

A Review on Phytopharmacopial Potential of *Epilobium angustifolium*

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ABSTRACT

Nature has been a source of medicinal agents for thousands of years, and an impressive number of modern drugs have been isolated from natural sources which are based on their use in traditional medicine. *Epilobium angustifolium* L is a perennial herbaceous plant that belongs to the *Onagraceae* family. It exhibits various therapeutic properties like anticancer, antibacterial, anti-inflammatory, antioxidant, and anti-aging properties. *Epilobium angustifolium* L. contains polyphenols and secondary metabolites like oenothin B. Information was collected via Medline, PubMed, and Science Direct. Also some data have been collected from scientific journals, books, and reports. This review gives the current information on the chemical composition, traditional uses, and documented biological activities of *Epilobium angustifolium* L. These studies reveal that *Epilobium angustifolium* L is a source of medicinally active compounds and have various pharmacological effects. These studies will be helpful to create interest toward *Epilobium angustifolium* L and may be useful in developing a new direction for further research. *Epilobium angustifolium* L. is a medicinally important plant belongs to Onagraceae family. Extract from the plant is used in the treatment of many diseases for its anti-tumor, antimicrobial, anti-inflammatory, antioxidant, anti-ulcer and many other properties. The medicinal properties of fireweed have been attributed to its high content in polyphenols and more particularly to the most abundant of its secondary metabolites: Oenothin B.

Key words: *Epilobium angustifolium* L, Oenothin B Pharmacological effects, Herbaceous, Biological activities.

INTRODUCTION

Epilobium angustifolium is a remedial plant that belongs to the Onagraceae family, which contains more than 200 different species. It is called “fireweed” in North America, “rosebay willow-herb” in Great Britain and “maitohorsma” in Finland.¹ Within *Epilobium* species, *E.angustifolium* is one of the well-known medicinal plants which is used worldwide in customary medicine. Extracts obtained from rosebay willow-herb shows a variety of pharmacological effects.² *Epilobium* taxa has both *in vitro* and *in vivo* studies to show many therapeutic properties, including anti-inflammatory, antiandrogenic, antiproliferative, antimicrobial, Antinociceptive, and antioxidant effects.³ *Epilobium angustifolium* is widely used in non-traditional medicine to treat gastrointestinal disorders, mucous membrane lesions, such as mouth ulcers, wounds healing, skin sores, swelling.⁴ In the last few decades there has been a growing interest in phytochemical composition of various parts of *Epilobium* plants. Ellagitannins is the major bioactive compounds present in *Epilobium* plants. Some ellagitannins present in the plant exhibit immune modulatory activity.

The main biologically active component in *Epilobium* taxa is Oenothin B (a dimeric macrocyclic ella-

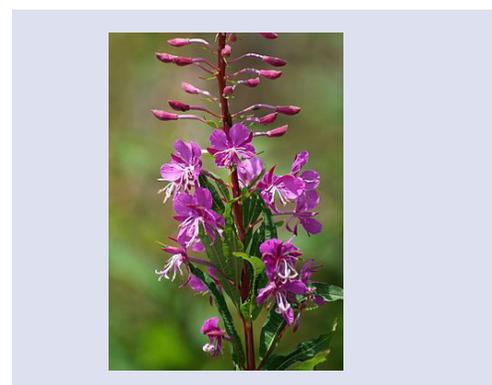


Figure 1: Morphology of *Epilobium angustifolium*

gitanin) which is present in high concentrations in *Epilobium* species. Earlier studies on Oenothin B has been revealed significant antioxidant, antitumor, antibacterial, and antiviral activities.³

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The aim of this paper is to give comprehensive review on the chemical composition, traditional uses, and documented biological activities of plant belonging to the *Epilobium angustifolium*.

Botanical Description

Herbaceous perennial, forming colonies by extensive system of pseudo-rhizomes; stem erect, up to 3 m tall, simple to much branched on top of, glabrous to very pubescent with little upwardly curled trichomes, the inferior parts with exfoliating epidermis; leaf blades linear to broadly elliptic or lanceolate, the abaxial midrib glabrous to very pubescent; inflorescence showy, with from several to 100 flowers; petals pink, 3-17 mm broad, 7-22 mm long; style usually hairy at base; stigma opening 2-3 days after anthesis. Capsule with up to several hundred comate seeds.⁵

Geographical Distribution

Epilobium angustifolium is indigenous throughout Canada and most of the United States except for Kansas, Oklahoma, Texas, Missouri, Arkansas, Kentucky, and the southeastern states. In Indiana, Ohio, and North Carolina fireweed is classified as an Endangered species, and in Tennessee it is a Species of Concern. It grows mainly in forest and alpine meadows, in semi-shaded mixed forests and forest edges, and along rivers and streams. This versatile plant can grow almost anywhere. Its main association is as an active colonizer of recently burned areas, behavior that has earned fireweed its name.^{6,7}

Active Compounds

Plant belonging to the *Epilobium* genus area rich source of secondary metabolites, especially polyphenols including flavonoids, phenolic acids and tannins. Apart from polyphenols, some lipophilic compounds such as steroids, triterpenoid and fatty acids have also been isolated and identified from the *Epilobium* species.⁸

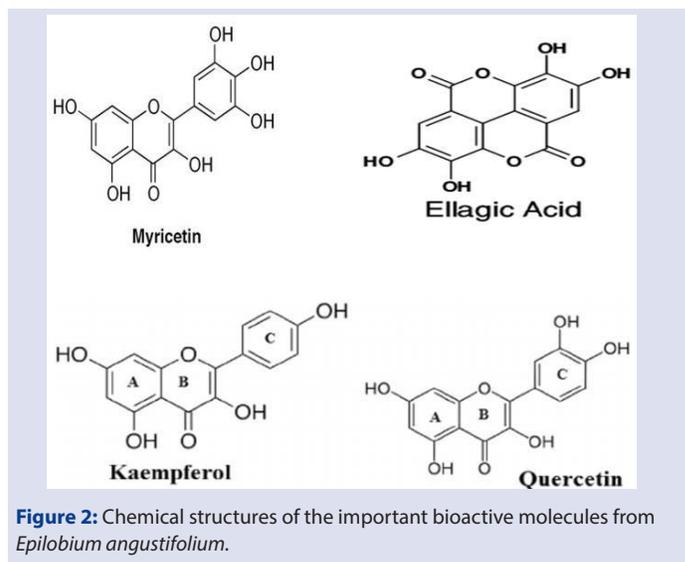
A variety of polyphenols present in *Epilobium angustifolium*. Three major polyphenol groups have been identified in *Epilobium angustifolium* extracts: flavonoids, phenolic acids, and ellagi tannins. Flavonoids consist of flavonol aglycones (quercetin, kaempferol, and myricetin) and flavonoid glycosides, such as afzelin (kaempferol-3-O-rhamnoside), juglalin (kaempferol-3-O-arabinofuranoside), avicularin (quercetin-3-O- α -arabinofuranoside), hyperoside (quercetin-3-O-galactoside), isoquercetin (quercetin-3-O-glucoside), quercitrin (quercetin-3-O-rhamnoside), and miquelianin (quercetin-3-O-glucuronide).⁹ Miquelianin is the main flavonoid in *Epilobium angustifolium*, among the flavonoid glycosides that have been identified in *Epilobium* species. Whereas myricitrin (myricetin-3-O-rhamnoside) was found to be the main flavonoid in other species. Some of these compounds are active constituents of many remedial plants that are used in conventional medicines for their neuroprotective, anti-inflammatory, antioxidant, anti-proliferative, and other pharmacological properties. Tellimagrandin I-based oligomeric ellagitannins are relatively high-molecular weight polyphenols.¹⁰

From *Epilobium angustifolium* extracts several other oligomeric tannins have been isolated, including oenothein A (trimer), and tellimagrandin I-based heptameric ellagitannins. Oenothein B is a macro cyclic ellagitannin. Important biological activity shown by Oenothein B which include antioxidant, immunomodulatory, tumor cell cytotoxicity, enzyme inhibition, and enzyme induction.²

Ellagic acid which is a marker of ellagi tannins occurrence has been detected. *Epilobium* species including the most popular *E. angustifolium*, *E. hirsutum* and *E. parviflorum*. Valoneic acid dilactone has been reported in *E. angustifolium*.¹

While other quinic acid esters have only been detected in *Epilobium angustifolium* using the HPLC-DAD-MS method.¹¹ Also Cholesterol,

campesterol, stigmasterol, β -sitosterol and its glycosides and esters have been reported from *Epilobium angustifolium*.¹



Traditional Uses

Fireweed infusion or tea has been reported for the treatment of migraine headaches, insomnia, anemia, delirium tremens, infections, and colds. *Epilobium angustifolium* extracts have been helpful in gastric ulcer; duodenal ulcer; gastritis; colitis; various gastrointestinal disorders, such as dysentery and diarrhea; and prostate or urinary problems, such as urethral inflammation, micturition disorders, prostatic adenoma, and benign prostatic hyperplasia (BPH).²

Epilobium angustifolium infusions due to its astringent, demulcent and emollient properties, were commended by American herbal list in the 19th and early 20th century as a very effective agent to treat gastrointestinal diseases such as dysentery and diarrhea of different aetiologies as well as other bowel and intestinal disorders associated with infection, irritation and inflammation.¹ *Epilobium angustifolium* is used to treat whooping cough, hic cough and asthma.¹² A poultice made from the leaves of *Epilobium angustifolium* was applied to burns, bee stings, aches and in swelling by Gwich'in people.¹³ The medicinal properties of fireweed have been attributed to its high content in polyphenols and more particularly to the most abundant of its secondary metabolites: oenothein B.¹⁴ *Epilobium angustifolium* has also been used topically as a cleansing, soothing, antiseptic, also healing agent to treat minor burns, skin rashes, ulcers, and for treatment of inflammation of the ear, nose, and throat.¹⁵

Pharmacological Reports

Anti-inflammatory activity

Epilobium angustifolium aqueous extracts have also been reported to have anti-inflammatory properties which reduced carrageenan-induced paw edema.¹

Analgesic activity

Fireweed extracts have been reported to exhibit analgesic properties using hot plate and writhing tests.¹³

Antiviral activity

Epilobium angustifolium extracts administration, prior to influenza virus exposure reduced mortality and increased survival mean time. These effects were even more striking when infection occurred seven days after

the last administration of the extract, where mortality rate was reduced by 50% and survival mean time was increased fivefold.³

Anti-tumor activity

Epilobium angustifolium extracts have also been reported to exhibit anti-tumor properties, including inhibition of human prostate epithelial cell PZ-HPV-7 growth. Likewise, treatment of androgen-sensitive human prostate adenocarcinoma cells LNCaP with *Epilobium* extracts (20–70 µg/ml) resulted in a significant increase in the number of apoptotic cells. Various *Epilobium* extracts, including extracts from *Epilobium angustifolium*, caused a similar inhibitory effect on the proliferation of human cancer cell lines and inhibited DNA synthesis in human astrocytoma cells 1321N1.¹ In addition, aqueous extract of *E. angustifolium* demonstrated higher antiproliferative activity than ethanol extracts.^{16,17}

Anti-Oxidant activity

Epilobium angustifolium aqueous extracts are able to scavenge superoxide anion (O₂⁻) and hydroxyl radicals, as well as inhibit ROS production by stimulated neutrophils.¹

CONCLUSION

Epilobium angustifolium is a medicinal plant which is widely used in conventional medicine. Oenothien B is biologically active polyphenols present in this plant extract. The remedial effects of *Epilobium angustifolium* polyphenol are mediated by multiple mechanisms, including direct killing of cancer cells and microbes, antioxidant activity, metal Chelation and both pro-inflammatory and anti-inflammatory immune modulation. Further, a better understanding of *Epilobium angustifolium* active molecules and their mechanisms of action is essential for maximizing the therapeutic potential of this interesting plant and ensuring safe use of these compounds as therapeutics.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ABBREVIATIONS

HPLC-DAD-MS: High performance liquid chromatography with diode array detection and Mass spectrometry **BPH:** benign prostatic hyperplasia **PZ-HPV-7:** Human papillomavirus type-7 **LNCaP:** Lymph node carcinoma of the prostate **DNA:** Deoxyribonucleic Acid **ROS:** Reactive Oxygen Species

SUMMARY

- Epilobium angustifolium* L. is a medicinally important plant belongs to Onagraceae family.

- Extract from the plant is used in the treatment of many diseases for its antitumor, antimicrobial, anti-inflammatory, antioxidant, anti-ulcer and many other properties.
- The medicinal properties of fireweed have been attributed to its high content in polyphenols and more particularly to the most abundant of its secondary metabolites: oenothien B.

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