

Exploring the medicinal potential of curry leaves: A review on *Murraya koengii*

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Abstract

Murraya koenigii, commonly known as curry leaf, is a sweet tropical and subtropical plant native to India. It is a large shrub or small tree with pinnate leaves that are extensively used in Indian cuisine for flavoring foodstuffs. Curry leaves are not only a popular ingredient in many South Indian curries but also have numerous health benefits. They are rich in nutrients and can be used as a natural calcium supplement, making them beneficial for women with calcium deficiency and osteoporosis. The leaves are also used externally to cure eruptions and skin problems. The volatile oil extracted from the leaves of *Murraya koenigii* has been found to have various pharmacological properties, making it useful in the cleaner industry. Curry leaves are an important part of Indian cuisine and traditional medicine, and their nutritional and medicinal value makes them a valuable resource for promoting health and well-being.

Keywords: *Murraya koenigii*; Pharmacological Activity; Mahanimbine; Anti – Oxidant

1. Introduction

A little spreading shrub can reach a height of around 2.5 meters. The dinghy on its main stem can be hulled off longitudinally to expose the white wood below, and the stem itself has a 16 cm perimeter. The leaves have reticulate veining, are exstipulate, and are bipinnately compound. Each of them has 24 shaft-shaped leaflets that are 4.9 cm long, 0.5 cm broad, and held up

by a 0.5 cm long petiole. They are around 30 cm long. Each terminal cyme that bears 60 to 90 blooms is the inflorescence. Bisexual, white, funnel-shaped, stalked, ebracteate, regular, actinomorphic, pentamerous, hypogynous, and pleasantly perfumed are the characteristics of the flowers. A fully blown bloom has an average perimeter of 1.12 cm. Green, inferior, five-lobed, and persistent is the calyx. Each of them has 24 shaft-shaped leaflets that are 4.9 cm long, 0.5 cm broad, and held up by a 0.5 cm long petiole. They are around 30 cm long. Each terminal cyme that bears 60 to 90 blooms is the inflorescence. Bisexual, white, funnel-shaped, stalked, ebracteate, regular, actinomorphic, pentamerous, hypogynous, and pleasantly perfumed are the characteristics of the flowers. A fully blown bloom has an average perimeter of 1.12 cm. Green, inferior, five-lobed, and persistent is the calyx. Five shaft-shaped petals, each about 5 mm long, make up the white, polypetalous corolla. Ten dorsifixed stamens, grouped in two rings of five each, make up the polyandrous androecium. The larger stamens are 5 mm in length, and the lesser ones are 4 mm. The gynoecium has a superior ovary, a short style, and a brilliant, sticky stigma. It is 5–6 mm long. The oblong to globular fruits are 1.4 to 1.6 cm in length and 1 to 1.2 cm in width. When fully grown, they become black and have a highly reflective surface. They weigh around 880 mg and have a volume of 895 microliters. Wistaria blue (640/2) is the pulp color. Depending on the cultivar, there are 32 to 80 fruits in each cluster. A solitary seed that is 11 mm long and 8 mm diameter is found inside each fruit. The seeds have a capacity of 460 microliters, weigh 445 mg, and are spinach green (0960/3). (14) Native to

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India, Bangladesh, Nepal, Sri Lanka, Burma, and Malaysia, this species may reach elevations of up to 1650 meters (1) Curry leaf plant, or *Murraya koenigii* Spreng., is a member of the Rutaceae family, which has 1600 species and more than 150 genera. "Surabhinimba" is its Sanskrit name. Regional names for the plant include Kurrypatte in Hindi, Karivempu in Tamil, and Barsunga in Bengali. (11)



Figure 1 Murraya Koenigii leaves

1.1. Plant profile

It was reported that *Murraya koenigii*, commonly known as curry patta or Daun kari in Malaysia, is a semi-evergreen aromatic tree that belongs to the family **Rutaceae**. It was mentioned that the leaves of *Murraya koenigii* are widely used in Indian cookery and have served as a staple in traditional medicine for centuries. The findings further indicated that the leaves are rich in nutrients such as protein, carbohydrates, fiber, minerals, carotene, and nicotinic acid. Moreover, exploration results showed that curry leaf extract contained about **23.73% alkaloids, 1.24% flavonoids, 8.74% saponins, 4.4% phenolics, and 5.2% tannins**. (13). They also contain various bioactive compounds, including crystalline glycosides, carbazole alkaloids, koenigin, girinimbine, isomahanimbine, koenine, koenidine, and koenimbine. The leaves have a distinctive slightly pungent, bitter, and feebly acidic taste, and retain their flavor and quality even after drying. (1)

Globally, the genus *Murraya* comprises 14 species, of which only two are found in India: *Murraya koenigii* (Spreng) and *Murraya paniculata* (Linn). Among them, *Murraya koenigii* is widely used in Indian cuisine, valued for its strong aroma that arises from chemical constituents such as β -gurjunene, β -caryophyllene, β -elemene, and O-phellandrene. The leaves are also rich in compounds like β -pinene, β -caryophyllene, β -phellandrene, and α -pinene, which exhibit antimicrobial activity and help in controlling food spoilage.

Interestingly, *Murraya koenigii* occurs in three morphotypes, each with distinct characteristics:

- The regular type is fast-growing, with dark green leaves and a pleasant aroma.
- The dwarf type is shrub-like, having light green leaves and a bushy appearance.
- The brown type possesses the strongest fragrance, characterized by thick, small, dark brown leaves.
- Each morphotype is unique in its features and intensity of aroma. (11)

1.2. Images



Figure 2 Murraya Koenigii Leaves And Seeds

1.3. Synonym

Gandla, Gani (Kumaon), Bhursanga (Orissa), Mahanimb (Sanskrit), and Karivempu (Tamilnadu) are a few of the frequently used synonyms in India.

1.3.1. Foreign Names

Curry leaves go by the following names in different languages

English: Curry depart, Danish: Karrry bald, Dutch: Kerriebladeren, Burmese: Pindosine Feuilles de curry in French Curry Blatter in German, Daun Kari in Indonesian, Fogli de Cari in Italian, and Hoja de Curry in Spanish

1.3.2. Botanical Classification

Curry leaves are botanically known as *Murraya koenigii* Spreng, after the Swedish physician and botanist Johann Andreas Murray and the naturalist Johann König. *Murraya koenigii* is

Categorized as follows

- Plantae is the kingdom; Tracheobionta is the sub-kingdom.
- Spermatophyta is the superdivision.
- Class: Magnoliopsida; Division: Magnoliophyta
- Family: Rutaceae; Order: Sapindales; Subclass: Rosidae Species: *Murraya koenigii* Spreng - Genus: *Murraya* J. Koenig ex L (2)

1.4. Physical Characteristics of the Curry Leaf Plant:

It was reported that the curry leaf plant is a spreading shrub that usually develops into a small tree. It was mentioned that it can reach a height of 4 to 6 meters, with a trunk diameter of up to 40 cm. The observations indicated that the stem has a girth of about 16 cm and is often dark green to brownish in color, marked with distinctive spots. It was further noted that when the bark is peeled longitudinally, it exposes white wood underneath. The findings also revealed that the compound leaves bear 11 to 21 leaflets, each measuring 2 to 4 cm in length and 1 to 2 cm in width..(5)

1.4.1. History of Curry Leaves

It was noted that the use of curry leaves as a flavoring agent dates back to ancient times. It was mentioned that early Tamil literature from the 1st to 4th centuries AD described their use in flavoring vegetables, and it was further stated that Kannada literature also referred to curry leaves a few centuries later.

1.4.2. Origin and Spread

It is thought that the term "curry" came from the Tamil word "kari," which means spicy sauces. Curry leaves, referred to as "kari-pattha" in several regions of India, are still strongly linked to South Indian cooking. Due to its ability to enhance taste, curry leaves are now grown not just in India and Sri Lanka but also in Southeast Asia, Australia, the Pacific Islands, and Africa. (3)

1.4.3. Traditional Uses of *Murraya koenigii*

Murraya koenigii, commonly known as curry leaves, has traditionally been valued for its wide range of uses. It was mentioned that as a flavoring agent, fresh leaves, dried leaf powder, and essential oil are incorporated into food and even in soaps. The essential oil was further noted to be utilized in the cosmetic industry, the soap industry, and in aromatherapy. It was also stated that the roots and bark are applied externally to treat skin eruptions.

Medicinally, it was highlighted that *Murraya koenigii* has traditionally been employed for several purposes, including functioning as an antiemetic (preventing vomiting), antidiarrheal, febrifuge (reducing fever), blood purifier, antifungal, and anti-inflammatory agent. It was further indicated that it has also been used to relieve body aches, kidney pain, and vomiting. (4)

1.4.4. Uses of *Murraya koenigii*

Murraya koenigii, or curry leaves, have various uses in traditional medicine and cuisine. It was mentioned that the leaves are used as anthelmintics (to treat worm infestations), analgesics (to relieve pain), digestives (to aid digestion), and appetizers (to stimulate appetite). They were also noted to be employed in the treatment of piles, inflammation, cuts, dysentery, bruises, and edema. Furthermore, it was stated that the roots and bark of *Murraya koenigii* possess purgative properties (to induce bowel movements) as well as stimulating properties.

1.4.5. Modern research

recent studies that the essential oil extracted from curry leaves possesses a wide range of medicinal activities, including antioxidative, hepatoprotective (liver-protecting), antimicrobial, antifungal, anti-inflammatory, and nephroprotective (kidney-protecting) effects.

It was further stated that these therapeutic properties are attributed to the presence of various chemical constituents, such as carbazole alkaloids, terpenoids, flavonoids, phenolics, carbohydrates, carotenoids, vitamins, and nicotinic acid. (5)

1.4.6. Pharmacological Activities of *Murraya koenigii*

It was reported that *Murraya koenigii*, or curry leaves, contain various chemical constituents responsible for different pharmacological activities. It was mentioned that compounds such as koenimbine, murrayacine, and murrayazoline exhibit anti-diabetic activity. It was further noted that Mahanimbine and girinimbine possess anti-cancer activity, while mahanine and koenimbine show anthelmintic activity. Additionally, murrayacine and murrayazolidine were stated to have antipyretic activity, and koenimbine was highlighted for its chemoprotective activity. It was also reported that isomahanine has effects on dental caries, whereas koenine exhibits anti-diarrheal activity. (2)

1.5. Extraction Method

1.5.1. Soxhlet Extraction

It was described that the Soxhlet extraction was carried out in the following way. About 10 g of plant material, ground to a particle size of 0.425 mm, was wrapped in a white muslin cloth and placed in the Soxhlet apparatus between the condenser and the round-bottom flask. It was mentioned that the flask contained 400 mL of solvent prepared from 50% methanol and 50% water.

It was further explained that when the solvent boiled, it evaporated and condensed, thereby filling the extraction chamber with fresh solvent. Once the chamber became full, the siphon released the solvent back into the flask, carrying the dissolved plant compounds with it. This process was reported to have continued for 7 hours.

Regarding the comparison of polyphenol content, it was stated that the extract obtained through the Soxhlet method was analyzed for total polyphenol content. The value obtained was considered the maximum concentration, and

experimental results from batch extraction and ultrasound-assisted extraction were compared with this reference value. (7)



Figure 3 Soxhlet Extraction

1.6. Identification

1.6.1. UV Spectroscopy

The pharmacological properties, phytochemistry, and therapeutic uses of *Murraya koenigii* were found to be summarized in this paper. Reports state that *M. koenigii* includes bioactive compounds such as alkaloids, polyphenols, and terpenoids, especially P-alpha-5. Important pharmacological properties for *M. koenigii* and its derivatives were also described, including antiproliferative, proapoptotic, antiangiogenic, immunomodulatory (BPCR), and antioxidant effects. (15)

1.6.2. Accuracy Assessment

It was reported that the accuracy of the developed method was determined using recovery studies. For this purpose, aliquots of Mahanimbine were fortified with three different concentration levels

1.6.3. Robustness Evaluation

It was reported that the robustness of the method was evaluated by testing its sensitivity to minor changes in chromatographic conditions,

1.6.4. Force Degradation Studies

It was reported that the forced degradation study of Mahanimbine was performed under various stress conditions, including water, acid (0.1N HCl), base (0.1N NaOH), an oxidizing agent (10% H₂O₂), and UV light(9)

1.7. Identification

1.7.1. Terpenoids (Salkowski's Test)

5 ML leaf extract + 2 ml chloroform + 3 ML conc. sulphuric acid



Reddish brown color



Presence of terpenoids

1.7.2. Phytosterols (Salkowski's Test)

2ML leaf extract + 5 mL chloroform + a few drops of concentrated sulphuric acid.



The formation of a brown ring



presence of phytosterols.

1.7.3. Alkaloids (Dragendorff's Test)

5 ML extract +2 mL of Dragendorff's reagent



An orange-red precipitate confirmed



the presence of alkaloids.

1.7.4. Tannins (Lead Acetate Test)

few drops of 1% lead acetate solution +5 mL of the aqueous extract.



The formation of a yellow or red precipitate



presence of tannins.

1.7.5. Phenols (Ferric Chloride Test)

1 mL of the extract +2 mL of distilled water+ few drops of 10% aqueous ferric chloride solution.



bluish-black color confirmed



the presence of phenolic compounds.

1.7.6. Glycosides

A small portion of the extract was dissolved+ 1 mL of water+ aqueous sodium hydroxide was added.



yellow coloration



presence of glycosides.

1.7.7. Saponins (Froth Test)

The extract was diluted with 20 mL of distilled water and vigorously shaken for 15 minutes



Persistent froth formation confirmed the presence of saponins.

1.7.8. Flavonoids (Ferric Chloride Test)

2 mL of the extract +few drops of 10% aqueous ferric chloride solution.



Presence green color



presence of flavonoids. (10)

1.8. TLC system

A study claims that in order to maximize the analytical conditions, TLC silica gel 60F254 plates were used as the stationary phase. It was stated that a number of solvent combinations were investigated in order to select a suitable mobile phase for analysis. Following a thorough review of the literature, a number of hexane and ethyl acetate combinations in v/v ratios (8:2, 9:1, 9.5:0.5, and 7:3) were evaluated. After the first TLC analysis, the hexane–ethyl acetate mixture (7:3 v/v) was selected as the final mobile phase. The following was an additional explanation of the semi-automated TLC conditions:

Using a Lino mat V applicator, 4 μL of Mahanimbine and Koenimbine standards, along with F1, F2, and F3, were applied to TLC silica gel 60F254 plates (20×10 cm) at a rate of 150 nL s^{-1} . The plates were then developed in CAMAG twin trough chambers to a distance of 70 mm using the selected mobile phase that had been pre-saturated for 20 minutes.

Following development, the plates were allowed to air dry before being examined using a TLC Scanner 4 at $\lambda = 291 \text{ nm}$ for koenimbine and 285 nm for mahanimbine. Slit size $6.00 \times 0.45 \text{ mm}$, data resolution $100 \mu\text{m/step}$, and scanning speed 20 mm/s were the reported scanning parameters. It was also claimed that the wavelengths for densitometric scanning were optimized by spectrum scanning in the 190–400 nm range and comparing the findings with the maximum wavelengths reported in the literature.

Finally, it was stated that the peak regions obtained from densitometric Analy (8)

1.9. Standardization

1.9.1. Standardization

Macroscopic and Microscopic Analysis

The fresh leaves of *Murraya koenigii* were examined for both macroscopic and microscopic characteristics.

1.9.2. Macroscopic Characters

The color, shape, and texture of the leaves were studied.

1.9.3. Microscopic Characters:

For quantitative microscopic analysis, the leaf peel was stained with safranin. The following parameters were assessed:

The average number of stomata per square millimeter of epidermis was calculated based on at least ten measurements taken from different regions of the leaf.

The stomatal index (S.I.) was determined using the formula:

$$S.I = \frac{SE}{E + S} \times 100$$

where **S** represents the number of stomata per unit area, and **E** represents the number of epidermal cells in the same unit area.

1.9.4. Powder Microscopic Observations

The leaf powder was sifted and subjected to both organoleptic and microscopic evaluation. On treatment with phloroglucinol, characteristic features were observed under the microscope.

1.9.5. Physico-Chemical Constants

The Physico-chemical properties of the powdered leaves were determined using standard procedures:

- **Loss on Drying:** Moisture and volatile oil content were measured by drying the powder at 105 °C for 5 hours, and the percentage weight loss was recorded.
- **Total Ash:** The total ash content, representing the inorganic residue left after combustion, was calculated as a percentage.
- **Acid-Insoluble Ash:** This parameter measured the silica content (e.g., sand and siliceous matter) in the ash, expressed as a percentage.
- **Water-Soluble Ash:** The water-soluble ash fraction was determined as the difference between total ash and the residue remaining after treatment with water.
- **Sulphated Ash:** The sample was ignited with sulphuric acid, and the remaining ash was weighed to determine sulphated ash content.
- **Alcohol-Soluble Extractives:** The amount of ethyl alcohol-soluble constituents extracted from the powdered material was quantified. (12)

2. Results and discussion

Because of its rich phytochemical composition, *Murraya koenigii* (curry leaves) has a wide variety of pharmacological and therapeutic capabilities, according to a study of numerous research investigations on the plant. Numerous bioactive substances, including as alkaloids (mahanimbine, girinimbine), flavonoids, tannins, glycosides, sterols, and essential oils, have been found through phytochemical studies to contribute to its wide range of biological activity. Several extracts of *Murraya koenigii*, including ethanolic, methanolic, and aqueous extracts, showed notable antioxidant, antibacterial, anti-inflammatory, antidiabetic, hepatoprotective, and anticancer properties in experimental investigations. High levels of free radical scavenging activity were seen in the leaves, suggesting that they may help prevent illnesses linked to oxidative stress. *Murraya koenigii* has also demonstrated encouraging results in lowering blood sugar levels, shielding liver cells from toxins, and preventing the formation of harmful bacteria and fungi. All of these results point to curry

leaves' significant potential for use in the creation of herbal formulations and nutraceutical goods. *Murraya koenigii*'s traditional use in Ayurveda is validated by the literature, which also emphasizes the need for additional clinical and formulation-based research to fully investigate its pharmacological potential.

3. Conclusion

It was determined that this review provided an overview of *Murraya koenigii*'s pharmacological characteristics, phytochemistry, and therapeutic applications. According to reports, *M. koenigii* contains bioactive substances such as terpenoids (particularly P-alpha-5), polyphenols, and alkaloids. Significant pharmacological actions, such as antiproliferative, proapoptotic, antiangiogenic, immunomodulatory (BPCR), and antioxidant effects, were also mentioned for *M. koenigii* and its derivatives.

Compliance with ethical standards

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