salt-tolerance (Chen *et al.*, 2013). Currently, Romania has the biggest cultivated area of *L. barbarum* plants in the European Union (Mocan *et al.*, 2018). Goji plant can handle a wide range of conditions (Patsilinakos *et al.*, 2018). They prefer a moderately moist, well-drained soil, but they are also fairly drought tolerant. The berries will produce and ripen the best in full sun. The ancient Chinese have identified 11,146 medicinal species from 383 families and more than 400 of which are widely used throughout the world (Shahrajabian *et al.*, 2018). Panax ginseng (Giseng) is a well-known herb in traditional Chinese medicine (TCM) (Li *et al.*, 2017). Panax means cure for all diseases, since it combines the Greek words "pan" meaning all and "zxos" meaning medicine (Jeong *et al.*, 2012). In TCM, it is believed that food and medicine come from the same origin, but with different uses and applications (Chan *et al.*, 2010). Therefore, it is common for Chinese people to incorporate different TCM herbs into their diet to produce various healthy food recipes to achieve better taste, more attractive appearance, improved texture of the food, and most importantly improved health (Guo *et al.*, 2008).

Materials and Methods

This review article included randomized control experiments, review articles, as well as observational and analytical study designs, which have been surveyed in Google Scholar, Scopus, Research Gate, and PubMed using keywords including "Goji berry, Ginseng, Traditional Chinese Medicine, and Sustainable Agriculture". All relevant papers in English and Chinese were searched. All authors screened the articles by reviewing the titles, abstracts, and whole manuscripts.

Results

Goji berry as a super-food and super-fruit in Traditional Chinese Medicine and Modern Industry: Himalayan people were the first healers who recognized the power of Goji Berry and utilized berries of the Goji vine that flourished in valleys of the Himalayas for thousands of years. Some sources state that wolf berries have been used in TCM for at least 2000 years (Williamson *et al.*, 2013). From a TCM point of view, the nature of Goji berry is calm and its flavour is sweet. According to TCM theory and practice, Goji berry can act on both the liver channel and kidney channel. Moreover, the major health benefits of Goji berry include its ability to nourish and tonify liver and kidney (Cieślik and Gębusia, 2012). It should be noted that Goji berry is used not only as a drug in TCM prescriptions to treat diseases but also as a popular food by Chinese people in their daily life for promotion of general health. According to the regulations of the China State Food and Drug Administration, Goji berry is one of the 87 TCM ingredients that can be used as both normal and functional foods (Bucheli *et al.*, 2011, Fiorito *et al.*, 2019). One theory about origin of the

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wolfberry stems from a speculation saying that Chinese farmers saw wolves sheltering among the dense Goji berry vines and called them so. Most of the world's Goji berry production centers are around areas in Northwestern China, where 200,000 acres of farmland are dedicated to Goji berry cultivation. Goji berry plantations can also be found in Inner Mongolia and Shaanxi (Zhu *et al.*, 2016). Goji berries provide eight essential amino acids that the body cannot synthesize. One of the most important reasons for popularity of Goji berries is the fact that they contain a high concentration of an antioxidant called Zeaxanthin. According to various studies, a diet containing Goji berries can increase a person's Zeaxanthin levels by 26 percent. Goji berry is frequently added to soups, hot pots, and herbal teas. It is also popularly soaked in wines alone or together with other TCM ingredients to make functional wines (Zhang *et al.*, 2015). Tang and Giusti reported that the fruit, known as black Goji is popular in TCM. On the basis of TCM view, Goji berry is mainly used in treating yin deficiency in liver and kidney. Dried Goji berry is commonly used in TCM preparations at a dose of 6-15 g, taken twice or thrice daily (Liu *et al.*, 2004). This fruit can also be a part of a mix of Chinese herbs are ground as a fine powder and used in honey pills (a TCM formulation in which honey is used as the main excipient to make pills) of 15 g each. Goji berry is one of the most popular TCMs regulated as a foodstuff that is used in nutricosmetic products in China. Nutricosmetics are used for the promotion of skin and hair health. Only angelica and pearl powder are more frequently found in nutricosmetic products in China (Bucheli *et al.*, 2011). Wojcieszek et al. reported that compounds identified in Goji berries are most likely to be responsible for better bioaccessibility of elements like copper and zinc to the human organism (Wojcieszek *et al.*, 2017). The berries are also used in traditional Korean medicine, traditional Japanese medicine, and traditional Tibetan medicine (Cho *et al.*, 2016). Goji Berry root bark is used for treating inflammation and certain skin diseases. Song et al. concluded that *L. barbarum* and its taurine component are valuable medicinal herbs for preventing diabetic retinopathy (Song *et al.*, 2011). Goji berries can provide almost twice vitamin A that a person needs in a day (Liu *et al.*, 2018). It has almost a third of the daily recommended vitamin C. Moreover, Goji berries are rich in some important and essential minerals including iron and potassium. Potterat and Endes et al. reported that this crop includes essential oils, vitamins (A, A, and C), amino acids, mineral elements (K, P, Ca, Mg, Fe, and Na), and betaine (Endes *et al.*, 2015, Potterat, 2010). Donno et al. mentioned that Goji berry is identified as a rich source of antioxidant compounds with health promoting properties comparable with other common fruit species. Recent studies have shown that antioxidant activities of some natural products are correlated with defense against oxidative stress and different human diseases including cancer, arteriosclerosis, and aging process (Donno *et al.*, 2015). Nutritional value compounds of Goji are very diverse, including polysaccharides, carotenoids, polyphenols, essential oils, betaine, vitamins, amino acids, and oligo elements (Forino *et al.*, 2016). Goji berries are rich in sugars (Montesano *et al.*, 2016) and lipids (Blasi *et al.*, 2017). Wojdylo et al. indicated that Goji carotenoids is natural, has nontoxic colorants to be used in drinks and cosmetics, and shows biological activity; for example, they act as antioxidants or precursors of vitamin A (Wojdyło *et al.*, 2018). Xie et al. reported that *Lycium Barbarum* could be utilized as pharmaceutical for treatment and also as an ingredient in Chinese cooking (Xie *et al.*, 2016). Cheng et al. reported that Goji berries have long been used to promote fertility as potent anti-aging and antioxidant agents. Goji berries are rich in ascorbic acid (approx. 42 mg/100 g) (Llorent-Martínez *et al.*, 2013) , thiamine, riboflavin, and vitamins E, B1, B2, and B6 (Wojdyło *et al.*, 2018). Furthermore, Goji berries contain carbohydrates (arabinose, rhamnose, xylose, galactose, mannose, and glucose) (Montesano *et al.*, 2016) organic acids (malic acid, citric acid, shikmic acid and fumaric acid) (Mikulic-Petkovsek *et al.*, 2012), and many minerals (potassium, sodium, phosphorus,

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magnesium, iron, calcium, zinc, and selenium) (Llorent-Martínez *et al.*, 2013, Nile and Park, 2014). Goji berries are also comprised of fatty acids (hexadecanoic acid, linoleic acid and myristic acid) (Blasi *et al.*, 2017) and amino acids (proline, betaine and taurine) (Potterat, 2010). Yun et al. indicated that the contents of nutritional components were significantly different in different tissues (Yun, 2001). The ratios of essential amino acids/total amino acids and ratios of essential amino acids/non-essential amino acids for the leaf, pollen, and flower were all higher than the criteria provided by FAO/WHO. The pollen and fruit contained highly unsaturated fatty acids. All tissues were good sources of mineral elements, polysaccharides, and phenolic compounds. Furthermore, they found that Ningxia wolfberry pollen, leaf, and flower can be a potential resource of nutrients for humans and animals. It is also effective on aging, increased metabolism, immune system, liver function, and glycemic control (Silva *et al.*, 2017). Soares deSousa et al. (Soares deSousa *et al.*, 2016) noted that Goji was rich in vitamins and minerals that protected the central nervous system, reduced the risk of glaucoma, had antitumor activity, prevented chronic diseases such as hypercholesterolemia, diabetes, and hepatitis reduced fatigue, caused greater resistance in exercise, and had a strong effect on prevention of aging. It has been found that flavonoids from wolf berries protect the blood cells and mitochnodria against oxidative damage (Luo *et al.*, 2004). Jin et al. demonstrated that *L. barbarum* polysaccharides have various important biological activities, such as antioxidant, immunomodulation, antitumor, neuroprotection, radioprotection, anti-diabetes, hepatoprotection, anti-osteoporosis, and antifatigue (Jin *et al.*, 2013). Masci et al. also concluded that the purified components of Goji berry may be potentially useful as adjuvants in treating diabetes and its correlated illnesses. Wolfberry polysaccharides were reported to have antioxidant activity in vitro (Masci *et al.*, 2018). A glucopyranoside and phenolic amides isolated from wolfberry root bark have also been found to have an inhibitory activity in vitro against human pathogenic bacteria and fungi. A human supplementation trial showed that daily intake of wolfberries increased plasma levels of zeaxanthin (Hempel *et al.*, 2017). On the contrary, clinical studies conducted by regulatory authorities showed that studies conducted in the West were not scientifically verified. Some health benefits of Goji berry include boosted immune system and flu protection, potential weight loss aid, antioxidants for eyes and skin, balanced blood sugar, and increased testosterone. It also helps to restore body homeostasis and strengthen the body energy (Protti *et al.*, 2017). The findings of Pehlivan Karakas et al. study shows that the methanol extract of *L. barbarum* has a significant effect on low levels of anxiety and depression like behaviors (Karakas *et al.*, 2016). Their results also indicate that females seem to benefit from the methanol extract of *L. barbarum* more than males in terms of anxiety and depression like behaviors as well as spatial learning behavior (Karakas *et al.*, 2016). Some researchers reported that the carotenoid profile of Goji berries was the subject of different reports; where, zeaxanthin-dipalmitate was confirmed as the major carotenoid of Goji berries (Fratianni *et al.*, 2018). Fratianni et al. mentioned that the dried samples of Goji berries could be used as a dietary source of carotenoid worthy for development and utilization. Dried fruits can be eaten raw, used in confectionaries or in bakery products, added to trail mix, cereals, muffins, energy bars, or soups (Rosa *et al.*, 2017). According to the findings, the dried fruits are red-orange, seeded, rich in vitamins of group B, C, E, contain 21 microelement including anticancer germanium (Llorent-Martínez *et al.*, 2013), 18 amino acids (8 of which the human body does not produce), and 4 irreplaceable polysaccharides that do not exist in food products. Goji berries contain not only high amounts of antioxidants, carotenoids, vitamin A, and zeaxanthin, but also rich in vitamins B and C and polysaccharides (Skenderidis *et al.*, 2018). In addition, flavonoids such as rutin, gentistic acid, and quercetin are the main active compounds present in the leaves of *Lycium barbarum* (Dermesonlouoglou *et al.*, 2018). *L. barbarum*

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extracts were proven to possess prosperity biological activities such as anti-ageing effects, and increased metabolism, antioxidant properties, anti-diabetes, glucose control, immunomodulation, anti-glaucoma, neuroprotection, anti-fatigue/endurance, cytoprotection, and antitumour activity (Potterat, 2010). Numerous studies indicated the powerful antioxidant potentialities achieved from *L. barbarum* molecules that promote various health protective effects (Abdennacer *et al.*, 2015). It is well documented that several traditional herbs and plant extracts have antioxidant properties and are potential candidates for the prevention and treatment of ROS-induced diseases (reactive oxygen species) (Leontopoulos *et al.*, 2017). Some researches indicated that components of berry fruits, especially Goji berry may inhibit virus replication both directly and indirectly, for example by blocking surface flycoproteins of influenza virus and stimulating immune system of the organism. As a result, berry fruits, such as Goji berry are raw materials of potential use in the prevention and treatment of influenza (Grazma-Michalowska *et al.*, 2017). The most important health benefits of Goji berry is presented in **Table 1**. Goji berries, dried nutrition facts, and analysis are represented in **Table 2**.

Micronutrients include the following:

- 11 essential and 22 trace dietary minerals
- 18 amino acids
- 6 essential vitamins
- 5 unsaturated fatty acids, including the essential fatty acids, linoleic acid, and alpha-liolenic acid
- Beta-sitosterol and other phytosterols
- 5 carotenoids, including beta-carotene and zeaxanthin (below), lutein, lycopene and cryptoxanthin, a xanthophyll
- Numerous phenolic pigments (phenols) associated with antioxidant properties

Goji berries also contain numerous phytochemicals like:

- Beta-carotene: 7 mg per 100 g dried fruit.
- Zeaxanthin. Reported values for zeaxanthin content in dried wolfberries vary considerably from 25 mg per 100 g to 200 mg per 100 g. The higher values make wolfberry one of the richest edible plant sources known for zeaxanthin content. Up to 77% of the total carotenoids present in wolfberry exist as zeaxanthin (Fratianni *et al.*, 2018).

Ginseng in traditional Chinese medicine: Traditional Chinese medicines originate in ancient China with a 5000-year history. They are rooted in ancient Eastern philosophies such as Taoism and focus on a holistic view between humans and nature. Through the observations of universal principles within the nature, TCM inquiries from a macro level into the microcosm of human physiology and the mutual relationships between our body's internal workings and the external environment (Cheung *et al.*, 2017). Traditional Chinese medicine is still commonly used in China. More than half of the population regularly uses traditional remedies, with the highest prevalence of use in the rural areas. About 5000 traditional remedies are available in China; they account for approximately one fifth of the entire Chinese pharmaceutical market. *P. quinquefolius* is used in TCM to treat deficiency conditions associated with symptoms such as fatigue, irritability, thirst, and dryness of the mouth and respiratory tract (Chen *et al.*, 2004). The most important common names of ginseng in different parts of world are American ginseng, finger root, sang, tartar root, red berry, man's health, root of life, dwarf groundnut, garantogen, jinshard, ninsin, little man, and garent-oquen. The name "ginseng" originates from the Chinese word "Jen Sheng" and means man herb because of the human-like shape of the root or rhizome of the plant. The word Panax means cure all and describes the traditional belief that ginseng has properties that heal all bodily diseases (Kim *et al.*, 2018). Currently, 14 plants including 12 species and two infraspecific taxa, have been classified under the genus Panax (Shin *et al.*, 2015). The three major commercial ginseng sorts are the Korean ginseng (*Panax ginseng Meyer*), the Chinese ginseng (*Panax notoginseng* (*Burk.*). *F. H.*), and the American ginseng (*Panax quinquefolius L.*), used worldwide as herbal

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medicines for thousands of years. Ginseng is also part of Sasang Constitution Medicine and Korean Oriental Medicine. Recent studies have shown that processing ginseng alters its chemical profile and may change its properties and pharmacological activities (Wan *et al.*, 2015). The origin of ginseng dates back to prehistory. In China, Shennong (Divine Peasant), is also known as Emperor Yan, the Yellow Emperor, one of the three Emperors, and the Emperor who is said to have started herbal medicine about 5500 years ago. Shennong tasted hundreds of plants to discover many medicinal herbs. As a result, 365 kinds of herbs were listed and divided into three classes according to their degree of toxicity (Yun, 2001). The superior ones are non-toxic and serve to reinforce vital energy, which can be taken regularly.

Bioactive phytochemicals of ginseng and their therapeutic roles: Panax ginseng constitutes of organic (80%-90%) and inorganic substances (approximately 10%) and consists of a number of active constituents, such as saponins or ginsenosides, carbohydrates, nitrogenous substances, phytosterol, essential oils, organic acids, amino acids, peptidoglycans, carbohydrate, nitrogen-containing compounds, fatty acids, vitamins, minerals, and other phenolic compounds (Beccaria *et al.*, 2018). Lakshmi et al. mentioned that the use of medicinal plant either as a single drug or in combination is helpful in the health of human being (Lakshmi *et al.*, 2011). Medicinal plants can be important sources of previously unknown chemical substances with potential therapeutic effect. They have shown that the main active components of *Panax ginseng* are ginsenosides, which have been shown to have a variety of beneficial effects. Ginsenosides are classified into two main groups known as protopanaxadiol (PPD) and protopanaxatriol (PPT), based on the hydroxylation pattern at C6 and attachment of sugar moieties (Pace *et al.*, 2015). Panax bioactive phytochemicals and their proven therapeutic roles are presented in **Table 3**.

Patel and Rauf also mentioned antioxidant, anti-inflammation, anti-fatigue, anti-diabetic, anti-tumor, immunomodulation, anti-obesity, cardioprotective, anti-microbial, neuroprotective, and aphrodisiac properties (Patel and Rauf, 2017). They introduced ginseng as a complementary and alternative medicine (CAM). Ginseng polysaccharides composed of starch-like glucan and pectin with pectin accounting for around 20% of water-soluble polysaccharides (Sun *et al.*, 2019). Ginsenosides are distributed in many parts of the ginseng plant including root, leaf, and berry (Kim *et al.*, 2014). Different parts of the plant contain distinct ginsenoside profiles, which may exhibit different pharmacological activities (Kim *et al.*, 2014). Shi et al. revealed that the leaf and root hair contain higher ginsenoside levels than the root (Shi *et al.*, 2007). Wan et al. concluded that the contents of malonyl ginsenosides, amino acids, and polysaccharides are ranked as fresh ginseng > frozen ginseng > white ginseng > stoved ginseng > red ginseng > black ginseng based on a decreasing order (Wan *et al.*, 2015). They also mentioned that more attention should be paid to processing to control the quality of ginseng products. A lot of studies were conducted on the pharmacological properties of Ginseng extract such as lipid-lowering, anti-allergic, anti-diabetic, anti-inflammatory, hypoglycemis and anti-stress, anti-aging, anti-diabetic, anti-carcinogenic, anti-fatigue, anti-adhesive, anti-depressive, hypocholesterolemic and hypolipidemic, hepatoprotective activities, immune-modulatory activities, improving working memory and perceptual systems, stimulation and inhibition of central nervous system, and inhibiting the growth of tumor cells, especially in female reproductive system (Balusamy *et al.*, 2019). Kim et al. confirmed use of Ginseng as an anti-oxidant supplement (Kim *et al.*, 2011). Kim et al. also found that *P. ginseng* might be a potential alternative medicine for the prevention and treatment of natural aging-induced osteoporosis in human (Kim *et al.*, 2018). Kuo et al. reported that glutamine and arginine were the two major free proteinogenic amino acids in the ginseng plants and constituted over 50% of all the free amino acids detected in the root (Kuo *et al.*, 2003). Uluisik and Keskin *Panax ginseng* root powder may be useful for hepatic

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damage and fibrosis associated with high cholesterol diet (Uluisik and Keskin, 2016). These beneficial effects of ginseng on liver enzymes are attributed to its active components knows as ginsenosides. Lee and Rhee reported potential use of ginseng in prevention and treatment of chronic inflammatory diseases such as diabetes, rheumatoid arthritis, and allergic asthma (Lee and Rhee, 2017). Qi et al. found that ginseng appears to be a promising radio-protector and is capable of attenuating the deleterious effects of radiation on normal human tissue, especially for cancer patients undergoing radiotherapy that might be associated with its anti-oxidation and immunomodulation properties (Wan *et al.*, 2015). Key points of Panax ginseg is shown in **Table 4**. Concentration of medical ingredients (Comparison of saponin in ginsengs of various sources) is shown in **Table 5**.

Table 1. The most important health benefits of Goji berry.

Helps to slow down the growth of cancer cells
Helps to improve gastrointestinal functions
Aids in improving eyesight and protects skin against UV rays
Effective in increasing semen quantity and improving sperm quality
Beneficial in reducing stress and fatigue
Reduces risk of cardiovascular diseases
Contains high level of anti-oxidant
Helps to protect liver against infections
Helps to reduce high cholesterol
Aids in controlling diabetes
Protects brain cells from damage
Help lower blood sugar level
Boosts immune system
Promote restorative sleep

Table 2. Goji berries, dried nutrition facts and analysis per serving.

Nutrients	Amount
Vitamin A	26822.00 IU
Vitamin C	48.4 mg
Carbohydrate	77.06 g
Fiber	13.0 g
Sugars	45.61 g
Fat	0.39 g
Saturated fatty acids	0.000 g
Fatty acids, total trans	0.000 g
Calcium, Ca	190.00 mg
Iron, Fe	6.80 mg
Sodium, Na	298.00 mg
Cholesterol	0.00
Ash	0.78 g
Water	7.50 g
Protein	14.26 g
Alanine	0.698 g
Arginine	0.722 g
Aspartic acid	1.711 g
Cystine	0.144 g
Glutamic acid	1.431 g
Glycine	0.304 g
Histidine	0.157 g

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Isoleucine	0.261 g
Leucine	0.456 g
Lysine	0.233 g
Methionine	0.087 g
Phenylalanine	0.271 g
Proline	1.000 g
Serine	0.498 g
Threonine	0.358 g
Tyrosine	0.222 g
Valine	0.316 g

Table 3. *Panax* bioactive phytochemicals and their proven therapeutic roles

Panax ginseng (Chinese ginseng) *Panax quinquefolius* (American ginseng)
Ginsenoside (Rb, Rc, Rd, re, Rf, Rg, Rh) Polysaccharides Oligosaccharides Saponins
• Anticancer effect • Protection against Diabetic retinopathy and cardiomyopathy • Neural stem cell proliferation • Attenuation of β-amyloid generation • Protection from ischemia-induced oxidative stress and apoptosis • Protection from impairment of hippocampal neurons • Attenuation of pathogen virulence factors production • Treatment of erectile dysfunction • Fatigue alleviation in multiple sclerosis • Prevention of atopic dermatitis and rheumatoid arthritis • Amelioration of high fat diet-induced obesity

Table 4. Key points about Panax ginseng.

Efficacy	• Psychologic functioning: effective; conflicting evidence • Physical performance: ineffective • Immune system: effective • Diabetes: modest effect; evidence limited
Adverse effects	Nausea, diarrhea, euphoria, insomnia, headaches, hypertension, hyptension, mastalgia, vaginal bleeding, blood pressure abnormalities
Interactions	Caution advised about concomitant use with phenelzie (Nardil), warfain (Coumadin), oral hypoglycemics, insulin, or caffeine, and about use in patients with hypertension or bleeding
Bottom line	A safe, well-tolerated herbal medicine that may be used for a variety of medical conditions

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Table 5. Concentration of medical ingredients (Comparison of saponin in ginsengs of various sources)

	Korean red Ginseng	Korean white Ginseng	Hwagi-sam (American ginseng)	Sanchi-sam (Chinese ginseng)	Bamboo-sam (Japanese ginseng)
Total kinds of saponin	30	23	14	15	8
Panaxadiols	18	15	9	6	6
Panaxatriols	11	7	4	9	4
Oleananes	1	1	1	-	1

Conclusion

Goji berry is used in food and culinary, Wolfberries have long played important roles in TCM, since they are believed to enhance immune system function, improve eyesight, protect liver, boost sperm production, and improve circulation among other effects. The northwest regions of China are among the main producing areas of *L. barbarum*, including Xinjiang, Tibet, Ningxia, Inner Mongolia, Qinghai, and Gansu. Currently, China is the major supplier of *L. barbaru* products in the world. In China, Goji berries are collected and prepared as a decoction or ground into a powder and mixed with other herbs. Goji berry is widely used as a functional food, mainly for its antioxidant action due to a high content of vitamin C. Anti-aging, antioxidant, immunomodulating, hypotensive, antimicrobial, antifungal, antiviral, anti-diabetic, neuroprotective, and anticancer properties have been associated with *L. barbarum*. In TCM science, it has been reported that this crop is good to improve eyesight and to strengthen the liver and kidney. L. barbarum contains polysaccharides, carotenoids, including zeaxanthin, vitamins, and flavonoids. The roots contain alkaloids, flavonoids, betaine, and vitamins E, B1, B2 and B6. Additionally, Goji berries are rich in ascorbic acid, thiamine, and riboflavin. Moreover, Goji berries contain carbohydrates such as arabinose, rhamnose, xylose, galactose, mannose and glucose, organic acids namely malic acid, citric acid, shikimic acid, and fumaric acid, and many minerals like potassium, sodium, phosphorus, magnesium, iron, calcium, zinc, and selenium. Now, Goji is enjoying the enormous popularity worldwide after it was made into Goji berry tea, bars, beer, cookies, cuttings, dessert, drinks, eye cream, extract, powder, essential oil, facial cream, face mask, jelly, smoothie, jam, muffin, supplement, tablets, and etc. Ginseng is known to possess various biological activities including boosting the immune system, improving the blood circulation, and enhancing memory, antifatigue effects, antioxidant effects, and causing positive effects on menopausal disorder. Ginseng contains saponing, an element of glycosides; nitrogenous compounds such as protein, amino acid, nucleic acid, and alkaloid; fat-soluble ingredients such as fatty acid, ethernal oil, polyacetylene, phenolic compound, phytosterol and terpenoid; sacchardies such as monose, oligosaccharide, polysaccharide and pectin; vitamins and inorganic substances; and many other useful ingredients. Ginsenosides are usually divided into three groups: (1) the PPD ginsenosides, (2) the PPT ginsenosides, and (3) the oleanonic acid-type saponins; five major ginsenosides, Rb1, Rb2, Rc, Re, and Rg1, which belong to the PPD and PPT types, constituting more than 80% of all ginsenosides. Several pharmacological activities have been reported for ginseng extracts including its effects on the central nervous system; antipsychotic action; tranquilizing effects; protection from stress ulcers; increase of gastrointestinal motility; anti-fatigue action; endocrinological effects; enhancement of sexual behaviour; acceleration of metabolism; or synthesis of carbohydrates, lipids, RNA, and proteins. All in all, this review article allowed verifying that Goji berries and Ginseng were sources of compounds with valuable nutritional and bioactive properties; therefore, they could be useful for incorporation into foods with functional properties. Goji berries and ginseng could also provide industrial

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sustainability and may be considered as organic superfood and superfruit in not only Asian countries but also western countries.

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Authors' contributions

This manuscript was suggested and conducted by Qi Cheng, Wenli Sun and Mohamad Hesam Shahrajabian conducted and wrote the review article and Qi Cheng supervised the findings of this research. All authors read the manuscript and confirmed it for publication.

Conflicts of interest

The authors declare no conflict of interest in this study.

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