

# A Review of Leek (*A. ampeloprasum* L.), an Important Vegetable and Food Ingredient with Remarkable Pharmaceutical Activities

Mohamad Hesam Shahrajabian<sup>1</sup>, Wenli Sun<sup>1</sup>, Qi Cheng<sup>1,2,\*</sup>

<sup>1</sup>Biotechnology Research Institute, Chinese Academy of Agricultural Sciences, Beijing, CHINA.

<sup>2</sup>College of Life Sciences, Hebei Agricultural University, Baoding, Hebei, China; Global Alliance of HeBAU-CLS&HeQiS for BioAI-Manufacturing, Baoding, Hebei, CHINA.

## ABSTRACT

**Introduction:** This edible vegetable has been used as food and traditional herbal medicine in different countries. Most population of the world, especially in developing countries relies on traditional medicine. **Methods:** They keywords of leek, traditional Medicine, health Benefits and *A. ampeloprasum*, western medicine and pharmaceutical science were searched in Google Scholar, Scopus, Research Gate and PubMed. **Results:** *Allium ampeloprasum* is considered a rich source of secondary metabolites, including phenolic acids and their derivatives, flavonoids (flavan, flavanone, flavones, flavonol, dihydroflavonol, flavan-3-ol, flavan-4-ol and flavan-3,4-diol) and flavonoid polymers (proanthocyanidins or condensed tannins). The most important flavonoid aglycone in leek is kaempferol. The total polyphenol, flavonoids and tannin contents and antioxidants activities were strongly influenced by the environmental conditions. The most important health benefits are anti-asthma, antiseptic, diuretic, antibacterial,

antioxidant, antifungal and it is good to protect skin against damage and decreasing risk of gastrointestinal diseases. **Conclusion:** Leek is one important vegetable which can promote good health and serves as a primary defense mechanism against diseases.

**Key words:** Leek, Traditional Medicine, Health Benefits, *A. ampeloprasum*.

## Correspondence:

**Dr. Qi Cheng**

Biotechnology Research Institute, Chinese Academy of Agricultural Sciences, Beijing-100081, CHINA.

Phone no: +86-13051039294

E-mail: chengqi@caas.cn

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## INTRODUCTION

Among the species of medicinal plants, some are mainly confined to folk medicine and some are used as occasional or local substitutes for the main species listed in the *Materia Medica*.<sup>1-5</sup> Traditional medicine such Traditional Persian Medicine (TPM), Traditional Chinese Medicine (TCM), Traditional Indian Medicine (TIM) and etc, which are essential parts of the health care system in most Asian countries, relies on natural products and has been playing a very important and significant role in health protection and disease control for thousands of years.<sup>6-10</sup> Genus *Allium* contains around 500-700 species and there are edible, medicinal and ornamental species among them.<sup>11</sup> All plants in the *Allium* family are herbaceous, cool-season, biennial vegetables that are grown as annuals. Leeks (*Allium ampeloprasum* var. *porrum*) are robust, winter-hardy biennials that do not form a hard bulb like onions or garlic. Instead, they are grown for their long and thick white stem. Persian leek is one of the most widely used herbal foods among Iranians.<sup>12</sup> Sadeghi *et al.*<sup>13</sup> also reported that *Allium ampeloprasum* subsp. *persicum* is an endemic Iranian plant which is known as Persian Leek and widely cultivated all over the country. The *Allium ampeloprasum* complex, widely spread in the Mediterranean area, comprises a group of taxa with similar morphology and habitat.<sup>14</sup> On the basis of botanical studies, Iranian Taree has been classified as sub-species of *A. iranicum* W. subsequently, it had been concluded that (*A. ampeloprasum* L. ssp. *Porrum*) and Iranian Taree are in the sub-species *ampeloprasum* from the morphological and cytological points of view. Leeks are sweeter than onions and have a creamy texture when cooked. Leeks are more cold tolerant than onions and garlic but prefer wetter conditions for its site requirements. Leek is one of the economically most important field vegetable crops in Europe,<sup>15</sup> and it is especially vulnerable up to harvest to weed interference and nutrient leaching due to its relatively long vegetation period and its open canopy up to harvest.<sup>16</sup> It is also widely distributed in China.<sup>17,18</sup> Guenaoui *et al.*<sup>19</sup> mentioned that *Allium ampeloprasum* evolved as a complex of different cyto- and morpho-types widely distributed either in the wild or domesticated range of the Mediterranean regions. Botanical classification of leek is shown in Table 1.

## CHEMICAL CONSTITUENTS

The members of *Allium* genus are rich in various bioactive constituents including flavonoids, sulphuric compounds and saponins with a variety of biological activities including antimicrobial, antihypertensive, antihyperlipidemic, antidiabetic, anti-atherosclerotic and anticarcinogenic effects.<sup>20-22</sup> Leek (*Allium ampeloprasum* Linn.) is believed to have anti-hepatotoxic and antifungal activities.<sup>23</sup> *Allium* species are considered rich sources of secondary metabolites, including phenolic acids and their derivatives, flavonoids (flavan, flavanone, flavones, flavonol, dihydroflavonol, flavan-3-ol, flavan-4-ol and flavan-3,4-diol) and flavonoid polymers (proanthocyanidins or condensed tannins) which have significant health benefits.<sup>24,25</sup> It has been reported demonstrated that kaempferol is the main flavonoid aglycone in leek.<sup>26,27</sup> Ulianych *et al.*<sup>28</sup> did agrobiological evaluation of *Allium ampeloprasum* L. variety samples in comparison with *Allium sativum* L. cultivars and they have reported that *Allium ampeloprasum* variety samples had a higher content of ash and carbohydrates, which depended more on calorie content, while garlic cultivars had significantly higher protein content relative and higher fat content relatively to both *Allium ampeloprasum* variety samples. They have finally concluded that *Allium ampeloprasum* L. samples had better chemical composition and higher nutritional value. Arfa *et al.*<sup>29</sup> concluded that wild leek can be considered a good source of antioxidants to its cultivated relatives and other conventional vegetables and the total polyphenol, flavonoids and tannin contents and antioxidants activities were strongly influenced by the environmental conditions. The plant has a large amount of cysteine sulfoxides, which has anti-diabetic and antioxidant properties.<sup>30</sup> It has some active ingredients similar to garlic, which can be useful for serum glucose and lipids.<sup>31</sup> The medicinal property of *Allium ampeloprasum* is mainly due to the presence of many sulfur containing bioactive constituents such as dimethyl disulfide, methyl propenyl disulfide, propyl propenyl disulfide, dimethyl trisulfide, methyl propyl trisulfide, methyl propenyl trisulfide, S-methyl cysteine sulfoxide, S-propyl cysteine sulfoxide, S-propenyl cysteine sulfoxide and N-( $\gamma$ -glutamyl)-S-(E-1-propenyl) cysteine.<sup>32</sup> *Allium ampeloprasum* has higher amount of methiin and propiin,

**Table 1: Botanical classification of Leek.**

Kingdom	Plantae
Clade	Angiosperms
Clade	Monocots
Order	Asparagales
Family	Amaryllidaceae
Sunfamily	Allioideae
Genus	<i>Allium</i>
Species	<i>ampeloprasum</i>

respectively,<sup>31</sup> which is an important component of flavors and they are thought to be beneficial to health also.<sup>33</sup> Strati *et al.*<sup>14</sup> found that higher total phenolic content was found in green leek leaf extracts compared to white leek stem extracts, due to a possible relationship between polyphenol production and sunlight radiation. Chemical and nutritional characterization of *Allium ampeloprasum* L. are water, energy, protein, total fat, carbohydrate, dietary fiber, ash, dry matter, glucose, fructose, sucrose, polysaccharides, oxalic acid composition, glutamic acid, malic acid, citric acid, succinic acid, macro and micro nutrient and heavy metal.<sup>33-35</sup>

## PHARMACEUTICAL SCIENCES

*Alliums* were revered to possess anti-bacterial and anti-fungal activities and include the powerful antioxidants, sulfur and other numerous phenolic compounds which arouse significant interests.<sup>36,37</sup> According to the Dictionary of Chinese Herbal Medicines, Chinese leek seeds, with the ability to tonify the kidney, have been reportedly used since antiquity as traditional Chinese medicine for treatment of impotence and nocturnal emissions which are ejaculations and orgasms that excessively occur while a person is sleeping.<sup>38</sup> Feghhi-Najafabadi *et al.*<sup>39</sup> reported that it has been used for the treatment of headache, hemoptysis, asthma, obesity, constipation, hemorrhoids and goat. The ultrasonic extracts of leek parts can be used in the food industry for both product protection against oxidation and their numerous biological and pharmacological activities.<sup>40</sup> Ibrahim and Kenawy<sup>41</sup> noted that Leek leaf extract (LLE) has strong anthelmintic activity and can be used in killing of inactivation of metacercarial parasitic infection in fish. Abbas and Awad<sup>42</sup> revealed that the injection of catfish with low dose of leek extract may contribute in protecting fish from harmful effect of benzo[a]pyrene (BaP) through enhancement biotransformation and immune systems. Moram *et al.*<sup>43</sup> Showed that leek juices administration attenuated the severity of oxidative damage accompanying dimethoate toxicity with hepatoprotective properties. Al-Hadedy *et al.*<sup>44</sup> reported the success of using leeks as a preservative to length of storage cheese and the leeks added a new flavor of Iraqi soft cheese and it has increased the consumer acceptance. Mehdizadeh *et al.*<sup>45</sup> indicated that, *Allium ampeloprasum* L. can contribute to the survival of probiotic and beneficial microorganisms in unsuitable storage conditions and improve the tissue and sensory properties of the product. It has been shown that its active ingredients have a protective effect against injuries induced by harmful agents, serum cholesterol lowering agents, establishing a basic condition for some body functions and vasodilator.<sup>46</sup> Dey and Khaled<sup>34</sup> reported antitoxic, antioxidative, immunostimulating, anti-inflammatory property of *Allium ampeloprasum* crown it as a Megical herb in modern era where peoples are suffering from unwanted side effects of synthetic drugs. Al-Hashemi<sup>47</sup> discovered that the aqueous of leek extract acts as increase insulin in white female rats while negative effect of aqueous extract of leek on cholesterol, urea and creatinine and weight of the rats. Benede

*et al.*<sup>48</sup> suggested that leek extract may have potential anti-allergic effects due to its antioxidant and anti-inflammatory properties. Lorigooini *et al.*<sup>49</sup> showed that the dietary intake of *Allium* could be beneficial for prevention of cardiovascular diseases. Sedighi *et al.*<sup>50</sup> concluded that *Allium ampeloprasum* leaf hydro-alcoholic extract could affect rat ileum motor activity by affecting beta adrenergic receptors and voltage dependent calcium channels and it might be used to treat digestive problems. Koca and Tasci<sup>51</sup> noticed that leek contains potassium and selenium in high amounts which suggests that leek has the potential of contributing to the nutritional and health needs of their consumers. Fatoorechi *et al.*<sup>12</sup> suggested that persian leek might be considered as a herbal food that can reduce liver TG accumulation induced by high fat diets. Feghhi-Najafabadi *et al.*<sup>39</sup> revealed that moderately low amount of phenolic compounds and weak DPPH (1,1-diphenyl-2-picrylhydrazyl) scavenging activity for all extracts of *A. ampeloprasum* subsp. *persicum*. But, leaves extract showed good total antioxidant capacity and H<sub>2</sub>O<sub>2</sub> scavenging activity. Its seeds have also been traditionally used as an appetizer and aphrodisiac and for the treatment of neuralgia, vitiligo, chronic diarrhea, freckle and hemorrhoids.<sup>52</sup> Mosavat *et al.*<sup>53</sup> showed that the topical use of leek cream can be as effective as a standard antihemorrhoid cream.

## CONCLUSION

*Allium* with around 800 species is an important genus of Amaryllidaceae family which widely spread in the northern hemisphere. Leeks (*Allium ampeloprasum* var. *porrum*) are robust, winter-hardy biennials that do not form a hard bulb like onions or garlic. Instead, they are grown for their long and thick white stem. Persian leek is one of the most widely used herbal foods among Iranians. The members of *Allium* genus are rich in various bioactive constituents including flavonoids, sulphuric compounds and saponins with a variety of biological activities including antimicrobial, antihypertensive, antihyperlipidemic, antidiabetic, anti-atherosclerotic and anticarcinogenic effects. Kaempferol is the main flavonoid aglycone in leek. Nutrition therapy on the basis of traditional Asian medicine (TAM) is quite effective at treating common diseases

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## CONFLICT OF INTEREST

The authors declare no conflict of interests.

## ABBREVIATIONS

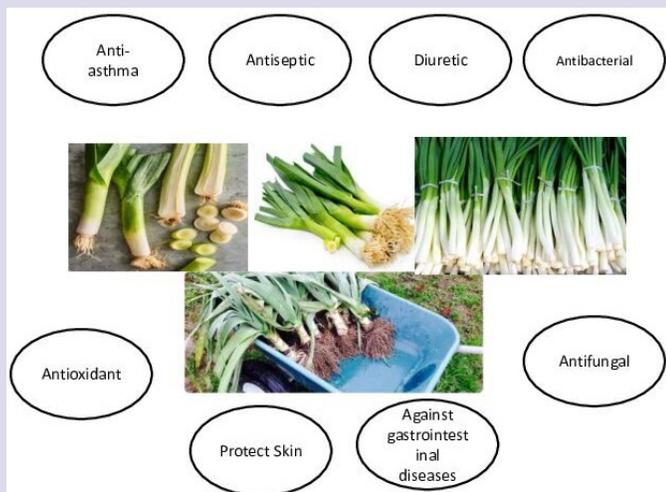
TPM: Traditional Persian Medicine; TIM: Traditional Indian medicine.

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### PICTORIAL ABSTRACT



### SUMMARY

- *Allium* with around 800 species is an important genus of Amaryllidaceae family which widely spread in the Northern hemisphere.
- Leeks (*Allium ampeloprasum* var. *porrum*) are robust, winter-hardy biennials that do not form a hard bulb like onions or garlic.
- The members of *Allium* genus are rich in various bioactive constituents including flavonoids, sulphuric compounds and saponins.
- Leek is one of the most important vegetable with tremendous health benefits such as anti-asthma, antiseptic, diuretic, antibacterial, antioxidant, antifungal and it is good to protect skin against damage and decreasing risk of gastrointestinal diseases.

### ABOUT AUTHORS



**Dr. Mohamad Hesam Shahrajabian:** He is a senior researcher of Agronomy and Biotechnology. He is interested in crops and herbs which are related to traditional medicine, especially Chinese and Iranian traditional medicine and crops relating to organic farming and sustainable agriculture.



**Dr. Wenli Sun:** She is an assistant researcher working on related topics of traditional Chinese medicine, allopathic influence and sustainable agriculture. She is also working on topics which are related to Biotechnology and Molecular Sciences.



**Prof. Dr. Qi Cheng:** He is a professor of Biotechnology and his researches have connected with agrobiotechnology. Presently, he is interested to traditional Chinese medicine and molecular researches.