

PHARMACOLOGICAL USES OF MURRAYA KOENIGII

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ABSTRACT

Murraya koenigii is a traditionally used medicinal plant, and its leaves have great therapeutic potential. Our goal was to determine the in vitro antibacterial activity of ethanolic preparations from this plant. The current study examines the antibacterial activity and qualitative screening of secondary metabolites in an extract from the leaves of *M. koenigii*, a member of the Rutaceae family. Acetone, ethanol, and aqueous extracts were among the different solvent systems with varied polarity that were used to screen for plant metabolites. During this analysis, the crude extracts revealed the presence of volatile oil, phenol, steroids, and terpenoids, but none of flavonoids, carbohydrates, saponins, or phlobatannins. Alkaloids found in extracts of ethanol and acetone. On the other hand tannins were absent only in acetone extracted. The ethanolic leaf extract was tested against Gram positive and Gram negative bacterial pathogens. Plant extract showed antibacterial activity against *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus*, *Enterococcus faecalis* while no inhibitory activity against *Klebsiella pneumoniae*. The phytochemical property of *M. koenigii* may be attributed to the presence of flavonoids and phenolic compounds with rich antioxidant potential. Thus, curry leaves could be effective for prevention of bacterial infections and may be considered as an alternative to antibiotic regimen Curry Leaf (*Murraya koenigii*) is native to South Asia famous among various cuisines for its flavor and aroma. The "Magical plant of Indian Spice," *Murraya koenigii*, has been utilized by tribal people to treat a variety of ailments. In addition to being used as a culinary enhancer, it is also employed as a folk remedy in many villages. *Murraya koenigii* is used to treat morning sickness, kidney pain, stomach problems, and dysentery. Koenigin, bicyclomahanimbicine, cyclomahanimbine, murrayastine, coumarine, koenidine, and pypayafolinecarbazole are examples of carbazolealkaloids with significant therapeutic properties.

I. INTRODUCTION

Curry leaf, or *Murraya koenigii*, is a member of the Rutaceae family, which has 1600 species and 150 genera. It has been discovered to be indigenous to South Asia, specifically Bangladesh, Sri Lanka, and India.¹ *Murraya koenigii* has been used since the first and fourth centuries AD. *Murraya koenigii* is referred to as Kari in Tamil and Kannada literature and is utilized as a flavoring ingredient. Because of its scent and aroma, it is regarded as one of the key elements in South Asian cuisine.¹ Because it keeps its flavor and other characteristics even after drying, it is a common spice and condiment in tropical nations. Pinene, sabinene, caryophyllene, cardinol, and cardinene are the main components that give curry leaf its flavor and fragrance.² The entire plant has been used traditionally for stomachic and tonic purposes. Researchers have discovered that *Murraya koenigii* contains a variety of bioactive phytochemicals, including terpenoids, essential oils, phenolics, minerals, proteins, β -carotene, and lutein. It can be used raw, dehydrated, ground into a powder, or cooked. It goes by several different names, for example.³

Karuveppilai in Tamil,

Surabhinimba in Sanskrit,

Curry Leaf in English, and

Mitha Neem in Hindi.

Because of their compound leaves, curry leaf plants can also be used as decorative shrubs and hedges. *Murraya koenigii* is grown throughout India and is found in the damp forests of Asia, especially in Nepal, Bhutan, Laos, Pakistan, and Thailand. It is seldom ever seen outside of India's influence zone.⁴ Herbal medications should be utilized extensively to treat a wide range of disorders because they are inexpensive, very effective, and have little adverse effects. The various applications and possibilities of curry leaf are explained in this review.⁵

Kingdom of Taxonomy Classification

Magnoliophyta Division,

Class Magnoliopsida

Subclass Rosidae

Family, Rutaceae

Genus, Murraya

Species, Plantae

Subkingdom, Tracheobionta

Superdivision, Magnoliophyta

Division, Magnoliophyta L.

II. APPLICATIONS OF CURRY LEAF

Customary Uses: This plant's leaves have a distinct flavor and perfume. As a result, they are utilized in several curries, particularly in South India. To strengthen the gums and teeth, other plant parts like the stem are utilized for washing.⁶ An anti-periodic made with betel nut juice, honey, and powdered dry curry leaf is used in Ayurvedic medicine. This plant's leaves are applied externally to burns, bruising, eruptions, and animal attacks that are poisonous. They are used to treat dysentery internally.⁷

murraya koenigii is utilized as an antidysentric and stimulant to treat diabetic mellitus. An antiemetic is made by infusing burnt leaves. The leaves' steam distillates have anti-anemic, stomachic, carminative, purgative, and febrifuge properties. Because of their bitter and acrid qualities, the leaves and roots have analgesic, cooling, and anti-helminthic effects. They are also used to treat piles, reduce inflammation, thirst, heat in the body, and itching. They have shown beneficial for various blood problems such as leucoderma.⁸ These leaves can help treat rheumatism and influenza. The root juices have been shown to be effective in treating kidney-related discomfort and to have hepatoprotective properties. Fruits have several therapeutic qualities, one of which is astringency. They are also quite nutritious. Moreover, the herb contains hypoglycemic, antihypercholesterolemic, and anticancer properties.⁹

Antimicrobial Properties :

Three known steroids and six known alkaloids have been identified from the stem bark of *M. koenigii*, along with a dimeric carbazole alkaloid called 3,3'-[oxybis(methylene)] bis (9-methoxy-9Hcarbazole) and a derivative of benzoisofuranone called 3ξ-(1ξ-hydroxyethyl)-7-hydroxy-1-isobenzofuranone.¹⁰ It was observed that the minimum inhibitory concentration (MIC) of these substances ranged from 3.13 to 100 µg/ml. The antibacterial properties of 21 distinct plant species' methanolic extracts were examined against both Gram negative and Gram positive bacteria, per a review of the literature. It's been noted that *M. Koenigii* exhibits the strongest antibacterial activity. antibacterial properties of the plant's essential oil, which mostly comprises of α-pinene, sabinene, and trans-caryophyllene, against *Bacillus subtilis*, *Staphylococcus aureus*, *Corynebacterium pyogenes*, *Pasteurella multocida*, and *Proteus vulgaris*. After fresh leaves are extracted using acetone, three functional carbazole alkaloids are obtained: mahanine, mahanimbine, and marrayanol.¹¹ These substances exhibit notable antibacterial and inhibitory effects on topoisomerase I and II. *Microsporium gypseum* and *A. fumigates* also yield positive results. When used diluted, *Murraya koenigii* effectively combats *Candida albicans*. The ethanolic extracts of the entire plant, with the exception of *Murraya koenigii*'s roots, do not exhibit any discernible antifungal action against *Microsporium canis*, *Trichophyton mentagrophytes*, or *Cryptococcus neoformans*. The anti-protozoal activity of an ethanolic extract of the entire plant—not just the roots—as well as the roots by themselves has been investigated.¹² Only the root extract of the plant exhibits activity against *Entamoeba histolytica*, whereas the entire extract has an antispasmodic effect on the ileum of isolated guinea pigs. In dogs and cats, antihypertensive activity has also been noted.¹³

Antihelminthic Properties:

The anti-helminthic activity of *M. koenigii*'s petroleum ether and methanolic extracts has been evaluated against the adult Indian earth worm, *Pheretima posithuma*. The reference was piperazine citrate.¹⁴ The worms were housed in three different extract concentrations in order to monitor paralysis and mortality.¹⁵ The fact that the hue of the body faded after death was noticed supports the leaves' anti-helminthic qualities.

Furthermore, the methanolic extract at 100 mg/ml exhibited strong anti-helminthic activity in contrast to the petroleum ether, which shown only modest activity.¹⁶

Antioxidative Characteristic:

M. koenigii leaf extracts were made with dichloromethane, which contained carbazole alkaloids. Based on lag time, they were evaluated for their oil stability index (OSI) and their capacity to scavenge radicals, specifically the 1-1-diphenyl-2-picrylhydrazyl radical, in order to attain a stable state.¹⁷ Three groups were created out of the twelve isolated carbazoles. The aryl hydroxyl substituent present in the carbazole ring is crucial in maintaining the thermal oxidation and reaction rate stability in the face of DPPH radicals.¹⁸

Antioxidant properties were demonstrated by the two carbazole alkaloids that were isolated from M. koenigii leaves: mahanimbine and koenigine. Additionally, koenigine demonstrated strong radical-scavenging abilities.¹⁹ Using sodium nitroprusside as a NO donor in vitro, the plant extract of M. koenigii has been examined for any potential regulatory influence on nitric oxide levels. The outcome suggests that the plant may be a new and potent therapeutic treatment for the oxidation of peroxynitrite, which is produced when too much NO is generated, and for radical scavenging of NO, which regulates pathological situations.²⁰

Antidiabetic Characteristic:

Mahanimbine, a chemical component of M. koenigii, has been injected into Swiss mice with streptozotocin-induced diabetes to test its anti-diabetic effects. Mahanimbine has been demonstrated to lower blood sugar levels by improving the insulin action, either by raising peripheral glucose uptake or by secreting more pancreatic beta cells from the islets of Langerham.²¹ In comparison to acarbose, mahanimbine also demonstrated a notable alpha amylase inhibitory effect. Additionally, when the mice were treated with this extract, the amount of glucose-6-phosphate dehydrogenase enzyme was increased, and hepatic and muscular glycogenesis was normalized leading to optimal consumption of glucose.²²

Lipid peroxidative activity inhibitor Rats given curry leaf extracts exhibit lower blood levels of malondialdehyde, but their liver and heart demonstrate noticeably higher levels of hydroperoxides and conjugated dienes. Catalase, glutathione-S Transferase, glutathione reductase, glutathione peroxidase, and superoxide dismutase activities all sharply rise in the kidney, liver, and heart when glutathione levels decrease, demonstrating glutathione's anti-lipid peroxidative activity.²³

Anti-Tumor Activity:

In mice, intraperitoneal injections of Dalton's Ascitic Lymphoma (DAL) cells were administered. As a result, the number of cancer cells significantly rises, indicating that the mice's cancer is progressing.²⁴ The test drug's inhibitory impact on tumor cells was demonstrated by the decrease in cancer cells in the mice treated with *Murraya koenigii* ether extracts. In certain animals, peritoneal fluid buildup is also linked to an increase in tumor weight. Atypical peritoneal cavity expansion is consequently observed.²⁵

The animals' life duration is increased and the tumor weight is decreased when they are treated with the extract. Curry leaf's strong anti-tumor effect was so demonstrated. Girinimbine also strongly causes HepG2 cells to undergo programmed cell death, which paves the path for additional analysis in preclinical human hepatocellular carcinoma models. *Murraya koenigii* has been shown to have the ability to operate as an immune-modulatory agent by stimulating humoral immunity and phagocytic function. This is demonstrated by the fact that it significantly increases the phagocytic index by removing carbon particles from the bloodstream quickly. Nevertheless, cellular immunity cannot be stimulated by the extracts.

Hepatoprotective properties the extract from M. koenigii leaves' hepatoprotective properties. The effect was caused by the combination of minerals like zinc, iron, and copper, as well as α -tocopherol and ascorbic acid, taken from the leaves, and carbazole alkaloids including girinimbine, mahanine, mahanimbine, isosomahanimbine, murrayazolidine, and murrayazoline. M. koenigii is therefore a rich and advantageous source of free radical quencher. Hepatocyte membrane stabilizing activity and a decrease in fat metabolism influence the process.²⁶

Using hydroethanolic leaf extracts of *Murraya koenigii* at doses of 200, 400, and 600 mg/kg body weight, hepatotoxic rats treated with CCl₄ showed elevations in hepatic superoxide dismutase, ascorbic acid, catalase, reduced glutathione, and a decline in lipid peroxidation, along with a marked decrease in the levels of alanine

amino transferases, aspartate aminotransferases, alkaline phosphatases, and total bilirubin. Curry leaf may have hepatoprotective properties since mice treated with *Murraya koenigii* showed low CCl₄-induced lesions, according to microscopic investigations. Similar to the common medication L-ornithine L-aspartate (LOLA), the carbazole alkaloids and tannins from the aqueous extracts have excellent hepatoprotective action against ethanol-induced hepatotoxicity. When CCl₄-induced liver damage is present, the acetone extract of powdered dry bark protects liver cells compared to the rat control group and other solvents.²⁷

The capacity to improve memory The levels of protective antioxidants such as catalase, glutathione peroxidase, glutathione reductase, reduced glutathione, and superoxide dismutase in brain homogenates are improved by total alkaloid extracts of *Murraya koenigii* leaves at doses of 20 and 40 mg/kg. Additionally, there has been evidence of a decrease in nitric oxide and lipid peroxidation. There has also been a decrease in anticholinesterase activity and an increase in acetylcholine levels. Consequently, these characteristics are advantageous in preventing neurodegenerative illnesses like Alzheimer's. In older mice, the leaf extracts also significantly increase cognitive abilities, such as memory, which may have applications in the treatment of dementia.²⁸

Ability to mend injuries Aqueous extracts of *M. koenigii* have been used to study the wound healing potential of male albino rats using an excision and incision wound model. In the incision wound model, mice treated with the extract exhibited significantly higher tensile strength than the mice in the control group.²⁹ A significant decrease in the wound area was seen in the excision wound model. Therefore, it was clear that by assisting in the reduction of the wound's surface area, the aqueous extracts of *M. koenigii* sped up the healing process.

impact on dental cavities Bacterial species including *Porphyromonas gingivalis* and *Streptococcus mutans* are the cause of dental cavities. Dental caries in golden hamsters are reduced when curry leaf extract is fed to them.³⁰ *Murraya* extract, which is found in foods including juices, sweets, chewing gum, cakes, and biscuits, and which also contains isomahanine, murrayanol, and mahanine, inhibits 86.2% of the production of methyl sulphhydryl by *Fusobacterium nucleatum*. The above-mentioned chemicals identified in *M. koenigii* leaf extract are shown to be effective as oral disinfectants to guard against periodontal diseases and dental caries, which is why toothpaste formulations employ them as active components.³¹

Apply to cosmetic products :

Hyaluronidase inhibitors are present in *M. koenigii*, and they are prepared in a cream basis. Because of this extract's hyaluronidase inhibitory activity as well as its moisturizing and antioxidant qualities, it is used in skin-lightening cosmetics.³² Herbal formulations that include *M. koenigii* stem extract as one of their constituents have been shown to improve erythema, lighten skin, and improve rough skin.³³ Research on *M. koenigii*'s sun protection qualities has revealed that it can also be used to preserve skin's natural pigmentation or as an adjuvant to boost the activity of other formulations.³⁴ The sun protection factor (2.04±0.02) of the curry leaf oil cream indicates that it can be used to preserve the natural pigmentation of the skin.³⁵

III. CONCLUSION

Murraya koenigii has great promise as a therapeutic herb. Since ancient times, bioactive substances have been extensively utilized in primary conventional healthcare systems in impoverished nations. Curry Leaf is a useful Herbal medicine should be given top priority while developing new medications.

Murraya koenigii needs to be taken into consideration for various clinical and non-clinical research projects in order to thoroughly investigate its pharmacotherapeutics, toxicity, correct standardization, and clinical trials, all while keeping an eye on its various applications.

Murraya koenigii has great promise as a therapeutic herb. Since ancient times, the underdeveloped world has relied heavily on bioactive substances for its basic conventional healthcare systems. Given its value as a herbal remedy, curry leaf needs to be given top priority while developing new medications. *Murraya koenigii* should be taken into consideration for various clinical and non-clinical research projects in order to thoroughly investigate its pharmacotherapeutics, toxicity, correct standardization, and clinical trials, all while keeping an eye toward its many applications.

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