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Review on *Murraya koenigii*: Multipurpose Role in Management of Human Health



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ABSTRACT

“Medicine is food and food is medicine” is the best way to describe how the ailments were cured by using the plants during the ancient period. The “Magical plant of Indian Spice” (*Murraya koenigii*) has served humankind not only as a food enhancer but also as a village or folk medication to cure many disorders. The tribal communities have used many parts of the *Murraya koenigii* to cure them. *Murraya koenigii* is an important culinary plant of Indian origin and has been a component of many formulations used in the Ayurvedic system of medicine for many centuries. The plant consists of various active phytochemical constituents such as koenimbine, koenine, mahanimbine, murrayazolidine, murrayazoline, murrayacine, girinimbine, mukoeic acid, etc. These bioactive compounds possess antioxidant, antimicrobial, anthelmintic, analgesic, anti-inflammatory, antidiarrheal, hepatoprotective, and antitumor properties. The present review incorporates the description of *Murraya koenigii*, its ethnobotany, phytochemical constituents, and various pharmacological activities of crude extracts, fractions, and isolated compounds which could lead to the development of viable drugs for the treatment of a variety of ailments.

INTRODUCTION

Murraya koenigii, commonly known as curry leaf or *Kari Patta* in Indian dialects, belongs to the family Rutaceae which represent more than 150 genera and 1600 species. It is a highly valued plant for its characteristic aroma and medicinal value. It is an important export commodity from India as it fetches good foreign revenue. The plant is a rich source of carbazole alkaloids, coumarins, acridine alkaloids. *M. koenigii* has been widely used in Indian cookery for centuries and has a versatile role to play in traditional medicine. The plant is credited with tonic and stomachic properties. Bark and roots are used as stimulants and externally to cure eruptions and bites of poisonous animals. Green leaves are eaten raw for the cure of dysentery, diarrhea and for checking to vomit. Leaves and roots are also used traditionally as bitter, anthelmintic, analgesic, curing piles, inflammation, itching and are useful in leucoderma and blood disorders. Several systematic scientific studies are also being conducted regarding the efficacy of the whole plant or its parts in different extract forms for the treatment of different diseases. ¹ Various part of *Murraya koenigii* has been used in traditional or folk medicine for the treatment of rheumatism, traumatic injury and snake bite. The *Murraya* species has the richest source of carbazole alkaloids. Further, carbazole alkaloids have been reported for their various pharmacological activities such as anticonvulsant, antitumor, anti-inflammatory, diuretic, antiviral, and activities. The leaves of the plants are full of antioxidants, namely, tocopherol, β -carotene, and lutein, and possess ant oxidative and anti-lipid peroxidative activities, protecting against oxidative stress. ²

Plant Profile ³

Kingdom: Plantae

Sub-kingdom: Tracheobionta

Superdivision: Spermatophyta

Division: Magnoliophyta

Class: Magnoliopsida

Subclass: Rosidae

Order: Sapindales

Family: Rutaceae

Genus: *Murraya J. koenigii* ex L.

Species: *Murraya koenigii* L. Spreng

Vernacular names⁴

The plant is known by different vernacular names in the different areas by the local people mentioned in Table 1. It is commonly called meetha neem, karipatta, Kari Patta, karhinimb, curry leaves, and kathniel.

Table No. 1: Names used worldwide of *Murraya koenigii*

Sr. No.	Language	Vernacular names
1	Marathi	Karipat, Kari Patta, Karhinimb, Jhirang
2	Hindi	Meetha neem, Karipatta, Kathnim, Bursunga
3	Bengali	Barsunga
4	Gujarati	Mitho limdo
5	Kannada	Karibevu
6	Malayalam	Karuveppilai, Kareapela
7	Oriya	Bansago.
8	English	Curry leaves
9	French	Feuilles de cari, Feuilles de curry
10	Burmese	Pindosine, Pyim daw thein
11	Danish	Kerry bald
12	Dutch	Kerriebladeren
13	German	Curry Blatter
14	Indonesian	Daun Kari
15	Italian	Fogli de Cari
16	Spanish	Hoja

Plant description

Murraya koenigii is a small shrub of about 2-2.5 m in height and dark green and brown stem. The leaves are long and are seen to be in reticulate venation. Leaves, exstipulate, bipinnately compound, 30 cm long, each bearing 24 leaflets, having reticulate venation; leaflets, lanceolate, 4.9 cm long, 1.8 cm broad, having 0.5-cm-long petiole. Flowers found on the

plants are white, funnel-shaped having a sweet aromatic smell and round-shaped fruits are 1.4-1.6 cm in length.⁵

History

The history of curry leaves is seen in the early 1st to 4th century AD. In Tamil and Kannada literature, it was updated as the word 'Kari' with its uses. The word now popularly used for the *Murraya koenigii* is curry leaf which originated from the Tamil word Kari which means 'spiced sauce'. In the early literature of Tamil and Kannada, the use of *Murraya koenigii* is described as the flavoring agent for vegetables. Today *Murraya koenigii* are grown as the cultivated crop in India, Sri Lanka, Southeast Asia, Australia, Pacific Islands, and Africa as flavoring agents for the food.⁶

Habit and habitat

The plant *M. koenigii* is an aromatic and more or less deciduous shrub or a small tree found in almost all parts of India up to an altitude of 1500 m commonly in forests often as gregarious undergrowth. The species belongs to India and it is commonly occurring in the foothills of the Himalayas, Assam, Sikkim, Kerala, Tamilnadu, Andhra Pradesh, and Maharashtra. It is also found in evergreen and deciduous forests of peninsular India, often as underwood.

Soil and climate

Murraya koenigii is found all over India, Sri Lanka, and the Andaman Islands and is commonly grown in every climatic condition. The tree is hardy and flourishes up to 600 m in Sri Lanka and up to 1500 m in the Himalayas. It grows well in almost any type of soil if there is good drainage.

Propagation

Propagation is usually done by seeds, but it also can be done by root suckers or air-layers. The seedlings are transplanted when they are 1 year old. They are planted in the field at 3-5 m spacing between them.

Harvesting

The first harvesting of the leaves can be taken out about 6 months after sowing and altogether two pickings are possible during the first year, while in the subsequent years, three normal

pickings can be done. In harvesting, leaves are plucked individually, or the terminal cluster of foliage complete with the silky, new purplish shoots are clipped off. Care should be taken not to allow plucking to expose the branches and trunk to sunburn.

Morphological characteristics ⁷

Leaves

Curry leaves are aromatic having a characteristic aroma, curry leaves are shiny and smooth with paler undersides. Leaves are pinnate, exstipulate, having reticulate venation, and having ovate-lanceolate with an oblique base, with 11-21 leaflets. Leaflets are short-stalked, alternate, gland-dotted, and having 0.5 cm long petiole. The leaf margins are irregularly serrate. The yield of a bush is approximately found about 480 g in three to four pickings.



Figure No. 1: *Murraya koenigii* Leaves

Stem

The stem of *Murraya koenigii* is brown to dark green, with dots on the bark like a small node on it, when the bark was peeled off longitudinally under the exposing the white wood underneath; the girth of the main stem is 16 cm up to 6 meters in height and 15 to 40cm in diameter.



Figure No. 2: *Murraya koenigii* Stem

Flowers

The flowers of curry leaves are small, white fragrant and funnel-shaped, regular, pentamerous, stalked, complete, ebracteate, hypogynous, persistent, inferior, green, corolla, polypetalous, androecium, polyandrous, lanceolate, stigma, bright, sticky, style, short, ovary, inflorescence, a terminal cyme, the diameter of a flower is 1.12 cm in the fully opened form, each cluster bear approximately 60 to 90 flowers at a time after flowering at once, 5-lobed calyx, with petals in having length 5 mm and the petals are 5 in number, with stamen in number 10 and in small in size approximate number 4 mm, dorsifixed, arranged into circles, with long superior gynoecium with size 5 to 6 mm. Curry tree flowers have a sweet fragrance, bisexual with self-pollinated for produce blackberries in small size with shiny appearance containing a large visible seed with the number.



Figure No. 3: *Murraya koenigii* Flowers

Fruits

Fruits of the *Murraya koenigii* occur in cluster form varies from 32 to 80 in number. The fruits are in the ovoid or subglobose and small in size in the spinach green color seed in one or two numbers which are enclosing each other in the thin pericarp. The fruits are 1 to 1.2 cm in diameter with length 1.4 to 1.6 cm, purple-black after-ripening and they are edible and yield 0.76% of a yellow volatile oil. Curry leaf fruit is 11 mm long and weighs about 445 mg. The plant produces small white flowers which can self-pollinate. The weight of pulp is 880 mg and the volume is 895 microliters. The seeds of the *Murraya koenigii* are poisonous and should not be consumed for any purpose.



Figure No. 4: *Murraya koenigii* Fruits

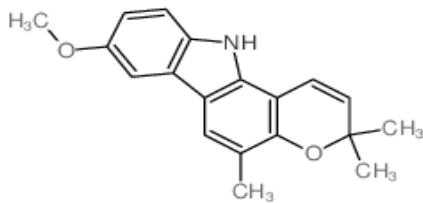
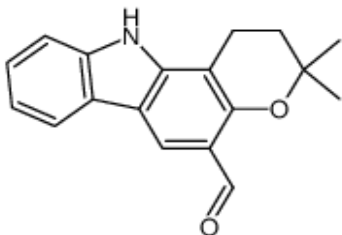
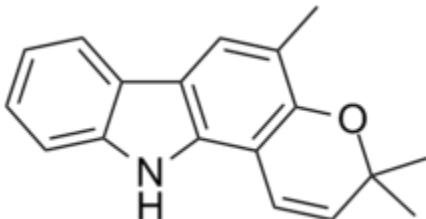
Chemical constituents

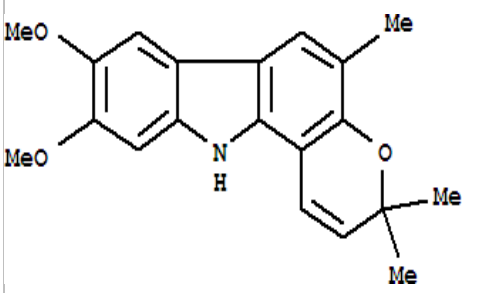
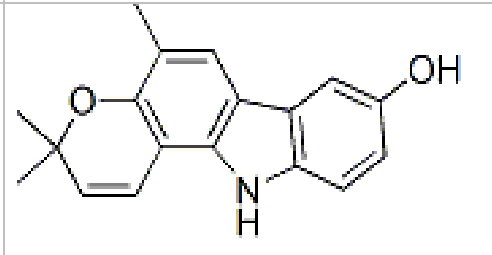
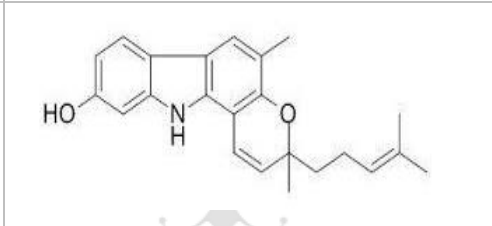
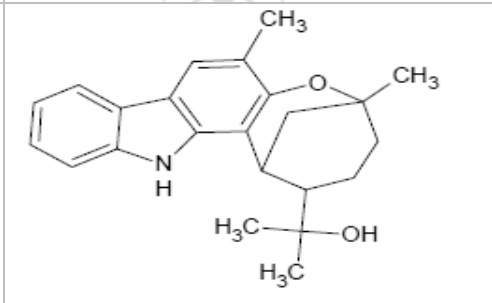
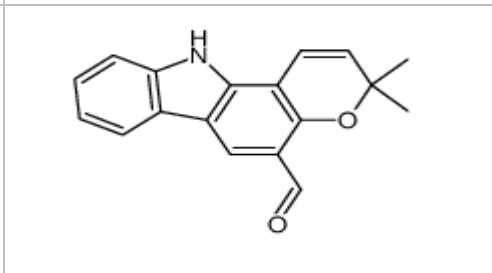
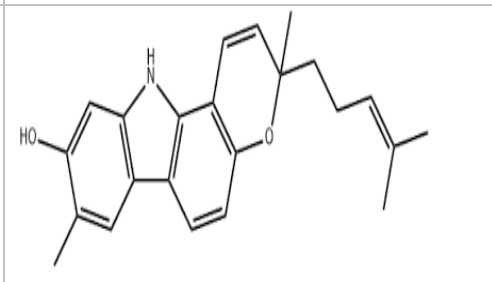
Murraya koenigii is a very rich source of organic compounds with different phytoconstituents such as phenols, steroids, saponins, quinones, alkaloids, flavonoids, tannins, carbohydrates, proteins, and volatile oils.^{8,9} Bark contains carbazole alkaloids namely mukoenine-A, B and C and murrastifoline-F, bis-2-hydroxy-3- methyl carbazole, bismahanine, bi koeniquinone-A, bismurrayaquinone-A, murrayacine, murrayazolidine, murrayazoline, mahanimbine, girinimbine, koenioline, and xynthyletin.¹⁰ Leaves contains koenimbine, O- methyl Murray mine, O- methyl mahanine, isomahanine, bismahanine, bispyrayafoline, glycozoline, 1-formyl-3 methoxy- 6-methyl carbazole, 6, 7-dimethoxy-1-hydroxy-3-methyl carbazole, koenigine, koenine, koenidine, and (-) mahanine, mahanimbine, isomahanimbine, koenimbidine, murrayacine, Isomahanimbicine, euchrestine B, mahanine, mahanimbicine, mahanimbine. The leaves of *Murraya koenigii* also consist of protein, carbohydrates, fiber, minerals, carotene, vitamin C, Nicotinic acid.¹¹⁻¹³ The general phytochemical tests were carried out to check the presence of major chemical constituents viz. phenols, steroids, saponins, alkaloids, flavonoids are represented in Table 2. The different phytochemical constituents present in *Murraya koenigii* along with the reported pharmacological activity are enlisted in Table 3.

Table No. 2: General phytochemical tests for identification

Sr. No.	Test	Observations	Inferences
1	Mayer's reagent test	Shows formation of white-or cream-colored precipitates	Alkaloid present
2	Bromine water test	Formation of white precipitates	Phenolic compounds present
3	Lead acetate test	Formation of yellow precipitates	Flavonoids present
4	Honeycomb test	Shows honeycomb-like frothing formation	Saponin present
6	Salkowski test	Form the yellow to brick red coloration	Sterols, Triterpenes present

Table No. 3: Chemical constituents with tested pharmacological activities

Sr. No.	Constituent	Chemical structure	Activity
1	Koenimbine		Anti-diarrhea
2	Murrayacine		Anti-microbial
3	Girinimbine		Anti-tumour

4	Koenimbidine/ Koenidine/ Koenigicine		Anti-diarrhea
5	Koenine		Antioxidant
6	Mahanine		Cytotoxicity, Anti-microbial, Anticancer
7	Mahanimbine		Antioxidant, Antimicrobial, Anti-diabetic and Hyperlipidaemic
8	Murrayacinine		Antioxidant, Anti-microbial, Antidiabetic and Hyperlipidaemic
9	Isomahanine		Cytotoxicity, Antioxidant, Anti-microbial, Antidiabetic and Hyperlipidaemic

Traditional uses

Fresh leaves, dried leaf powder, and essential oil are widely used for flavoring soups, curries, fish and meat dishes, eggs dishes, traditional curry powder blends, seasoning, and ready-to-use other food preparations. The essential oil is also utilized by the soap and cosmetic aromatherapy industry. Curry leaves are boiled with coconut oil till they are reduced to a blanked residue which is then used as an excellent hair tonic for retaining natural hair tone and stimulating hair growth. It is traditionally used as a whole or in parts as antiemetics, antidiarrheal, febrifuge, blood purifier, antifungal, depressant, anti-inflammatory, body aches, for kidney pain and vomiting.¹⁴

Ethnobotanical uses

The leaves of *Murraya koenigii* are generally used as fresh or dry leaf powder for flavoring soups, curries, fish and meat dishes, egg dishes, traditional curry powder blend, etc. The essential oil of the leaves is used by the aromatherapy industry in making soaps and cosmetics. The leaves are boiled with coconut oil and the blanked residue obtained is being used as a natural hair tonic which helps to promote hair growth and prevent the premature greying of hair. It is also used as a blood purifier, febrifuge, and anti-inflammatory, body ache for kidney pain, as an anthelmintics, and in vomiting. It has also been proved to be effective against diabetes mellitus. The paste of fresh leaves is applied for burns, bruises, and skin eruptions. The leaves and roots are used as an analgesic, cure inflammation and itching, treat leucoderma, and other various blood disorders like piles. The infusion of toasted leaves can be used to stop vomiting. The paste of fresh leaves is applied locally to remove the poison of the animal bite from the body.¹⁵⁻¹⁷

Table No. 4: Ethnobotanical uses with the plant part

Sr. No.	Plant part used	Ethnobotanical uses
1	Whole plant	Stimulant, Hair tonic, Blood purifier, Antidepressant, Anti dysentery, Anti-diarrheal, Anti-fungal, Anti-inflammatory, Antiemetic, Febrifuge, Stomachic, Anti-periodic
2	Stem	Datum for cleaning, strengthen gums and teeth
3	Bark	Hair tonic, Stomachic, and Carminative
4	Leaves	Stomachic, Purgative, Febrifuge, Anti-anaemic, Anti-helminthic Analgesic, Anti-ulcer, Antinociceptive, Anti-amnesic, Anti-inflammatory, cooling and itching, Hair tonic, Stimulant of hair growth, Hypoglycemic activity
5	Fruits	Astringent
6	Roots	Anthelmintic, Analgesic, Cooling agent, Reduces inflammation, itching

Pharmacological activity

The different pharmacological activities of *Murraya koenigii* studied by In vivo and In vitro studies are as follows:

In vivo studies

Anthelmintic effect

The ethanolic and aqueous extract of the *Murraya koenigii* leaves showed anthelmintic activity when compared with the standard drug Piperazine. It is believed that the tannins present in the leaves are a polyphenolic compound that is responsible for anthelmintic activity. The methanolic extract also possesses anthelmintic activity against Indian earthworm in a dose-dependent manner such as it may cause paralysis in Indian earthworm in 18 minutes and cause lethal effect in 45 minutes.¹⁸

Hypoglycaemic effect

The plasma glucose levels were found to decrease in the alloxan-induced rats on treatment with aqueous and methanolic extract of *Murraya koenigii* leaves. The ethanolic extract of the

Murraya koenigii stem shows a remarkable reduction in the blood glucose level, total cholesterol level, triglyceride, and body weight. Mahanimbine which is a carbazole alkaloid obtained from *Murraya koenigii* leaves shows antihyperglycemic and hypolipidemic activity, in which intraperitoneal administration of 50 mg/kg and 100 mg/kg once a week for 30 days has shown anti-hyperglycemic effects and hypolipidemic effects on streptozotocin-induced adult male Wistar rats with non-hypoglycemic shock in diabetic rats. In the 30 days of the treatment, there was found a significant reduction in the total cholesterol level, triglycerides, low-density lipoprotein, and very-low-density lipoprotein and an increase in high-density lipoprotein levels. Furthermore, mahanimbine shows marked alpha-amylase inhibitory effects and weak *alpha-glucosidase* inhibitory effects compared with the synthetic drug, acarbose.¹⁹

Anti-inflammatory activity

The leaves of *Murraya koenigii* were subjected to extraction with three various solvents: petroleum ether, chloroform, and ethanol. A dose of 250 mg/kg was selected which is a 1/10th of 2500 mg/kg which was considered as LD50 and the dose was administered via the oral route. Compared to the three solvents, it was found that ethanolic extract shows a significant reduction in carrageenan-induced paw edema in the albino rats of the Wistar strain. Furthermore, it was found that the methanol and aqueous extract of *Murraya koenigii* leaves is effective against carrageenan-induced edema in male albino rats at the dose of 400 mg/kg, compared to petroleum ether and hexane extracts which has no decrease in the inflammation. The methanol extract was found to have the utmost anti-inflammatory activity compared to aqueous extract.²⁰

Inotropic activity

The ethanolic extract of the fresh leaves of *Murraya koenigii* shows a positive inotropic effect on the isolated frog heart in a dose-dependent manner. It was suggested that the positive inotropic activity is achieved by an increase in the availability of calcium from the extracellular sites by the *Murraya koenigii*.²¹

Antidiabetic activity

Mahanimbine, a chemical constituent of *M. koenigii* was isolated from column chromatography of the petroleum ether extract of dried plant. The anti-diabetic activity was performed on the streptozotocin-induced Wistar rats by using pure compounds at a dose of 50 mg/kg and 100 mg/kg. The possible mechanism by which the mahanimbine decreases blood

sugar level may be by potentiating of insulin effect either by increasing the pancreatic secretion of insulin from beta cells of islets of Langerhans or by increasing the peripheral glucose uptake. Mahanimbine showed an appreciable *alpha-amylase* inhibitory effect as compared with acarbose.²²

Antiulcer Activity

Antiulcer activity of aqueous and ether extracts of *M. koenigii* was studied in a reserpine-induced gastric ulcer model in albino rats. Extracts were effective in gastric ulceration and suggested as protective as ranitidine. Crude aqueous extract of leaves showed anti-ulcer activity which was evaluated by using models of acute gastric lesions induced by ethanol-induced, aspirin-induced, cold restraint stress, and pylorus ligation in rats. Animals were pre-treated with doses of 200 mg/kg and 400 mg/kg of aqueous extract which showed an efficient reduction in lesion index, the total affected area, and percentage of the lesion in comparison with the control group in the ethanol-induced, aspirin-induced, cold restraint stress-induced ulcer and pylorus ligation models. These observations confirm that aqueous extract of leaves of *M. koenigii* can act as a good anti-ulcer drug.²³

Anti-diarrheal activity

The bioassay-guided fractionation of the n-hexane extract of the seeds of *M. koenigii* resulted in the isolation of three pure compounds of bioactive carbazole alkaloids, kurryam, koenimbine, and koenine. Of the three compounds, kurryam and koenimbine exhibited significant inhibitory activity against castor oil-induced diarrhea and PGE₂-induced enter pooling in rats. The compounds also produced a significant reduction in gastrointestinal motility in the charcoal meal test in Wister rats.²⁴

Analgesic and antinociceptive activity

The methanolic extract of leaves showed an analgesic effect in the hot plate model and formalin-induced paw licking response in mice. The activity might be linked to the processes involved in the prevention of sensitization of nociceptors, downregulation of the sensitized nociceptors, or blockade of the nociceptors at peripheral and central levels. Methanol extracts were taken at different concentrations, viz. 100 mg/ml, 200 mg/ml, and 400 mg/ml. Among these 400 mg/ml showed prolific results.²⁵

Anti-lipid peroxidative activity

The status of lipid peroxidation was investigated in rats fed with *M. koenigii*. The concentration of malondialdehyde showed a significant decrease, while hydroperoxides and conjugated dienes were significantly increased in the liver and heart. Glutathione levels in the liver, heart, and kidney were lowered in rats after administering this plant. Glutathione reductase, Glutathione peroxidase, Glutathione- S Transferase, SOD, and catalase activity showed a sharp increase.²⁶

Wound healing effect

Male albino rats were used to check the wound healing activity by screening with ethanolic extract of leaves of *M. koenigii*. In the excision, the wound healing model reveals that three groups that were taken for wound healing activity showed a decrease in wound area from day to day. The incision model showed a significant increase in tensile strength of the 12-day old wound due to treatment with *M. koenigii*. Thus, the leaves of *Murraya koenigii* were proved to possess significant wound healing capacity.²⁷

***In-vitro* studies**

Antimicrobial activity

Benzoisofuranone derivatives along with six known carbazole alkaloids and three known steroids were isolated from the stem bark of *M. koenigii*. These compounds are found to be effective in the range 3.13-100 µg/ml concentration. Literature survey revealed that methanolic extracts of 21 plant species were screened for *in vitro* antibacterial activity against multi-resistant bacterial isolates including gram-positive and gram-negative strains. Studies showed that *M. koenigii* showed maximum antibacterial activity. *Staphylococcus epidermidis* was significantly inhibited by *M. koenigii*. Mahanimbine, murrayanol, and mahanine are three carbazole alkaloids isolated from the acetone extract of the fresh leaves of *M. koenigii*. Of these three, murrayanol showed an IC₅₀ of 109 µg/mL against hPGHS-1 and an IC₅₀ of 218 µg/mL against hPGHS-2 in anti-inflammatory assays, while mahanimbine displayed antioxidant activity at 33.1 µg/ml. All these three carbazole alkaloids were mosquitocidal and antimicrobial and exhibited topoisomerase I and II inhibition activities.²⁸

Antioxidative property

Isolated carbazole alkaloids from dichloromethane extract of leaves of *M. koenigii* were

evaluated based on oil stability index together with their radical scavenging ability against DPPH radical based on lag time to reach a steady-state. The 12 carbazoles were classified into 3 groups. It suggested that an aryl hydroxyl substituent on the carbazole ring plays a role in stabilizing the thermal oxidation and rate of reaction against DPPH radicals. The antioxidative properties of the leaf extracts of *Murraya koenigii* using different solvents were evaluated based on the oil stability index OSI together with their radical scavenging ability against 1, 1-diphenyl-2-picrylhydrazyl. Mahanimbine and koenigin, two carbazole alkaloids, isolated from the leaves of *M. koenigii* showed antioxidant activity. Koenigine also showed a high degree of radical-scavenging properties.²⁹

Antibacterial activity

The essential oil from *Murraya koenigii* leaves showed antibacterial effects against *B. subtilis*, *S. aureus*, *C. pyogenes*, *P. Vulgaris*, and *Pasteurella multocida*. The pure oil was active against the first three organisms even at a dilution of 1: 50033. The acetone extract of the fresh leaves of *Murraya koenigii* on fractionation gives three bioactive carbazole alkaloids named mahanimbine, murrayanol, and mahanine, which has shown mosquitocidal, antimicrobial, and topoisomerase I and II inhibition activities.³⁰

Antipyretic activity

The rats were fevered by parenteral administration of Brewer's yeast at the dose of 10 mg/kg. All the extracts of the *Murraya koenigii* leaves are being tested but the ethanolic extract shows more activity as compared to petroleum ether and chloroform extract. Paracetamol at the dose of 150 mg/kg was taken as a standard drug.³¹

Cytotoxic activity

The extract of *Murraya koenigii* roots consists of Girinimbine is a carbazole alkaloid that possesses cell death via apoptosis in a dose-dependent manner in A549 cells. It can also be via a classical mitochondrial pathway with cytochrome C release and *caspase*-dependent apoptosis.³²

Anti-obese activity

The ethanolic extract of the *Murraya koenigii* leaves was administered orally to male Wistar rats for 30 days. The results show a reduction in body weight, cholesterol, and triglyceride as well as controls glycemic levels.³³ The different pharmacological activities done on *Murraya*

koenigii plant along with used plant part and plant extract are summarized in Table 5.

Table No. 5: Pharmacological activities are done on the *Murraya koenigii* plant

Sr. No.	Pharmacological activity	Plant part	Extract
1	Anti-inflammatory	Leaf	Ethanol, Petroleum ether, Chloroform, Methanol
2	Anti-amnesic	Leaf	Petroleum ether
3	Hypocholesterolemic	Leaf	Ethanol
4	Memory enhancer	Leaf	Petroleum ether
5	Anti-helminthic	Leaf	Alcoholic
6	Anti-bacterial	Bark, Leaf	Petroleum ether, Alcohol
7	Anti-cancer	Stem bark	Petroleum ether
8	Anti-diabetic	The whole plant, fresh leaf, fruit.	Aqueous, methanol
9	Antidiarrheal	Seeds	n-hexane
10	Anti-fungal	Leaf	Petroleum ether, alcohol, and acetone
11	Radioprotective and chemoprotective	Leaf	Methanol
12	Analgesic and Antinociceptive	Leaf	Methanol
13	Anti-oxidant	Leaf	Methanol and Aqueous
14	Cardiovascular	Leaf	Aqueous
15	Skin pigmentation	Leaf	
16	Anti-lipid peroxidative	Leaf	Methanol
17	Anti-tumor	Leaf	Petroleum ether
18	Anti-ulcer	Leaf	Aqueous
19	Cytotoxicity	Roots, stem	Aqueous
20	Wound healing activity	Leaf	Ethanol
21	Phagocytic activity	Leaf	Methanol

CONCLUSION

The curry leaves have been used as folk medicine since ancient times as a spice and as a flavoring agent for curries, soup, and other foodstuffs. The leaves and their extracts possess various therapeutic activities and treat the various ailments affecting humans. The antimicrobial activity of the plant extract also helps to prevent microbial infection and possesses mosquitocidal activity. The curry leaves are a very important herb being used since ancient times and till today.

REFERENCES

1. Jain V, Momin M, Laddha K. *Murraya koenigii*: an updated review. International Journal of Ayurvedic and Herbal Medicine. 2012; 2(4): 607-627.
2. Verma S. Overview study on murraya koenigii (Mitha Neem): Rutaceae. Journal of Drug Delivery and Therapeutics. 2018; 8(4): 90-92.
3. Dey VT, Lepcha U. *Murraya koenigii* (L): a multipotential medicinal plants. International Research Journal: Life Sciences Leaflets. 2017; 90: 11-13.
4. Mishra RK. Curry leaves (*Murraya koenigii* Spreng.). Van Sangyan. 2018; 5(7, 8): 23-28.
5. Roop JK. *Murraya koenigii* (Linn.): a plant with potential therapeutic properties. International Journal of Biological and Medical Research. 2018; 9(3): 6466-6472.
6. Chauhan B, Dedania J, Mashru RC. Review on murraya koenigii. World Journal of Pharmacy and Pharmaceutical Sciences. 2019; 6(3): 476-493.
7. Goel A, Sharma A, Kulshrestha S. A phytopharmacological review on *Murraya koenigii*: an important medicinal plant. International Journal of Pharmaceutical Sciences Review and Research. 2020; 62(2): 113-119.
8. Jain M, Gilhotra R, Singh RP, Mittal J. Curry leaf (*Murraya koenigii*): a spice with medicinal properties. MOJ Biology and Medicine. 2017; 2(3): 236-256.
9. Gupta S, Paarakh PM, Gavani U. Isolation of phytoconstituents from the leaves of murraya koenigii linn. J Pharm Res. 2009; 2: 1313-1314.
10. Rao BRR, Rajput DK, Mallavarapu GR. Chemical diversity in curry leaf (*murraya koenigii*) essential oil. Food Chem. 2011; 126: 989-994.
11. Chowdhury BK, Jha S, Bhattacharya P, Mukherjee J. Two new carbazole alkaloids from murraya koenigii. Ind J Chem. 2001; 40: 490-494.
12. Tachibana Y, Kikuzaki H, Lajis NH, Nakatani N. Comparison of anti-oxidative properties of carbazole alkaloids from murraya koenigii leaves. J Agric Food Chem. 2003; 51: 6461-6467.
13. Handral HK, Pandith A and Shruthi SD. A review on murraya koenigii: multipotential medicinal plant. Asian J Pharm Clin Res. 2012; 5(4): 5-14.
14. Saini SC, Reddy GBS. A review on curry leaves (*murraya koenigii*): versatile multi-potential medicinal plant. American Journal of Phytomedicine and Clinical Therapeutics. 2015; 3(4): 363-368.
15. Gupta P. A review on therapeutic use of murraya koenigii (L.) Spreng. International Research Journal of Modernization in Engineering, Technology and Science. 2020; 2(7): 93-97.
16. Rana VS, Juyal JP, Blazquez MA. Chemical constituents of the volatile oil of murraya koenigii leaves. Int J Aromatherapy. 2004; 14(1): 23-25.
17. Kumar VS, Sharma A, Tiwari R, Kumar S. *Murraya koenigii* (curry leaf): a review. Journal of Medicinal and Aromatic Plant Sciences. 1999; 21(4): 1139-1141.
18. Gahlawat DK, Jakhar S, Dahiya P. *Murraya koenigii* (L.) Spreng: an ethnobotanical, phytochemical and pharmacological review. Journal of Pharmacognosy and Phytochemistry. 2014; 3(3): 109-119.
19. Kumar A, Tripathi A, Dora J, Tripathi R. Anthelmintic activity of methanolic extract of murraya koenigii leaves (Linn). International Journal of Research in Pharmaceutical and Biomedical Sciences. 2011; 2(4): 1698-1700.

20. Vinuthan MK, Kumar GV, Ravindra JP, Jayaprakash Narayana K. Effects of extracts of *murraya koenigii* leaves on the levels of blood glucose and plasma insulin in alloxan induced diabetic rats. *Indian Journal of Physiology and Pharmacology*. 2004; 48(3): 348-352.
21. Darvekar VM, Patil VR, Choudhari AB. Anti-inflammatory activity of *murraya koenigii* spreng on experimental animals. *Journal of Natural Product and Plant Resources*. 2011; 1(1): 65-69.
22. Shah KJ, Juvekar AR. Positive inotropic effect of *murraya koenigii* (Linn.) spreng extract on an isolated perfused frog heart. *Indian Journal of Experimental Biology*. 2006; 44(6):481-484.
23. Phatak RS, Khanwelkar CC, Datkhile KD, Hendre AS. Investigation of antioxidant and antidiabetic activities of *murraya koenigii* leaves methanolic and aqueous extract by in-vitro methods. *International Journal of Research in Pharmaceutical Sciences*. 2018; 9(4): 1460-1464.
24. Patidar DK. Anti-ulcer activity of aqueous extract of *murraya koenigii* in albino rats. *International Journal of Pharma and Bio Sciences*. 2011; 2(1): 524-529.
25. Sharma P, Vidyasagar G, Bhandari A, Singh S, Bhadoriya U. A pharmacological evaluation of antidiarrhoeal activity of leaves extract of *murraya koenigii* in experimentally induced diarrhoea in rats. *Asian Pacific Journal of Tropical Disease*. 2012; 2(3):230-233.
26. Sale K, Mirunalini R, Mano J, Manimekalai K. Evaluation of analgesic activity of *murraya koenigii* and *coriandrum sativum* leaves extract in animal model. *Asian Journal of Pharmaceutical and Clinical Research*. 2018; 11(1): 328-331.
27. Phatak RS, Khanwelkar CC, Matule SM, Datkhile KD, Hendre AS. Antihyperlipidemic activity of *murraya koenigii* leaves methanolic and aqueous extracts on serum lipid profile of high fat-fructose fed rats. *Pharmacognosy Journal*. 2019; 11(4): 830-841.
28. Jadhav VS, Ghawate VB. Evaluation of combined wound healing activity of ethanolic extracts of leaves of *Murraya koenigii* and *Nyctanthes arbortristis* on rats. *Drug Invention Today*. 2017; 9(2): 24-27.
29. Tirumalasetti J, Basavaraju A, Praveena H. In vitro evaluation of antimicrobial activity of methanolic extract of *murraya koenigii* leaves (curry leaves). *International Journal of Pharmaceutical and Phytopharmacological Research*. 2014; 4(2): 123-125.
30. Iqbal Z, Mehmood HK, Hussain M, Mehmood MR. Antioxidant activity of essential oil from the leaves and stems of *murraya koenigii*. *World Journal of Pharmaceutical Research*. 2017; 6(7): 267-273.
31. Harbi HA, Irfan UM, Ali S. The antibacterial effect of curry leaves (*murraya koenigii*). *European Journal of Pharmaceutical and Medical Research*. 2016; 3(10): 382-387.
32. Rageeb MD, Usman MD, Barhate SD. Phytochemical evaluation and effect of antipyretic activity on *murraya koenigii* spreng leaves extract. *International Journal of Pharmaceutical and Chemical Sciences*. 2012; 1(1): 231-236.
33. Mohan S, Abdelwahab SI, Cheah SC, Sukari MA, Syam S, Shamsuddin N. Apoptosis effect of girinimbine isolated from *murraya koenigii* on lung cancer cells in vitro. *Evidence- Based Complementary and Alternative Medicine*. 2013; 2013: 1-12.
34. Tembhumne SV, Sakarkar DM. Anti- obesity and hypoglycemic effect of ethanolic extract of *murraya koenigii* (L) leaves in high fatty diet rats. *Asian Pacific Journal of Tropical Disease*. 2012; 2(1): 166-168.