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A Brief Review on Pharmacological Potential of *Allium porrum*

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ABSTRACT

Allium porrum is a major vegetable crop worldwide. Most of its production and consumption is in western Europe, with France and Belgium being the world's greatest producers. Dry leek is the most consumed vegetable after potato. *Allium porrum* is an herbaceous plant from the Liliaceae family and has been widely used in Persian foods as a flavour component. The *Allium ampeloprasum* is categorized into wild leek, cultivated leek, kurrat, pearl onion, tare and great-headed garlic based on their diverse cytogenetic and morphological characters. Leeks are known for their characteristic flavour and medicinal value. Leeks have excellent nutritional properties and are a rich source of bioactive compounds and phytochemicals, Leaves contains lot of fibre, calcium, phosphorus, vitamin A, vitamin B_1, vitamin B_2 and vitamin C. Consumption of leeks causes a reduction of the risk of hypercholesterolemia, blood pressure, arteriosclerosis and platelet aggregation which helps in the prevention of cardiovascular diseases. Besides these, the leeks have antimicrobial activity against various bacteria and fungi and viruses.

Keywords: *Allium*, *Allium porrum,* leek, gallic acid, organosulfur compounds, pharmacological activities.

INTRODUCTION

Allium, a genus belongs to the family Liliaceae, and utilized in folk medicine since ancient times. It comprises approximately 500 species, with the most widely used ones being onions (*Allium cepa*), garlic (*Allium sativum*), leeks (*Allium porrum*), chives *(Allium schoenoprasum*), and shallots (*Allium ascalonicum*). These plants have been employed for centuries due to their pungency, flavoring value, and medicinal properties[1].*Allium* species are distributed across the northern hemisphere, thriving in arid climates on open, dry, and sunny terrains. They are rarely found in dense vegetation and are considered weak competitors to weeds. The richest area for these species stretches from the Mediterranean basin to Central Asia and Pakistan[2].

Allium species contain various bioactive compounds, including organo-sulphur compounds, phenolic compounds, non-structural and soluble carbohydrates, amino acids, and organic acids. The volatile sulphur compounds provide flavor and quality properties for leeks, while phenolics other bioactive components offer health-promoting properties such as antimicrobial, anti-atherosclerotic, anti-tumorigenic, and immunomodulatory effects[3].

In Brazil, *Allium porrum* is a daily staple in the diet and is widely cultivated and consumed. It is also essential to many European cuisines. All parts of *Allium porrum* have an offensive, pungent odor and

an acrid taste due to an essential oil, with allyl sulphide being the main ingredient[4].
Like other members of the *Allium* species, *Allium porrum* produces non-protein sulphur amino acids derived from cysteine, such as alk(en)yl cysteine sulfoxides. These amino acids serve as precursors to sulphur volatiles, which are formed when plant tissue cells are ruptured by the enzyme allinase, resulting in the production of sulphur volatiles mainly in the form of thiosulfinates that subsequently breakdown and rearrange into disulphides and trisulphides[5].
Recent studies have shown that consuming leeks can reduce serum triglycerides in hypercholesterolemia, lower the risk of prostate, colorectal, stomach, and breast cancer, as well as aid in the prevention of neural tube defects and other disorders[6].

TAXONOMICAL CLASSIFICATION [7]

Table 1: Taxonomical classification of *Allium porrum*

Kingdom	Plantae
Order	Liliales
Family	Liliaceae/Amarydillaceae
Genus	Allium L
Species	*Allium porrum* L.

REGIONAL NAMES: [8]

Table 2: Vernacular names of *Allium porrum*

English	leek
Spanish	porro, puerro
French	poireau, porreau
Portuguese	alho-porro
Germany	porree
Italy	porro.

HABITAT
Leeks planted in spring season as either bulbs or seedlings in mounds. Seedlings planted at a depth that is two or three times their width. As the plants grow, the soil mounded around their stems up to the lowest leaf joint is called blanching and produces a longer, tenderer white stem for cooking and eating. Leeks can be harvested when they are at half an inch to two inches thick (one to six centimetres) or after 120 to 210 days of growth. It is preferable to harvest them before the soil freezes. Any small, uprooted leeks that are not ready can be replanted [9].

DISTRIBUTION
Allium porrum was native in temperate regions, cultivated in Africa, Asia-temperate, Asiatropical, Australia, Europe and Southern America. The largest areas of leek cultivation can be found in western European countries where it is cultivated on about 30,000 ha[10] .
Leek is a major source of inulinase production. Inulinase is 2,1-β-D-fructan fructanohydrolase which yields 95% of fructose by removal of the terminal fructose residues from the non-reducing end of the inulin molecule. Its beneficial role includes enhancing iron absorption in children, ethanol removal from blood of highly intoxicated persons, higher sweetening capacity with low calories, prevention of colon cancer, and coronary heart disease, obesity, hypercholesterolemia, type 2 diabetes, hypertension, cataract, osteoporosis and disturbances in the GIT (colic pain, dyspepsia) [11-12].

BOTANICAL DESCRIPTION
Leeks characterized by a long white stem of uniform length and short green leaves and cultivated under open field conditions [13] .
Leeks are upright and have broad, flattened blue-green to grey-green leaves that arch and it pointed at the tip. The leaves overlap to create the long stem base. The base of the leek is white and slightly bulbous Leeks produce surprisingly pretty flowers in the spring of their second year. The perfectly round flower clusters rise from tall, leafless stems. A single plant will typically produce one flower head comprised of lots of white, starry flowers. Occasionally, the heads will have small bulbs instead of flowers[14] .
Leaves: linear to linear-lanceolate, shorter than scape, blade solid, flat, channelled, 1-5cm or more, slightly conduplicate and abaxially keeled.
Bulbs: Solitary, cylindrical, some with poorly developed bulbs, others ovoid with 1-2 large bulbs and yellowish to light brown.
Flowers: urceolate, 4-5.5mm [8].

CHEMICAL CONSTITUENTS [15]

There are plenty of reports about the constituents in the different parts of *Allium porrum* including quercetin-3-O-β glucopyranoside-7-O-α-rhamnpyranoside, quercetin-3-O-α-rhamnopyranoside, quercetin4'-O-β-glucopyranoside, kaempferol3-O-β-glucopyranoside, kaempferol-7-O-βglucopyranoside, quercetin, isorhamnetin, kaempferol, p-coumaric acid, astragalline, ferulic acid and gallic acid. Leaves contains lot of fibre, calcium, phosphorus, vitamin A, vitamin B_1, vitamin B_2 and vitamin C.

PHARMACOLOGICAL ACTIVITIES

ANTI-HYPERTENSIVE ACTIVITY:

Oral administration of alcoholic extract *Allium porrum* (250 and 500mg/kg) exhibits significant reduction of the elevated systolic blood pressure induced by L-NAME (50mg/kg) compared with hypertensive control group [16]. L-NAME is a nitric oxide synthase inhibitor thus it inhibits nitric oxide synthesis from its precursor L-arginine which has been shown to be the active principle of the endothelium derived relaxing factor, it leads to vasoconstriction and hypertension [17].

ANTI-DIABETIC ACTIVITY:

The effect of *Allium sativum* and *Allium porrum* on D-glucose, fluid absorption and transport across everted intestinal sacs of rat was studied. Different concentrations of *Allium sativum* and *Allium porrum* (2.5 and 5.0mg/ml) were incubated in the intestinal segments in the mucosal solution. Data obtained from the investigation explain that *Allium sativum* and *Allium porrum* inhibit the active transport of D-glucose across rat enterocytes and found that increased concentrations of *Allium sativum* and *Allium porrum* at 2.5 and 5.0mg/ml in the mucosal solution significantly decreased the absorption as the transport across the rat intestine.

The D-glucose absorption along with transport significantly inhibited at 2.5 and 5.0mg/ml of *Allium sativum* and *Allium porrum*, which compared to the control experiment groups found to be more potent than *Allium sativum* on glucose uptake in diabetic rats[18].

ANTI-INFLAMMATORY ACTIVITY:

The anti-inflammatory activity of novel steroidal saponins investigated using an acute inflammation model and the results measured by inhibition of carrageenan induced mouse paw oedema. The carrageenan-induced inflammation is a biphasic phenomenon. The early phase of oedema attributes to the release of histamine, serotonin and similar substances. The later phase results mainly from the potentiating effects of prostaglandins on mediator release. The steroidal saponins showed significant anti-inflammatory potential, promptly controlling both phase of inflammation and provoking an inhibition of oedema formation similar to the reference compound dexamethasone. It shows anti-oedematous properties with potency similar to that of bioactive compounds isolated from other medicinal plants used against inflammatory disorders [19].

HYPOLIPIDEMIC AND ANTI ATHEROSCLEROTIC EFFECT:

The anti-hypercholesteraemic effect of a hydroalcoholic extract of *Allium porrum* L. bulbs evaluated in rabbits on hypercholesteraemic diet. The extract at three doses was given as 250, 500 and 1000 mg/kg of body weight. Plasma total cholesterol decreased in all groups treated with *Allium porrum* extract in a dose-dependent fashion. The increase of the hypocholesterolaemia effect of the extract in the period of treatment (12 weeks) indicates that the anti hypercholesteraemic effect of *Allium porrum* is dose dependent. Leek-treated animals also showed a decrease in the atherogenic index which is generally believed to be beneficial since the HDL level inversely correlated with coronary heart disease and reduction in this ratio is considered as an anti-atherosclerotic factor[20] [21].

ANTI-BACTERIAL ACTIVITY:

The aqueous extracts of leaves *Allium porrum* showed higher activity against Gram-positive bacteria rather than Gram-negative bacteria. The inhibition zone reached 31mm in diameter against Bacillus subtilis, Staphylococcus aureus and Streptococcus pneumonia. On the other hand, the zone of inhibition reached to 26, 56, 25, 24 mm in diameter against Pseudomonas aeruginosa, Proteus vulgaris and Escherichia coli respectively. The presence of organosulphur compounds is responsible for antimicrobial activity[22] [23] . The leaf and stem extracts of *Allium porrum* L. was also effective against Klebsiella pneumoniae, Escherichia coli, Proteus mirabilis[24] .

ANTIFUNGAL ACTIVITY:

New spirostanol saponins from *Allium porrum* are isolated, showing effectiveness against Fusarium culmorum [25] .Additionally, three new dibenzofurans (Porric acid A, B, C) isolated from the bulbs of *Allium porrum* exhibit antifungal activity against Fusarium culmorum [26] .Moreover, leaf and stem extracts of *Allium porrum* are effective against Candida albicans and Aspergillus niger [3] .

ANTI-PLATELET ACTIVITY:

Extracts of *Allium porrum* inhibit platelet aggregation due to the presence of flavonoids. Kaempferol, found in the extract, also inhibits platelet aggregation and ATP stable forms through interactions with flavonoids [27] .Furthermore, plants with higher concentrations of phenolic substances have a good iron-chelating potential, making the extract a potential alternative chelator for treating conditions like thalassemia [28] .

GASTROPROTECTIVE ACTIVITY/ANTI-ULCEROGENIC ACTIVITY:

Glucofructans isolated from the hot water extract of *Allium ampeloprasum var. porrum*, along with steroidal saponins from *Allium porrum*, exhibit significant gastroprotective activity by interfering with ulcerogenic mechanisms and showing cytoprotective properties [19] [29] .

ANTI-PROLIFERATIVE ACTIVITY:

Two new sapogenins, 12-keto-porrigenin, and 2,3-seco-porrigenin, isolated from the organic extract of *Allium porrum*, exhibit significant anti-proliferative activity against murine Leukemia (P388) cell lines [30] .

ANTI-TRYPANOSOMAL ACTIVITY:

Intra-peritoneal injection of ethyl acetate and ethanol extracts of *Allium porrum* causes feeble changes in pre-treatment and post-treatment parasitemia levels in experimental rats with trypanosomiasis. However, there is significant clearance in parasitemia in the control group, indicating trypanosomal reduction activity compared to the control group [31] [32] .

IMMUNOLOGICAL ADJUVANT ACTIVITY:

Mice immunized with oval albumin conjugated with steroidal saponins from *Allium porrum* show a greater response compared to those combined with commercial adjuvants. This response develops rapidly after immunization and persists at high levels for at least 3 days [19] [33] . .

ANTI-OSTEOPOROTIC:

Oral administration of alcoholic extract of *Allium porrum* (250 and 500 mg/kg) exhibits significant antioxidant activity, resulting in a significant elevation in decreased bone mineral density in osteoporotic rats compared to the control group. Flavonol derivatives such as quercetin and kaempferol stimulate osteoblastic activity, suggesting potential pharmacological tools for treating osteoporosis [34-35] .

CHELATING AGENT:

The hydroalcoholic extract of *Allium porrum* at a dose of 400 mg shows significant iron-chelating properties compared to the control. Lower doses also reduce iron and ferritin

content, albeit to a lesser extent. The extract's effects are similar to that of the standard drug Deferoxamine, indicating its potential as an iron chelating agent [36].

MAST CELL STABILIZING ACTIVITY:

Leek extract decreases the degranulation of human mast cells in a dose-dependent manner, suggesting potential anti-allergic effects [37].

NEPHROPROTECTIVE ACTIVITY:

The aqueous extract of *Allium porrum* shows protective effects against cisplatin-induced nephrotoxicity in rabbits, indicating its potential therapeutic use in counteracting nephrotoxicity in cancer patients undergoing chemotherapy [38].

CONCLUSION AND FUTURE PROSPECTS:

Allium porrum, commonly known as leek, emerges as a versatile botanical with significant pharmacological potential, supported by its rich chemical composition and historical medicinal use. Its diverse array of bioactive compounds, including organo-sulphur compounds, phenolic compounds, and vitamins, underpin its various health-promoting properties.

The extensive pharmacological activities demonstrated by *Allium porrum*, such as anti-hypertensive, anti-diabetic, anti-inflammatory, antimicrobial, anti-platelet, and more, underscore its potential therapeutic utility in managing a wide range of health conditions, including cardiovascular diseases, diabetes, inflammation-related disorders, and infections.

The full therapeutic potential of *Allium porrum* can be realized, contributing to the development of novel and effective therapeutic agents for various health challenges. Moreover, fostering interdisciplinary collaboration between botanists, pharmacologists, clinicians, and traditional medicine practitioners would further accelerate progress in this field. Ultimately, *Allium porrum* holds promise as a valuable resource in the pursuit of global health and well-being.

Further scientific investigation into different parts of *Allium porrum* is necessary to unveil additional pharmacological properties.

Declaration by Authors

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