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Short Review

Chinese onion, and shallot, originated in Asia, medicinal plants for healthy daily recipes

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Abstract

Shallot is an important part of diet of many populations and there is long-held belief in their health enhancing properties. Shallots, like onions, are a member of the Allium family, but their flavor is richer, sweeter, yet more potent. The most important benefits of shallots are high source of antioxidants, improve heart health, cancer prevention, diabetes, anti-inflammatory, antimicrobial, might help fight obesity, and help to prevent or treat allergies. Shallots are a rich source of flavonoid antioxidants such as quercetin and kaempferol. They contain sulfur antioxidant compounds such as diallyl disulfide, diallyl trisulfide, and allyl propyl disulfide. Shallots hole proportionately more concentration of vitamins and minerals than in onions, especially vitamin-A, pyridoxine, folates, thiamin, vitamin-C etc. Chinese onion has very complex nutritional composition and holds the better characteristics for its potential development as a food ingredient, source of antioxidant; it contains secondary metabolites such as flavonoids, particularly flavonols and anthocyanin, phytosterols and saponins. It is also one of the most important medicinal plant in Eastern Asia. It contains many vitamins and minerals and it is rich in sulphur amino acids. Chinese onion was found to possess a panoply of bioactive compounds and numerous pharmacological properties, including antimicrobial, antioxidant, analgesic, anti-inflammatory, anti-diabetic, hypolipidemic, anti-hypertensive and immune-protective effects.

Keywords: Chinese onion; health benefits; shallot; traditional herbal plants

Introduction

The traditional healer plants provide health care services based on religious background, knowledge, culture, attitudes and beliefs (Shahrajabian *et al.*, 2020a; Shen *et al.*, 2020; Sun *et al.*, 2020a,b). Both natural products and traditional medicines have great importance (Shahrajabian *et al.*, 2019a,b,c). Traditional medicine refers to health practices, knowledge, approaches and beliefs incorporating plants and herbs based on both ancient and modern pharmaceutical science (Ogbaji *et al.*, 2018; Shahrajabian *et al.*, 2019d,e,f,g; Sun *et al.*, 2019a,b). Traditional Asian medicine plays an important role in sustainable agriculture and food systems, it is also offers a holistic and significant approach to prevent diseases while making suitable usage of organic and

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herbal products (Soleymani and Shahrajabian, 2012; Ogbaji *et al.*, 2013; Ge *et al.*, 2018; Shahrajabian *et al.*, 2018; Soleymani and Shahrajabian, 2018; Sun *et al.*, 2019c; Shahrajabian *et al.*, 2020b,c).The aim of this review is survey on the most important chemical constituent, health benefits and medicinal usage of shallot and Chinese onion.

Shallot

Shallots (*Allium ascalonicum* L.) are a perennial crop that is grown as an annual for its cluster of small bulbs or cloves. Shallots are valuable spices for both flavoring dishes and as medicinal plants (Swamy and Veere Gowda, 2006). Shallot is a hardy member of the onion family that is famous for its delicate, meaty, onion-like flavor. Persian shallot, a bulb producing plant from Alliaceae, is wildly growing plant collected for its bulbs, and it is called Mooseer in Farsi, are oval, white skinned and completely different from common shallot (*Allium ascalonicum*) (Ebrahimi *et al.*, 2019). Persian shallot is native and endemic of Iran and grows as a wild plant across Zagross mountains at high elevations of different provinces from Northwestern to Southern of Iran with the climate of very cold to moderate cold (Moradi *et al.*, 2013). Shallot is a major component of many Asian diets and is widely believed to be beneficial to health (Jalal *et al.*, 2011). Tesfa *et al.* (2015) found that shallot can be a substitute where bulb onion does not do well, however, the production of shallot can be limited due to poor soil fertility, lack of improved production techniques, unimproved varieties and high post-harvest losses. Shallots are a unique vegetable that is used by domestic consumers as every day seasoning, raw materials of food industry, and medicine (Setyadjit and Sukasih, 2015). The most common diseases of shallots are downy mildew, bacterial soft rot and neck rot, and the most important insects are onion maggot and onion thrips. The benefit of shallot is as a source of carbohydrate, vitamin A, B, and C. 1-butene, 1-(methylthio)-(Z) (18.21%), methyl methylthiomethyl disulfide (8.41%), dimethyl tetrasulfide (6.47%), piperitenone oxide (4.55%) are the most abundant components of Persian shallot and comprised 37% of the essential oil. Ebrahimi *et al.* (2008) showed that Iranian shallot landraces are important in mineral elements and essential fatty acids content and are recommended for human nutrition. Sittisart *et al.* (2017) showed that shallots extracts contained some polyphenols such as apigenin, gallic acid, catechin, quercetin, kaempferol and tannic acid which are famous compounds possessing antifungal activity. Golubkina *et al.* (2019) indicated that shallot is an excellent candidate for the health-centered strategy of producing functional foods with high levels of Se and antioxidants; and the usage of arbuscular mycorrhizal fungi and selenium application represent environmentally friendly strategies to enhance the overall yield and quality performances of shallot bulbs. Fattorusso *et al.* (2002) reported two new furostanol saponins, named ascalonicoside A1/A2 (1a/1b) and ascalonicoside B (4), respectively, along with compounds 2a and 2b. Phaiphan *et al.* (2019) discovered that heating and shallot supplementation can massively improve the quality of apple juice. Yin *et al.* (2006) suggested the use of shallot and scallion oils in food systems which may enhance lipid and microbial stability. Raeisi *et al.* (2016) concluded that the application of 3% ajwain seed extract gave the best antioxidant and antimicrobial activities, as well as sensory, up to 15 days of storage, followed by 3% shallot fruit extract. Leelarungrayub *et al.* (2006) stated that organic solvent and aqueous extracts of garlic and shallot bulbs had significant antioxidant potential, as measured by decreases in free radicals and an ability to inhibit lipid oxidation. Wongmekiat *et al.* (2008) indicated the protective potential of shallot extract against CsA nephrotoxicity and suggest a significant contribution of its antioxidant property to this beneficial effect. Chen *et al.* (2011) have shown the potential of shallots for use in treating adenoviral infection activities. Krejcova *et al.* (2014) found that the important usage of Persian shallot for the treatment of inflammatory disorders. They have introduced 2-[(Methylthio)methyldithio] pyridine *N*-oxide with high anti-inflammatory effects. Falahati *et al.* (2011) indicated that crude juice of shallot has anti-candidal activity and might be promising in treatment

of candidiasis. Kongkaew and Phichai (2010) found that dried shallot powder, which was effective at inhibiting the growth of *Trichoderma* spp. isolated from Yanagi mushroom. Jalal *et al.* (2011) found that Iranian shallot extracts appear to improve learning and memory impairments in fructose-fed rats. Shallot can be a candidate for prevention and treatment of many diseases related to inflammation and malignancy. Leelarungrayub *et al.* (2004) indicated that hexane-extract shallot had very high activity on protecting the human erythrocyte from radicals and is possible to be modified for medical plants or commercial product in the future. Sadat Hosseini *et al.* (2017) found that the Persian shallot extract could be considered as a potential candidate for production of drug for the prevention or treatment of human hepatoma. Shallot crude juice has antifungal activity and looks promising to be an alternative for chemical antifungal agents that have sometimes serious effects. Rattanachaikunsopon and Phumkhachorn (2009) reported that shallot oil inhibits pathogenic bacteria including *Bacillus cereus*, *Camplobacter jejuni*, *Escherichia coli O 157:H7*, *Listeria monocytgenes*, *Salmonella enterica*, *Staphylococcus aureus*, and *Vibrio cholerae*. Farajii *et al.* (2018) stated that the shallot extract was preferred in both terms of reducing microbial growth and suitable sensory properties. Fresh crude juice of shallot bulbs has markedly anti-fungal effect, and also shallot extract has more anti-saprophytes effect at 0.25% followed by *C. albicans* and dermatophytes. Kazemian *et al.* (2017) noted that hydroalcoholic shallot extract increases the number of germ cells in mice tested and helps amplify the sexual ability of male mice. Shallot as traditional medicine are for febrifuge, diabetes, blood sugar and blood cholesterol, prevents thickening and hardening of the blood vessels and ulcers (Setyadjit and Sukasih, 2015). Setyadjit and Sukasih (2015) also reported that shallot powder is widely used as an industrial raw material such as in snacks production, seasoning in cooking, and medicine. Persian shallot has been reported to have a range of health benefits which include anticarcinogenic, hypoglycemic, hypolipidemic, antioxidant, antibiotic properties, kidney and liver protective effects (Moradi *et al.*, 2013). All in all, shallots have more antioxidants, minerals and vitamins than onions. They are a rich source of flavonoid antioxidants such as quercetin, kaempferol, etc. They contain sulfur antioxidant compounds as diallyl disulfide, diallyl trisulfide, and allyl propyl disulfide, which convert to allicin through enzymatic action following disruption of their cell surface while crushing, and chopping. Alicin reduces cholesterol production by inhibiting the *HMG-CoA reductase* enzyme in the liver cells. The phytochemical compounds allium and Allyl disulfide in eschalots have anti-mutagenic and anti-diabetic properties. Medicinal properties of Persian shallot are shown in Figure 1. The most important health benefits of shallots are indicated in Figure 2. Whole shallot plant is shown in Figure 3.

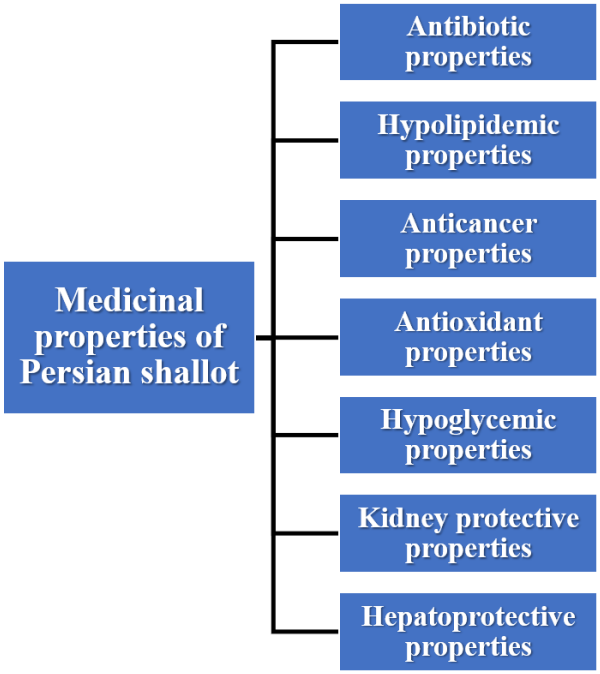

Figure 1. Medicinal properties of Persian shallot

Figure 2. The most important health benefits of shallots

Figure 3. Whole shallot plant

Chinese onion

Traditional medicinal science in Asia, as a stand origin of *Allium* plants, is one of the high-born therapeutic systems in terms of the various herbals and age (Asemani *et al*., 2019). *Allium* species are supposed to be ones of the world's oldest cultivated vegetable. Most of the edible *Allium* species are native to the mountains of central Asia. The economically most important *Allium* crop species (common onion and garlic) are worldwide use as species, vegetables, and medicinal plant; and traditionally, they pay important role in the daily diet in Asia (Teshika *et al*., 2018). Chinese onion (*A. chinense* G. Don), also known as oriental onion, is an ancient vegetable native to China (Yan *et al*., 2009; Wang *et al*., 2019). In China, its bulbs are constantly served as sweet or sour pickles after steeped in sugar and brine, and it is also common to cook with other ingredients to afford various featured Chinese cuisine (He *et al*., 2018). Bulbs are purplish or grayish white and covered by a semi-transparent, dry membranous skin. They have a crisp texture and a strong onion-like but distinctive odor, and the leaves of Chinese onion grow up to 50 cm long and resemble those of chives but are angular rather than round and less erect. Whole plant local Chinese onion is presented in Figure 4.

Figure 4. Whole plant of local Chinese onion

Phytochemical investigates on Chinese onion have led to the isolation of sulfur-containing compounds which responsible for its onion-like flavor, nitrogen-containing constituents, and steroidal saponins (Wang *et al.*, 2016). The plant-derived polyphenols from genus *Allium*, serve beneficial roles in humans. The most important health benefits of Chinese onion are shown in Figure 5.

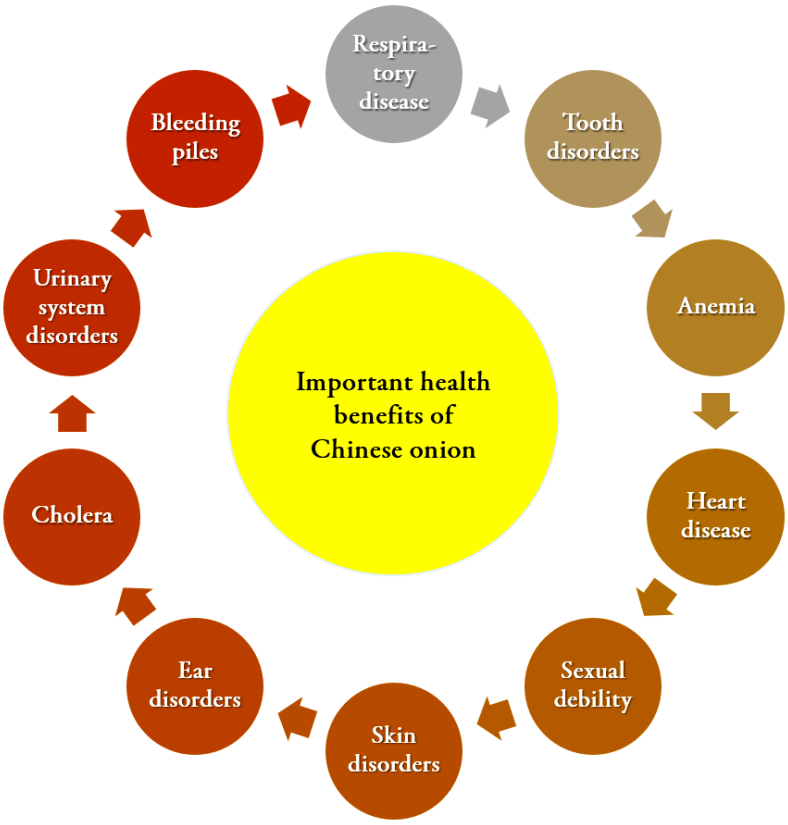

Figure 5. The most important health benefits of Chinese onion

The plant-derived phytochemical flavonols include quercetins and quercetin glycosides (Pan *et al.*, 2018). Quercetins have been reported to exhibit anti-cancer and anti-inflammatory activities (Rohn *et al.*, 2007). They have also reported that the bulbs of this plant are main source of a Chinese traditional medicine "Xiebai", which is used for the treatment for chest pain, stenocardia, and heart asthma. Chinese onion polysaccharides have attracted a great deal of concern to their therapeutic properties, especially anti-cancerous, anti-oxidant, anti-diabetic, anti-microbial properties and of course immunomodulatory role (Zhu *et al.*, 2018). Flavonoids and organosulfur compounds are the two major classes of secondary metabolites found in *Allium* believe to promote beneficial health effects. Asemani *et al.* (2019) discovered that the phytochemical analysis of various *Allium* genus members showed that, 16 species have proved potential anticancer properties due to the accumulation of various sulfur and organic compounds like S-allyl mercaptocysterin, quercetin, flavonoids, and ajoene. Sulfur components of Chinese chive (*Allium tuberosum* Rottl. Ex Sprengel) and Rakkyo (*Allium chinense* G. Don) were isolated, and the sulfur compounds account for 88 and 94% of the total volatiles in the isolated extract of Chinese chive and rakkyo, respectively. It has been reported various furostanol saponins, steroidal saponins, and spirostane saponins in isolated extract of it (Ren *et al.*, 2010). On the basis of traditional Chinese medicine, onions' special features are warm and hot tastes, together with functions such as warming the lungs to reduce phlegm, warming the stomach during digestion, detoxifying and destroying intestinal

worms, decreasing swelling and soreness, and decreasing blood pressure and blood lipids (Yang *et al.*, 2018). Several studies have shown that preparations from Xiebai show a number of biological activities, including anti-atherogenic, hypolipidemic, anti-platelet aggregation, antihypertension, antioxidant and analgesic effects (He *et al.*, 2018). Xiebai as a food is often pickled as a pleasing seasoning or cooked with other ingredients to afford various delicious Chinese dishes, providing nutrition and health benefits, and traditionally it is used in combination with other herbs, in the treatment of multiple diseases of cardiovascular, respiratory and gastrointestinal systems (He *et al.*, 2018). Sulfur compounds from alliums have played a key role in defense. Asemani *et al.* (2019) concluded that chemical constituents of *Allium* genus are involved in various mechanisms such as hindering cell cycle, inhibiting signaling pathways, inducing apoptosis, and antioxidant activity interfere with diverse stages of formation, growth, differentiation, and metastasis of cancer cells. Zhou *et al.* (2011) reported that the high consumption of *Allium* genus reduced the risk for various cancers. Yu *et al.* (2015) provides evidence for the cytotoxicity of *A. chinense* saponins (ACSs) and a strong foundation for further research to establish the theoretical basis for cell death and help in the design and development of new anticancer drugs. They have declared that ACSs induced morphological changes, accelerated cell death and exhibited concentration dependence, inhibited cell proliferation and exhibited dose dependence, inhibited the migration rates of B16 and 4T1 cells, inhibited cell colony formation and exhibited dose dependence, inhibition of tyrosinase activity of B16 cells treated with ACSs, ACSs inhibited tumor growth and protected the liver and spleen against injury. They have reported that *Allium* genus maybe the promising dieto-therapeutic vegetables and organopolysulfides as well as quercetin mechanism in the treatment of chronic diseases. Lin *et al.* (2016) showed that ethanol extract from *A. chinense* showed notable antioxidant activity, and its high-dose essential oil extract both meaningfully reduce serum and hepatic total cholesterol, triglyceride, and low-density lipoprotein levels and increased serum and hepatic total cholesterol, triglyceride, and low-density lipoprotein levels and increased serum high-density lipoprotein levels in high fat-diet Wistar rats. Yang *et al.* (2018) implied that onion oil has anti-obesity properties that can counteract the effects of a high-fat diet (HFD) on body weight, adipose tissue weight and serum lipid profiles. Liu *et al.* (2014) found that the essential oil of *A. chinensis* and the major constituents demonstrated strong contact and fumigant toxicity against the booklice; they have suggested that the essential oil of *A. chinense* maybe recommended effectively in pest control programs.

Conclusions

Shallot is a horticultural commodity belonging to spice vegetables. Shallots (*Allium ascalonicum* L.) are a perennial crop that is grown as an annual for its cluster of small bulbs or cloves. Persian shallot is native and endemic of Iran and grows as a wild plant across Zagross mountains at high elevations. Shallot is an important source of carbohydrate, vitamin A, B, and C. Phenolic compound in Shallot consist of gallic acid, eriodictyol, apigenin, isoquercetin, kaempferol, quercetin, rutin, catechin and tannic acid. The most important health benefits of shallots are cut cancer risk, improve heart health, aid detoxification, help control diabetes, improve brain health, help to fight obesity and treat allergies, boost bone health, maintain vision health, boost immunity, improve skin health, increase abdominal health and keep hair healthy. The dominants medicinal properties of Persian shallot are antibiotic properties, hypolipidemic properties, anticancer properties, antioxidant properties, hypoglycemic properties, kidney protective properties and hepatoprotective properties. Chinese onion (*Allium chinense*) widely cultivated as a vegetable and native to China. Its bulbs are commonly processed into pickles and spices. The bulb is anthelmintic, anti-inflammatory, antiseptic, antispasmodic, carminative, diuretic, expectorant, febrifuge, hypoglycaemic, hyptensive, lithontripic, stomachic and tonic. It can also use to prevent oral infection and tooth decay. The most important chemical constituents of the essential oil derived from *Allium chinense* are 1) dimethyl disulfide, 2) diallyl sulfide, 3) allyl isothiocyanate, 4) methyl allyl disulfide, 5) methyl propyl disulfide, 6) α-Pinene, 7) dimethyl trisulfide, 8) β-Pinene, 9) 1,3-Dithiane, 10) limonene, 11) diallyl disulfide, 12) linalool, 13) methyl allyl trisulfide, 14) methyl propyl trisulfide, 15) dimethyl tetrasulfide, 16) diallyl trisulfide, 17) diallyl thiosulfinate, and 18) allyl methyl tetrasulfide. Integration of traditional medicine into conventional medicine will provide much more promises for the future. This review article allowed verifying shallot and Chinese onion as sources of compounds with valuable nutritional and bioactive properties with great ability for incorporation into foods with functional properties.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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