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Review Article

A Comprehensive Review of *Bidens Pilosa*: Botanical Features, Phytochemical Constituents, Pharmacological Properties, and Safety Profile

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ABSTRACT

Bidens pilosa L. (Asteraceae) is a widely distributed medicinal plant traditionally used in various systems of medicine for the management of numerous ailments. The plant is found in many tropical and subtropical areas and is distinguished by its capacity to adapt to a variety of environmental circumstances. Numerous bioactive substances, including flavonoids, polyacetylenes, phenolic acids, terpenoids, and alkaloids, have been identified by phytochemical investigations. Modern pharmacological studies demonstrate its broad therapeutic potential, including anti-inflammatory, antioxidant, antimicrobial, antidiabetic, anticancer, hepatoprotective, and immunomodulatory effects. This review summarises the current scientific knowledge of *B. pilosa* with an emphasis on its phytochemistry, pharmacological activities, safety profile, and potential for drug development, while highlighting research limitations and future directions. Despite its enormous therapeutic potential, further research is needed to standardise extracts, clarify mechanisms of action, and carry out well-planned clinical trials to verify its effectiveness and safety. All things considered, *Bidens pilosa* is a promising source of bioactive substances with possible uses in the development of pharmaceuticals and nutraceuticals.

INTRODUCTION

Plants are a significant source of pharmacologically active secondary compounds that can be utilised in medicine to treat certain diseases and ailments, as well as to promote and maintain human health [1]. The genus *Bidens*,

belonging to the Asteraceae family, includes around 230 species [2]. Numerous biological activities have been documented for various plants of this genus [3]. *Bidens pilosa* L. is likely the most extensively studied species within its genus [4]. BP is a plant found in tropical and sub-tropical

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regions, commonly utilised in traditional medicine and contains a variety of phytochemicals [5]. *Bidens Pilosa* was identified by Carl Linnaeus in 1753. This is a typical perennial plant that grows worldwide in both temperate and tropical climates. It has long been used in food and medicine without any noticeable side effects [6]. It is commonly known as: blackjack, amor seco, masaquía sillcao, chipaca, cadillo, picao preto, cuamba, Spanish needles, broom stick, beggar's ticks, cobbler's pegs, pitchforks, devil's needles, picao preto, and farmers' friends [7]. *Bidens pilosa* L. var. *radiata* (BPR), *B. pilosa* L. var. *pilosa* (BPP), and *B. pilosa* L. var. *minor* (BPM) are common variants of a plant [3]. In this review, we are going to briefly discuss the geographical distribution, botanical description, phytochemical constituents, pharmacological activities, toxicity and safety profile.

Geographical Distribution:

Bidens pilosa is extensively distributed across China, Japan, America, and Africa. Originating in South America [8]. *Biden Pilosa* is thought to exist in other regions of the world due to its hardiness, capacity to grow in practically any habitat, and explosive reproductive power. As a result, they can be found in countries other than Africa, including Martinique, Dominica, the Caribbean, Mexico, Bolivia, Quechua, Quechua, India,

Taiwan, Brazil, Australia, the United States, and Peru [9]. Although its introduction history in India is still unknown, *B. pilosa* has been imported as a decorative or therapeutic herb across much of the world. Since its introduction, it has spread throughout the nation, even to the Himalayan Mountain ranges. *B. pilosa* is found in Himachal Pradesh, Uttarakhand, and Sikkim's subtropical, temperate, and sub-alpine regions. It prefers disturbed habitats like roadsides, agricultural fields, and forest edges, but has also been observed in undisturbed forests and grasslands [10]. Different species of *B. pilosa* were also reported to be found in the Western Ghats region of Karnataka [11]. It can be accidentally introduced in the field during cultivation or purposely used for ornamental purposes. The plant is commonly found as a weed in fields, but it is also grown on a limited scale in nations like Nigeria, Benin, and Zimbabwe for food and medicinal purposes. Blackjack is widely distributed in tropical Africa and is considered an agricultural weed that poses a threat to other plants, according to a previous study. The type of plant in consideration is an invasive weed that poses a threat to other plants. As a result, it was eradicated to preserve other species [9].

Synonym: *Bidens biternata*, *Bidens chinensis*, *Picao preto*, *clavelito de monte*, *Spanish needles* [8].

Table 1: Taxonomic Classification [12]

kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Asterales
Family	Asteraceae
Genus	<i>Bidens</i>
Species	<i>Bidens pilosa</i> L.

Traditional Uses:

B. pilosa is used as an herb and as an ingredient in teas and herbal remedies. Its branches and leaves, both dried and fresh, are used in sauces and teas [12]. It is neutral and has the properties of removing heat and detoxifying. The herb is frequently used to treat scabies, discomfort, damage, and insect stings, or in combination to alleviate urinary retention [13]. The young leaves can be added to soups, stews, or salads, which are filled with

essential nutrients including calcium, zinc, magnesium, and dietary fibre, making the plant useful both as food and a natural medicine [14]. The roots are thought to be useful in the treatment of cancers and malaria. The plant decoction is used to treat diabetes and inflammation in Martinique. The herbal tea made from the aerial portions is said to have anti-inflammatory and anti-allergic properties in South Africa [15].



Figure 1: *Bidens pilosa* plant



Figure 2: Immature fruiting head

Botanical Description:

Bidens pilosa is a glabrous or hairy plant that has historically been thought to have significant medicinal, nutritional, and ethnomedical importance [4]. It is an erect, highly branched plant with a strong, fragrant odour. It also has white ray flowers and many yellow tubular flowers [6]. It is a herbaceous plant that grows once a year (or twice). The plant grows to a height of 20-180 cm, with quadrangular stems and hairy straggling branches. It bears alternating leaves with 3-5 pinnate leaflets, each supported by a petiole (10-70 mm long). The leaves are broadly oval and serrate, measuring 30-70 mm in length and 12-18 mm in width. Capitula form at the ends of the main stems and lateral branches, expanding to 5-12 mm in diameter. Capitula include 0-8 ray florets and 35-55 disk florets. The ray floret corollas are white-yellow and are 7-15 mm in length. The ray florets contain

underdeveloped pistils and no stamens. The disk florets have 3-5 mm long, yellow corollas, five stamens, and well-developed pistils that are 2-3 mm long. Its fruits are black linear cypselae with 2-5 stiff awns of 2-4 mm long [16], and the whole plant is usable, presenting a bitter taste, neutral properties, and non-toxicity [17].

Growth Conditions and Ecology:

B. pilosa has the capacity to develop dense thickets and grow quickly. By extending the boundaries of its dense thickets, the species dominates crops in agricultural fields and eradicates native plant species in imported regions [16]. *B. pilosa* possesses several features that make it highly adaptable to changing environmental circumstances, such as high seed production, effective dispersal, a wide range of germination, and the capacity to thrive in a variety of soil types. Furthermore, reports

indicate that the plant reproduces vegetatively by developing adventitious roots from lower nodes on its lateral branches ^[10]. According to earlier research, *B. pilosa* seeds could germinate at a variety of temperatures, and light significantly accelerated the process ^[18]. Due to its rapid growth and high resource consumption, the plant can compete with other species for resources. Its allelopathic qualities can also prevent other plants from growing and serve as a host for diseases and pests that could affect native species and other crops. Therefore, in many regions of the world, *B. pilosa* is seen as a serious danger to agricultural and natural ecosystems ^[10]. Crop productivity and quality are negatively impacted by *B. pilosa* infection. Additionally, *B. pilosa* serves as a vector for the spread of infections to agricultural crop plants. The productivity of crops may be decreased by *B. pilosa* due to the spread of insects and diseases ^[16].

Phytochemical Constituents:

Bidens pilosa is abundant in phytochemicals, including saponins, alkaloids, polyacetylenes, flavonoids, and diterpenes ^[19], phenolic acids, terpenoids, steroids, and other components, of which flavonoids and polyacetylenes are the main constituents. Flavonoids are a class of polyphenols that are widely distributed in plants and display a variety of bioactivities. More than a hundred flavonoids have been extracted from *B. pilosa* to date, and they have been shown to have hepatoprotective, cytotoxic, and antioxidant

properties. Acetylenes are a class of chemicals with one or more carbon–carbon triple bonds in their backbones. More than fifty acetylenes have been isolated from *B. pilosa* and are said to have significant anti-cancer, anti-malaria, and anti-diabetes properties ^[20]. Polyacetylene derivatives—particularly phenylheptatriyne—are key bioactive phytoconstituents found in the essential oils of *B. pilosa* ^[15], which possess antibacterial, antiprotozoal, and antiangiogenic properties ^[21]. Various flavones, flavanones, and flavonol aglycones and/or their glycosides have also been identified in *B. pilosa*, particularly quercetin and kaempferol glycosides ^[15]. *B. pilosa* is reported to contain quercetin 3-O-beta-D-galactoside, eupatorin, apigenin, quercetin, isoquercitrin, luteolin, okanin, butein and derivatives, astragalin, centaureidin, marein, quercetin 3-O-robinobioside, apigenin 7-O-glucopyranoside, axillaroside ^[11]. This plant also contains centaurein, centaureidin, butein (BT), luteolin (LT), linoleic acid (LA), cytopiloyne (CP), ethyl caffeate (EC), and chlorogenic acid (CA) ^[22]. Phytochemical analysis of the aerial portions of this plant resulted in the identification of 10 polyacetylenes and 9 flavonoids, including four novel polyacetylenes and a new chalcone glucoside ^[23].

Pharmacological Activities:

The Taiwan Ministry of Health and Welfare has approved *B. pilosa* as a legal herb for human and animal consumption ^[21].



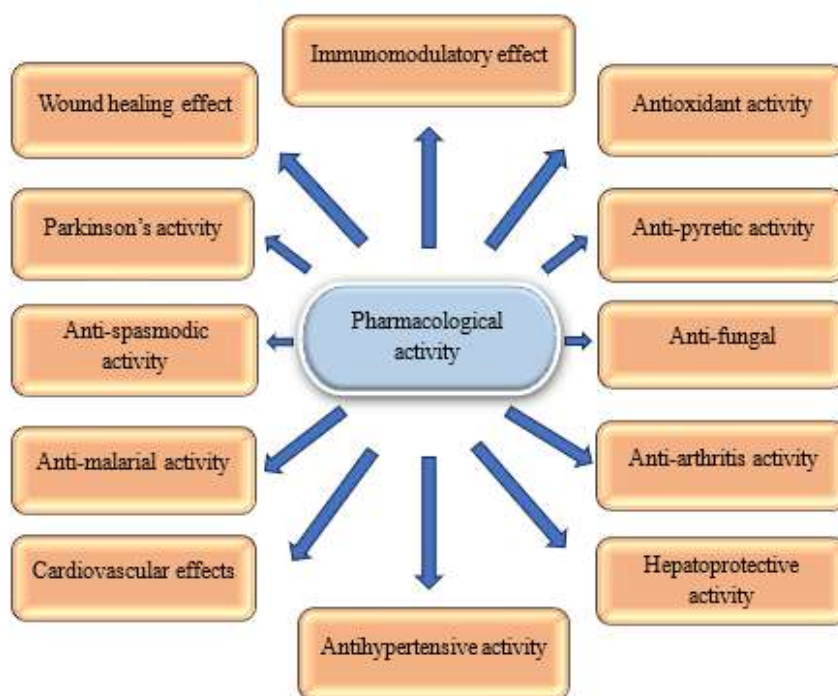


Figure 3: Pharmacological Activities of *Bidens pilosa*

Antioxidant Activity:

The antioxidant activity of different extracts from *B. pilosa* leaves and stem bark was examined using the DPPH radical scavenging and ferric reducing power assays. Acetone extract from leaves, methanol extract from leaves, acetone extract from stem bark, and methanol extract from stem bark all showed significant radical scavenging action. The methanol extracts from both the leaves and the stem bark were the most effective in this DPPH experiment. On the other hand, the acetone extract from the leaves of *B. pilosa* showed a stronger ferric reducing capacity [24].

Anti-hypertensive Activity:

B. pilosa extract was found to prevent the development of hypertension and reduce raised blood pressure levels. The extract also lowered the significantly raised plasma insulin levels caused by the high fructose meal. These findings imply that the antihypertensive effect of *B. pilosa* leaf

methanol extract is due in part to improved insulin sensitivity [25].

Anti-malaria/anti-plasmodial activity:

B. pilosa extract was found to prevent the development of hypertension and reduce raised blood pressure levels. The extract also lowered the significantly raised plasma insulin levels caused by the high fructose meal. These findings imply that the antihypertensive effect of *B. pilosa* leaf methanol extract is due in part to improved insulin sensitivity [26].

Anti-Arthritis Activity:

B. pilosa flavonoids reduce collagen-induced arthritis by inhibiting the receptor activator of nuclear factor- κ B ligand/receptor activator of nuclear factor- κ B/osteoprotegerin pathway, which leads to proinflammatory cytokine production. In addition, total flavonoids from *B. pilosa* may be a good treatment option for rheumatoid arthritis [27].

Antipyretic Activity:

Antipyretic activity was assessed in several extracts and solvent fractions from the *Bidens pilosa* entire plant. The methanolic extract had the most antipyretic activity, equivalent to paracetamol in rabbit pyrogen models. Paracetamol was utilised as the baseline medication for comparison. The antipyretic effect of the extract was assessed by the drop-in body temperature following treatment [28].

Hepatoprotective Activity:

With improvements in transaminase levels, oxidative stress indicators, and histology, total flavonoids from *B. pilosa* dramatically decreased liver damage in both acute CCl₄-induced liver injury in mice and hepatic fibrosis in rats [29]. By lowering lipid peroxidation and serum transaminases and maintaining antioxidant activity, hydroethanol extract and ethyl acetate fraction enriched in quercetin-derived flavonoids shielded the liver of mice against CCl₄-induced hepatotoxicity [30]. Water extract of *B. pilosa* improved liver functions, decreased fibrosis and enzyme markers in a rat model of cholestatic liver injury [31].

Anti-fungal Activity:

Essential oils from leaves and flowers of *B. pilosa* demonstrated considerable antifungal activity against several fungal strains in vitro. The study investigated chemical components by GC–MS and assessed antimicrobial activities [32]. In microbiological tests, ethyl acetate and methanolic extracts of *B. pilosa* roots and leaves showed fungal growth inhibition, suggesting strong antifungal action against the examined pathogens [1].

Vasodilatory and Cardiovascular Effects:

The ethyl acetate extract of *B. pilosa* was tested in a rat model of hypertension induced by L-NAME (a nitric oxide synthesis inhibitor). Results showed improvement in blood pressure and vascular function, with mechanisms suggested to include vasodilation and antioxidant activities [33]. The *Bidens pilosa* extract reduced blood pressure in normal and hypertensive rats in a dose-dependent manner. Evidence revealed that vasodilation, as well as impacts on heart function, contributed to the pressure-lowering effect [34].

Immunomodulatory Activity:

Human peripheral blood mononuclear cells (PBMCs) and antigen-presenting cells (macrophages and dendritic cells) were used in the study to assess non-polar extracts and fractions of *Bidens pilosa*. A direct immunomodulatory mechanism is suggested by the extract's modulation of PBMC proliferation and induction of anti-inflammatory macrophage (M2) polarisation and semi-mature dendritic cell state [35]. The aqueous infusion increased cytokine production in whole blood cells, demonstrating both antioxidant and immunomodulatory effects [36].

Antispasmodic/Smooth Muscle Relaxant Activity:

Among other pharmacological benefits (antidiarrheal, vasodilatory), reviews of *B. pilosa* emphasise its muscle relaxant properties and traditional usage for gastrointestinal issues, indicating smooth muscle regulation [37]. Isolated rat aortic smooth muscle strips precontracted with KCl and norepinephrine were relaxed in a dose-dependent manner by an aqueous leaf extract of *Bidens pilosa*, indicating smooth muscle relaxant qualities that are conceptually comparable to antispasmodic action [38].



Wound healing activity:

various extracts of *B. pilosa* leaves (petroleum ether, ethyl acetate, and methanol) were examined for wound healing efficacy utilising a scratch assay on HaCaT human keratinocyte cells. Increased cell migration, which is a crucial aspect of wound healing, was shown by the extracts' significant improvement in wound closure. Flavonoids, alkaloids, phenolics, terpenoids, and volatile oils were found in a phytochemical study and may be involved in this action [39]. Fresh leaf juice from *B. pilosa* considerably accelerated wound closure in a mouse skin excision wound model when compared to conventional treatment (BIAFINE). With no oral or cutaneous toxicity noted, the study also demonstrated immunomodulatory effects (e.g., alterations in phagocytic index and leukocyte/platelet responses), indicating both wound healing and immune support qualities [40].

Anti-Parkinsons Activity:

Bidens pilosa was shown to have neuroprotective potential, especially due to its antioxidant and cerebellar tissue-protective properties. *Bidens pilosa* at high dosages maintained cerebellar morphology, decreased oxidative stress, and increased catalase and SOD activity. These results imply that *Bidens pilosa* is a potential neuroprotective agent [41].

Toxicology and Safety Profile:

The safety and toxicity profile of *B. pilosa* has attracted increased attention, particularly given its extensive use in traditional medicine and its developing therapeutic promise. Acute and subchronic toxicity investigations in animal models have typically yielded a positive safety profile. In animal studies, oral administration of aqueous and methanolic extracts of *B. pilosa* at

dosages up to 2 mg/kg resulted in no death, overt toxicity symptoms, or substantial histopathological abnormalities in major organs, indicating that the plant has minimal acute toxicity. Sub-chronic toxicity trials, conducted over several weeks of daily dosing, have similarly found no significant changes in haematological, biochemical, or hepatic indices, further establishing its safety in extended use [14]. Systematic toxicology is critical for the further development of BP or its constituents as nutraceuticals and botanicals for human or animal use. So far, the oral acute and 4-week toxicity of BP in rats and/or mice has been partially investigated. In a mouse oral acute toxicity investigation, the median lethal dosage (LD50) for BP extracts in water and ethanol was 12.3 g/kg body weight (BW) and 6.2 g/kg BW, respectively. Oral administration of the BP water extract at up to 1 g/kg BW/day, once a day, resulted in no significant mortality or alterations in rats over 4 weeks, as demonstrated by survival rate, body weight, and organ examination. According to the overall findings, it is generally accepted that rats can safely consume the BP aqueous extract at a daily dose of 1 g/kg BW [42].

CONCLUSION:

Bidens pilosa is a widely distributed medicinal plant with a long history of traditional use across tropical and subtropical regions. Its wide geographic range, specific botanical traits, flexible growing conditions, and ecological resilience are highlighted in this review, all of which add to its abundance and accessibility. According to phytochemical analyses, *B. pilosa* is abundant in bioactive substances, such as terpenoids, alkaloids, phenolic acids, flavonoids, and polyacetylenes, many of which are in charge of its varied pharmacological characteristics. Its traditional therapeutic uses have been supported by



experimental research that has shown a wide variety of biological actions, including anti-inflammatory, antioxidant, antibacterial, antidiabetic, anticancer, hepatoprotective, immunomodulatory, and wound-healing properties. Although there have been reports of variances pertaining to plant parts, extraction techniques, dosage, and length of usage, toxicological and safety tests typically show minimal toxicity and a positive safety profile at therapeutic levels. There are still a number of gaps in *Bidens pilosa's* pharmacological potential. It is still necessary to standardise extracts, identify active principles, clarify specific mechanisms of action, and conduct thorough toxicity evaluations. Furthermore, to confirm its effectiveness and safety in people, carefully planned clinical trials are required. Overall, *Bidens pilosa* represents a valuable source of bioactive compounds with significant therapeutic potential, warranting further research for its development into safe and effective phytotherapeutic agents.

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Conflicts of Interest:

The authors declare no conflicts of interest.

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