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Review on Immunomodulatory Activity of the Plant *Hedera Helix*

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ABSTRACT

Originating in Europe, Hedera helix was most likely introduced to the United States by early settlers as a decorative vine. This plant's attractive, glossy, dark green leaves keep it a well-liked, low-maintenance evergreen ground cover. It is currently widespread in eastern and southern states, with Oregon and Washington seeing the worst ecological effects. The intriguing thing about Hedera helix is that, depending on its age and sun exposure, it has two different leaf forms. The most common number of lobes on the leaves of this groundcover is three to five. When mature plants in full sun reach flowering age, they frequently have oval, unlobed. In our region, Hedera helix L. is frequently grown as an indoor ornamental plant, though it also does well outdoors in milder climates. Because of its well-known ability to withstand challenging circumstances, it has naturally been used extensively in both teaching and research. Its leaf form and size under different conditions have been the subject of numerous studies. Although they were only three years old, the leaves that were surveyed were still green and vigorous and were taken from a location about twenty inches from the base of the main stem. The leaf used for the measurements was 5.8 cm long. Five stations were selected from the lateral half of the leaf to obtain sample areas for analysis; three stations were closer to the center, and two were closer to the outer edge.

Keywords: Hedera helix, ecological, ornamental plant, vigorous.

Introduction

Hederae folium (Ivy leaf) consists of the whole or cut, dried leaves of *Hedera helix* L.

collected in spring or early summer with a minimum of 3.0% of hederacoside C. *Hedera helix* L. (English ivy, Common ivy) is an evergreen dioecious woody liana, one of the 15 species of the genus *Hedera*, Araliaceae family. The whole leaves are coriaceous, 4–10 cm long and wide, cordate at the base. The lamina is palmately 3–5 lobed. The upper surface is dark green with a paler, radiate venation, while the lower surface is more greyish-green and the venation is distinctly raised. The flowering stems are formed by 3 to 8 cm long, ovate-rhomboid to lanceolate leaves. Small, greenish-yellow flowers in 3–5 cm diameter umbels are produced from summer until late autumn; the fruit is small black berries that ripen in winter. Although it is native to Western, Central, and Southern Europe, common ivy has also been brought to North America and Asia. It is a widely used decorative plant in various nations. Triterpene saponins (2.5–6%) are the biologically active compounds that give rise to H. helix's medicinal applications. Hederacoside P (1.7–4.8%), Hederacoside D (0.4–0.8%), Hederacoside B (0.1–0.2%), and Monodesmoside α-herein (0.1–0.3%) are the bidesmosidic glycosides of hederagenin. Phenolics (flavonoids, anthocyanins, coumarins, and phenolic acids), amino acids, steroids, vitamins, volatile and fixed oils, β-lectins, and polyacetylenes are some of the other groups of the identified compounds. Hedera leaves are approved by the German Commission E to treat respiratory tract catarrhs and the symptoms of chronic inflammatory bronchial conditions. For the treatment of liposclerosis (also known as "cellulitis"), topical application of a Hedera-saponin complex (hederacoside C, B, and α-hederin) is useful. Also mentioned were the characteristics that promote weight loss. Creams, lotions, and shampoos that are emollient and relieve itching, containing extract from Hedera helix, are used in cosmetics and skin conditions. Hedera leaves are also applied externally to treat parasites and treat gout and rheumatism in traditional medicine. Hedera helix is used in homeopathy to treat inflammation of the respiratory tract, rheumatic diseases, and hyperthyroidism.

Figure 1: Picture of *Hedera helix* plant.

Morphological Character

Evergreen climbing plants like Hedera helix can reach heights of 20–30 m (66–98 ft) when they grow on suitable surfaces like trees, cliffs, or walls. In areas without any vertical surfaces, they can also grow as ground cover. It uses matted pads on its aerial rootlets to adhere tenaciously to the substrate as it climbs. The variety of plants and other factors affect their ability to climb on surfaces. Hedera helix favors surfaces that are nearly neutral in pH, non-reflective, rough, and darker. It usually grows in a wide range of soil pH values, with 6.5 being ideal. It also likes damp, shaded areas and stays out of direct sunlight, which encourages drying out in the winter. The leaves are of two types: juvenile leaves, which are palmately five-lobed and grow on creeping and climbing stems, and adult leaves, which are unlobed and cordate and grow on fertile flowering stems exposed to full sun, usually high in tree crowns or on the top of rock faces. The leaves are alternating, measuring 50–100 mm (2–4 in) in length and have a 15–20 mm (0.6–0.8 in) petiole. The tiny flowers are produced in 3-to 5-cm-diameter (1.2-to 2.0-in) umbels from late summer to late fall. They are greenish-yellow in color and incredibly rich in nectar, which is a crucial late-fall food source for bees and other insects. The berries, which range in color from purple-black to orange-yellow and measure 6-8 mm (0.2-0.3 in) in diameter, ripen in late winter[9]. A significant amount of birds rely on these berries for food.

Figure 2: *Hedera helix* leaves

Taxonomical Classification

Kingdom: Vertebrates Class: Dicotyledonae, Phylum: Spermatophyta, Subphylum: Angiospermae Family: Araliaceae, Order: Araliales Species: Hedera helix, Genus: Hedera

Distribution

Egypt, Libya, Morocco, Tunisia; Asia, Armenia, Georgia, Russian Federation, Iran, Iraq, Palestine, Lebanon, Syria, Turkey; Europe, Belarus, Latvia, Lithuania, Moldova, Ukraine, Austria, Belgium, Germany, Hungary, Czechoslovakia, Netherlands, Poland, Switzerland, Denmark, Ireland, Norway, Sweden, United Kingdom, Albania, Bulgaria, Former Yugoslavia, Italy, Romania, France, Portugal, Spain); Australasia, Australia, New Zealand; and North America, Canada, United States.

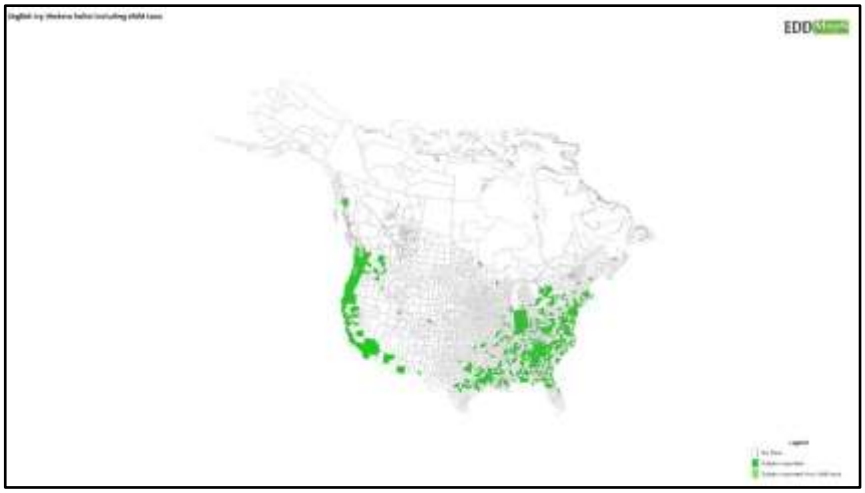

Figure 3: Geographical distribution of *Hedera helix.*

Habitat

Hedera helix is a particularly pernicious nemesis to natural areas because it is a groundcover and climbing vine that poses a threat to both disturbed and undisturbed forests. Climbing vines slowly kill trees from the base upwards, suffocating native wildflowers and seedlings and forming a thick mat along the forest floor, all while impeding natural regeneration. Strongly extending vines enclose the branches, hindering photosynthesis and resulting in upward branch death. The tree will eventually die as a whole. Trees with thick vine coverings are more likely to topple over during storms, posing a risk to nearby residences, public spaces, and parks.

Prevention and Control

Hand removal of minor H. helix infestations is possible. Observe and eliminate any resprouts.

Since pulled plants that are left on the ground can continue to grow, care should be taken when bagging and removing the plants.

Large H. helix infestations typically call for a combination of foliar herbicide treatments and chopped stump removal. Cut each stem as close to the ground as you can when vines have grown into the tree canopy. Then, cut again a little higher up and remove the cut pieces. Eventually, the top part of the vine will rot, die, and fall off the tree. Apply a 50% triclopyr solution to the recently chopped surface of the rooted stem. A foliar solution of 4 percent glyphosate plus 0.5 percent to 1 percent non-ionic surfactant or 2 percent triclopyr plus 0.5 percent non-ionic surfactant can be used to treat H. helix groundcovers, making sure that all of the leaves are well-wet. As H. helix is evergreen, it can be treated all year long as long as there are several days when the temperature stays above 55 to 60 degrees Fahrenheit. It's likely that multiple treatments are required to achieve total control. Glyphosate solutions generally function best on Helix helicoides in the spring, while triclopyr solutions perform best in the summer and fall.

Chemical Constituents

The main substances that exhibit biological activity are called triterpene saponins. Hedera helix has been shown to contain triterpene saponins, flavonoids, polyacetylenes, and certain phenolic compounds. The therapeutic effect of ivy leaf extract has been specifically linked to α-hederin, a triterpene saponin, due to its β2-adrenergic effects, which result in the spasmolytic, bronchodilatory, mucolytic, and expectorant actions. Hederacoside C, a different triterpene saponin, is also known to metabolize into its active form and cause the same physiological effects as α-hederin.

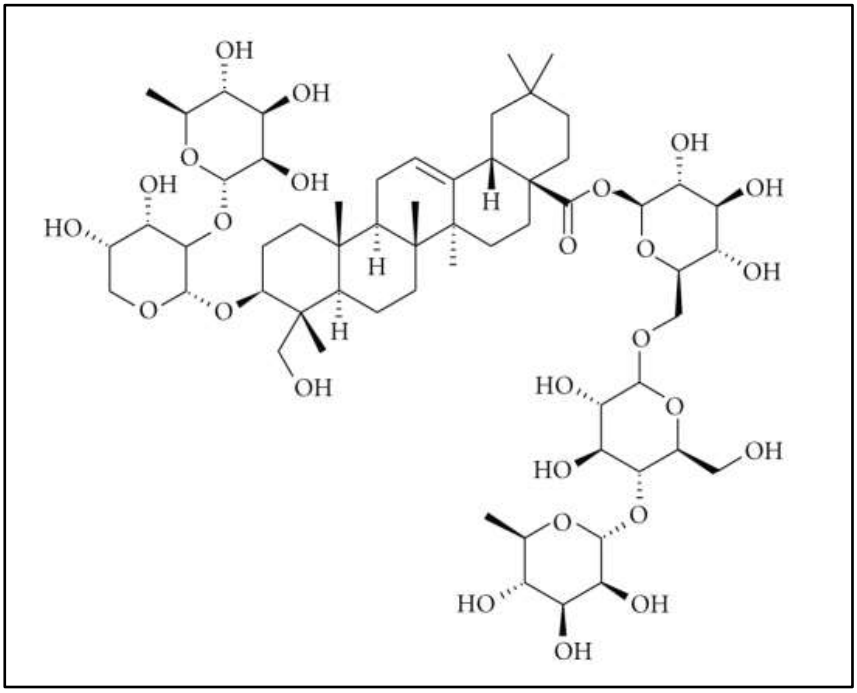

Figure 4: Structure of Hederocoside C

Traditional Use

It was used to treat acute and chronic inflammatory bronchial disorders symptomatically as well as common colds accompanied by coughs. The berries and leaves were taken orally as an expectorant to treat bronchitis and cough. The leaves were also used as an analgesic and anti-inflammatory. Boiling Hedera helix leaves were applied to the affected area of the body to combat worms, scabies, and ringworms. Depending on the amount consumed, it was used as a stimulant, narcotic, and hallucinogenic to treat depression. In Turkey, a Hedera leaf decoction was used to treat diabetes. It was applied topically to cracks, cuts, chapped skin, and insect bites as a protective measure and as a calming and anti-pruriginous remedy.

Respiratory Effect

By employing bovine tracheal smooth muscle strips for isometric tension measurements, the bronchiolytic effect of α-hederin was demonstrated. It is likely that α-Hederin prevented heterologous desensitization brought on by high concentrations of muscarinic ligands such as methacholine, which in turn enhanced isoprenaline-induced relaxation indirectly.

Anti-inflammatory and Analgesic Effect

The anti-inflammatory qualities of the Hedera helix ethanolic extract were examined. When formalin was used to induce paw edema, intraperitoneal injections of 7.5 ml/kg bw ethanol extract demonstrated anti-inflammatory activity (88.89% inhibition), in contrast to diclofenac, which demonstrated 94.44%. Research has also been done on the impact of Hedera helix ethanol extract on arthritis. It had a strong anti-inflammatory effect that was evident in a noticeable decrease in arthritic symptoms.

Anti-cancer Activity

The cytotoxicity results show that, when tested on the brine shrimp bioassay, eight fractions of air-dried Hedera helix extract possessed cytotoxic activity, with β-amyrin being the compound responsible for this activity. Hedra helix's methanolic extract of the leaves exhibited cytotoxic activity (LC50: 802.73 µg), according to a bioassay using brine shrimp. Subsequent analysis revealed that the phenolic compound, with an LC50 of 161.84 µg, was the active ingredient.

Anti-microbial Effect

With MIC values of 0.3–1.25 mg/ml for Gram-positive bacteria (Bacillus spp., Staphylococcus spp., Enterococcus spp., and Streptococcus spp.), 1.25–5 mg/ml for Gram-negative bacteria (Salmonella spp., Shigella spp., Pseudomonas spp., Escherichia coli, and Proteus vulgaris), and 2.5 mg/ml for Candida albicans, the mixture of saponins from Hedera helix leaves, which contained a significant amount of hederacoside C.

Anti-parasitic Effects

In vitro, tests on promastigote and amastigote forms of Leishmania infantum and Leishmania tropica revealed that the saponins of Hedera helix exhibited antileishmanial activity. On promastigote forms, monodesmosides were found to be just as effective as the reference compound (pentamidine). Only hederagenin demonstrated significant activity against amastigote forms, matching that of the reference compound, N-methylglucamine antimonate.

Antioxidant Effect

The DPPH radical scavenging activity of the stem extracts from Hedera helix was found to be 84.95% for ethyl acetate, 68.24% for methanol, 52.35% for dichloromethane, and 44.75% for n-hexane.

Conclusion

Hedera helix is a promising medicinal plant with a wide range of pharmacological activities that could be used in several medical applications due to its effectiveness and safety. The current review covered the chemical constituents, pharmacological effects, and therapeutic importance of Hedera helix.

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