



Malabar Spinach (*Basella alba*) as an Underutilised Nutrient-Rich Leafy Vegetable

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ABSTRACT

Malabar spinach (*Basella alba*) is a fast-growing leafy vegetable widely cultivated in tropical and subtropical regions. Although commonly consumed in traditional cuisines, it remains underutilised in many areas despite its impressive nutritional and medicinal potential. The plant is rich in vitamins, minerals, dietary fiber and bioactive compounds such as flavonoids and betacyanins, which contribute to its antioxidant, anti-inflammatory, antimicrobial and wound-healing properties. In addition to its health benefits, Malabar spinach is well suited for kitchen garden cultivation due to its adaptability to warm climates, minimal input requirements and extended harvesting period. It can be incorporated into a variety of dishes, including pulse-based preparations popular in regions such as Bihar. Given its nutritional value, therapeutic properties and ease of production, promoting the cultivation and consumption of Malabar spinach may support dietary diversity, household nutrition security, and sustainable food practices.

Keywords: Betacyanin, Indian Spinach, Bio-Active Compound, Pigments, Sustainable

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1. INTRODUCTION

Malabar spinach is also known as Indian spinach, Ceylon spinach, climber spinach and vine spinach. It is commonly found in India, China and other parts of Asia. Malabar spinach belongs to the genus *Basella* and is classified into two types, *Basella rubra* L. and *Basella alba* L as described by Carl Linnaeus, the father of modern taxonomy. These two species are differentiated based on their leaf characteristics and stem colour. *Basella rubra* is characterised as a red-stemmed species, whereas

Basella alba is green-coloured with a bigger stem compared to *B. rubra*. These plants are extremely heat-tolerant, allowing them to thrive under high-temperature conditions and making them suitable for cultivation in tropical and subtropical regions. Malabar spinach is a perennial vine that is widely cultivated as a cool-season leafy vegetable and produces fleshy, stalkless spherical fruits that are purple in colour and are also used as dye, as shown in Figure 1. In Bihar and several other parts of India commonly named Pui Saag. Traditionally, Malabar spinach has been used since

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ancient times for antioxidant, antiviral, anticancer, anti-ulcer and cholesterol lowering effect as well as wound-healing properties (Chaurasiya *et al.*, 2021). It also acts as a mild laxative to relieve digestive discomfort, its leaf paste is also applied to cure skin irritation. In addition to commonly consumed as leafy vegetable in the form of curry, dal and stir-fry preparations, Malabar spinach is nutritionally dense as it contains a good amount of essential macronutrients such as carbohydrates, protein, fats and dietary fibre along with it is also a good source of vitamins A and C, iron and calcium and its leaves contain carotenoids, organic acids, and betacyanins. Furthermore, the fruit extract of green Malabar spinach, i.e. *Basella alba*, is used as a natural indicator for detecting the end-point of acid-base titrations (Mitra & Das 2016).



Figure 1. Morphology of *Basella alba* plant(A) along with leaves(B), stem(C), fruits(D) and seeds(E) (source: Tarique *et al* 2024)



Figure 2. Malabar spinach

2. GEOGRAPHICAL DISTRIBUTION

Malabar spinach (*Basella alba* L. and *Basella rubra* L.) is widely cultivated in tropical and subtropical regions of Asia and is also grown in parts of Africa and America. In India, it is cultivated particularly in eastern, southern and north-eastern regions including Bihar, West Bengal, Odisha, Jharkhand, Assam, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala. Because of its heat tolerance, it is suitable for warm and

humid growing conditions and is frequently cultivated in home gardens, kitchen gardens and small-scale farms (Figure 2).

3. CULTIVATION AND DISTRIBUTION

Malabar spinach can be cultivated in home gardens as well as on a commercial scale, particularly in warm, humid and lowland environments. It grows vigorously under warm conditions and performs well in fertile, well-drained soils rich in organic matter. A soil pH around 6.0–7.0 is generally suitable. Propagation is mainly through seeds or stem cuttings. Land preparation should provide a friable and well-drained seedbed, and organic manure may be incorporated to improve soil fertility. Seeds can be sown during suitable warm periods depending on the local climate. Regular irrigation helps maintain adequate soil moisture and supports vigorous vegetative growth. Weeding and provision of stakes or trellis support promote vine growth and facilitate harvesting. Common pests include aphids and caterpillars, while leaf spot and root-rot diseases may occur under favourable conditions. Harvesting usually begins after 40–45 days of sowing. Fresh and young leaves along with succulent shoots are picked at regular intervals, allowing multiple harvests. With efficient management, the crop can produce an average yield of 20–30 tonnes per hectare.

4. NUTRITIONAL PROFILE

Basella alba is a nutrient-rich green leafy vegetable valued for providing scientific amount of key nutrients and health supporting photochemical. Despite its impressive nutritional value, Malabar spinach remains underutilised, largely because of inadequate consumer awareness. Conventional spinach is more commonly preferred, although Malabar spinach contains similar levels of essential nutrients.

4.1 Macronutrient composition

Macronutrients are nutrients required by the body in relatively large amounts and include carbohydrates, proteins and fats. Malabar spinach is a low-energy leafy vegetable that contributes modest amounts of carbohydrate and plant protein with relatively low fat content.

Table 1. Proximate composition of raw Malabar spinach per 100 g (USDA-ARS, 2016)

Nutrient	Amount per 100 g
Water	93.1 g
Energy	19 kcal
Carbohydrate	3.4 g
Protein	1.8 g
Fat	0.3 g

4.2. Micronutrient composition

Malabar spinach provides several essential vitamins and minerals involved in normal physiological functions, including vision, antioxidant defence, bone metabolism, energy metabolism, electrolyte balance and blood formation.

Table 2. Selected micronutrient composition of raw Malabar spinach per 100 g (USDA-ARS, 2016)

Nutrient	Amount per 100 g	Major role
Vitamin A	400 µg RAE	Vision, immune function and epithelial/skin health
Vitamin C	102 mg	Antioxidant defence and collagen synthesis
Calcium	109 mg	Bone health, muscle contraction and cellular signalling
Iron	1.2 mg	Haemoglobin formation and oxygen transport
Magnesium	65 mg	Enzyme activity and energy metabolism
Potassium	510 mg	Fluid balance, nerve transmission and muscle function
Sodium	24 mg	Electrolyte balance, nerve transmission and muscle function
Zinc	0.43 mg	Enzyme activity, protein synthesis and immune function
Phosphorus	52 mg	Bone mineralisation and energy metabolism
Folate	140 µg	DNA synthesis and cell division

5. PHARMACOLOGICAL SIGNIFICANCE

Various studies have documented the medicinal significance of *Basella alba*. It exhibited antimicrobial activity against pathogenic bacteria, including *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli*. Research findings have also indicated that leaf extract, particularly when combined with supportive compounds such as glycerine, demonstrates notable wound healing. Further studies have revealed that the seeds of *Basella alba* contain ribosome-inactivating proteins associated with antiviral activity. In addition, extracts prepared using ethanol have shown anti-inflammatory effects, suggesting potential therapeutic relevance. Experimental evidence has also suggested that the

presence of bioactive pigments such as betacyanins and flavonoids in the fruits contributes to strong antioxidant activity. These findings indicate functional potential, but further toxicological, mechanistic and clinical research is required before therapeutic claims can be established.

6. INDUSTRIAL USAGE

The leaves and fruits of Malabar spinach contain natural pigments such as betacyanins and flavonoids. The presence of betalain pigments gives stalks, petioles and fruit their characteristic red-violet colouration (Sagar *et al.*, 2022). Betalin-rich extracts from *Basella alba* fruits (Figure 3) have been used as natural colourants in food products such as yogurt (Akhtaruzzaman *et al.*, 2025). Due to their beneficial health properties and natural origin, these pigments are considered a safer alternative to synthetic food colourants (Sutor-Świeży *et al.*, 2024). In addition to their application in food formulation, betalain extracts are also used in the pharmaceutical and cosmetic industries (Khan *et al.*, 2015). Other than that, the pigment extracted from the fruit of *Basella alba* is widely used in the textile industry as a dyeing agent.



Figure 3. Fruits of Malabar spinach and the extracted pigments

7. CULINARY USAGE

Due to its palatable Flavour and mucilaginous nature, it can be conveniently incorporated into daily diets owing to its mild taste, soft texture and nutritional value. The leaves and tender stem can be incorporated in various cuisines. Traditionally, Malabar spinach is commonly consumed as cooked vegetable dishes and pulse-based preparations locally called “poi saag dal” (Figure 4b). Nowadays, Malabar spinach is also incorporated in value-added recipes such as *Basella alba* paratha, pakora (Figure 4a), cheela, dosa, smoothie, functional beverages and salad bends. Malabar spinach has a delightful flavour that can be paired with an array of ingredients such as wild mushrooms, tomatoes and roasted sweet potatoes from soups to flavourful salads this leafy green is an excellent choice for adding some excitements in daily menu. For example, Malabar spinach Tambli (Figure 4c) is a

refreshing summer dish from Konkani cuisine. It is a yoghurt-based preparation that is usually served chilled, making it perfect for hot weather. The recipe combines fresh yoghurt with ingredients such as cumin seeds, grated coconut, red chilli and a small amount of ghee. Along with its cooling effect, the dish is nutritious and easy to prepare. Its simple ingredients and pleasant taste make it a healthy as well as delicious option for summer.



Figure 4. (a) Poi saag pakora, (b) Poi daal saag fry and (c) Tambli

8. GROWING MALABAR SPINACH IN KITCHEN GARDENS

Both red and green Malabar spinach are conveniently available in local markets as well as e-commerce websites such as Amazon and Flipkart. Seeds can be directly sown in rows spaced approximately one foot apart. Seeds are typically placed 1-2 inches apart and later thinned to maintain about six inches between plants. Germination may be slow, sometimes requiring up to four weeks even under favourable temperature conditions around 65-67 °F. Regular irrigation maximises yields and also prevents flowering that causes bittering of leaves. Malabar spinach has promising market potential, particularly with organic and speciality produce segments. Consumer awareness can be enhanced through educational materials, sampling and cooking demonstrations, which may encourage purchase of this lesser-known crop.

9. CAUSES OF LIMITED UTILISATION OF MALABAR SPINACH

Despite its many valuable qualities, Malabar spinach remains a neglected and underutilised crop and has not yet secured a strong position in the mainstream leafy vegetable market. Preferred leafy vegetables such as spinach, amaranth and coriander are generally seasonal and are mostly available during the winter season. In contrast, malabar spinach, which can be easily grown in kitchen gardens, provides fresh and tender leaves throughout the year. This makes it especially valuable for improving household nutrition. Leafy vegetables are important sources of essential

micronutrients and can contribute to improving nutritional security and reducing micronutrient deficiencies (Gharibzahedi *et al.*, 2025). In this context, Malabar spinach has immense potential due to its nutrient-rich nature. It is a rich source of essential vitamins and minerals. However, its wider adoption is limited by several factors, including low consumer awareness outside traditional growing areas, low market demand, lack of organised seed production and distribution systems, and insufficient research and crop improvement efforts. In addition, its mucilaginous texture makes it less acceptable to some consumers. Despite these challenges and past neglect, underutilised crops such as Malabar spinach are now gaining recognition for their role in sustainable agriculture. They are resilient to changing climatic conditions, can grow under limited resources, and contribute significantly to nutritional security. Malabar spinach also adds diversity to diets, strengthens the food system, and supports future sustainability.

10. FUTURE PERSPECTIVE OF MALABAR SPINACH

10.1. Strengthening research on therapeutic attributes

The pharmacological potential of Malabar spinach is yet to be explored. Future research should focus on identifying the bioactive compounds responsible for its therapeutic properties. Advanced techniques should be used to elucidate the mechanism of action of these compounds at the molecular level, which will provide deeper insights into their health benefits and pave the way for the development of new pharmaceuticals (Singh *et al.*, 2024). Clinical trials should also be conducted to assess the efficacy and safety of Basella extract, helping to explore its potential in managing chronic illnesses such as inflammation and cardiovascular diseases (CVD).

10.2. Market opportunities

The market potential can be increased by developing value-added products without compromising the nutritional quality of the plant. Malabar spinach leaves can be used to prepare instant soup premixes (Singh *et al.*, 2024), and various other products can be developed by focusing on their functional and therapeutic properties. Collaboration between researchers, industry stakeholders and policymakers will be crucial for establishing an effective regulatory framework and promoting commercialisation (Singh *et al.*, 2024).

10.3. Sustainable agriculture

The cultivation of Malabar spinach is eco-friendly and can enhance biodiversity and soil health. As a sustainable crop, it requires fewer agricultural

inputs and less intensive farm machinery, making it suitable for environmental friendly farming system.

10.4 Public awareness

Public awareness about the nutritional and health benefits of locally available Malabar spinach should be increased. Education and campaigns, cooking demonstrations, and inclusion in school meal programs can encourage its consumption. Taking expert collaboration, such as nutritionists and dietitians, can help integrate Malabar spinach into the mainstream diet.

11. CONCLUSION

Basella species are highly nutritious and can be easily cultivated in tropical, subtropical and temperate regions across the world. Both species *Basella alba* and *Basella rubra*, are widely found in many states of India and occur in almost all agro-ecological regions of the country. Various field observations and research studies suggest that *Basella* species are well adapted to a wide range of soil conditions, which makes them suitable for cultivation. *Basella* varieties possess rich nutritional value and therapeutic importance, with significant potential for profitable cultivation in tropical and temperate areas. They can help meet essential dietary requirements of the expanding population. The crop is naturally hardy and requires relatively fewer crop management inputs, making it easier to cultivate compared to many other leafy vegetables. These attributes make it ideally suited for resource-limited farmers in developing regions. Furthermore, cultivation of locally available *Basella* can encourage environmentally suitable agriculture and strengthen on-farm diversity. It can also motivate farmers to conserve and utilise other neglected and underused crops adapted to local agro-climatic conditions. However, further extensive field surveys in different agro-climatic regions are needed to assess the genetic diversity of these species. Such studies would support the development of improved agronomic practices and breeding programs aimed at enhancing nutritional quality, yield potential, and environmental adaptability.

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