

Murraya koenigii: An Aromatic Herb Bridging Culinary And Medicinal Traditions

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Abstract:

Murraya koenigii Linn is commonly known as meethi neem. Except for the higher Himalayan regions, the curry tree is native to India and can be found almost anywhere on the Indian subcontinent [5]. As a medicinally significant herb of Indian origin, Murraya koenigii (M. koenigii) belongs to the Rutaceae family, which is widely used in Ayurvedic medicine [2]. In addition to being used to treat a number of ailments, the Murraya koenigii plant is widely used in Indian traditional medicine as a herb, spice, and condiment. Because of their perceived safety, efficacy, and affordability, almost 80% of people worldwide rely on herbal products [4]. The antibacterial, antihypertensive, cytotoxic, antidiabetic, antioxidant, and bronchial respiratory problem-relieving qualities of curry leaves have been demonstrated [5]. The present study aimed to review the pharmacognostic, phytochemical, and ethanobotanical properties of the Murraya koenigii plant [4]. The plant contains a large number of carbazole alkaloids. Furthermore, a number of phytocompounds have been found and isolated, including girinimbine, mukoeic acid, murrayazolidine, murrayazoline, murrayacine, koenimbine, koenine, mahanimbine, and others [7]. This review describes Murraya koenigii, the pharmacological effects of its isolated components, and the bioactivity of the extract on multiple animal models in various laboratories [17].

Keywords: Murraya koenigii, Pharmacognostic, Mahanimbine, Papillomas, Leucoderma, Myelosuppression.

1.Introduction:

Medicinal plants are being used by many people in developing countries for skin care, medical treatment, financial gain, and cultural advancement [2]. 80% of people still get their primary care from plant-based drugs, mostly in developing countries, according to WHO estimates. WHO, 1978. Various Indian medical systems, such as Ayurveda, Siddha, Unani, and local health customs, use a variety of plants to cure human and animal ailments [4]. The fragrant, primarily deciduous shrub or small tree Murraya koenigii can reach a height of six meters. Up to 1,500 meters above sea level, it can be found all over India, typically as gregarious undergrowth in forests. It is cultivated for its aromatic leaves [6]. Curry leaves, as the leaves of this plant are frequently called, help with indigestion, nausea, and vomiting by improving digestive secretions. This plant's leaves, stem bark, and root have all yielded carbazole alkaloids through phytochemical analyses (2–8)[8]. Ancient medical systems have indicated that it has blood-purifying, tonic, stomachic, antiemetic, antidiarrheal, dysentery, febrifuge, and delicious qualities in curries and chutneys. To heal bruises and breakouts, the oil is employed externally in the soap and fragrance industries [5]. Additionally, curry leaves are known to help maintain long, healthy hair [10]. It has been demonstrated that Murraya koenigii is a medicinally relevant plant due to its numerous bioactive components, despite scientists paying little to no attention to it [17].



Fig no.01 : Stems of *Murraya koenigii* [07]

2. Synonyms:

The plant has several local names, which are listed below:

Marathi	Kadhi patta, Kadhi limb
Sanskrit	Kaidarya, Kalasakah, Girinimba, Surabhinimba
Hindi	Meetha neem, Kari patta
Malayalam	Kariveppila, Karivepu
Kannada	Karibevu, Sambara bevu, Karibevina
Bengali	Barsanga, Misti nim, Kari gachh
Gujarati	Mitho limbdo, Kadhi limbdo
Punjabi	Meethi neem, Kari patti
Oriya	Bhrusanga patra, Basango, Barsan
Assamese	Norsingho, Norsinghor paat
Tamil	Kari llai, Karuveppilai, Karivembu
Telugu	Karepaku, Karivepaaku, Kari vepa chettu

Table no.01: Synonyms in Indian languages^[17]

English	Curry leaves
Thai	Bai makrood
Burmese	Pindosine, Pyin-taw-thein
Dutch	Karriebladeren
French	Feuilles de Cari
German	Curry blatter
Italian	Fogli di cari

Table no.02: Synonyms in other languages^[17]

3. Botanical profile of murraya koenigii:

The little shrub *Murraya koenigii* has brown and dark green stems and reaches a height of roughly 2 to 2.5 meters. The plants produce white, funnel-shaped flowers with a sweet, fragrant aroma and spherical, 1.4–1.6 cm long fruits [28]. In addition to its short, 15–40 cm diameter, grayish or brown stem, this plant has rich foliage. Each of its 11–21 leaflets, which are bipinnate compound leaves, is 2-4 cm long and 1-2 cm wide. Each leaflet has a distinct aroma. The seeds are around 11 mm long and 8 mm in diameter, with a weight of roughly 445 mg[55].

Table no.03: Taxonomical/Scientific Classification of *Murraya koenigii*^[58]

Category	Botanical description
Kingdom	Plantae
Subkingdom	Tracheobionta (vascular plant)
Superdivision	Spermatophyta (seed plant)
Division	Magnoliophyta (flowering plant)
Class	Magnoliopsida
Subclass	Rosidae
Order	Sapindales
Family	Rutaceae
Genus	<i>Murraya</i>
Species	<i>Murraya koenigii</i>

4. Cultivation:

In May, just prior to the start of the monsoon season, the curry leaf plant is planted. It is cultivated by the propagation method. Fifteen months after the plants mature, the leaves are harvested. When fully grown, a curry tree can yield about 100 kg of leaves each year. Established plants require a sunny, well-drained spot. They could easily take over your space if you have it. As the plants become larger, keep cutting them to guarantee a consistent supply of new leaves for cooking. Water and feed often during the growing season.

Throughout the winter, the pot should be kept in a warm, frost-free environment (at least 12°C). In early April, move the plants to a light, warm spot (about 18 to 20°C), wet the pot, and repot if needed [62].



Fig no. 02: Flowers of *Murraya koenigii* [21]

5. Uses of *Murraya koenigii*

5.1. Traditional uses:

The herb has been used to treat a number of ailments in traditional Indian medicine. The entire plant is considered tonic and stomachic. Because bark and roots are stimulants, they are applied externally to treat skin breakouts and hazardous bites. Green leaves are used as a febrifuge and to cure diarrhea [6]. Fresh leaf powder and essential oils from *M. koenigii* are useful for seasoning food and preparing meals that are ready to eat. Because of their potent antibacterial qualities, essential oils made from leaf extracts can also be used as flavorings and fragrances in traditional practice. To make a superb hair tonic that encourages healthy hair development and maintains a normal hair tone, fresh curry leaves are boiled in a mixture of coconut oil until they are reduced to a black residue. Whole or portioned curry leaves have long been used as antidepressant, antifungal, blood-purifying, anti-inflammatory, and antidiarrheal medications [2].

5.2. Medicinal uses:

The steam distillate of the leaves has purgative, febrifuge, stomachic, and antianemic effects. The cooling, acrid, bitter, anti-helminthic, and analgesic qualities of the roots and leaves are all present. It lowers body heat, thirst, piles, inflammation, and itching. It also helps with leucoderma and blood issues. To avoid vomiting, the toasted leaves are used as an infusion. The juice from the root helps with renal pain [4]. Leaf extract from *M. koenigii* can reduce blood glucose and cholesterol levels in diabetic mice and, after treatment, reduce body weight [5].

5.3. Culinary uses:

In South Indian vegetarian and fish dishes, as well as Sri Lankan meat and poultry curries, the leaf of *M. koenigii* is frequently used. In addition to adding taste to salad dressings made with yogurt, it also adds flavor to vegetable dishes such as fried cabbage, lentils, beans, okra, or eggplant. In most cases, it is removed prior to eating. In addition, the leaf gives chilled foods and buttermilk a distinct peppery flavor. When roasted in oil or ghee, it adds crunch and a stronger taste to a variety of vegetarian recipes. To add taste or garnish to soups, sambars, and curries, it is sometimes powdered, crushed, or roasted [62].



Fig no.03 : Leaves of *Murraya koenigii* [28]

6. Phytochemistry of *M. koenigii*:

Murraya koenigii has an abundance of organic compounds with a wide range of chemical identities. Plant extracts prepared in solvents including petroleum ether, ethyl acetate, chloroform, ethanol, and water have been shown by numerous researchers to include alkaloids, flavonoids, and sterol [7]. The mature curry leaves are 63.2% wet, contain 1.15% nitrogen protein, 14.6% total sugars, 13.06 percent total ash, and 14.6% protein. It also contains 18.92% total sugars, 14.6% starch, 6.15% fat, and 6.8% crude fiber. A total of 13.06% ash is present in the leaves, of which 1.35% is acid insoluble, 27.33% is cold water (20°C) soluble, up to 33.45% is hot water soluble, and 1.82% is alcohol soluble [37]. To determine the amount of volatile oil in the leaf powder, we conducted tests. Chemical methods were employed in the first phytochemical screening for a number of secondary metabolites, such as carbohydrates, alkaloids, and phytosterols [51].

7. Pharmacological activities:

A thorough discussion of *M. koenigii*'s pharmacological actions is provided.

7.1. Antidiabetic activity:

Studies on the alkaloids in *M. koenigii* leaves have shown that they have inhibitory effects on the enzyme aldose reductase, glucose utilization, and other enzyme systems, which prolongs the anti-diabetic positive effects. Its capacity to prevent α -glucosidase was also investigated and found to be effective. Alpha glucosidase inhibitors are commonly used in the treatment of patients with type 2 diabetes [21]. The chemical component mahanimbine is present in the petroleum ether extract of *Murraya Koenigii*. Mahanimbine has been shown to boost insulin levels and decrease blood sugar via promoting the pancreatic release of insulin from β -cells. Another study compares the chemical substance mahanimbine to the anti-diabetic drug acarbose and found that it also inhibits α -amylase [58].



Fig no.04: Fruits of *Murraya koenigii* [51]

7.2. Anticancer activity:

Root bark koenoline was found to have cytotoxic effects on the KB cell culture test system. It was shown that 9-formyl-3 methyl carbazole had mild cytotoxic effects on both Adriamycin-resistant P 388 mouse leukemia cell lines and mouse melanoma B 16 (Chakraborty et al., 1997). In both in-vitro (short-term incubation technique) and in-vivo (Dalton's ascitic lymphoma, or DAL) anticancer models, the effects of *M. koenigii* extracts have been tested in male Swiss albino mice. According to Nutan et al. (1998), 106 DAL cells were injected intraperitoneally into the mice. Using 7, 12 skin papillomas caused by dimethylbenz (a) anthracene (DMBA) and stomach papillomas caused by benzo (a) pyrene, the potential of curry leaf to prevent cancer was examined. Chemoprotective responses reduced the tumor load (papillomas/mouse) and the proportion of tumor-bearing mice in both models. Additionally, increases in DT diaphorases, glutathione S-transferase, and acid soluble sulphhydryl compounds were found [54].

7.3. Antiulcer Activity:

The antiulcer effects of *M. koenigii* aqueous and ether extracts were tested in albino rats with stomach ulcers caused by reserpine. Extracts were found to be effective in healing stomach ulcers and to be just as protective as ranitidine 26. Crude leaf aqueous extract showed anti-ulcer activity in rat models of acute gastric lesions brought on by ethanol-induced, aspirin-induced, cold-restrain stress, and pylorus ligation. Animals were pretreated with 200 mg/kg and 400 mg/kg of aqueous extract in the ethanol-induced, aspirin-induced, cold-restrain stress-induced ulcer and pylorus ligation models. This effectively decreased the lesion index, total affected area, and percentage of lesion in comparison to the control group. These results provide credence to the notion that an aqueous extract of *M. koenigii* leaves may serve as a potent anti-ulcer drug 27[68].

7.4. Antidiarrhoeal activity:

The main cause of mortality from diarrhea is dehydration, which results from the loss of electrolytes in diarrheal stools [33]. Using a fractionation procedure guided by bioassay, three pure compounds of bioactive carbazole alkaloids—kurryam, koenimbine, and koenine—were separated from the n-hexane extract of *M. koenigii* seeds. Of the three compounds, kurryam and koenimbine showed significant inhibitory activity against castor oil-induced diarrhea and PGE2-stimulated enter pooling in rats. The compounds also dramatically reduced intestinal motility in the charcoal meal test of Wister rats [68]. The carbazole alkaloids koenimbine and kurryam, which were isolated from *M. koenigii* seeds, demonstrated significant and dose-dependent antidiarrheal effects when administered orally to rats. While a dose of 50 mg/kg had a stronger effect than 5 mg/kg of diphenoxylate, the standard drug, a dose of 30 mg/kg had an effect similar to that of 5 mg/kg of diphenoxylate. It also dramatically decreased the rats' propulsion of charcoal meal through the gastrointestinal tract and PGE2-induced enteropooling. Thus, the present study shows that *M. koenigii* contains a lot of carbazole alkaloids with antidiarrheal qualities. The leaves of this plant contain a considerable amount of koenimbine as well [33].

7.5. Hypocholesterolemic activity:

Older mice were used to test for hypocholesterolemic activity using a crude ethanol extract of *M. Koenigii* plant leaves. The experiment was confirmed when the cholesterol levels of aged mice dropped in a dose-dependent manner. The 500 mg/kg dose was comparable to simvastatin, a common cholesterol-lowering drug, and was demonstrated to be more effective than the 300 mg/kg dose. Carbazole alkaloids are an important phytochemical component of plants that have been demonstrated to exhibit a variety of biological characteristics, such as anti-oxidant, anti-diabetic, anti-microbial, and lipid-lowering effects [68].

7.6. Antifungal activity:

The essential oil extracted from the leaves of *Murraya koenigii* exhibited antifungal activity against *Microsporum gypseum*, *Candida albicans*, *Candida tropicalis*, *A. niger*, and *A. fumigates*, even at a dilution of 1:500. The ethanolic extract of the leaves shown fungitoxicity against *Colletotrichum falcatum* and *Rhizoctonia solani* 35. However, neither *Trichophyton mentagrophytes*, *Cryptococcus neoformans*, nor *Microsporum canis* were inhibited by the ethanolic extract of *Murraya koenigii*'s roots or the complete plant, with the exception of the roots [29].

7.7. Anti-oxidant activity:

Due to their antioxidant qualities in the environment or at work, *M. koenigii* leaf aqueous extracts considerably shield rat heart tissue from oxidative stress brought on by cadmium. Oxidative stress has been observed to result in changes in lipid peroxidation levels, decreased glutathione, protein carbonyl content, and the activity of cardiac antioxidant and pro-oxidant enzymes, all of which demonstrate that cadmium damages tissue [21]. Green leafy veggies are well known for their high antioxidant content. *Murraya koenigii* leaves were shown to have the best antioxidant potential when compared to four other green vegetables. According to the investigations, aqueous extracts of *Murraya koenigii* leaves showed a robust defensive mechanism against cadmium-induced damage to the rats' cardiac tissues. *Murraya koenigii* was demonstrated to lessen the adverse effects of piroxicam-induced gastrointestinal damage in arthritic patients by inducing and curing stomach ulcers in rats. It has been discovered that the benzene component of *Murraya koenigii* has antimutagenic and antioxidant qualities in experimental mice [28].

7.8. Antimicrobial activity:

The hexane, methanol, and chloroform extracts of the *M. koenigii* root were evaluated against strains of *A. niger*, *C. albicans*, and *T. rubrum* as well as *B. subtilis*, *S. aureus*, *E. coli*, and *S. typhi*. Hexane, methanol, and chloroform extracts of the root were well received by all strains under study; the methanol extract showed the strongest antibacterial activity. The root's aqueous extract was also shown to be advantageous against the tested microorganism, and all three of the previously described extracts demonstrated efficacy against *S. aureus*. Antibacterial activity against *B. subtilis*, *S. aureus*, *C. pyogenes*, *P. vulgaris*, and *P. multocida* was demonstrated by the essential oil that was isolated from the roots. The pure oil continued to be effective against the first three infections even after being diluted 1:500. After fractionation, the acetone extract of *M. koenigii* roots yields three bioactive carbazole alkaloids: mahanimbine, murrayanol, and mahanine. These alkaloids have antibacterial, mosquito-cidal, and inhibitory effects on topoisomerase I and II [21].

7.9. Antihelminthic activity:

To test the antihelminthic effect, the adult Indian earthworm "*Pheretima posithuma*" was employed. The organism was chosen due to its resemblance to intestinal roundworm parasites in humans. Petroleum ether and alcoholic extracts were selected for the activity, while piperazine citrate served as a reference. The ether and methanolic extract concentrations were 25 mg/ml, 50 mg/ml, and 100 mg/ml, respectively. In order to determine how long it took for each worm to become paralyzed and die, worms were observed. It was said that paralysis occurs when the worms do not come back to life, even in ordinary saline. The worms died when they lost their ability to move and their body color began to fade. A dose of 100 mg/ml of alcoholic plant leaf extract demonstrated significant antihelminthic activity, while petroleum ether had modest antihelminthic activity [68].

7.10. Immunomodulatory activity:

According to the current study, the methanolic extract of *Murraya koenigii* leaves exhibits phagocytic activity, myelosuppression produced by cyclophosphamide, and the capacity to modulate humoral and cellular immune responses to the antigenic challenge by ovalbumin. The immunomodulatory activity of *M. koenigii* was examined by evaluating its effects on phagocytic function, antibody titre, DTH reaction, and cyclophosphamide-induced myelosuppression in mice. The injection of methanolic extract revealed immunostimulating effect both in vitro and in vivo. The results of the present investigation showed that the humoral immune response was generally higher, as evidenced by the higher antibody titre in response to ovalbumin. DTH causes erythema at the site of antigen infection and is antigen-specific in vaccinated animals. Typically, DTH causes an induction that shows up within 24 to 72 hours, as well as an influx of immune cells at the injection site, as well as macrophages and basophils in mice. T-cells are required to initiate the response. The extract does not have any effect on cell-mediated immunity because it does not stimulate T-lymphocytes, especially TDTH-lymphocytes, as demonstrated by the non-significant difference in the DTH response [15].



Fig no. 05: Benefits of *Murraya koenigii* [27]

Sr. No.	Pharmacological activity	Plant part	Extract
1.	Antidiabetic	Whole plant, fresh leaf, fruit	Aqueous, methanol, Petroleum ether
2.	Anticancer	Stem bark	Petroleum ether
3.	Antiulcer	Leaf	Aqueous, ether
4.	Antidiarrhoeal	Seeds	n-hexane
5.	Hypocholesterolemic	Leaf	Ethanol
6.	Antifungal	Leaf	Ethanol
7.	Antioxidant	Leaf	Aqueous, methanol
8.	Antibacterial	Bark, leaf	Petroleum ether, alcohol
9.	Anthelmintic	Leaf	Alcohol
10.	Immunomodulatory	Leaf	Methanol

Table no.04: Pharmacological activities done on *Murraya koenigii* plant^[68].

CONCLUSION:

Curry leaves, or *Murraya koenigii*, are a valuable plant that are widely used in both culinary and medicinal applications. They are a mainstay of Indian cooking and have a variety of medicinal qualities, such as hepatoprotective, antibacterial, anti-inflammatory, antidiabetic, and antioxidant effects. The presence of many bioactive components, including alkaloids, flavonoids, and essential oils, is primarily responsible for these positive effects. Curry leaves' historic Ayurvedic uses have been confirmed by contemporary scientific studies, highlighting their potential medical benefits. In conclusion, curry leaves are a valuable

natural resource that has a lot of potential for use in the culinary, pharmaceutical, and nutraceutical industries. As such, they should be investigated and developed further.

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