

PHYTOCHEMISTRY AND THERAPEUTIC APPLICATIONS OF *BASELLA ALBA*: A
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ABSTRACT

Cancer, autoimmune diseases, microbial infections and oxidative stress are becoming unavoidable threats in recent times. Radiation, chemotherapy, and surgery are examples of conventional therapies that have evolved, but problems including side effects, opportunistic infections, and the evolution of drug resistance remain. Thus, it is essential to develop novel therapeutic strategies that use plant derivatives as powerful therapeutic agents with minimal side effects. *Basella alba* is one such plant that has several phytochemicals, such as flavonoids, alkaloids, phytosterols, tannins, and triterpenoids, that help treat a variety of diseases. The main objective of the current study is to highlight the phytochemical and pharmacological investigations conducted on the plant so that more pharmacological research can be conducted to investigate its untapped potential. In recent years, the demand for plant-based therapeutics has increased significantly due to the limitations and adverse effects associated with conventional treatments. *Basella alba*, commonly known as Malabar spinach, is a medicinal plant widely recognized for its rich phytochemical profile and diverse pharmacological properties. The present review aims to provide a comprehensive overview of the phytochemical constituents and therapeutic potential of *Basella alba* based on previously published studies. Various Phytoconstituents such as flavonoids, phenolic compounds, alkaloids, terpenoids, and fatty acids have been identified in different parts of the plant, contributing to its biological activities. Experimental studies have demonstrated that *B. alba* exhibits significant antioxidant, anticancer, anti-inflammatory, antimicrobial, antiulcer, and wound healing properties. These activities are primarily attributed to its ability to modulate oxidative stress, inflammatory pathways, and cellular proliferation. Despite promising findings, most studies are limited to in vitro and animal models, and there is a lack of clinical validation. Therefore, further research focusing on clinical trials, standardization of extracts, and identification of active compounds is necessary to establish its therapeutic efficacy and safety. Overall, *Basella alba* represents a valuable natural source of bioactive compounds with potential applications in the development of novel therapeutic agents.

KEYWORDS: *Basella alba*, phytochemicals, immunomodulation, antioxidant, and GC-MS analysis.**INTRODUCTION**

Medicinal plants have been a valuable source of therapeutic chemicals for the treatment of human illnesses since ancient times. Even in the face of major advances in modern medicine, the development of new therapeutics from natural materials is vital due to the prevalent belief that natural medicine is healthier than synthetic treatments. Since 1980, the World Health Organization (WHO) has supported the growth of

phytotherapy and traditional medicine in many countries. Ayurveda and Siddha, the two main traditional Indian medical systems, are primarily plant-based. According to the WHO, almost 80% of people worldwide use traditional medicine to treat a range of ailments. Therefore, the development of traditional medicine is essential.

In this sense, one plant that is a good source of several phytochemicals that can treat a variety of illnesses is *Basella alba*. This plant grows quickly, reaching a length of 10 meters. It's a vegetable with leaves. The thick, heart-shaped leaves have a mucilaginous texture and a subtle flavour. The leaves range in length from 3 to 9 cm and in width from 4 to 8 cm. The tiny white, bisexual flowers are carried on branching peduncles or axillary spikes. Its fruits are 5 to 6 mm in diameter, ovoid or spherical in shape, meaty, and purple when fully grown.^[1] It is native to southern Asia and is commonly referred to as Indian spinach or Malabar spinach. The stem of the cultivar *Basella rubra* is reddish-purple. In eastern and southern India, the plant's leaves and stems are utilized in cooking. In both the eastern and western hemispheres, it is commonly grown in areas with moderate temperatures and is widely distributed in tropical climates. It is grown almost everywhere in India, especially in lower Bengal and Assam, and is an important element of diets, according to Watt. It is considered a food plant in the Philippines, where it is boiled and eaten like spinach. The leaves are used to cure wounds in Malaya and India.

1.1 Taxonomy

- Kingdom: Plantae
- Order: Caryophyllales
- Family: Basellaceae
- Genus: *Basella*
- Species: *Basella alba* Linn.^[1]



Figure 1: Malabar spinach with red stem.

The various synonyms of the plant *Basella alba* are *Basella cordifolia* Linn, *Basella lucida* Linn, Pothaki, Upodika, Maalava, Turangi, Kantaki. The common names of the plant are Malabar spinach, Indian spinach, Ceylon spinach, Vine spinach. The various vernacular names are Hindi: Poi ki Bhaji, Telugu: Bachhali, Tamil: Kodip pasali, Kannada: Basale soppu, Marathi: Mayalu,

Bengali: Pui shak, Oriya: Poi saga, English: Malabar spinach, Indian spinach, Ceylon spinach.

Traditional use: The herb is recognized to have emollient, diuretic, and demulcent properties. Chinese medicine uses the entire plant, claiming that it can neutralize toxins and lower fever. The crushed or pulped leaves are applied as a poultice for ulcers and to speed up the healing of abscesses. Constipation in children and pregnant women is treated with the decoction of the leaves, which is thought to have laxative qualities. The plant's juice is used in food coloring, as a rouge on the skin of the face, and as a dye for official seals.^[1] They have anti-inflammatory and anti-ulcer properties, particularly those with red stems.^[2]

2. Phytochemicals reported in the plant

One of the helpful techniques for identifying different bioactive substances that are in charge of different pharmacological actions, such as antioxidant value that depends on the presence of flavonoid and phenolic compounds, further aids in the treatment of cancer, etc., is qualitative analysis.^[4] The alcoholic, ethyl acetate, and methanolic extracts of the plant have good phenolic and flavonoid contents, according to their analysis of the total phenoli and total flavonoid content of *Basella alba* leaf extract. The total phenolic content of the methanolic extract was 533.28 ± 0.16 , while the total flavonoid content was 446.02 ± 0.1 . These phenolic flavonoid chemicals have the ability to stop cell proliferation, inflammation, and aging. At 1.4 mg/100g, malabar spinach was shown to be high in kaempferol, a flavonoid that protects against cardiovascular disease and cancer. employed GC-MS analysis to validate the findings after isolating, identifying, and characterizing flavonoids from *B. alba* L. using TLC and IR. This study's GC-MS examination identified 49 compounds, the most concentrated of which was 1-Methyl-4-isopropylcyclohexyl 2-hydroperfluorobutanoate.^[20] *Basella alba* contains organic acids, carotenoids, betacyanins, triterpene oligoglycosides, and basellasaponins A, B, C, and D. The leaf extract contains vitamins A, C, E, B1, B2, B3, B9, folic acid, protein, fat, and minerals like iron, calcium, and magnesium. The first phytochemical test of the plant's leaf extracts revealed high levels of flavonoids and polyphenols, moderate levels of alkaloids, tannins, glycosides, carbohydrates, vitamins, and minerals, and low levels of saponins.

Table 1: f *Basella alba* leaves and their reported biological activities.

S. No.	Compound name	Compound nature	Type of extract	Biological activities
1	Pentadecanoic acid	Saturated fatty acid	Ethanol	Anti-inflammatory, anti-anaemic, dyslipidemic] and antibiofilm.[3,2]
2	n- Hexadecenoic acid	Saturated fatty acid	Ethanol	Cytotoxic and anti-inflammatory.[3,4]
3	Cis-13-Octadecanoic	Monounsaturated fatty	Ethanol	Antioxidant and anti-inflammatory.[36]

	acid	acid		
4	Oleic acid	Monounsaturated fatty acid	Ethanol	Anti-inflammatory, immunomodulator and antitumor
5	Octadecanoic acid	Saturated fatty acid	Ethanol	Antioxidant
6	Linoleic acid	Polyunsaturated fatty acid	n-Hexane	Antioxidant, anti-inflammatory, anticancer, hepatoprotective and antiarthritic
7	Caryophyllene	Sesquiterpenoid	n-Hexane	Neuroprotective, cardioprotective, nephroprotective, gastroprotective, immunomodulator and anticancer.
8	Phenol, 2,6-bis(1,1-dimethylethyl)-	Aromatic and phenolic compound	Methanol	Anti-inflammatory and anti-atherosclerotic.[19]
9	l-Heptatriacotanol	Alcoholic compound	Methanol	Antioxidant, anticancer and antimicrobial.[45]

3. Reported pharmacological activities of *Basella alba*

3.1. Cytotoxic and anticancer activity

employed XTT to evaluate *B. alba* methanolic extract's anticancer activity against the colorectal cancer cell lines HT-29 and HCT-116. The results showed that the extract exhibited the highest cytotoxicity against HT-29 at a concentration of 50g/ml and inhibited cell growth by 78.9% in 72 hours. After 48 hours, extract in HCT-116 and HT-29 was shown to exhibit IC₅₀ values of 51µg/ml and 22µg/ml, respectively, with 70% cell growth suppression. These findings showed that a variety of phenolic and flavonoid components with strong antioxidant activity were present in the extract. Both colon cancer cell lines had a cell cycle arrest at the G₀/G₁ phase after being treated with this extract.^[9]

The cytotoxic activity of a methanolic extract of the whole *B. alba* plant was evaluated in this study using the MTT assay on human leukemic cell lines U937 and murine macrophage cell lines RAW 264.7. The results showed that the extract has no effect on RAW 264.7 cells and is specific for leukemic cells. At doses ranging from 10µg to 200µg, the extract significantly decreased the proliferation of U937 cells in a concentration and time-dependent manner. The IC₅₀ value was found to be 24.54µg/ml. The DNA laddering experiment employing gel electrophoresis proved its apoptotic activity.

3.2. Antioxidant activity

This study used the phosphomolybdate test, DPPH, superoxide, and hydroxyl radical scavenging capabilities to assess and validate the plant *Basella alba*'s strong antioxidant activity. This study demonstrated the plant's methanolic extract's capacity to scavenge DPPH radicals at dosages ranging from 28.24% to 94.81% (20 to 100µg/ml). The extract's IC₅₀ values for the DPPH assay, superoxide radical scavenging activity, phosphomolybdate assay, and hydroxyl radical scavenging activity were 46.6±0.0, 47.2±1.2, 918.5±0.1, and 380.3±0.9, respectively.

B. alba Linn ethanol extract lessens acrylamide-induced oxidative stress in Wistar rats. Studies of antioxidant activity were conducted on the tissues of the kidney and liver. Serum from the treated animals was analyzed for signs of hepatic and renal function. The treatment with

100 and 250 mg/kg body weight significantly reduced the elevated renal and hepatic biomarkers. The results of the study suggest that the plant may have chemoprotective qualities against acrylamide-induced oxidative stress in wistar rats.^[25]

Antiulcer activity

In aspirin-induced albino rats, P. Venkatalakshmi et al. (2012) examined the anti-ulcer activity of *B. alba* leaf extract and found that the plant showed gastroprotective qualities. The ulcer index, percentage of ulcer inhibition, stomach pH, pepsin concentration, glutathione reductase (GSH), vitamin C, and vitamin E were all found to be affected by *B. alba* leaf extract. After consuming aspirin (150 mg/kg) and ethanolic leaf extract of *Basella alba* (200 mg/kg body weight) together for 21 days, the rats demonstrated 66% ulcer inhibition and an ulcer index of 8.59±0.19.

Gastric juice pH was higher in mice treated with plant extract (4.2±0.3) compared to those treated with aspirin (2.17±0.12). Pepsin levels were lower in animals treated with plant extract (2.4±0.05) compared to those treated with aspirin alone (4.3±0.1).^[18]

Wound healing activity

examined the capacity of several gel formulations comprising aqueous extract from *B. alba* to treat wounds in male albino rats. This study found that the greatest potential for wound healing was demonstrated by a 20-day course of treatment with *B. alba* leaf extract. Rats in the solvent control and untreated groups epithelized in 35 and 39 days, respectively, while those treated with *B. alba* did so in 23 days. As a result, it was found that *B. alba* aqueous extract greatly enhances burn wound contraction.^[24]

DISCUSSION

The present study highlights that *Basella alba* is rich in flavonoids, phenolic compounds, and fatty acids, which are responsible for its significant pharmacological activities. The strong antioxidant activity observed may be attributed to the free radical scavenging ability of phenolic and flavonoid compounds. Similarly, the presence of caryophyllene and unsaturated fatty acids

contributes to anti-inflammatory and anticancer properties through modulation of cellular pathways.

The cytotoxic activity against cancer cell lines suggests its potential as a natural anticancer agent. However, most studies are limited to in vitro and animal models, and there is a lack of clinical evidence. Therefore, further studies including clinical trials and detailed mechanism-based investigations are required to validate its therapeutic efficacy and safety.

CONCLUSION

In conclusion, *Basella alba* is a nutritionally and pharmacologically valuable plant that exhibits a wide range of biological activities, including antioxidant, anticancer, anti-inflammatory, antiulcer, and wound healing effects. These properties are primarily attributed to its rich phytochemical composition, particularly flavonoids, phenolic compounds, and fatty acids.

The available evidence suggests that *B. alba* holds significant potential as a natural source of therapeutic agents. However, the current research is largely limited to preliminary studies, and there is a need for extensive clinical investigations to confirm its efficacy and safety in humans. Standardization of extracts and identification of active constituents will further enhance its applicability in modern medicine.

Overall, *Basella alba* represents a promising candidate for future drug development, and continued research may lead to the discovery of novel compounds with significant therapeutic benefits.

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