

REVIEW ARTICLE

Lactuca serriola: Short Review of its Phytochemical and Pharmacological Profiles

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ABSTRACT

Lactuca serriola Linn (prickly lettuce) is a common weed in cultivated fields belong to the Asteraceae family. Its leaves are used as a vegetable, eaten raw, or cooked. The present review attempts to furnish a brief overview of pharmacognosy, traditional uses, phytochemical, pharmacological activities, and the industrial applications of the *Lactuca serriola* (*L. serriola*) that will further explore its potential using the scientific process. Notarized information on pharmacognosy, traditional uses, phytochemical, pharmacological activities, and industrial applications of the *L. serriola* was gathered from authenticated online sources, like Scopus, Google Scholar, Research Gate, Science Direct, Elsevier, PubMed, and Web of Science. Additional information was collected from traditional sources, such as, books, book chapters, journal articles, and scientific publications sourced from the college library. *L. serriola* has a conventional use in the treatment of headache, insomnia, nervousness, hypertension, palpitation, fever, etc. It has been found in a recent finding that *L. serriola* contains active components that have biological functions in disease control. They display diverse pharmacological activities, including sedative, hypnotic, diuretic, antioxidant, anesthetic, antispasmodic, anticancer, antibacterial, a bronchodilator, and vasorelaxant. The interest was due to its availability and cost-effectiveness, drawing the attention of many researchers screening for various bioactive substances.

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INTRODUCTION

It is known for ages that wild plant species are essential for humans' well-being, development of livelihood, and resilience to the ecosystem. They offer valuable economic, social, and ecological benefits.¹

In most societies and more significantly in developing countries, wild plants generate tremendous direct economic benefits being an important source for significant marketed goods (food, medicinal plant, firewood, cork, etc.), as well as, high indirect value for non-marketed services (biodiversity conservation, soil protection, water regulation, recreation possibilities).²

According to the World Health Organization (WHO), more than 80% of the world's population relies on traditional medicines for their primary health care needs. The medicinal value of plants lies in some chemical substances that produce a definite physiologic action on the human body. The most important of these bioactive compounds are alkaloids, flavonoids, tannins, and phenolic compounds.³

Al-Rawi and Chakravarty's study is considered the first pioneering study in Iraq that classified many wild Iraqi plants.⁴

One of these wild plants is *Lactuca*, which belongs to the Asteraceae family. The generic name *Lactuca* and the common name lettuce derived from the Latin word *lactus* (milk), a milky fluid that flows from the stems when they break or cut, called Lactucarium used in the 19th century as an adulterant for opium. *Lactuca* genus comprises about 100 species out of 17 European, 10 North American, 33 tropical east African, and about 40 Asian species.⁵ In Iraq, *Lactuca* is represented by two species, viz., *Lactuca sativa* (garden lettuce), which is a cultivated variety, and *L. serriola* (wild lettuce), which is a wild variety.⁴

L. serriola L. is a winter or summer annual, meridional temperate, and west-euroasiatic species, although it has a synanthropic world-wide distribution nowadays. The taxon displays considerable morphological, geographic, and genetic variation and ranges over a broad spectrum of different habitats. There are two forms within *L. serriola* L., viz., *L. serriola* L. f. *serriola* and *L. serriola* L. f. *integrifolia*. Recently, *L. serriola* has spread throughout Europe as an invasive weed. It is considered a progenitor of cultivated lettuce (*Lactuca sativa* L.).⁶

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The present review attempts to furnish a brief overview of pharmacognosy, traditional uses, phytochemical, pharmacological activities, and industrial application of *L. serriola*, which will help exploit its unexplored potential through a more scientific process.

TAXONOMIC CLASSIFICATION⁷

Kingdom: Plantae
Phylum: Angiosperms
Order: Asterales
Family: Asteraceae
Subfamily: Cichorioideae
Genus: *Lactuca*
Species: *L. serriola*
Synonym: *Lactuca scariola* L.
Vernacular names: Prickly lettuce, wild lettuce, jagged lettuce, compass plant, China lettuce, wild lettuce, wild opium, *Kahu* and *Khas*.

L. serriola is known as the compass plant because, in the Sun, the upper leaves twist round to hold their margins upright.

HABITAT AND DISTRIBUTION

Habitat

L. serriola is found in harbors, ballast soil deposits, industrial areas, waste ground, heaps of earth, road cuttings, roadsides, yards, flower beds, and new lawns.⁸

Distribution

A study of the genetic structure and diversity of natural populations of *L. serriola* showed that genetically the most diverse populations studied are located in eastern Turkey and Armenia. They had most of the alleles present in peripheral communities, while the latter has only part of the allele diversity present in eastern Turkey and Armenia. This suggests that eastern Turkey, Armenia, and adjacent regions of southwest Asia are likely the center of origin of *L. serriola*. A significant correlation of genetic distance with geographical longitude further indicates that the species has spread first to the Mediterranean basin and then to Central and Western Europe.⁹

Botanical Distribution^{10,11}

Height

40–80 cm (16–32 inches)

Stem

Lower part short-spiny, to a certain extent, glabrous (Figure 1)

Flower

Single flower-like 1 to 1.5 cm (0.4–0.6 inches) capitula surrounded by involucre bracts, capitula flowers pale yellow, tongue-like, tip five-toothed. Stamens-five. The gynoecium is composed of two fused carpels. Capitula in a dense, cyme-like group.

Flowering Time

July to August

Leaves

Alternate, apparently vertically side-by-side in two rows, stalkless. Blade long, with sagittate base, pinnately lobed, unevenly toothed margins, rigid, bluish-green, midrib on underside spiny, and green (Figure 1). The young leaves are eaten raw as a salad or cooked, although it has a somewhat bitter taste.

Fruit

Wide-edged, greyish green, 6–8 mm (0.24–0.32 inches) long achene, crowned by a pappus of grayish-white unbranched hairs.

TRADITIONAL USES

The *L. serriola* plant has traditional medicinal uses, like a sedative, hypnotic, expectorant, cough suppressant, purgative, demulcent, diuretic, antiseptic, vasorelaxant, and antispasmodic. Thus, it is used to manage bronchitis, asthma, pertussis, gastrointestinal, and various other ailments.¹²

The whole plant is rich in a milky sap that flows freely from any cut on the plant. The milky sap becomes hard and dries upon coming in contact with air. The sap contains "*Lactucarium*," used in medicine for its medicinal properties, such as, anodyne, antispasmodic, digestive, diuretic, hypnotic, narcotic, and sedative properties. *Lactucarium* neither has the effect of a feeble opium, but without its tendency to cause digestive upsets, nor is it addictive. It is taken internally in the treatment of insomnia, anxiety, neuroses, hyperactivity in children, dry coughs, whooping cough, rheumatic pain, etc. Concentrations of *Lactucarium* are low in young plants and most concentrated when the plant comes into flower. It is commercially collected by cutting the plants' heads and scraping the juice into China vessels several times a day until the plant is exhausted. An infusion of the fresh or dried flowering plant can also be used.¹³ The fixed oil from the seeds is said to possess antipyretic and hypnotic properties.¹⁴

CHEMICAL COMPOSITION

Organic

It is composed of alkaloids (0.02%), sugar and glycosides (6.5%), volatile oil in traces, fat (2.2%), gums (2.16%), organic



Figure 1: Photo of *L. serriola*

acids (1.06%), carotene (16 mg), saponins, phytosterols, phenolic compounds, flavonoids, tannins, carbohydrates, and triterpenoids.^{12,15}

Inorganic

The plant contains vitamins like vitamin B1 (22%), vitamin C (44%), vitamin E (32%), vitamin K (0.2 mg), and minerals like sodium, potassium, magnesium, iron, sulfur, chloride, and phosphorus.^{12,16}

Seeds

The phytochemical investigations of seeds revealed the presence of alkaloids (*Lactucarium* is a mixture of lactucin, and three bitter substances lactocin, lactucopicrin, and lactucic acids), organic acid (oxalic acid), sesquiterpene esters, and triterpenoid saponin.¹⁷

Leaves

The phytochemical screening for *L. serriola* leaves' methanolic extracts showed glycosides, saponins, phytosterols, phenolic compounds, and flavonoids (quercetin-3-*O*-*P*-*D*-glucopyranoside, luteolin-7-*O*- β -*D*-glucopyranoside, luteolin, quercetin, and kaempferol), tannins, carbohydrates, and triterpenoids.^{18,19}

Stems

A brown viscid substance obtained following evaporation of the plant juice, called *Lactucarium*, a triterpenoid saponin isolated from stem possesses antibacterial activity, and also *L. serriola* contains antioxidant flavonoids.^{18,20}

REPORTED PHARMACOLOGICAL STUDIES

Spasmolytic, Bronchodilator, and Vasorelaxant Activities

A study by Janbaz K. *et al.* found that the methanolic extract of *L. serriola* possesses spasmogenic, spasmolytic, bronchodilator, and vasorelaxant activities. The spasmogenic activity may be attributed to some cholinergic constituents. In contrast, the spasmolytic effect may be due to Ca⁺⁺ channel blocking components that may cause relaxation of gastrointestinal, tracheal, and aortic smooth muscles.¹⁷

Analgesic and Sedative Activities

L. serriola exhibited dose-dependent potent analgesic activity. Fayyaz *et al.* reported that the methanolic extract of *L. serriola* could produce significant analgesic activity but failed to show an anti-inflammatory effect.²¹

Furthermore, Wesolowska and colleagues evaluated the analgesic and sedative properties of Lactucin and its derivatives lactucopicrin and 11 β , 13-dihydrolactucin in mice, the results revealed that Lactucopicrin is the most potent analgesic of the three tested compounds. Lactucin and lactucopicrin, but not 11- β , 13-dihydro-lactucin, also showed sedative properties in the spontaneous locomotor activity test.²²

Antimicrobial Activities

L. serriola exhibited antibacterial effects; Al-Marzoqi *et al.* proved this fact in a study while evaluating the effects of the crude phenolic, alkaloid, and terpenoid compounds extracts of *L. serriola* L. on human pathogenic bacteria.²³

Moreover, Yadava *et al.* had isolated a new triterpenoid saponin from the seeds of *L. serriola*; this compound showed antimicrobial activity against various bacteria and fungi.²⁰ A study of Balogun *et al.* revealed that the aqueous and methanolic leaf extracts of *L. serriola* demonstrated a significant dose-dependent antipseudomonal activity against multi-drug resistant *Pseudomonas aeruginosa* clinical isolates.²⁴

Antioxidant Activities

Kim manifested the antioxidant activity of *L. serriola* by measuring the radical scavenging effect on DPPH (1, 1-diphenyl-2-picrylhydrazyl) radical and found that the methanolic extract of the aerial parts of *L. serriola* showed intense radical scavenging activity.¹⁸ Besides, El-Esawi *et al.* showed the effects of genetic transformation and hairy root induction in enhancing the antioxidant activities of *L. serriola* L.²⁵

Anticancer Activities

Elsharkawy E and Alshathly M found that the methanol extracts prepared from leaves and stems of *L. serriola* showed cytotoxic activity against A549, HePG, MCF7, and HCT116.²⁶

Anxiolytic and Antidepressant Activities

A randomized placebo-controlled double-blind trial of *L. serriola* Linn seeds on mixed anxiety depressive disorder has shown a significant effect in reducing anxiety and depressive symptoms.²⁷

All these reported pharmacological studies may provide a scientific basis to validate the traditional use of *L. serriola* in the management of some neurological, respiratory, gastrointestinal, and vasospastic ailments.

Application of *L. serriola* in Industries

The wild green plants, especially *L. serriola*, have been and are still of interest in industrial applications. Ambasta S.P mentioned in his book that *L. serriola* seeds' oil is used in industries as soap-making, paints, and varnish.²⁸

Furthermore, many attempts were made by Al-Soufi M.A. to isolate two different types of enzymes (protease and polyphenol oxidase) from *L. serriola* leaves.^{29,30} Proteases prove to be of great importance in various industries, like the detergent industry, leather industry, food industry, pharmaceutical industry, therapeutics, and industrial waste management. Simultaneously, polyphenol oxidase has a wide range of applications and usage in food processing industries and medicine. Polyphenol oxidase is used commercially to remove phenols from wastewaters to make them potable. They are also highly preferred in the food production plants to enhance tea and coffee color and aroma.^{31,32} The exploitation of wild plants to produce different types of enzymes with diverse applications is considered one of the most promising future alternatives.

CONCLUSION

The present review summarizes some essential phytochemical investigations, pharmacological studies, and industrial applications. *L. serriola* has its importance as anticancer,

antibacterial, antifungal, spasmolytic, a bronchodilator, and vasorelaxant. These reported activities indicate that *L. serriola* can be a very promising plant for therapeutic utility. Further investigation may be done to determine the active ingredients, mechanisms of action, and utilities of *L. serriola* so that *L. serriola* can be established as a future standard drug owing to its scope.

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