



A REVIEW ARTICLE ON CURRY LEAF (*Murraya koenigii*)

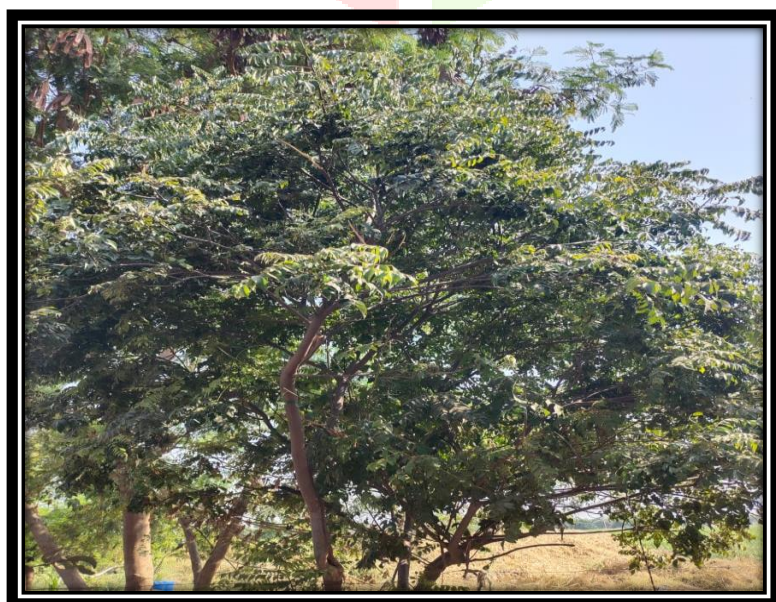
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ABSTRACT: The aim of this review study is to update information about pharmacognostical, Phytochemical and pharmacological studies of *Murraya koenigii*. Curry leaf is an aromatic tropical and sub-tropical plant originated from India. Besides its culinary purpose, curry leaf is known for its medicinal and industrial applications. To evaluate the versatile multi-potential medicinal use of *Murraya koenigii*. Literature suggests the various activity of *Murraya koenigii* especially in leaf, stem, bark & oil. The goal of the current study was to identify the phytochemical components found in curry leaf powder. In all three solvent extracts—methanol, ethanol, and aqueous—the study found the presence of alkaloids, flavonoids, glycosides, steroids, cardiac glycosides, saponins, phenols, tannins, terpenoids, quinones, amino acids, and protein. The Rutaceae family, which is frequently employed as a medicinally significant herb of Indian origin in the Ayurvedic system of medicine, includes *Murraya koenigii* (*M. koenigii*). The leaves, stems, and bark of this plant are abundant in carbazole alkaloids, which have strong pharmacological and biological effects. The review paper focused on different pharmacological, phytoconstituents, taxonomical classification of this plant.

KEYWORDS - *Murraya koenigii*, pharmacological activity, history, taxonomy etc.



INTRODUCTION - Curry leaf (*Murraya koenigii*) is a member of the *Rutaceae* family, which has 150 genera and 1600 species [1]. It has been determined to be native to South Asia, specifically to Bangladesh, India, and Sri Lanka [2]. The first and fourth centuries AD are when *Murraya koenigii* was first used. The whole plant is thought to be tonic and stomachic and has historical applications [3]. In addition to Karuveppilai in Tamil, Mitha Neem in Hindi, and Surabhinimba in Sanskrit [4]. Due to their compound leaves, curry leaf plants can also be utilised as a hedge and decorative shrub [5]. The green leaves of *M. koenigii* are used to treat edema, bruising, piles, diarrhoea, inflammation, itching, and fresh cuts. Somewhat purgative are the roots. They are energising and utilised for general body aches. Snake bites can be treated with the bark [6–9]. According to reports, the essential oil made from *M. koenigii* leaves has hepatoprotective and anti-oxidative properties [10–13]. The fastest-growing variety of *Murraya koenigii*, with attractive, dark-green leaves, is the standard variety. The dwarf variety develops as a shrub with outstretched branches that looks bushy, light green leaves that are slightly taller than those of the ordinary kind, and a distinct perfume. The brown variety, which has the thickest and smallest leaf structure and is dark brown in colour, is the most fragrant [14]. The majority of people take herbal medications because they are thought to be safe, efficient, and affordable. *Murraya* In India, a medicinally significant herb known as *koenigii* (Curry Leaves/Kadhi Patta/Mitha Nimba/Giri Nimba) is frequently used as a spice, a condiment, and to treat a variety of illnesses. It is a common ingredient in Indian cuisine and is used with assurance in daily cooking because of its delicate flavour. Curry leaves contain a variety of essential nutrients, including nicotinic acid, vitamin B, C, A, and E, antioxidants, plant sterols, glycosides, and flavonoids, as well as carbohydrates, proteins, fibre, calcium, phosphorus, iron, magnesium, and copper. This plant's leaves are commonly used in Indian cuisine, and P-gurjunene, P-caryophyllene, P-elemene, and O-phellandrene² are the chemical compounds that give them their distinctive aroma. Whether alone or in combination, the presence of -pinene, -caryophyllene, -phellandrene, and -pinene can prevent food from spoiling[14].

Fig. No. 1 *Murraya koenigii* plant

History: From the first to the fourth centuries AD, curry leaves have a documented history. It was updated as the word "kari" with its uses in Tamil and Kannada literature. Curry leaf, a term now frequently used to refer to *Murraya koenigii*, is derived from the Tamil word kari, which means "spiced sauce." [15]. The usage of *Murraya koenigii* as a vegetable flavouring ingredient is mentioned in early Tamil and Kannada literature. As a culinary flavouring agent, *Murraya koenigii* is now grown as a cultivated crop in India, Sri Lanka, Southeast Asia, Australia, the Pacific Islands, and Africa [16].

Plant Description:

The plant is grown and distributed all over India. From the Himalayas to Sikkim, Uttarakhand, Garhwal, Bengal, Assam, Western Ghats, and Cochin to Travancore. Seeds are used for propagation, and they germinate well in light shade. in humid forests between 500 and 1600 metres high in Guangdong, South Hainan, South Yunnan (Xishuangbanna), Bhutan, Laos, Nepal, Pakistan, Sri Lanka, Thailand, and Vietnam, for example. The curry leaf, or *Murraya koenigii*, is a tiny tropical to subtropical tree or shrub that normally reaches heights of 6 to 15 feet. It is famous for its flavorful, aromatic curry leaves, which are a key component of Indian and Asian cuisine. This tree is indigenous to wet forests in Sri Lanka and India.

Curry leaves travelled to Malaysia, South Africa, and Reunion Island with South Indian immigration. They are hardly found outside of the Indian zone of influence. *Murraya koenigii* is an unarmed, semi-deciduous, aromatic shrub or small tree with imparipinnate, glabrous, and highly scented leaves. It has a robust, woody trunk and branches. Herbal tea may be made from curry plant flowers. Fresh leaves from the plant can be picked and used to salads. The plant's essential oil has been used to enhance the flavour of fruits in ice creams, confections, baked products, soft drinks, and chewing gum.

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Leaflets are alternating, short-stalked, gland-dotted, and have nine to twenty-five or more leaflets. Small, pubescent flowers with a deep five-cleft calyx are white and fragrant. Five free, white, glabrous, spotted glandular petals. The fruits are tiny, oval or subglobose, glandular, and have a thin pericarp covering one or two spinach-green seeds.

They grow in dense clusters. *Murraya koenigii* is a tiny tree or shrub with a fragrant stem that may grow up to 7 metres tall with a diameter of 14 to 42 cm [17].

Morphological Characteristics:

A little spreading shrub that grows to a height of about 2.5 metres. Its main stem is 16 cm in diameter and has a bark that can be peeled off lengthwise to reveal the white wood below. Exstipulate, bipinnately compound leaves with reticulate venation are 30 cm long, each containing 24 lance-shaped leaflets that are 4.9 cm long, 1.8 cm wide, and have a 0.5 cm long petiole.

The average diameter of a fully opened flower is 1.12 cm; the inflorescence is a terminal cyme with each bearing 60 to 90 flowers; the calyx is 5-lobed, persistent, inferior, green; and the flowers are bisexual, white, funnel-shaped, sweetly scented, stalked, complete, ebracteate, regular, actinomorphic, pentamerous, and hypogynous. Corolla, white, inferior, polypetalous, with five lance-shaped petals; length, 5 mm; androecium, polyandrous, with ten stamens, dorsifixed, arranged into circles of five each; shorter stamen, 4 mm long; longer stamen, 5 to 6 mm; gynoecium, 5 to 6 mm long; stigma, bright, sticky; style, short; ovary, superior. Fruits are oblong to spherical, 1.4 to 1.6 cm long, and 1 to 1.2 cm wide.

They weigh 880 mg and have a volume of 895 microliters. Fully mature fruits are black. a highly reflective surface; Wistaria blue 640/2 pulp; and 32 to 80 fruits each cluster, depending on the variety. One seed per fruit, measuring 11 mm long by 8 mm wide, and having the colour spinach green (0960/3); it weighs 445 mg and has a volume of 460 microliters [18].

Taxonomic Classification:

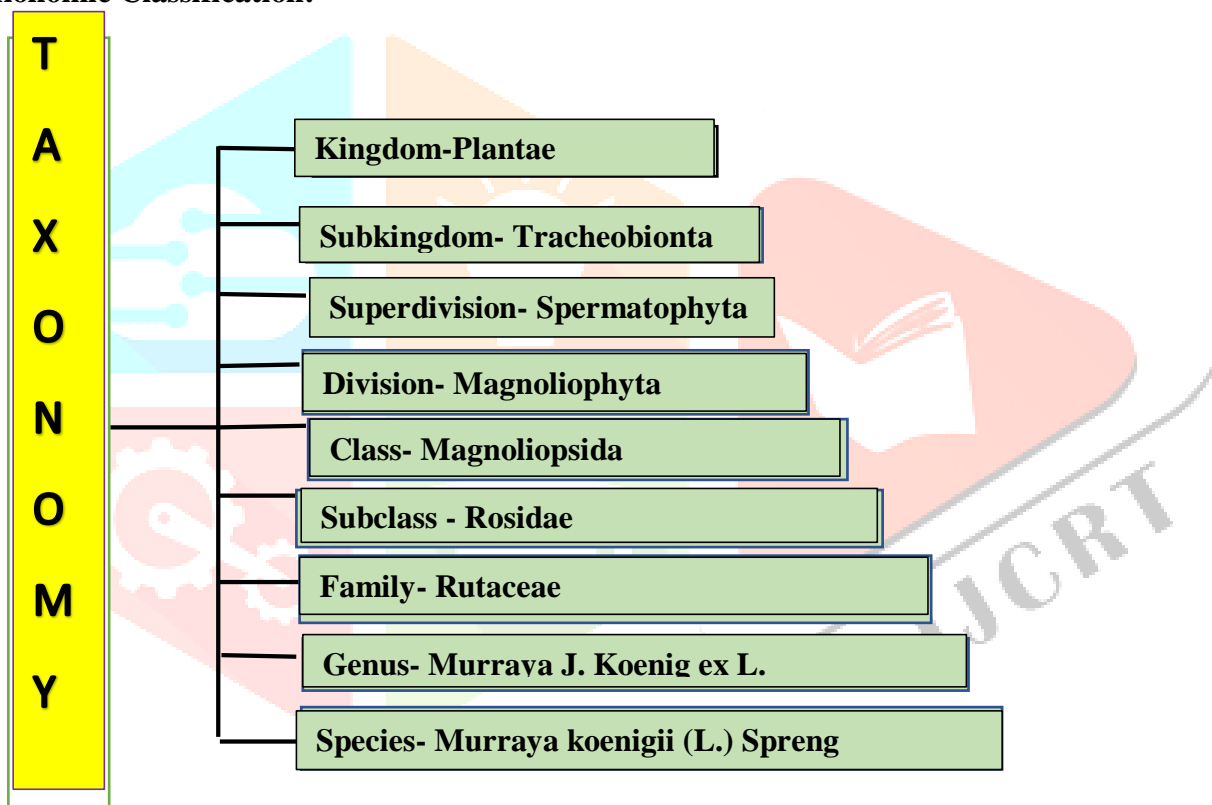


Fig No. 2: Taxonomy of *Murraya koenigii* [19]

Traditional Use:

The curry leaf plant is well-known in South Asian cuisine for its unusual flavour and scent. It has long been used as a natural treatment [20]. The fragrant leaves are frequently used to flavour curries in order to increase appetite and digestion [21]. Locally, leaves are used to cure rheumatism, external wounds, burns, and to remove poison from toxic animal bites [22]. To prevent vomiting, use leaves that have been baked (cooked, crisped) [23]. When consumed on an empty stomach, finely ground leaves serve as a laxative and are beneficial for stomach troubles [24]. Morning sickness is treated with fresh leaf juice blended with lime and sugar, and drinking root juice relieves kidney pain [25]. Stem is employed to clean teeth that strengthen the gums [26].

Geographical Distribution -

All over India, *Murraya koenigii* is grown and distributed. It can be found from Sikkim to the Garhwal, Western Ghats, Bengal, Assam, and Travancore-Cochin regions. Under full or partial shade, the seeds germinate without restriction. Particularly in Guangdong, South Hainan, and South Yunnan, one can find these curry leaves in damp forests 500–1600 metres in height. Thailand, Nepal, Laos, Sri Lanka, Bhutan, and Vietnam. The curry leaves arrive in Malaysia, South Africa, and Reunion Island together with the South Indian immigration [27]. The plant is grown and distributed all over India. From the Himalayas, Uttarakhand, Sikkim, Garhwal, Bengal, Assam, Western Ghats, and Travancore-Cochin, it can be found in the wild. Seeds are used for propagation, and they germinate well in light shade. in humid forests between 500 and 1600 metres high in Guangdong, South Hainan, South Yunnan (Xishuangbanna), Bhutan, Laos, Nepal, Pakistan, Sri Lanka, Thailand, and Vietnam, for example. Curry leaves travelled to Malaysia, South Africa, and Reunion Island with South Indian immigration. They are hardly found outside of the Indian zone of influence [28].

Synonyms of curry leaf :

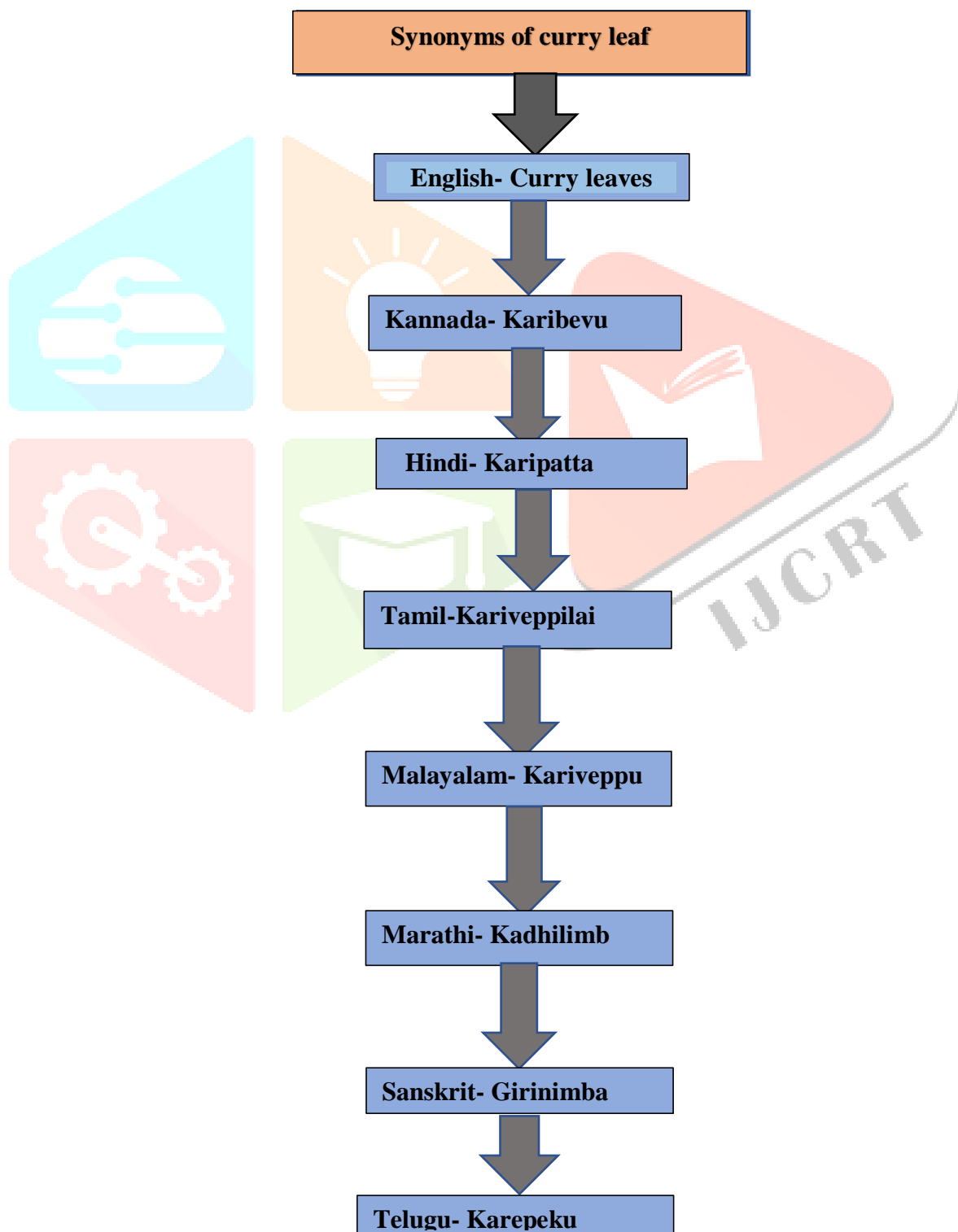


Fig. No. 3: synonyms of *Murraya koenigii*

Phytoconstituents of Plant:

1. LEAF :

The leaves of *Murrayakoenigii* contain koenimbine, O-methyl murrayamine, O-methyl mahanine, isomahanine, bismahanine, and bispyrayafoline, as well as koenigine, koenine, koenidine, mahanimbine, isomahanimbine, koenimbidine and murrayacine, isomahanimbicine, Euchrest The glycozoline, 1-formyl-3-methoxy-6-methyl carbazole, and 6, 7-dimethoxy-1-hydroxy-3-methyl carbazole are the main components of dried leaves. Additionally, *Murraya koenigii*'s leaves contain nicotinic acid, protein, carbs, fibre, minerals, and carotene. [29]



Fig.No.4: Leaf of *Murraya koenigii*

2. SEED :

Koenimbine, koenine, and kurryam are the three biologically active carbazole alkaloids found in *Murraya koenigii* seeds. Additionally, mahanimbine, girinimbine, koenimbine, mahanine, and isomahanine are present in the seed. The seeds of *Murraya koenigii* contained minor furocoumarins like xanthotoxin, isobyaknagelicol, byakangelicol, and isogosferol in addition to an indicolactone, anisoalctone, and 2,3epoxyindicolactone, which is a furocoumarin lactone. This would be the first furocoumarin with a mono terpenoid lactone chain The seeds of *Murrayakoenigii* also included bergaptan, isoheraclenin, isoimperatonin, oxypeucedanin, isopimpinellin, and isoimperatonin.



Fig.No. 5: Seed of *Murraya koenigii*

3. FRUIT :

Mahanimbine and koenimbine can be extracted from the *Murrayakoenigii*'s fruit using petroleum ether. Along with mahanimbine, murrayazolidine, girinimbine, koenimbine, and mahanine, isomahanine and murrayanol were also discovered.



Fig.No. 6: Fruit of *Murraya koenigii*

4. ROOT:

Murraya koenigii roots contain bioactive substances such as marmesin-1''-O-rutinoside, murrayanol, and murrayagetin. Additionally, the bark of the plant was used to extract the three monomeric and five binary carbazole alkaloids mukoenine-A, B, and C, as well as murrastifoline-F. These compounds included bis-2-hydroxy-3-methyl carbazole, bismahanine, bi koeniquinone-A, and bismurrayaquinone-A. The roots' benzene extract contains mukoline and mukolidine. Girinimbine was also discovered in the root, and the root bark contains koenoline, a chemical that is a synonym for 1-methoxy-3-hydroxy methyl carbazole. [30]

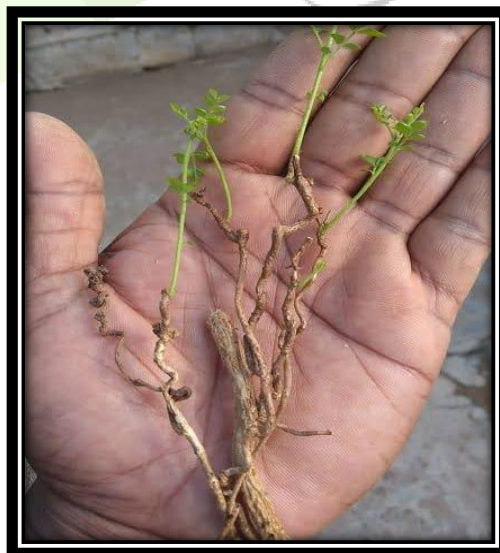


Fig.No. 7: Root of *Murraya koenigii*

5. FLOWER :

The plant spends the majority of its energy on nurturing the blossoms before they mature and transform into fruits. The plant's growth is severely slowed as a result. So, immediately cut off the flower buds from the plant unless you have a cause to grow the curry leaf seeds. linalool (32.83%), elemol (7.44%), geranyl acetate (6.18%), myrcene (6.12%), allo-ocimene (5.02), α -terpinene (4.9%), and (E)- β -ocimene (3.68%) as the main compounds



Fig. No. 8: Flower of *Murraya koenigii*

Pharmacological Activity:

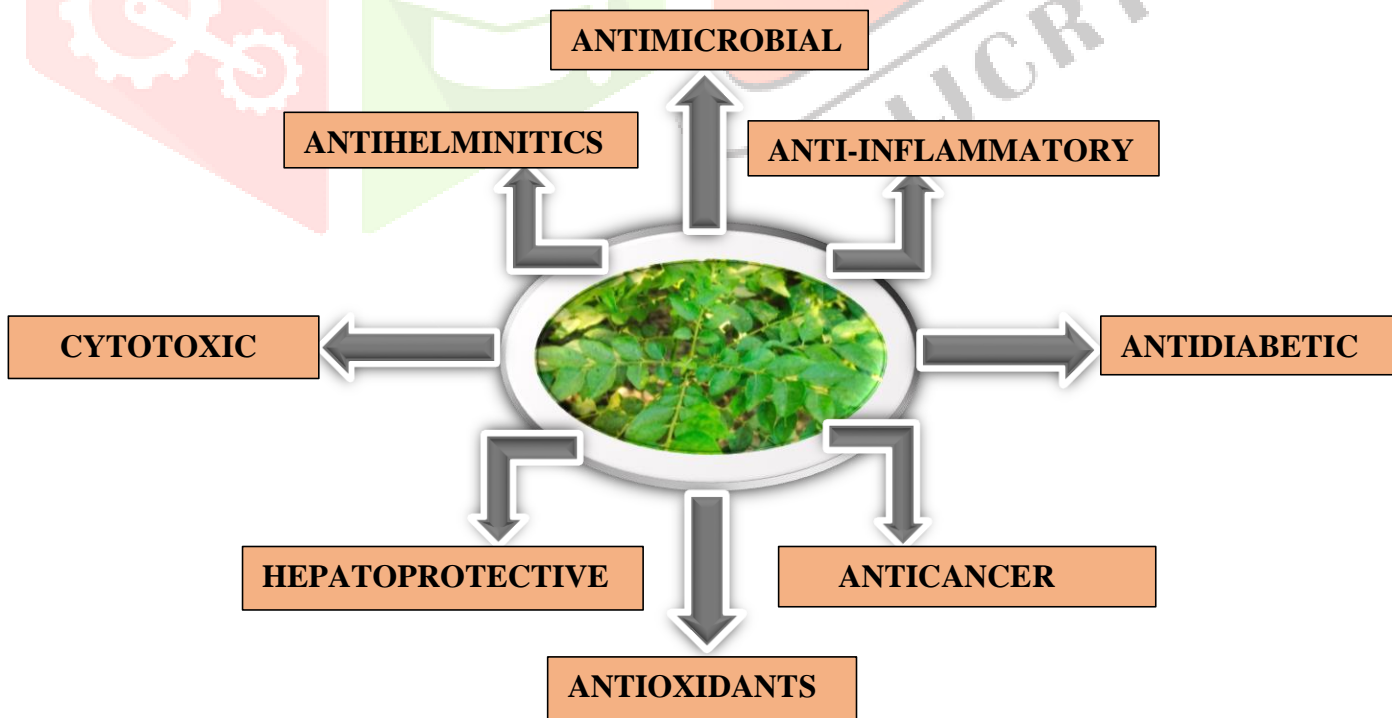


Fig No. 9: Pharmacological Activity of *Murraya Koenigii*

1. Antimicrobial Activity:

Anti-microbiological action *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, and fungi strains of *Aspergillus niger*, *Candida albicans*, and *Trichophyton rubrum* were evaluated against the *Murraya koenigii* root extract in hexane, methanol, and chloroform. All of the bacteria examined responded favourably to the root extracts of *Murraya koenigii* made of hexane, methanol, and chloroform, although the methanol extract had the most antimicrobial effects overall and was most efficient against *Staphylococcus aureus* and *Trichophyton rubrum*. The aqueous root extract was determined to be ineffective against the tested pathogen, and *Staphylococcus aureus* was vulnerable to all three of the aforementioned extracts. [31]

2. Anti – inflammatory Activity:

In comparison to petroleum ether and hexane extracts, which do not reduce inflammation, it was discovered that *Murraya koenigii* leaf extract in methanol and aqueous form is effective against carrageenan-induced edoema in male albino rats at a concentration of 400 mg/kg. When compared to the aqueous extract, the methanol extract was determined to have the strongest anti-inflammatory properties. [32]

3. Antidiabetic Activity:

The petroleum ether extract of the dried plant was subjected to column chromatography in order to isolate mahanimbine, a chemical component of *M. koenigii*. On streptozotocin-induced Wistar rats, the anti-diabetic action was tested using the pure substance at doses of 50 mg/kg and 100 mg/kg. Mahanimbine may lower blood sugar levels by potentiating the effects of insulin, either by boosting pancreatic insulin secretion from islets of langerhans beta cells or by enhancing peripheral glucose uptake. When compared to acarbose, mahanimbine significantly inhibited alpha-amylase. [33]

4. Anticancer Activity:

In HepG2 cells, carbazole girinimbine, which is isolated from *Murraya koenigii* bark, causes extensively programmed cell death. The findings of the investigation carried out in 2010 provided proof that mahanine was involved in the death receptor arbitrated extrinsic route of apoptosis. Although it strangely failed to develop in K562 cells, it demonstrated anti-cancer action in MOLT-3 cells. In addition, pyrayafoline, murrifoline, and three carbazole alkaloids, including mahanine, have significant efficacy against HL-60 cells. also validated mahanine as the main anti-cancerous bioactive chemical in *M. koenigii*. [34]

5. Antioxidant Activity:

Reactive oxygen species (ROS) are frequently produced as by-products of cellular metabolic activities and exogenous stimulation. Examples of ROS include singlet oxygen (O_2), hydrogen peroxide (H_2O_2), the superoxide anion (O_2^{\bullet}), and the hydroxyl radical ($\bullet OH$). These ROS cause homeostatic disturbances that result in oxidative stress, which causes cell death and tissue damage. [35] High quantities of ROS can harm biomolecules like lipids, proteins, and nucleic acids. [36] Even while antioxidant defence mechanisms like enzymatic and non-enzymatic antioxidants are in place and working, unchecked ROS accumulation throughout the course of a person's lifetime encourages the onset of age-dependent diseases including cancer, atherosclerosis, arthritis, etc. [37] Natural antioxidants derived from plant sources have been viewed as a possible therapeutic for the prevention and treatment of various illnesses, particularly cancer, cardiovascular disease, and neurological disorders. [38,39]

6. Hepatoprotective Activity:

The effectiveness of readily available medical treatments for liver problems is insufficient. Herbs have been utilised to treat a variety of medical conditions since ancient times; plant extracts and other natural substances have important uses as hepatoprotective agents. It is the organ most exposed to xenobiotics since it is the location of drug metabolism and the detoxification of hazardous metabolites [40]. When crude aqueous extracts of *M. koenigii* were tested against ethanol-induced hepatotoxicity in test animals, the hepatoprotective effect was prolonged. *M. koenigii* has been shown to be useful in preserving the enzymatic oxidant status and to extend a protective effect in liver impairments caused by persistent drinking [41].

7. Cytotoxic Activity:

The secondary metabolites found in *M. koenigii* that can kill or impede the proliferation of cancer cells add to the cytotoxic effect of the extract from the plant's leaves. This outcome indicated a possible *M. koenigii* natural product that may be developed as an anticancer drug. Cytotoxic Function Koenoline, an isolated carbazole alkaloid from the root bark of *M. koenigii*, was found to be cytotoxic to the KB cell culture system [42].

8. Antihelminthics Activity:

Pheretima posithuma, an adult Indian earth worm, was the subject of the antihelminthic action. The organism was chosen because it resembles the parasitic human intestine round worms. Extracts made from petroleum ether and alcohol, as well as piperazine citrate, were chosen for the experiment. At dosages of 25 mg/ml, 50 mg/ml, and 100 mg/ml, ether and methanolic extracts were consumed. Worms were kept under observation to note how long it took for individual worms to become paralysed and die. When the worms do not resuscitate even in regular saline, paralysis is rumoured to develop. The worms' loss of motility and subsequent fading of body colour signalled their death. Among these, a 100 mg/ml concentration of an alcoholic plant leaf extract demonstrated substantial antihelminthic efficacy.

Conclusion:

Murraya koenigii is a valuable medicinal plant used globally in different traditional systems of medicine. We attempted to provide morphological, phytochemical, and ethnopharmacological information on *M. koenigii* in this review. This plant shows antimicrobial, anti-inflammatory, antidiabetic, cytotoxic, anticancer, antioxidant, antihelminthics, and hepatoprotective activities.

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