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Review Article

# A Review on *Murraya koenigii*: The Miracle Plant

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**ABSTRACT**

*Curry plant, botanically known as Murraya koenigii is an aromatic and deciduous shrub with approximately 6m of height. Since traditional times it has been used in treatment of various acute and chronic diseases. It is a well-known Ayurvedic herb and used in various multiple formulations. Numerous researchers have been focused at validating traditional uses as well as magnifying the different compounds which are responsible for their activities and mechanism of action. Till date, many phytoconstituents of murraya including Bicyclomahanimbicine, Girinimbine, Isomahanine, Koenimbine, Koenoline, Lutein and many more have been found. The various preclinical studies revealed that Murraya have different therapeutical properties like wound healing capacity, anti-carcinogenic potential, Hepato-protective, anti-fungal as well as anti-bacterial activity.The most interesting part of this plant is that every part of it including stem, leaves, roots and flowers have its own therapeutic potential in preventing the various harmful diseases. The objective of current review is to understand the concept of pharmacological (in vitro as well as in vivo) parameters, morphological characterstics, safety/toxiciy studies, phytochemical investigation, pharmacognostic studies along with the current trends in research on Murraya koenigii.*

***Keywords:*** *Meethi Neem, Curry plant, pharmacognostic character, phytochemistry*

## Introduction

Since classical times, plants have been used as natural remedies for various different problems and has a prolonged record of curing and preventing diseases in traditional system of medicine**.** Nowadays, there are vast numbers of people in developed as well as developing countries that rely on medicinal plants for healthcare, skin care, cultural developments and economic benefits. There is considerable information available on medicinal plants and their use by indigenous cultures in preservation of traditional heritage as well as to boost health care and drug developments. India is one of the major producers of medicinal plants in the world and one of the best initiators in the discovery of herbal medicine. At present, World Health Organization (WHO) is engaging their focus towards developing countries like India to encourage them to practice the use of herbal medications for treatment of various different disorders as these drugs have least amount of side effects and high efficacy.

*Murraya koenigii* is a sub-tropical tree generally called as "Kari Patta" in India belonging to family Rutaceae. Though there are many different varieties of this plant are available, *M. koenigii Sprengis*is more widely used due to its potent medicinal activity. It is aromatic and deciduous shrub and is up to 6m in height. The curry leaf tree is indigenous to India, Sri Lanka, the Andaman Islands, and Bangladesh. The word 'curry' originated from the Tamil word 'Kari which means 'spiced sauce'.

## Plant Description

It is a shrub or a small tree having a main, dark greenish to brown, stem with several dots on it. The bark is longitudinally peeled off to expose the white wood that lies underneath and leaves are bipinnately compound having reticulate venation, bearing leaflets. The flowers are small, white in color, bisexual; deeply five cleft calyxes, pubescent, having five petals which are free, glabrous, whitish in color, and with dotted glands. Fruits are seen to occur in close clusters, small ovoid or sub-globose, glandular with a thin pericarp. The seeds are bi-seeded, with spinach green color.[1] Moreover; this plant is the major source of carbazole alkaloids, major bioactive coumarins, and acridine alkaloids.[2] Phytochemicals including Mahanine[3], Koenidine[4], girinimibine[5], bispyrapyfoline[6], murrayanine[7] are the major constituent of Kari Patta. Essential oils present in the herb are utilized as sun protection, for healthy, long, strong, lustrous hair.[8,9,10,11,12] The curry plants have also been utilized as flavoring agents in Indian cookery for centuries and have a vital role in the development of conventional herbal and ayurvedic medications.[13,14,15] Leaves and roots are also utilized typically as anthelmintic, analgesic, anti-hemorrhagic, anti-inflammatory, orofacial dyskinesia, itching and are utilized in pigmentation and hematological disease.[16,17] They have various medicinal properties[18] and clinical utilizations i.e. anti-oxidative, cytotoxic, antimicrobial, antibacterial, anti-ulcer,anti-hyperipidemic[19,20],febrifuge and blood purifier.[21,22] Carbazole alkaloid shows activity against *Trichomonas gallinae in,* treating *Acne vulgaris* and *Tinea* infection such as Onchomycosis

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(*Tinea pedis*).[23] It also shows a protective effect in Dalton's Ascitic Lymphoma.

**CULTIVATION:**

A central plant having the fragrant smell and remedial worth has a little tree, growing 4–6 m (13–20 feet) tall, with a trunk up to 40 cm (16 in) breadth. The fragrant leaves are pinnate, with 11-21 flyers, every pamphlet is 2–4 cm (0.79–1.57 in) long and 1–2 cm (0.39–0.79 in) wide. White blossoms which can self-fertilize to deliver little sparkling dark berries containing a solitary, huge practical seed. However, the berry mash is eatable with a sweet yet therapeutic dynamic by and large, neither the mash nor seed are utilized for culinary purposes.

**Temperature & Climate:**

The tree of *M. koenigii* fills best in zones 9-12 and when the temperature is above or around 65°F. Its stature ranges between 6 to 15 feet and its width ranges between 4 to 12 feet. Seeds or suckers from the grown-up trees might be utilized for proliferation. Prior to planting, the husk ought to be taken out from the seed. This strategy requires 1-2 years for the plant to turn out to be completely settled. The tree ought to be filled in rich, all-around depleted soil in full daylight or fractional shade. Assuming it is developed open air, it ought to be situated in a space that doesn't get a ton of wind. Regardless of whether filled in a pot or open air, permit the dirt to dry a little in the middle of watering since moist soil will advance root decay.

During sweltering summer climate, the curry leaf tree ought not be set in direct daylight or the leaves can get burned by the sun. Relocating the tree into a greater pot might be done following a year and the roots ought to be undisturbed. There are three sorts of curry leaf trees: ordinary, overshadow, and gamthi. The standard kind develops quick and is tall. The leaves from this plant are normally sold in supermarkets. The gamthi type develops thick leaves, yet it becomes gradually. This assortment has the most grounded fragrance.

**Harvesting:**

Harvesting actually boosts health of the plant. When the tree has grown larger at the peak season, plucking off fresh aromatic leaves to flavour stews and soups. Regular harvesting improves the present and future growth of the plant.

Fig 1: Tree of *Murraya koenigii*

Fig 2: Fruits of the plant

Fig 3: Leaves of the plant

Fig 4: Flowers of the plant

**Synonyms**

The plant is known by various local names as given bellow:

| | |
|---|---|
| **English** | Curry Leaf |
| **Hindi** | Kathnim, Mitha Neem, Kurry Patta |
| **Irula** | Kuruveppilai |
| **Kerala** | Kariveppilei |
| **Sanskrit** | Mahanimb |

**Taxonomic Classification**

Detail taxonomical classification of plant is given bellow:

| | |
|---|---|
| **Kingdom** | Plantae |
| **Sub-kingdom** | Tracheobionta |
| **Superdivison** | Spermatophyta |
| **Division** | Magnoliophyta |
| **Class** | Magnoliopsida |
| **Subclass** | Rosidae |
| **Order** | Sapindales |
| **Family** | Rutaceae |
| **Genus** | *Murraya J. Koenig ex L* |
| **Species** | *Murraya koenigii L. Spreng.* |

**Physiochemical parameters of *Murraya koenigii***

Assessment of the Physicochemical boundaries like ash content, extractive values and moisture content according to standard convention depicted in WHO guidelines.[24]

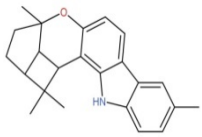
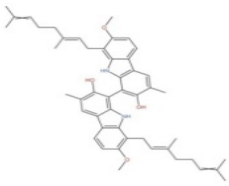
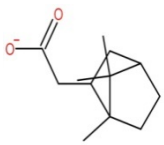
**Table 1: Physiochemical studies**

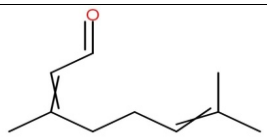
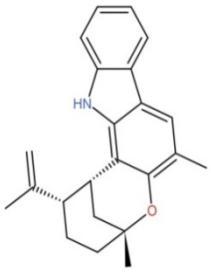
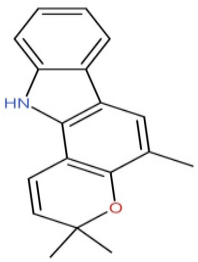
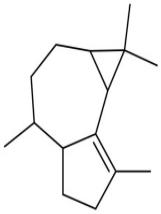
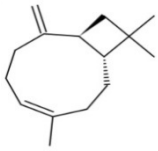
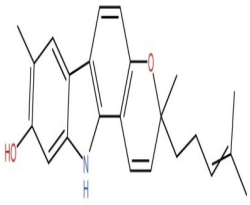
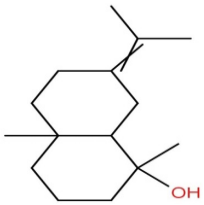
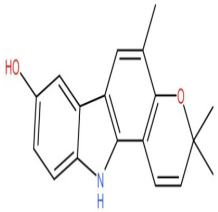
| S.No. | Physiochemical parameter | Value |
|---|---|---|
| **1.** | **Acid Insoluble Ash Value** | 2.26 %W/W |
| **2.** | **Total Ash Value** | 7.85%W/W |
| **3.** | **Sulphated ash value** | 3.82 %W/W |
| **4.** | **Determination of ethereal oils** | 1.5 %W/W |
| **5.** | **Ethanol soluble extractive value** | 5.8%W/W |
| **6.** | **Foaming index** | NIL |
| **7.** | **Loss on drying** | 8.6 %W/W |
| **8.** | **Optical rotation at 25°C** | + 4.8 |
| **9.** | **Refractive index at 25°C** | 1.5021 |
| **10.** | **Saponification value** | 5.2 |
| **12.** | **Specific gravity at 25°C** | 0.9748 g/cm$^3$ |

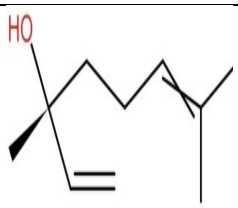
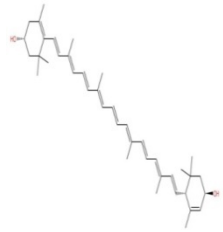
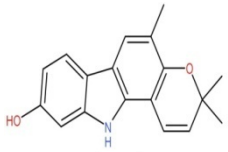
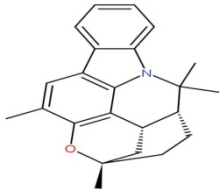
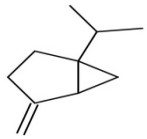
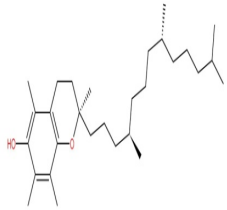
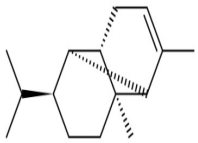
**Phytochemistry of *Murraya koenigii***

Medicinal properties of the plant are associated with the active phyto-constituents that are present in the plant.[12] These plants may be volatile or non-volatile. *Murraya koenigii*is a plant with diverse activities due to presence of numerous different phyto-constituents. *The*extracts of leaves, root, stem bark, fruits, and seeds have yielded alkaloids, flavonoids, terpenoids, and polyphenols. The leaves have notably high source of various vitamins, such as vitamin A; vitamin B3; vitamin B1, calcium, magnesium and sodium.[25,26] Wide ranges of carbazole alkaloids, essential oils, terpenoids, and flavonoids have various significant roles in the management of several human syndromes.

**Table 2: Structure, IUPAC name, Chemical nature, Pharmacological mechanism, medicinal utilization of phytoconstituents by the usage of different parts of *M. koenigii***

| S.No | Major Phytoconstituents | Structure | Nature | Pharmacological actions |
|---|---|---|---|---|
| **1.** | Bicyclomahanimbicine |  | Terpenoid Alkaloids | Dilatory action of blood vessel |
| **2.** | **Bismurrayafoli-ne E** |  | Carbazole Alkaloid | Antioxidant effect, possess anti-diabetic potential. |
| **3.** | **Bornyl Acetate** |  | Terpene | Naso-inhalers, |

| | | | | |
|---|---|---|---|---|
| **4.** | **Citral** |  | Monoterp-enoidal Aldehyde | Oral hygiene protection |
| **5.** | **Curryanine** |  | Indole Alkaloid | Reduced Total Cholesterol (Tc) And Triglyceride (Tg) Levels |
| **6.** | **Girinimbine** |  | Indole Alkaloid | By Blocking 5-Lipooxygenase Activity and Anti-parasitic effect, COPD treatment, |
| **7.** | **Gurjunene** |  | Carbotric-yclicSesquiter-pene | Treat rheumatoid arthritis, pain in synovial joints, other bone related problems caused from the $Ca^{2+}$ deficiency |
| **8.** | **Iso Caryophyllene** |  | Sesquiterpenoid | Analgesic |
| **9.** | **Isomahanine** |  | Pyrano Carbazole Alkaloids | Radiation protection activity |
| **10.** | **Juniper Camphor** |  | Terpenoid | Topical action, treatment of arthritis |
| **11.** | **Koenine** |  | Indole alkaloids | Anthelmintics activity |

| | | | | |
|---|---|---|---|---|
| **12.** | **Linalool** |  | Terpene Alcohol | Oral hygiene |
| **13.** | **Lutein** |  | Xanthoph-yll | Treat vitamin deficiency |
| **14.** | Murrayamine A |  | Carbazole Alkaloids | Inhibit cytotoxic activity |
| **15.** | **Murrayazoline** |  | carbozole alkaloid | Lower Oxidative Stress by acting on Paraoxonase 1 activity, Anti-diabetic potential. |
| **16.** | **Sabinene** |  | Terpenes | Treat arthritis, antioxidant, anti- microbial |
| **17.** | **Tocopherol** |  | Alcohol | Help in treatment of ulceration |
| **18.** | **α-Copaene** |  | Sesquiterpenoid | Eye Sight Improvement |

**Phytochemical Testing**: **Assessment of Qualitative Testing of Curry Leaves**

There are various analytical techniques by which active chemical compounds are determined. These methods can also be used for analysis of phytoconstituents in pharmaceutical formulations including ayurvedic products. Phytochemical test for the various secondary metabolites is described on table 3 that shows various positive and negative outcomes from the qualitative testing of these metabolites.[27]

**Table 3: Phytochemical testing of various secondary metabolites in different extraction medium (Methanolic extract, Acetate extract, Petroleum extract, Crude powder of curry leaves)**

| S. No. | Phytochemical testing of secondary metabolites | General test | Curry leaves extraction | | | |
|---|---|---|---|---|---|---|
| | | | Methanolic extract of curry leaves | Acetate extract of curry leaves | Petroleum extract of curry leaves | Crude powder of curry leaves |
| **1.** | **Tannins** | $FeCl_3$ (Ferric chloride) Test | +++ | +++ | - | +++ |
| **2.** | **Alkaloids** | Dragondroff's | - | - | + | + |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | test | | | | |
| | | Mayer's test | + | - | - | ++ |
| | | Wagner's test | +++ | +++ | + | ++ |
| **3.** | **Flavonoids** | Shinoda test | - | - | - | - |
| **4.** | **Steroids** | Liebermann-Burchard reaction | +++ | +++ | +++ | +++ |
| **5.** | **Cardiac glycosides** | Keller-Kilianni test | +++ | +++ | +++ | +++ |
| **6.** | **Saponins** | Frothing test | ++ | +++ | - | + |

(-): No presence, (+): present in minute concentration, (++): Moderate Presence, (+++): present in high concentration.

**Ethnopharmacological utilization of *Murraya koenigii***

*Murraya koenigii* is one of the plant species with potent therapeutic effect in the human body. The entire plant is utilized to treat different severe ailments. Generally, stem used in dental treatment or to treat disorders from the oral cavity, treat gums and provide strength. Bark used in digestion, as carminative, and stomach pain. Leaves use in various conditions such as neurological syndrome, GIT ailment, blood disorders, and in herbal cosmetic industry. Fruit and root are utilized as astringent and in nephropathic disorders, vitiligo, and hematological disorders respectively.

**Table 4: Ethnopharmacological profile of *Murraya koenigii***

| S.NO. | Part of plant | Ethnopharmacological utilization | Description of ethno pharmacology | Reference |
|---|---|---|---|---|
| **1.** | **Stem** | In Teeth disorders/ Buccal cavity/ oral cavity | Used for cleaning, strengthen gums, teeth, oral cavity and buccal cavity. Reduces tooth discoloration and reduces cavity in the teeth. | 28 |
| **2.** | **Bark** | Digestents | Bark of curry leaves utilized as the carminatives, enhance appetite,and help in other esophagus disorders and Stomach related ailments | 29 |
| **3.** | **Leaves** | GIT Disorder | Leaves of curry leaves are utilized in various disorders like:<br>Promote Appetite<br>Treat Acute Constipation | 30,31 |
| | | Hematological Disorder | Act as drug that is utilized to reduce pyrexia<br>Treat Anemia such as Sickle cell anemia, Haemophilia A | 32 |
| | | Anti-Microbial Action | Anti-helminthes | |
| | | Peptic Ulcer | Analgesic treatment in stomach<br>Treat peptic ulcer and Inhibit *Helicobacter pylori* activity in the stomach | 32,33 |
| | | Neurological Syndrome | Antinociceptive<br>Anti-amnesic<br>Inflammation<br>Itching | |
| | | Cosmetic Industry | Hair tonic,Hair color and Hair shampoo<br>Enhance hair growth with the Methi | |
| **4.** | **Fruit** | Astringent | Curry leaves used as an astringent and better cardiac functioning. | 30 |
| **5.** | **Roots** | Anti-inflammatory | Roots of curry leaves act as anti-helminthic, analgesic, cooling agent, anti-inflammatory, cure nephropathic disorders, vitiligo, hematological disorders | 30 |
| **6.** | **Whole plant** | Treat various disorders related to viral infections, neurological, genetic disorders | Used as antifungal, antiviral, anti-inflammatory, systemic purifier, antidepressant, Anti-dysenteric, antiemetic, Stomachic, treat pyrexia, | 30,31 |

**Pharmacological view of *Murraya koenigii***

***1. Wound healing efficacy of Murraya koenigii***

Various cellular processes, chemicals, multi factors are involved in the process of the wound healing effect. Curry leaves extend wound healing in male albino rats through notably enhanced wound contraction and minimized epithelialization, supporting the biosynthesis of protein which was evident in histopathological studies.

**2. *Activity of Murraya koenigii in the management of GIT related disorders***

Hydrocarbon extract of the *M. koenigii* seeds have antagonized effect that is in front of castor oil. Hence, induced diarrhea and Prostaglandin (PGE2) induced enteropooling in wistar rats. The studies reported, reduction in GIT related death rate was examined in the charcoal meal test in wistarrats.[33]

**3. *Antioxidant effect***

Maximal amount of the phytochemicals that are present in the curry leaves possess antioxidant efficacies.[34] Antioxidant potency depends on the total polyphenolic compounds, volatile oils and other compounds. Due to the presence of carbozole alkaloids that are currently isolated are of mahanimbine, koenigine and aryl hydroxyl group of alkaloids have maximal antioxidant activities.[35] Singlet oxygen ($O_2$), hydrogen peroxide ($H_2O_2$), the superoxide anion ($O_2•^-$), and the hydroxyl radical (•OH), are stimulate as byproducts of cellular metabolic reactions and exogenous induction. Reactive oxygen species create homeostatic imbalances and hence, shows oxidative stress.

**4. *Chemotherapeutic effect of Murraya koenigii***

It shows potent secondary metabolites that shows anticancer activity.[8] Cytotoxic activity was determined for three extracts: hexane, ethyl acetate, and methanol of curry leaves against the HeLa cell line. This extract shows potent toxicity of cell in nature in HeLa cancer cells.[36,37]

**5. *Antibacterial effect***

The present studies have demonstrated that curry plant have strong anti-microbial potential. Studies shows that volatile oils have antibacterial action against *B. subtilis, S.aureus, C. pyogenes, P. vulgaris and Pasteurella multocida*. The pure oil is active against *B. subtilis, S.aureus.*[37]

**6. *Hepatoprotective effect***

To treat hepatic disorders, chronic alcoholic disorder, and various diseased conditions related to liver curry leaves consider as the best herb for their treatment.[38] Carbazole alkaloids and tannins that are extracted from the curry leaves are used in the treatment of a liver disorder, liver toxicity in a HepG2 cell line model.[39,40]

**7. *Antifungal effect***

*Murraya koenigii* shows antifungal activity due to the ethereal oils present in the leaves of this plant.[41,42] The presence of alkaloids, terpenoids, flavonoids, phenolics, tannins, and saponins in the *M. koenigii*, possess mycosis activity or antifungal activity, shows antimicrobial action.[43,44] In vitro, antifungal activity may illustrate the utilization of leaves for the cure of bacterial dysentery and dermal eruptions in folklore medicines.

**8. *Anti-Diarrheal effect***

The bioassay guided fractionation of the n-hexane extract of the seeds of *Murraya koenigii* concludes in the extraction of three pure compounds of bioactive carbazole alkaloids, kurryam, koenimbine and koenine. Kurryam and koenimbine exhibited notably antagonizable pursuits in view of castor oil persuades diarrhea and PGE2 persuades enter pooling in Wistar rats.[45]

**9. *Antipyretic activity***

Rats dealing with pyrexia, introduced with the parental administration of 10mg/kg of brewer yeast and were found that the ethanol extract of leaves poses an antipyretic activity compared to petroleum ether extract and chloroform extract, with paracetamol dose of 150mg/kg as a standard drug.[46,47]

**Market Formulations of *Murraya Koenigii***

As people are getting more aware about beneficial effects of herbal plants and their products, the demand of herbal products has drastically increased over the past decade. Moreover, most cosmetic and pharmaceutical companies have now been focused to make natural plant-based formulations as these formulations have minimal side effects and maximum efficacy and these products are the choice of drugs for most people nowadays. *Murraya Koenigii* is used in many different formulations as essential oil, powder, juice, hair oil and many more as consumption of this plant boost immunity and has various other health benefits. Some of the formulations of curry plant are mentioned below:

**Table 5: Market Formulations of *Murraya Koenigii***

| | | |
|---|---|---|
|  |  |  |
| Company: Dr.tea<br>Dosage form: Curry leaf Tea bags | Company: Beam<br>Dosage form: Karapincha Tea | Company: Naturella<br>Dosage form: Capsules |

| | | |
|---|---|---|
| Uses: Maintaining Blood circulation. Help in indigestion, as antidote. | Uses: Anti-oxidants, help in cholestrol and diabetes | Uses: Cardiovascular Protector |
|  |  |  |
| Company: Kazima Perfumers<br>Dosage form: Curry leaf oil<br>Uses: Aromatherapy, anti-bacterial potential | Company: Aroma Seacrets<br>Dosage form: Essential Oils<br>Uses: Anti-ageing | Company: All Time Young<br>Dosage form: Powder<br>Uses: Source of Vitamin A, B, C, E and Iron |
|  |  |  |
| Company: Bombay Shaving Company<br>Dosage form: Hair Oil<br>Uses: Prevents hairfall and reverses hair ageing. | Company: Secrets of the Tribe<br>Dosage form: Tincture<br>Uses: Dietary Supplement | Company:Viroga Life<br>Dosage form: Capsules<br>Uses: Antioxidant, Hair Vitalizer, Boost digestion, reduces cholesterol. |
|  |  |  |
| Company: ae Naturals<br>Dosage form: Capsules<br>Uses: Improves eye sight, rich in Vitamin A, E & C. | Company: Secrets of the Tribe<br>Dosage form: Capsules<br>Uses: Dietary Supplements | Company: Vita Cloud<br>Dosage form: Extract<br>Uses: Promotes healthy hair |

**Conclusion**

This concludes that *Murraya koenigii* emerged as a good source of traditional medicine for diarrhea, neuroprotective, dengue, wound healing efficacy, viral infection, fungal problems, infection from *Entamoeba histolytica*, nephroprotective, diabetes mellitus, and

dermal disorders. It serves best in the herbal cosmetic industry. Several traditional utilizationshave now been justified by modern pharmacology research. Intensive investigations related to bioactive constituents for specific pharmacological action, their mechanism of action, safety, and efficacy could be the future research interests, to explore the plant exhaustively. There is a great promise for the development of novel drugs from *Murraya koenigii* to treat many human syndromes as a result of its effectiveness and safety.

**References**


1. Kumar VS, Sharma A, Tiwari R, Kumar S. *Murraya koenigii:* A review. Journal of Medicinal and Aromatic Plant and Sciences. 1999; 2(1):1139-1144.
2. Nadkarni KM. Indian Materia Medica. Edn 3, Vol.1, Popular Prakashan, Mumbai,1976, 196.
3. Kirtikar KR, Basu BD. Indian Medicinal Plants. Edn 2, Vol. I, Oriental Enterprises, Uttarchal Pradesh, 1981, 473.
4. Xie JT, Chang CZ, Mehendale SR. Curry leaf reduces blood glucose and blood cholesterol level in ob/ob mice. American Journal of Chinese Medicine. 2006;34(2):279–284.
5. Khan BA, Abraham A, Leelamma S. Role of *Murraya koenigii, Brassica juncea* in lipid peroxidation. The Journal of Physiology. 1996; 40(2):155–158.
6. Hatapakki BC, Aryavaidyan J, Ram HNA, Hukkeri IV. 2002; 16(1):40-44.
7. The Wealth of India. Council of Scientific and Industrial Research, New Delhi, 2003, 317.
8. Manfred F, John MP, Dajaja DS, Douglas AK. Koenoline, a further cytotoxic carbazole alkaloid from *Murraya koenigii. Phytochemistry.* 1985; 24: 3041-3043.
9. Shrinivasan K. Plant foods in the management of diabetes mellitus: spices as beneficial antidiabetic food adjuncts. International Journal of Food Science and nutrition 2005; 56(6): 399-414.
10. Shah KJ, Juvekar AR. Positive inotropic effect of *Murraya koenigii* (Linn.) Spreng extract on an isolated perfused frog heart. International Journal of Experiment Biology. 2006; 44,481- 484.
11. Prajapati ND, Purohit SS, Sharma AK, Kumar T. A Handbook of Medicinal Plants. Agrobios, Jodhpur, 2003; 352-353.
12. Narasimhan NS, Paradkar MV, Kelkar SL. Alkaloids of *Murraya koenigii*, Structures of mahanine, koenine, koenigine and koenidine. Indian Journal of Chemistry. 1970; 8:473-476.
13. Narasimhan NS, Paradkar MV, Chitguppi VP, Kelkar SL. Alkaloids *of Murraya koenigii,* Structures of mahanimbine, koenimbine, mahanine, koenine, koenigine and koenidine. Indian Journal of Chemistry. 1975; 13: 993-995.
14. Adebajo AC, Avoola OF, Iwalewa EO, Akindahunsi AA, Omisore NO, Cadewunmi CO. Anti-trichomonal, biochemical and toxicological activities of methanolic extract and some carbazole alkaloids isolated from the leaves of Murraya koenigii growing in Nigeria. Phytomedicine. 2006; 13(4): 246-54.
15. Tachibana Y, Kikuzaki H, Lajis NH, Nakatani N. Comparison of antioxidative properties of carbazole.
16. Adebajo AC, Reisch J. Minor furocoumarins of *Murraya koenigii*. Fitoterpia. 2000; 71(3): 334-7.
17. Bhattacharya P, Chowdhury BK. 2-Methoxy-3-Methyl Carbazole from *Murraya koenigii*. Indian Journal of Chemistry Section A. 1984; 24B(4):452.
18. Debosree G, Syed BF, Elina M. Protective effect of aqueous leaf extract of *Murraya koenigii* against lead induced oxidative Stress in rat liver, heart and kidney: a dose response study. Asian Journal of Pharmaceutical and Clinical Research. 2012; 5:54–59.
19. Gopalan C, Rama Shastri BV, Balasubramanian SC. Nutritive value of Indian Foods. New Delhi: ICMR. 1984: 66:117.
20. Prakash V, Natarajan CP. Studies on Curry Leaf. Food Science and Technology. 1974;11(6):284–286.
21. Jamil R, Nasir NN, Ramli H. Extraction of essential oil from Murraya koenigii leaves: potential study for application as natural based insect repellent. Journal of Engineering and Applied Science. 2016;11(4):1–5.
22. Iyer D, Uma DP. Phyto-pharmacology of *Murraya koenigii*. Pharmacognosy Reviews. 2008; 2:180-184.
23. Shree C, Islam A, Ahmad F. Structure function studies of *Murraya koenigii* trypsin inhibitor revealed a stable core beta sheet structure surrounded by alpha helices with a possible role for alpha helix in inhibitory function. International Journal of Biological Macromolecules. 2007; 41(4):410–414.
24. Madhu C. Divakar; Plant Drug Evaluation, 2nd Edition. Cd Remedies Publication. 2002;(49-52):84-89.
25. Bhandari P. Curry leaf (*Murraya koenigii)* or Cure leaf: Review of its curative properties. Journal of Medicine and Nutrition. Nutraceuticals. 2012; 2:92–97.
26. Igara C, Omoboyowa D, Ahuchaogu A, Orji N, Ndukwe M. Phytochemical and nutritional profile of *Murraya koenigii* (Linn) Spreng leaf. Journal of Pharmacognosy and Phytochemistry. 2016; 5:7–9.
27. Bonde SD, Nemade LS, Patel MR. *Murraya koenigii* (Curry leaf): Ethnobotany, phytochemistry and pharmacology: a review. International Journal of Pharmaceutical and Phytopharmacological Research. 2007; 4(5):45–54.
28. Saini SC, Reddy GBS. Assessment of Quality of Curry Leaves (*Murraya koenigii)*. International Journal of Science and innovative research. 2013; 2: (10):13-17.
29. The Wealth of India. A Dictionary of Indian Raw Materials and Industrial Products, New Delhi 2003: 4.
30. Parrota JA. Healing Plants of Peninsular India. USA: C.A.S.I. Publication, 2001.
31. Shirwaikar A, Ashwatha RHN, Mohapatra P. Antioxidant and Antiulcer activity of aqueous extract

of polyherbal formulation. Indian Journal of Experimental Biology. 2006; (44):474-480.
32. Sharma P, Gali V, Bhandari A, Singh S, Ghule S, Agrawal S. Antiulcer activity of leaves extract of *Murraya Koenigii* in experimentally induced ulcer in rats. 2011;(2):818-824.
33. Nagappan T, Segaran TC, Wahid MEA, Ramasamy P, Vairappan CS. Efficacy of carbazole alkaloids, essential oil and extract of *Murraya koenigii* in enhancing subcutaneous wound healing in rats. Molecules. 2012; 17:14449–14463.
34. Singh AG. Murraya Koenigii (L.) Spreng-Curry Leaves/Mitho Nim-A Miracle Plant. Butwal Campus Journal. 2020 Jul 1; 3(1):125-30.
35. Devatkal SK, Thorat PR, Manjunatha M, Anurag RK. Comparative antioxidant effect of aqueous extracts of curry leaves, fenugreek leaves and butylated hydroxytoluene in raw chicken patties. Journal of food science and technology. 2012 Dec;49(6):781-5.
36. Amna U, Halimatussakdiah PW, Saidi N, Nasution R. Evaluation of cytotoxic activity from Temurui (*Murraya koenigii* [Linn.] Spreng) leaf extracts against HeLa cell line using MTT assay. Journal of Advancement in Pharmaceutical Technological Research. 2019; 10:51–55.
37. Mohan S, Abdelwahab SI, Cheah SC, Sukari MA, Syam S, Shamsuddin N, Mustafa MR. Apoptosis effect of girinimbine isolated from *Murraya koenigii* on lung cancer cells in vitro. Evid.-Based Complement. Alternative Medicine. 2013.
38. Abuga I, Sulaiman SF, Wahab RA, Ooi KL, Rasad MS. In vitro antibacterial effect of the leaf extract of Murraya koenigii on cell membrane destruction against pathogenic bacteria and phenolic compounds identification. European Journal of Integrative Medicine. 2020 Jan 1; 33:101010.
39. Syam S, Abdul AB, Sukari MA. The growth suppressing effects of girinimbine on HepG2 involve induction of apoptosis and cell cycle arrest. Molecule. 2011; 16(8):7155–7170.
40. Manfo FPT, Nantia EA, Kuete V. Toxicological Survey of African Medicinal Plants. Elsevier; Yaoundé, Cameroon. Hepatotoxicity and Hepatoprotective Effects. African journal of Medicinal Plants. 2014; 223–256.
41. Maswada HF, Abdallah SA. In vitro antifungal activity of three geophytic plant extracts against three post-harvest pathogenic fungi. Pakistan Journal of Biological Sciences . 2013; 16:1698–1705.
42. Tripathi Y, Anjum N, Rana A. Chemical Composition and In vitro Antifungal and Antioxidant Activities of Essential Oil from *Murraya koenigii* (L.) Spreng. Leaves. Asian Journal of Biomedical and Pharmaceutical Sciences. 2018; 8:6–13.
43. Balde A. K., S D., C K. K. B., K B. A., M B. T., F, H., M, S. D., & A, M. Alteration Perimetriques Glaucomateuses Au Depistage : Experience Du Cades/O Donka De Conakry. Journal of Medical Research and Health Sciences, 2022 ;5(9) : 2210–2220.
44. Kishore N, Dubey NK, Tripathi RD, Singh SK. Fungitoxic activity of leaves of some higher plants. National Academy Science Letters. 1982; 5(1): 9.
45. Singh L, Sharma. *Murraya Koenigii* as Antifungal properties of some plant extracts. Geobios. 1978; 5(2):49.
46. Mandal S, Nayak A, Kar M, Banerjee SK, Das A, Upadhyay SN. Antidiarrhoeal activity of carbazole alkaloids from *Murraya koenigii* Spreng (Rutaceae) seeds. Fitoterapia.2010;81:72-4.
47. 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.