International Journal of Health Care and Biological Sciences

Review Article Open Access

Murraya koiginii: pytopharmacological,traditional and medicinal considerations

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Article History

Received on: 02-11-2022
Revised on: 15-11-2022
Accepted on: 24-12-2022

***Keywords*:**
Murraya koenigii, cytotoxicity, Cardioprotective effects, Anti-osteoporotic, Skin pigmentation, Mosquitocidal.

DOI:
https://doi.org/10.46795/ijhcbs.v3i4.376

Abstract

The *Murraya koenigii* plant is frequently used as a spice, herb, and condiment as well as a traditional treatment for a number of illnesses in India. Due to their reputation as being secure, efficient, and natural, herbal products are used by about 80% of people worldwide.The goal of the current study was to review the Murraya koenigii plant's ethnobotanical, pharmacognostic, phytochemical, and pharmacological properties. A variety of tribal communities use this plant's various parts extensively. The plant's leaves are used internally for vomiting, dysentery, and as a tonic, stomachic, and carminative. Anti-helminthic and analgesic properties, cures piles, reduces body heat, thirst, inflammation, and itching. Researchers have worked to confirm the effectiveness of the plant through scientific biological screening in response to numerous claims that it can treat a variety of diseases. A review of the literature reveals some notable pharmacological properties of the plant, including cytotoxicity, cardioprotective effects, anti-inflammatory, mosquitocidal, anti-osteoporotic, anti-ulcer, anti-tumor, skin pigmentation, anti-cancer, anti-diabetic, anti-diarrheal, and many other therapeutic benefits.

Keywords: *Murraya koenigii*, cytotoxicity, Cardioprotective effects, Anti-osteoporotic, Skin pigmentation, Mosquitocidal.

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Introduction

Murraya koenigii, commonly known as curry leaf or karipatta in Indian dialects, belongs to Family Rutaceae which represents more than150genera and 1600 species. *Murraya koenigii (L.)* is an aromatic more or less deciduous shrub or a small tree up to 6m. in height found throughout India up to an altitude of 1,500m. commonly in forest often as gregarious under-growths. It is cultivated for its aromatic leaves [1]. The plants grow best in tropical and sub-tropical climates in sunny to semi-shaded locations, though they can be sustained in other climates by moving pots to warm protected areas in winter and maintaining humid conditions in areas where summers are hot and dry. They are very frost sensitive. Soil needs to be enriched with lots of organic material and be well drained. Water well when the weather is dry but do not over-water. The plants require very little in the way of fertilizer. Seeds

germinate fairly readily [2]. Almost every part of this plant has a strong characteristic odour. The people of the plains, particularly of southern India, use the leaves of this plant as a spice in different curry preparations. Murraya koenigii contains carbazole alkaloids namely murrayanine, mahanimbine, girinimbine, murrayacine, isomurrayazoline, mahanine, koenine, koenigine, koenidine, koenimbine, 8,8′-biskoenigine. Other alkaloids are O-methylmurrayamine, O-methylmahanine, isomahanine, bismahanine and bispyrayafoline. The leaves are fair sources of vitamin A. They are also a rich source of calcium, but due to presence of oxalic acid in high concentration its nutritional availability is affected. The free amino acids present in leaves are: asparagine, glycine, serine, aspartic acid, glutamic acid, theonine, alanine, proline, tyrosine, and tryptophan. It contains 0.8% potash. The major constituents of curry leaf are monoterpenes [70%]; seed cotyledons [86%], constituting -pinene [52%] and cis-ßocimene [34%]. The plant has been used in traditional Indian medicine for a range of ailments. The whole plant is considered to be a tonic and stomachic. Roots and bark are stimulant and are applied externally for skin eruptions and poisonous bites. Green leaves are febrifuge and used in dysentery [3,4,5].

Plant Description [2,3,4]**:**

Murraya koenigii is more or less deciduous shrub or small tree reaching up to 6 m in height. The plant has a short trunk with 15-40 cm diameter, smooth, greyish, or brown bark and has dense shady crown. The main stem is dark green to brownish in colour. The leaves are bipinnately compound, 15-30 cm long, each bearing 11-25 leaflets alternate on rachis, 2.5-3.5 cm long ovate lanceolate with an oblique base. The leaf margins are irregularly serrate and petiole is 2-3 mm long. Inflorescence is terminal cymes; each bearing 60-90 flowers. Each flower is bisexual, white, funnel shaped sweetly scented, stalked, complete, ebracteate and regular with average diameter of fully opened flower being 1.12 cm. The calyx is deeply lobed with five cleft and pubescent. Petals are five with free, whitish, glabrous dotted glands. Fruits occur in close clusters. They are small ovoid or sub globose, glandular, with thin pericarp enclosing one or two seeds which are spinach green in colour. Fruits are 2.5 cm long and 0.3 cm in diameter wrinkled with glands and turns purplish black after ripening; are edible and yields 0.76% of a yellow volatile oil. The individual seed is 11 mm long, 8 mm in diameter and weights up to 445 mg.

Taxonomy of plant [2,3,4,6,7,8]

Kingdom-Plantae
Sub-kingdom- Tracheobionta
Super division- Spermatophyta
Division- Magnoliophyta
Class- Magnoliospida
Subclass- Rosidae
Order- Sapindales
Family- Rutaceae
Genus- Murraya J.Koenig ex L.
Species- *Murraya Koenigii L.* Spreng

Fig 1: *Murraya Koenigii L.*

Various names [3]

English- Curry leaves; Kannada- Karibevu; Hindi- Karipatta, Mitha nim; Tamil- Kariveppilai; Malayalam- Kariveppu; Marathi-Kadhilimb; Sanskrit- Girinimba; Telugu- Karepeku; Tulu-Bevusoppu; Portuguese- Folhas de caril; Russian- Listya karri; Spanish- Hojas de curry; Italian- Fogli di Cari; French- Feuilles de Cari; German- Curryblatter; Gujarathi- Mitho limado.

Distribution [3,4,5,6,7]

Murraya koenigii, according to the author, is found and cultivated throughout India. It can be found all the way from Sikkim to Garhwal, Bengal, Assam, the Western Ghats, and Travancore-Cochin. Under shade or partial shade, the seeds germinate freely. Curry leaves can be found in moist forests between 500 and 1600 metres in elevation, particularly in Guangdong, S Hainan, and S Yunnan. Bhutan, Laos, Sri Lanka, Thailand, Nepal, and Vietnam are among the countries involved. Curry leaves travel to Malaysia, South Africa, and Reunion Island with South Indian immigrants.

Table 1: Ethnobotanical profile of *Murraya koenigii* [4, 5]

Sl. No.	Plant part used	Ethnobotanical uses
1.	Whole plant	Used as

		Stimulant Hair tonic Blood purifier Antidepressant Antidysentery Antidiarrheal Antifungal Anti-inflammatory Antiemetic Febrifuge Stomachic Anti-periodic To cure Diabetes mellitus Leucoderma Body aches Kidney pain Vomiting
2.	Stem	Used as Datum for cleaning, strengthen gums and teeth
3.	Bark	Used as Hair tonic, Stomachic and Carminative
4.	Leaves	Used as Stomachic Purgative Febrifuge Anti-anaemic Anti-helminthic Analgesic Anti-ulcer Antinociceptive Antiamnesic Anti-Inflammation, cooling, and itching Hair tonic Stimulant of hair growth To cure Bruises and Eruption Night blindness, Vomiting Bites of poisonous animals Hypercholesterolemia lightening For Flavouring and Seasoning Memory enhancing Maintaining the natural skin Pigmentation and showed skin
		lighting and rough skin improving effect Losing weight Hypoglycaemic activity ıance Appetite and digestion
5.	Fruits	Used as Astringent
6.	Roots	Used as Anti-helminthic Analgesic Cooling agent Reduces Inflammation, itching To cure Kidney pain Leucoderma Blood disorders

Table 2: Biological activities of different chemical constituents identified from different parts of Murraya koenigii are: **[5]**

Sl.No.	Plant parts	Chemical constituents
1.	Stem bark	Girinimbine, Murrayanine, Marmesin-1'-O-beta-D-galactopyranoside, Mahanine, Murrayacine, Girinimbine, Mukoeic acid, Murrayazolinine, Girinimbilol, Mahanine, Pyrafoline-D and Murrafoline-I
2.	Leaves	Koenimbine, Koenine, Koenigine, Mahanimbine, Murrayazolidine, Murrayazoline, Girinimbine, Tocopherol, Isomahanimbine, Mahanimbine, Gurjunene, Murrayanol, Mahanine, Bismurrayafoline E, Euchrestine, Bismahanine, Bispyrafoline, Isomahanine, O-methyl murrayamine A, O-methyl mahanine, Lutein, Tocopherol, Carotene
3.	Root	Mukoline

4.	Seed	Koenoline, Kurryam, Koenine, Koenimbine

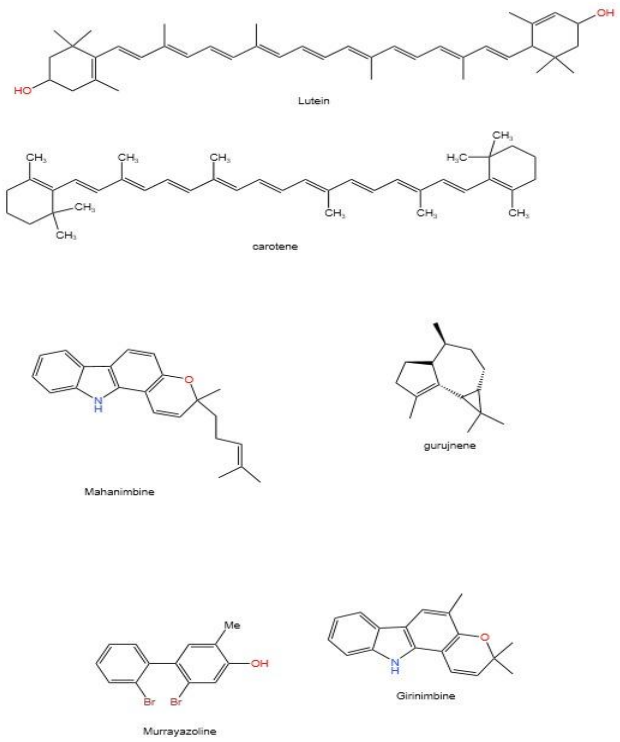

Fig 2: Phytochemical constituents *in Murraya koenigii L*

Microscopy and Macroscopy studies [9]

The macroscopical view of the leaves of *Murraya koenigii L*. Spreng is obliquely ovate or fairly rhomboid with acuminate obtuse or acute apex. The petiole is about 20 to 30 cm in length and the leaves have reticulate venation and dentate margin with an asymmetrical base. In the microscopic studies, it was elucidated that the stomata were distributed on abaxial surface and the adaxial surface does not have stomata and the type of stomata that was found is anomocytic. The transverse section of the leaves has a layer of epidermis which is composed of rectangular cell which serves as an outermost covering for both upper and lower layer. Furthermore, the author also stated that the upper epidermis was covered with deposition of cuticle, and in the midrib part or portion the epidermis has 1 to 4 layers of collenchymatous hypodermis with 2-5 layers of chlorenchyma cells which is filled with cholorophyll contents. The ground tissue consists of oval to polygonal parenchyma cell and is slanted with vascular bundle. Calcium oxalate can be found in this region which is in the form of sandy and prismatic crystal.

Table no. 3:*Phytochemical analysis of M. Koenigii extracted in different solvents*[3,4,5,6]

Phytochemicals	Aqueous	Ethanol	Methanol
Alkaloids	+ +	+	+
Carbohydrate	+ + +	+ + +	+ + +
Cardiac glycosides	-	+ + +	+ + +
Flavonoids	-	-	-
Phenols	+ +	+ +	-
Tannins	+	+	+
Terpenoids	+	+	+ +
Quinones	+ +	-	-
Phylobatannins	-	+	+
Amino acids	-	-	-
Protein	-	-	-

+ Presence of compound; + + + good results in compound; - absence of compound.

Pharmacological studies:

1.Anti-inflammatory activity [10]

The Anti-inflammatory effect of Methanolic extract of *Murraya koenigii* leaves on carrageenan induced paw edema in albino rats. Materials and methods-Thirty adult male albino rats weighing 175-200 grams were selected and allocated in to five groups of six animals each. The control group received vehicle 2 gum acasia (10ml/kg), Standard group received aspirin (200mg/kg) and test groups received Methanolic extract of Murraya Koenigii leaves (100mg/kg, 200mg/kg, 400mg/kg per oral respectively) 60 mts before giving sub plantar injection of 0.1ml of 1 carrageenan into left hind paw of the rats. The anti-inflammatory effect is estimated by measuring paw volume using plethysmograph. The results were tabulated and analysed with suitable statistical method. Results- Murraya Koenigii leaves showed statistically significant reduction of rat paw edema in a dose dependant manner. Maximum inhibition occurred at the dose of 400mg/kg-1(50.81) after 4th hour of carrageenan injection. ($p<0.001$). The results were comparable to that produced by standard drug aspirin. Conclusion- Murraya Koenigii leaves has anti-inflammatory activity which is comparable to aspirin. Further studies are essential to prove the anti-inflammatory activity of Murraya Koenigii in human.

2.Mosquitocidal activity [11]

Petroleum ether extract and the acetone extracts of *Murraya koenigii* leaves serves as larvacide for Aedes aegypti at the concentration range from 250ppm - 900ppm.

3. Anti-osteoporotic activity [12]

Anti –osteoporotic activity has been reported by leaves. A new carbazole alkaloid 8,8 ″ -biskoenigine which is a balanced dimer of the carbazole and koenigine was found to be effective in cathepsin B model with IC50 of 1.3 μg/mL.

4. Anti-ulcer activity [13]

Anti-ulcer activity of Aqueous extract of the leaves of Murraya koenigii was evaluated by using models of acute gastric lesions induced by ethanol induced, asprin induced, cold restrain stress and pylorus ligation in rats. Animals pre-treated with doses of 200 mg/kg and 400 mg/kg of Aqueous extract showed significant reduction in lesion index, total affected area and percentage of lesion in comparison with control group in the ethanol induced, asprin induced, cold restraint stress-induced ulcer and pylorus ligation models. These findings indicate that aqueous extract of the leaves of Murraya koenigii displays good antiulcer activity, corroborating the folk use of Murraya koenigii preparations, and contributing for its pharmacological validation.

5. Anti-Tumour assay [14]

A pure compound, Girinimbine has been isolated from stem bark of M. koenigii, was used to show the in-vitro anti-tumour promoting activity by measuring the percentage inhibition of induced early antigen EA of Epstein Barr virus EBV on the surface of Raji cells. Raji cells are B- human lymphoblastoids latently infected with EBV, in which the early antigen of the virus can be induced by phorbol 12- myristate 13-acetate and n-butyrate to express on the surface of cells which can be detected by immunofluorescence using human antisera of nasopharyngeal carcinoma. The study showed that the girinimbine strongly inhibited the induction of EA of EBV more than 90 % when tested at 16.0 and 32.0 μg/ml. The inhibition rate was moderate when tested at 8.0 μg/mL inhibition rate 58% and low at 4.0, 2.0 and 1.0 μg/mL inhibition rates of 46, 35 and 32%, respectively. The inhibition rate at fifty percent of the compound extrapolated from the dose response curve was 6.0 μg/ml.

6. Skin pigmenting [15]

The formulation of cream of essential oil of leaf of M. koenigii was found to have sun protection factor. It was postulated that cream parameters complied as per official acceptance criteria but the SPF sun pigmenting factor for curry leaf oil cream formulation showed minimum sun protection activity for sunlight and erythema. The cream was found useful in maintaining the natural skin pigmentation or it can be used as additives in other formulations to enhance the activity.

7. Anti-cancer [16]

Plants extract from *Murraya koenigii* was used for the synthesis of silver nanoparticles (Ag NPs) using silver nitrate solution. Ag NPs were characterized by UV–vis spectrophotometer, scanning electron microscope (SEM), Energy Dispersive Spectroscopy (EDX) and Fourier Transform Infra-Red Spectroscopy (FT-IR). The formation of stable silver nanoparticles reduced to the colloidal solution are observed by UV–vis spectrophotometer analysis. SEM determination of the brown coloured samples with well dispersed nanoparticles seen after treatment with silver nitrate showed the presence of silver nanoparticle whereas the EDX analysis performed is to confirm the presence of silver molecules in the sample and FTIR measurement carried out identifies the biomolecules present in M. koenigii leaf responsible for capping leading to efficient stabilization of the silver nanoparticles. The anticancer potential of the nanoparticles was evaluated using MTT assay on HT-29 colon cancer cell line. Ag NPs showed potent cytotoxic activity against the human colorectal adenocarcinoma (HT-29) cell line at higher concentrations. This study insights the M. koenigii synthesized silver Nano Particles could be an effective applicability drug candidate for colon cancer.

8.Antidiabetic property [17]

The ethanolic extract of M. koenigii reduced blood glucose levels significantly, and this action of M. koenigii reducing blood glucose is mediated by antioxidant properties and insulin-mimetic effects. M. koenigii also demonstrated a high antioxidant effect, lowering MDA levels, increasing GSH levels, and significantly lowering the homeostatic model assessment (HOMA)- insulin resistance index. Overall, M. koenigii appears to have anti-diabetic and antioxidant properties in rats.

9.Anti-Diarrheal activity [18]

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 gastro-intestinal motility in the charcoal meal test in Wister rats.

10.Cytotoxic Activity [19]

The isolated carbazole alkaloid as Koenoline from root bark of M. koenigii exhibited the cytotoxic activity against KB cell culture system.

11.Cardioprotectiveactivity [20]

The cardioprotective potential of *Murraya* leaf extract against doxorubicin-induced cardiotoxicity in rats. Rats were randomly divided into five groups with 10 animals in each group. Doxorubicin was administered intraperitonially at 18 mg/kg while lyophilized plant extract was administered orally at 2 g/kg. Dexrazoxane, at 180 mg/kg, was used as the positive control. Cardiac damage of doxorubicin control was evident with a significant increase in cardiac troponin I, NT-pro BNP, AST, and LDH compared to the normal control. Plant-treated group showed cardioprotective effect by significantly reducing ($p < 0.05$) all of the above parameters compared to doxorubicin control. Increased oxidative stress in doxorubicin control was evident with a significant reduction in reduced glutathione, glutathione reductase, glutathione peroxidase, total antioxidant capacity, superoxide dismutase, and catalase activity and a significant increase in lipid peroxidation compared to the control. Interestingly, treatment with *Murraya* leaf extract showed a significant increase in all of the above antioxidant parameters and a significant reduction in lipid peroxidation by showing an antioxidant effect. A significant increase in myeloperoxidase activity confirmed the increased inflammatory activity in doxorubicin control group whereas plant-treated group showed a significant reduction which expressed the anti-inflammatory effect of *Murraya* leaf extract. Doxorubicin-treated group showed histological evidence of extensive damage to the myocardium while plant-treated group showed a preserved myocardium with lesser degree of damage. Pre-treatment with *Murraya* leaf extract may replenish cardiomyocytes with antioxidants and promote the defence against doxorubicin-induced cardiotoxicity [11].

Table 4: Pharmacological activities done on *Murraya koenigii* plant.

Sl. No.	Pharmacological activity	Plant part	Extract	References
1.	Anti-inflammatory	Leaf	Methanolic	[10]
2.	Mosquitocidal	Leaf	Petroleum ether	[11]
3.	Anti-osteoporotic	Leaf	hydro-distilled	[12]
4.	Anti-ulcer	Leaf	Aqueous	[13]
5.	Anti-tumour	Bark	Petroleum ether	[14]
6.	Skin pigmenting	Leaf	-	[15]
7.	Anti-cancer	Tree,Leaf	Silver nanoparticles	[16]
8.	Anti- diabetic	Whole plant, fresh leaf, fruit	Aqueous, methanol	[17]
9.	Anti-diarrhoel	seeds	n-hexane	[18]
10.	cytotoxicity	Roots	Aqueous	[19]
11.	cardioprotective	Leaf		[20]

Conclusion

In recent years, ethnobotanical and traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and generally believed to be safe for human use. They obviously deserve scrutiny on modern scientific lines such as phytochemical investigation, biological evaluation on experimental animal models, toxicity studies, investigation of molecular mechanism of action s of isolated Phyto principles and their clinical trials. It is a best classical approach in search of new lead molecules for management of various diseases. Thorough screening of literature available on Murraya Koenigii depicted the fact that it is a popular remedy among the various ethnic groups, Vaidyas, Hakims and ayurvedic practitioners for cure of variety of ailments. Following the traditional and folk claims, very little efforts have been made by the researchers to explore the therapeutic potential of this plant. It is interesting to note that pure compounds and crude organic extracts of leaves of Murraya Koenigii have been screened for some pharmacological activities and found to possess cytotoxicity, cardioprotective effects, anti-inflammatory, mosquitocidal, anti-osteoporotic, anti-ulcer, anti-tumor, skin pigmentation, anti-cancer, anti-diabetic, anti-diarrheal, and many other therapeutic benefits and many more useful medicinal properties. Till other parts of plant such as seeds, leaves and seed oil which are documented to possess important medicinal virtues, are

not explored scientifically for their biological potential. In future study, the isolated principles from curry leaf needs to be evaluated in scientific manner using scientific experimental animal models and clinical trials to understand exact molecular mechanism of action, in search of lead molecule from natural resources.

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