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## Review Article

# Review Article on Bidens Pilosa Leaves: Pharmacogenetic Evaluation, Phytochemical Analysis, Taxonomical Classification, Traditional and Medicinal Uses, and Distribution

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## ABSTRACT

*Bidens pilosa* L., a member of the Asteraceae family, is a widely distributed medicinal plant with significant therapeutic potential. The plant is renowned for its pharmacological properties, including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and anticancer activities. This review provides a comprehensive evaluation of *Bidens pilosa*, focusing on its pharmacognostic features, phytochemical composition, taxonomical classification, traditional uses, and global distribution. The morphological and microscopic characteristics of the leaves, stem, and root are discussed, along with the plant's organoleptic properties and quality control parameters. The phytochemical analysis reveals the presence of bioactive compounds such as flavonoids (e.g., quercetin and kaempferol), terpenoids, alkaloids, saponins, and essential oils, which contribute to its diverse pharmacological effects. The plant's traditional uses in treating infections, wounds, digestive disorders, malaria, diabetes, and inflammation are examined, with modern pharmacological validation of these uses. Furthermore, *Bidens pilosa* is found in tropical and subtropical regions, including Asia, Africa, and Central and South America, thriving in disturbed habitats like roadsides, forests, and agricultural lands. Despite extensive ethnobotanical and pharmacological research, further studies are needed to explore the full therapeutic potential of *Bidens pilosa*, particularly in clinical settings. This review highlights the plant's importance as both a traditional remedy and a promising source of novel bioactive compounds for modern medicine.

## INTRODUCTION

## Introduction to *Bidens pilosa* (family: Asteraceae)

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The herbaceous plant *Bidens pilosa* L., sometimes referred to as Beggar's Tick, Spanish Needle, or Black-jack, is a member of the Asteraceae family. It is well known for its distinctive sticky seeds and tiny, yellow blossoms, and it is extensively distributed. It belongs to the genus *Bidens*, which includes more than 200 flowering plant species that grow in temperate and tropical climates worldwide (1). This species has garnered interest because of its many different phytochemical components as well as its important traditional and therapeutic applications (2).

### Common Names and Other Identifiers

Common names for *Bidens pilosa* include:

- **Black-jack**
- **Spanish Needle**
- **Beggar's Tick**
- **Hairy Beggarticks**

Depending on the geographic area, it is also occasionally referred to by regional names, such as Rabo de Gato in several Latin American nations or Khamta in India. The plant is distinguished by its small, yellow, daisy-like flowers and its characteristic long, narrow leaves. The seeds' thorny characteristics help them spread by allowing them to stick to clothing and animals (3).

### Overview of Its Global Distribution

Parts of Asia, Africa, Europe, and the Americas are among the many tropical and subtropical regions where *Bidens pilosa* can be found. It grows well in disturbed areas such the margins of forests, farms, and roadways. Originally from tropical America, it is now widespread on almost every continent in the world. Because of its quick growth and seed-dispersal methods, the plant has become invasive in several areas, most notably in parts of Asia and Africa. It is frequently observed as a weed in gardens and agricultural fields in tropical

areas. *Bidens pilosa* is prized for its therapeutic qualities, especially in traditional herbal medicine, even though it is considered a weed in some places (4).

### Taxonomical Classification

- **Kingdom:** Plantae
- **Phylum:** Angiosperms
- **Class:** Eudicots
- **Order:** Asterales
- **Family:** Asteraceae
- **Genus:** *Bidens*
- **Species:** *Bidens pilosa*

### Pharmacogenetic Evaluation of *Bidens pilosa* Leaves

#### Morphological Characteristics

- **Leaves:** *Bidens pilosa* leaves are oblong to lanceolate in form, with lengths of 3 to 12 cm and widths of 2 to 5 cm. Usually having three to five lobes on each side, the leaf edges are coarsely toothed or serrated (5).
- **Stem:** *Bidens pilosa* has a herbaceous, often erect stem that can reach a height of 1.5 meters. It usually has a little rough texture and is green or reddish-brown in color (6).
- **Root:** *Bidens pilosa* has a shallow, fibrous root system with long, thin lateral roots. When disturbed, the roots, which are typically white to pale yellow in color, release a subtle, earthy smell (7).
- **Flowers:** *Bidens pilosa* has tiny, daisy-like, yellow flowers with ray florets encircling a center disc. Usually 2 to 3 cm in diameter, the flowers are arranged in corymbs or heads. Particularly when eaten, they have a very bitter flavour (8).



## Microscopic Features

- **Trichomes:** Both glandular and non-glandular trichomes (hair-like structures) are seen on both leaf surfaces, particularly the underside, according to microscopic analysis (9).
- **Vascular Bundles:** The leaves have open, collateral vascular bundles. They run through the petiole and are situated along the midrib. The core vascular bundle is surrounded by a circular arrangement of well-developed xylem and phloem tissues (10).
- **Stomatal Arrangement:** The lower surface of the leaf is where the majority of the stomata are located. They are diacytic, which means that two secondary cells encircle them (11).
- **Epidermal Cells:** A thin layer of cuticle covers the single-layered epidermis. While the epidermal cells on the bottom surface are more elongated and slightly wavy, the cells on the upper surface are polygonal (12).

## Organoleptic Characteristics

- **Color:** The underside of fresh *Bidens pilosa* leaves is light green to pale, while the upper surface is dark green. The seeds are either black or brown, while the blossoms are vivid yellow (13).
- **Smell:** When crushed fresh, the plant has a moderate, earthy smell with faint fragrant undertones from the essential oils (14).
- **Taste:** The somewhat bitter flavor of the leaves and blossoms intensifies in the seeds. Flavonoids and other secondary metabolites are responsible for this bitterness (15).

## Physicochemical Properties

- **Water Solubility:** *Bidens pilosa* extracts have a modest level of water solubility. While non-polar substances like terpenoids and essential oils are best extracted using organic solvents, polar substances like flavonoids and phenolic acids dissolve in water (16).
- **Solubility in Organic Solvents:** The plant yields a significant amount of flavonoids, alkaloids, and essential oils and is very soluble in organic solvents like ethanol and methanol. Since many bioactive chemicals are extracted using organic solvents, these qualities are crucial for its medical applications (17).
- **pH Value:** *Bidens pilosa* leaf extract has a slightly acidic pH, usually between 5.5 and 6.5, making it appropriate for use in herbal formulations without irritating or unstable skin (18).

## 4. Phytochemical Analysis of *Bidens pilosa* Leaves

### Identification of Key Phytoconstituents

*Bidens pilosa* is rich in several bioactive phytochemicals that contribute to its medicinal properties. The primary phytochemicals identified in the plant are:

- **Flavonoids:** Known for their anti-inflammatory, anti-cancer, and antioxidant qualities, flavonoids are present in considerable numbers in the plant. Quercetin and kaempferol are two common flavonoids found in *Bidens pilosa* that have shown promise in preventing disorders linked to oxidative stress (19).
- **Terpenoids:** *Bidens pilosa* contains a lot of terpenoids, especially sesquiterpenes and diterpenes. These substances have a variety of biological properties, such as antibacterial,



anti-inflammatory, and anticancer properties. It has been demonstrated that terpenoids such as d-limonene and  $\beta$ -caryophyllene contribute to the plant's medicinal qualities (20).

- **Alkaloids:** *Bidens pilosa* contains alkaloids, including pyrrolizidine alkaloids, which have been shown to have pharmacological properties such as analgesic and anti-inflammatory actions (21).
- **Phenolic Compounds:** The antioxidant and anti-inflammatory properties of the plant are attributed to phenolic compounds, specifically phenolic acids like caffeic acid and chlorogenic acid. These substances are known to lessen oxidative cell damage and scavenge free radicals. The saponins found in *Bidens pilosa* have been connected to antibacterial, anti-inflammatory, and anticancer properties. These substances can also strengthen the immune system and regulate cholesterol levels (22).
- **Essential Oils:** Terpenes, alcohols, and esters are among the volatile substances found in *Bidens pilosa* essential oils. These oils have anti-inflammatory, antifungal, and antibacterial properties (23).
- **Fatty Acids:** *Bidens pilosa* contains fatty acids with anti-inflammatory and antioxidative properties, including palmitic acid, oleic acid, and linoleic acid (24).

### Biological Activity Based on Phytochemicals

The phytochemical profile of *Bidens pilosa* contributes to its various pharmacological effects:

- **Antioxidant Activity:** *Bidens pilosa*'s terpenoids, phenolic acids, and flavonoids all have strong antioxidant properties. By scavenging free radicals, these substances

lessen oxidative stress and shield cells from harm brought on by reactive oxygen species (ROS) (25).

- **Antibacterial Activity:** Research has shown that *Bidens pilosa* extracts have antibacterial qualities against a variety of viruses, fungi, and bacteria. These antimicrobial actions are thought to be mainly caused by essential oils and saponins, which stop the growth of bacteria like *Candida albicans*, *Staphylococcus aureus*, and *Escherichia coli* (26).
- **Anti-inflammatory Activity:** Because of its flavonoid and phenolic content, *Bidens pilosa* has been demonstrated to have anti-inflammatory properties. These substances modify inflammatory responses by preventing the synthesis of pro-inflammatory cytokines and enzymes such as cyclooxygenase-2 (COX-2) (27).
- **Anticancer Activity:** By halting cell division, triggering programmed cell death (apoptosis), and halting metastasis, the phytochemicals in *Bidens pilosa* have shown anticancer promise. Quercetin and kaempferol, for instance, have been shown to prevent the growth and spread of cancer cells in a variety of cancer types (28).
- **Antidiabetic Activity:** *Bidens pilosa* is a promising treatment for diabetes since its phenolic components, saponins, and flavonoids have demonstrated the ability to reduce blood glucose levels and enhance insulin sensitivity (29).

### 5. Traditional and Medicinal Uses of *Bidens pilosa*

#### Traditional Medicinal Applications

*Bidens pilosa*, commonly known as "Spanish needle" or "beggar's ticks," has been used in



traditional medicine across various cultures worldwide. Its medicinal uses are deeply rooted in folk medicine, particularly in Africa, Asia, and the Americas.

- **In African, Asian, and American folk medicine:** Indigenous populations in Africa utilize *Bidens pilosa* to cure a range of conditions, such as wounds, infections, and digestive issues. It is frequently applied as a decoction or poultice to abscesses, boils, and skin infections (30). The plant is used for its anti-inflammatory and antipyretic qualities throughout Asia, especially in traditional Chinese medicine (TCM), and is frequently used to treat ailments like fevers, hepatitis, and urinary tract infections. In the Americas, herbalists utilize *Bidens pilosa* to treat gastrointestinal disorders like dysentery and diarrhea. It is also frequently used in traditional medicines to cure coughs and sore throats (31).
- **To Treat Infections, Wounds, and Digestive Disorders:** *Bidens pilosa* is used to treat bacterial and fungal infections using a variety of plant extracts because of its well-known antibacterial qualities. In order to cure digestive issues including gastritis and diarrhea, the leaves, stems, and roots are usually boiled and used as an infusion (32). While the plant's anti-inflammatory properties serve to lessen wound pain and swelling, its antibacterial activity aids in the battle against infections. *Bidens pilosa* is also used by traditional healers as a topical paste or poultice to treat wounds, abrasions, and other skin infections (33).
- **Function in Treating Malaria, Fever, Diabetes, and Inflammation:** *Bidens pilosa* is used to treat fever and malaria symptoms in areas where the disease is endemic, especially in Africa and Asia. Compounds in the plant

have antimalarial properties that prevent *Plasmodium* parasites from growing (34). Additionally, it is frequently used to treat colds, fevers, and flu-like symptoms. Furthermore, *Bidens pilosa* has been used for centuries to treat diabetes; many herbalists suggest it because of its capacity to increase insulin sensitivity and decrease blood glucose levels. The plant can help manage illnesses including arthritis, joint pain, and inflammation because of its anti-inflammatory qualities (35).

### Modern Uses

In modern medicine, the pharmacological properties of *Bidens pilosa* have been studied extensively, validating many of its traditional uses. Research has confirmed its diverse range of biological activities and therapeutic applications.

- **Antioxidant Properties:** Because *Bidens pilosa* contains flavonoids, phenolic acids, and terpenoids, it has been demonstrated to have strong antioxidant activity. In order to avoid chronic diseases including cancer, neurological diseases, and cardiovascular diseases, these substances neutralize free radicals and shield cells from oxidative damage (36).
- **Antibacterial Properties:** Research has demonstrated that *Bidens pilosa* has antibacterial qualities, particularly against a variety of bacteria, fungi, and viruses. Extracts from the plant, especially the essential oils and saponins, have strong antibacterial properties against bacteria such as *Candida albicans*, *Staphylococcus aureus*, and *Escherichia coli*. *Bidens pilosa* is a possible natural alternative for the treatment of illnesses because of its antibacterial activity (37).



- **Anti-inflammatory Properties:** Bidens pilosa's flavonoid and phenolic content are responsible for its anti-inflammatory properties. It has been demonstrated to downregulate the activity of cyclooxygenase-2 (COX-2) and suppress the production of pro-inflammatory cytokines including TNF- $\alpha$  and IL-6. Because of this, it can be used to treat inflammatory illnesses, including arthritis and inflammatory bowel disease (38).
- **Antidiabetic and Antimalarial Effects:** Bidens pilosa has long been used to treat diabetes, and recent research has shown that it can reduce blood sugar levels (39). It has been demonstrated to lower the oxidative stress linked to diabetes and improve insulin sensitivity. Furthermore, Bidens pilosa is a useful plant for treating malaria, especially in endemic areas, because it contains bioactive chemicals with antimalarial properties (40).
- **Hepatoprotective Effects:** In animal experiments, Bidens pilosa has shown hepatoprotective effects, shielding the liver against oxidative stress, alcohol, and toxins. This is especially important for people who have liver illnesses because the plant can help heal inflammation and restore liver cells (41).
- **Anticancer Potential:** Studies have indicated that the flavonoid and terpenoid content of Bidens pilosa contributes to its anticancer effects. According to reports, these substances cause apoptosis, or programmed cell death, decrease the proliferation of cancer cells, and lessen the likelihood that tumor cells will spread (42). It has been demonstrated that flavonoids like kaempferol and quercetin are selectively cytotoxic to a variety of cancer cell lines, including those from the breast, prostate, and colon (43).

## 6. Distribution and Ecological Aspects of *Bidens pilosa*

### Global Distribution

*Bidens pilosa* is a cosmopolitan species found in tropical and subtropical regions across the world. It thrives in a wide range of climates and habitats, making it a highly adaptable plant. Its distribution spans continents, from Asia and Africa to Central and South America.

- **Habitat:** Bidens pilosa usually inhabits disturbed territory, such as waste grounds, agricultural fields, woodland borders, and roadside places. The plant favors locations with well-drained soil and mild sunlight (44). Because of its great adaptability, it may thrive in a variety of environmental settings, even places where human activity frequently causes disturbances. Additionally, it has been observed to infiltrate regions with damaged vegetation, where it successfully competes with other species (45).

### Geographic Areas:

**Asia:** Bidens pilosa is found throughout Southeast Asia and is utilized in traditional medicine, particularly in nations like Thailand, China, and India (46).

**Africa:** It can be found all over the continent of Africa, but especially in nations with tropical or subtropical temperatures. It has a significant function in African traditional medicine (47).

**Central and South America:** Bidens pilosa is widely distributed in these areas and has long been utilized in native therapeutic methods. In South America's tropical regions, it is common in Brazil, Colombia, and other nations (48).

### Environmental Conditions and Adaptability



*Bidens pilosa* is renowned for its exceptional capacity to adapt to a wide range of environmental circumstances. The plant can tolerate drought and sporadic flooding, and it may grow in a variety of soil types, including sandy and clay-rich soils. Although it can withstand occasional dry spells, it does best in regions with moderate to high rainfall. Depending on the climate, the plant can grow anywhere from sea level to 2,000 meters above sea level, yet it can thrive anywhere (49). Additionally, *Bidens pilosa* has a high level of disease and insect resistance, which helps explain its widespread range. In disturbed habitats, it frequently outcompetes other species because to its aggressive colonization style. With the help of its thorny fruits, which cling to people, animals, and objects to enable them spread over great distances, the plant has a high ability to rejuvenate through seed dissemination (50).

## 7. CONCLUSION

### Summary of Key Findings

*Bidens pilosa* is a highly versatile and widely distributed plant with significant traditional and modern medicinal applications. It has a rich phytochemical profile, containing flavonoids, terpenoids, alkaloids, saponins, and other bioactive compounds that contribute to its wide range of pharmacological activities, including antioxidant, and anti-inflammatory, antimicrobial, antidiabetic, and anticancer effects. Its traditional use spans continents, especially in Africa, Asia, and the Americas, where it is employed for treating infections, wounds, digestive disorders, malaria, fever, diabetes, and inflammation. Modern research has confirmed many of these traditional uses, and the plant has shown promise in treating diseases such as cancer, diabetes, malaria, and liver damage. Additionally, *Bidens pilosa* has been identified as an important source of natural products with potential therapeutic

properties, which could serve as an alternative to synthetic drugs in some cases.

### Importance of *Bidens pilosa* in Traditional and Modern Medicine

The importance of *Bidens pilosa* lies in its therapeutic potential, which has been utilized in folk medicine for centuries. In modern medicine, the plant offers promising benefits due to its biological properties, including its ability to treat chronic conditions such as diabetes, cancer, and inflammation. The plant's bioactive compounds make it a potential candidate for drug development, particularly for conditions where conventional treatments are insufficient or have adverse side effects. The widespread use of *Bidens pilosa* across different cultures highlights its importance as a natural remedy, and its continued use in traditional medicine supports its relevance in contemporary healthcare.

### Need for Further Research on its Medicinal Properties

Despite the promising findings, further research is necessary to fully understand the medicinal potential of *Bidens pilosa*. More clinical trials are needed to evaluate its safety and efficacy, especially in human populations. Future studies should aim to isolate and characterize additional bioactive compounds, explore their mechanisms of action, and determine the optimal dosages for therapeutic use. There is also a need to investigate the environmental factors affecting its distribution and growth, as well as the sustainability of its use in traditional medicine. Further research could lead to the development of *Bidens pilosa* as a reliable and effective alternative medicine or as an adjunct to conventional therapies.

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