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Proceeding Paper

The Health Benefits and Edible Properties of Leek †

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Abstract: Leek is one the main vegetable which can promote good health and serves as a primary defense mechanism against different diseases. Leek (*Allium ampeloprasum*) is a robust, winter-hardy biennial plant which does not form a hard bulb like garlic or onion, and they are grown for their thick and long white stem. One of the most important herbal food which is very common in Iran is persian leek. The keywords of medicinal properties, traditional medicine, leek, health benefits, flavones, flavonol, and tannin were searched in Scopus, PubMed and Google Scholar. Leek is rich in different bioactive components such as sulphuric components and flavonoids, and saponin with a variety of biological characteristics such as antihypertensive, antimicrobial, antidiabetic, antihyperlipidemic, anticarcinogenic and antiatherosclerotic effects. One of the most important flavonoids aglycone in leek is kaempferol. The aim of this manuscript is to introduce and survey the most important pharmacological benefits of leek. Nutrition therapy with application of leek on the basis of traditional and modern science can be an approprate choice at treating common diseases.

Keywords: leek; glycoside; medicinal plants; tannin; natural products; flavonol; flavones

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1. Introduction

This edible vegetable has been used as traditional herbal medicine and a super food in different countries [1–10], and most population of the world especially in developing countries relies on traditional medicine [16–21]. Leek utilization is very common in different traditional medicines such as traditional Chinese medicines, traditional Persian medicine, traditional Indian medicine, etc. [21–34]. Genus *Allium* contains around 500–700 species and there are medicinal, edible and ornamental species among them, and plants in *Allium* family are cool-season, herbaceous, biennial vegetables which are grown as annuals. Leek (*Allium ampeloprasum*) is winter-hardy and robust biennials which does not have a hard bulb like garlic or onions. Leeks are sweeter than onion which have a creamy texture when cooked. They are more cold tolerant than garlic and onions, however they prefer wetter conditions for its site requirements. Leek evolved as a complex of different cyto- and morpho-types widely distributed either in domesticated or wild range of the Mediterranean regions. The goal of the article is survey on the most notable pharmaceutical advantages and health benefits of leek with considering traditional knowledge and modern science of natural products. The current searching was done by the keywords in main indexing systems including Scopus, PubMed/MEDLINE, Institute for Scientific Web of Science, and search engine of Google Scholar. The keywords were health benefits, traditional medicine, leek, pharmaceutical science, glycoside, rutin, and flavones.

2. Leek and Pharmacological Benefits

Allium species are considered rich sources of secondary metabolites, including phenolics acids, and their derivatives, flavonoids such as flavanone, flavan, flavonol, flavones, dihydroflavonol, flavan-4-ol, flavan-3-ol and flavan-3,4-diol, and flavonoid polymers such as proanthocyanidins or condensed tannins which have tremendous health benefits [35,36]. The plant has a large amount of cystein sulfoxides, which has antioxidant and anti-diabetic properties [37], and it has some active ingredient similar to garlic, which can be useful for serum glucose and lipids [38]. The medicinal property of *Allium* is mainly because of the presence of many sulfur containing bioactive components such as methyl propenyl disulfide, dimethyl disulfie, propyl propenyl disulfide, methyl propyl trisulfide, dimethyl trisulfide, methyl propenyl trisulfide, S-methyl cystein sulfoxide, S-propyl cystein sulfoxide, and S-propenyl cystein sulfoxide [39]. Chemical and nutritional characterization of Allium ampeloprasum L. are energy, water, protein, carbohydrate, total fat, ash, dietary, glucose, dry matter, sucrose, fructose, oxalic acid composition, polysaccharides, malic acid, glutamic acid, succinic acid, macro and micro nutrient and heavy metal [40–42]. *Alliums* were revered to possess anti-fungal and anti-bacterial properties and include the powerful antioxidants, sulfur and other different phenolic components which arouse significant attentions [43,44]. Leek leaf extract has strong anthelmintic characteristic and it can be used in killing of inactivation of mtacercarial parasitic infection in fish [45]. Leek juices administration attenuated the severity of oxidative damage accompanying dimethoate toxicity with hepatoprotective effects [46]. *Allium ampeloprasum* L. can contribute to the survival of probiotic and beneficial microorganisms in unsuitable storage conditions and increase the tissue and sensory activities of the product [47]. In fact antioxidative, antitoxic, anti-inflammatory and immunostimulating activities of Allium ampeloprasum crown it as a magical herb in modern era where people are suffering from different side effects of synthetic drugs [41,48].

3. Conclusions

Leek is an edible vegetable which has been used as traditional herbal medicine and food in various countries as most population of the world in both developing and under developed countries rely on traditional herbal medicines. Leek is considered as a rich source of secondary metabolites such as flavav, flavones, flavanone, flavonol, flavan-3-ol, dihydroflavonol, flavan-3,4-dion, and flavan-4-ol as well as phenolic acids and their derivatives. The main flavonoid polymers of leek is condensed tannins and proanthocyanidins, and the most famous flavonoid aglycone in leek is kaempferol. Flavonoids, the total polyphenol and tannin contents and antioxidant properties are strongly affected by the environmental conditions. The most pharmacological advantages of leek are antiseptic, anti-asthma, diuretic, antibacterial, antifungal, antioxidant, and it is important natural medicine to protect skin again damage and reducing risk of gastrointestinal diseases. Leek is one the main vegetable which can promote goof health and serves as a primary defense mechanism against many diseases.

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References

1. Shahrajabian, M.H.; Sun, W. The golden spice for life: Turmeric with the pharmacological benefits of curcuminoids components, including curcumin, bisdemethoxycurcumin, and demethoxycurcumin. 2023, *ahead of print*. https://doi.org/10.2174/1570179420666230607124 94.
2. Shahrajabian, M.H.; Sun, W. The importance of salicylic acid, humic acid and fulvic acid on crop production. *Lett. Drug Des. Discov*. **2023**, *20*, 1–16. https://doi.org/10.2174/1570180820666230411102209.
3. Sun, W.; Shahrajabian, M.H. Therapeutic potential of phenolic compounds in medicinal plants-natural health products for human health. *Molecules* **2023**, *28*, 1845. https://doi.org/10.3390/molecules28041845.
4. Shahrajabian, M.H.; Petropoulos, S.A.; Sun, W. Survey of the influences of microbial biostimulants on horticultural crops: Case studies and successful paradigms. *Horticulturae* **2023**, *9*, 193. https://doi.org/10.3390/horticulturae9020193.
5. Shahrajabian, M.H.; Sun, W. Survey on medicinal plants and herbs in traditional Iranian medicine with anti-oxidant, anti-viral, anti-microbial, and anti-inflammatory properties. *Lett. Drug Des. Discov*. **2023**, *20*, 1707–1743. https://doi.org/10.2174/1570180819666220816115506.
6. Shahrajabian, M.H.; Marmitt, D.; Cheng, Q.; Sun, W. Natural antioxidants of the underutilized and neglected plant species of Asia and South America. *Lett. Drug Des. Discov*. **2023**, *20*, 1512–1537. https://doi.org/10.2174/1570180819666220616145555 8.
7. Shahrajabian, M.H.; Cheng, Q.; Sun, W.; The importance of neglected and underutilized medicinal plants from South America in modern pharmaceutial sciences. *Lett. Drug Des. Discov*. **2023**, *20*, 1688–1706. https://doi.org/10.2174/1570180819666220512113812.
8. Sun, W.; Shahrajabian, M.H.; Lin, M. Research progress of fermented functional foods and protein factory-microbial fermentation technology. *Fermentation* **2022**, *8*, 688. https://doi.org/10.3390/fermentation8120688.
9. Shahrajabian, M.H.; Cheng, Q.; Sun, W. Wonderful natural drugs with surprising nutritional values, Rheum species, gifts of the nature. *Lett. Org. Chem*. **2022**, *19*, 818–826. https://doi.org/10.2174/1570178619666220112115918.
10. Shahrajabian, M.H.; Cheng, Q.; Sun, W. The most important medicinal herbs and plants in traditional Chinese and Iranian medicinal sciences with antioxidant activities. *Lett. Drug Des. Discov*. **2022**, *20*, 818–826. https://doi.org/10.2174/1570180819666220414102700.
11. Shahrajabian, M.H.; Sun, W.; Cheng, Q. The importance of flavonoids and phytochemicals of medicinal plants with antiviral activities. *Mini Rev. Org. Chem*. **2022**, *19*, 293–318. https://doi.org/10.2174/1570178618666210707161025.
12. Shahrajabian, M.H.; Chaski, C.; Polyzos, N.; Petropoulos, S.A. Biostimulants application: A low input cropping management tool for sustainable farming of vegetables. *Biomolecules* **2021**, *11*, 698. https://doi.org/10.3390/biom11050698.
13. Shahrajabian, M.H.; Sun, W.; Cheng, Q. Different methods for molecular and rapid detection of human novel coronavirus. *Curr. Pharm. Des*. **2021**, *27*, 2893–2903. https://doi.org/10.2174/1381612827666210604114411.
14. Sun, W.; Shahrajabian, M.H.; Cheng, Q. Natural dietary and medicinal plants with anti-obesity therapeutics activities for treatment and prevention of obesity during lock down and in post-COVID-19 era. *Appl. Sci*. **2021**, *11*, 7889. https://doi.org/10.3390/app11177889.
15. Shahrajabian, M.H.; Chaski, C.; Polyzos, N.; Tzortzakis, N.; Petropoulos, S.A. Sustainable agriculture systems in vegetable production using chitin and chitosan as plant biostiumulants. *Biomolecules* **2021**, *11*, 819. https://doi.org/10.3390/biom11060819.
16. Shahrajabian, M.H.; Sun, W.; Cheng, Q. Molecular breeding and the impacts of some important genes families on agaronomic traits, a review. *Genet. Resour. Crop Evol*. **2021**, *68*, 1709–1730. https://doi.org/10.1007/s10722-021-01148-x.
17. Shahrajabian, M.H.; Sun, W.; Cheng, Q. Exploring *Artemisia annua* L., artemisinin and its derivatives, from traditional Chinese wonder medicinel science. *Not. Bot. Horti Agrobot. Cluj. Napoca*. **2020**, *48*, 1719–1741. https://doi.org/10.15835/nbha48412002.
18. Shahrajabian, M.H.; Sun, W.; Soleymani, A.; Cheng, Q. Traditional herbal medicines to over come stress, anxiety and improve mental health in outbreaks of human coronaviruses. *Phytother. Res*. **2020**, *35*, 1237–1247. https://doi.org/10.1002/ptr.6888.
19. Shahrajabian, M.H.; Sun, W.; Cheng, Q. Chemical components and pharmacological benefits of basil (*Ocimum basilicum*): A review. *Int. J. Food Prop*. **2020**, *23*, 1961–1970. https://doi.org/10.1080/10942912.2020.1828456.
20. Sun, W.; Shahrajabian, M.H.; Cheng, Q. Fenugreek cultivation with emphasis on historical aspects and its uses in traditional medicine and modern pharmaceutical science. *Mini Rev. Med. Chem*. **2021**, *21*, 724–730. https://doi.org/10.2174/1389557520666201127104907.
21. Sun, W.; Shahrajabian, M.H.; Cheng, Q. Barberry (*Berberis vulgaris*), a medicinal fruit and food with traditional and modern pharmaceutical uses. *Isr. J. Plant Sci*. **2021**, *68*, 1-11. https://doi.org/10.1163/22238980-bja10019.
22. Sun, W.; Shahrajabian, M.H.; Cheng, Q. Health benefits of wolfberry (Gou Qi Zi) on the basis of ancient Chinese herbalism and Western modern medicine. *Avicenna J. Phytomed*. **2021**, *11*, 109–119. https://doi.org/10.22038/AJP.2020.17147.
23. Shahrajabian, M.H.; Sun, W.; Cheng, Q. Improving health benefits with considering traditional and modern health benefits of *Peganum harmala*. *Clin. Phytosci*. **2021**, *7*, 18. https://doi.org/10.1186/s40816-021-00255-7.
24. Marmitt, D.; Shahrajabian, M.H. Plant species used in Brazil and Asia regions with toxic properties. *Phytother. Res*. **2021**, *35*, 4703–4726. https://doi.org/10.1002/ptr.7100.

25. Shahrajabian, M.H.; Sun, W.; Khoshkharam, M.; Cheng, Q. Caraway, Chinese chives and cassia as functional foods with considering nutrients and health benefits. *Carpathian J. Food Sci. Technol*. **2021**, *13*, 101–119. https://doi.org/10.34302/crpjfst/2021.13.1.9.
26. Shahrajabian, M.H.; Sun, W. Great health benefits of essential oils of pennyroyal (*Mentha pulegium* L.): A natural and organic medicine. *Curr. Nutr. Food Sci*. **2023**, *19*, 340–345. https://doi.org/10.2174/1573401318666220620145213.
27. Shahrajabian, M.H.; Sun, W. The important nutritional benefits and wonderful health benefits of cashew (*Anacardium occidentale* L.). *Nat. Prof. J*. **2023**, *13*, 2–10. https://doi.org/10.2174/2210315512666220427113702.
28. Shahrajabian, M.H.; Sun, W. A friendly strategy for an organic life by considering Syrian bean caper (*Zygophyllum fabago* L.), and parsnip (*Pastinaca sativa* L.). *Curr. Nutr. Food Sci*. **2023**, *19*, 870–874. https://doi.org/10.2174/1573401319666230207093757.
29. Shahrajabian, M.H.; Sun, W. Sustainable approaches to boost yield and chemical constituents of aromatic and medicinal plants by application of biostimulants. *Recent. Pat. Food Nutr. Agric*. **2022**, *13*, 72–92. https://doi.org/10.2174/2772574X13666221004151822.
30. Shahrajabian, M.H.; Sun, W.; Shen, H.; Cheng, Q. Chinese herbal medicine for SARS and SARS-CoV-2 treatment and prevention, encouraging using herbal medicine for COVID-19 outbreak. *Acta Agric. Scand. B Soil. Plant Sci*. **2020**, *70*, 437–443. https://doi.org/10.1080/09064710.20201763448.
31. Shahrajabian, M.H.; Sun, W.; Cheng, Q. Clinical aspects and health benefits of ginger (*Zingiber officinale*) in both traditional Chinese medicine and modern industry. *Acta Agric. Scand. B Soil. Plant Sci*. **2019**, *69*, 546–556. https://doi.org/10.1080/09064710.2019.1606930.
32. Shahrajabian, M.H.; Sun, W.; Cheng, Q. A review of ginseng species in different regions as a multipurpose herb in traditional Chinese medicine, modern herbology and pharmacological science. *J. Med. Plant Res*. **2019**, *13*, 213–226. https://doi.org/10.5897/JMPR2019.6731.
33. Shahrajabian, M.H.; Sun, W.; Cheng, Q. A review of astragalus species as foodstuffs, dietary supplements, a traditional Chinese medicine and a part of modern pharmaceutical science. *Appl. Ecol. Environ. Res*. **2019**, *17*, 13371–13382. https://doi.org/10.15666/aeer.1706_1337113382.
34. Sun, W.; Shahrajabian, M.H.; Cheng, Q. The insight and survey on medicinal properties and nutritive components of shallot. *J. Med. Plant Res*. **2019**, *13*, 452–457. https://doi.org/10.5897/JMPR2019.6836.
35. Augusti, K.T. Therapeutic and medicinal values of onions and garlic. In *Onion and Allied Crops Biochemistry, Food Science and Minor Crops*; CRC Press: Boca Raton, FL, USA. 1990; Volume 3, ISBN 0-8493-6302-4.
36. Lee, J.Y.; Mitchell, A.E. Quercetin and isorhamnetin glycosides in onion (*Allium cepa* L.) varietal comparison, physical distribution, coproduct evaluation and long-term stability. *J. Agric. Food Chem*. **2011**, *59*, 857–863.
37. Kumari, K.; Auguusti, K.T. Antidiabetic and antioxidant effects of S-methyl cystein sulfoxide isolated from onions (*Allium cepa* Linn) as compared to standard drugs in alloxan diabetic rats. *Ind. J. Exp. Biol*. **2002**, *50*, 1005–1009.
38. Fritsch, R.M.; Keusgen, M. Occurrence and taxonomic significant of cysteine sulphoxides in the genus *allium* L. (alliaceae). *Phytochemistry* **2006**, *67*, 1127–1135.
39. Ayumi, U.; Jun, O.; Hitomi, K.; Makoto, A.; Hiroshi, M.; Hidetoshi, S.; et al. Mechanisms of sulfide components expression and structural determination of substrate precursor in Jumbo Leek (*Allium ampeloprasum* L.). *Nippo Shokuhin Kagaku Kogaku Kaishi*. **2009**, *56*, 280–285.
40. Horie, H.; Yamashita, K. Non-derivatized analysis of methiin and alliin in vegetables by capillary electrohoresis. *J. Chromatogra A* **2006**, *1132*, 337–339.
41. Dey, P.; Khaled, K.L. An extensive review of Allium ampeloprasum a magical herb. *Int. J. Sci. Res*. **2013**, *4*, 371–377.
42. Devi, V.; Brar, J.K. Comparison of proximate composition and mineral concentration of *Allium ampeloprasum* (elephant garlic) and *Allium sativum* (garlic). *Chem. Sci. Rev. Lett*. **2018**, *7*, 362–367.
43. Haciseferogullari, H.; Ozcan, M.; Demir, F.; Calisir, S. Some nutritional and technological properties of garlic (*Allium sativum* L.). *J. Food Eng*. **2005**, *68*, 463–469.
44. Irkin, R.; Korukluoglu, M. Control of *Aspergillus niger* with garlic, onion and leek extracts. *Afr. J. Biotechnol*. **2007**, *6*, 384–387.
45. Ibrahim, T.B.; Kenawy, A.M. The impact of leek (*Allium amploprasum* L.) extract on prohemistomum vivax (Sonsino, 1982) encysted metacercariae in *Clarias gariepenus* fish. *Res. J. Pharm. Biol. Chem. Sci*. **2017**, *8*, 607–617.
46. Moram, G.S.E.; Kholief, T.E.S.; Ahmed, A.T.F. Antioxidant effect of radish (*Raphanus sativus* L.) and leek (*Allium porrum* L.) juices against hepatotoxicity and nephrotoxicity induced by dimethoate in male albino mice. *World J. Pharm. Res*. **2015**, *4*, 215–246.
47. Mehdizadeh, T.; Razavi, M.; Esmaeili, K.M. The effect of wild leek (*Allium ampeloprasum*) on growth and survival of *Lactobacillus Acidophilus* and sensory properties in Iranian white cheese. *J. Res. Innov. Food Sci. Technol*. **2019**, *7*, 431–444.
48. Shahrajabian, M.H.; Sun, W. Five important seeds in traditional medicine, and pharmacological benefits. *Seeds* **2023**, *2*, 290–308. https://doi.org/10.3390/seeds2030022.