International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 2, Issue 12, December, 2025
Page No.: 71-82

Review

Ethnomedicinal Significance, Phytochemical Profile, and Pharmacological Potential of *Murraya koenigii*

Tehreen Parveen*, Mandeep Pundir, Hardeep Kaur, Mandeep Kaur
School of Pharmaceutical Sciences, RIMT University, Mandigobindgarh, Punjab

Corresponding Author:
Tehreen Parveen

Email:
tehreen.parveen26@gmail.com

DOI:
10.62896/ijpdd.2.12.06

Conflict of interest: *NIL*

Article History
Received: 12/11/2025
Accepted: 14/12/2025
Published: 16/12/2025

Abstract:
The present work emphasizes traditional uses, phytochemical and pharmacology of a traditionally used and medicinally promising plant *Murraya koenigii*. It is traditionally used for various ailments such as diabetes mellitus, body pain, inflammation, vomiting, kidney pain, curing piles, leucoderma, blood purifier, snake bites, stomachic, carminative and osteoporosis. The plant contains alkaloids, sterols, triterpenoids, carotenoid, furocoumarins, flavonoids, tannins and glycosides are main class of phytochemical constituents. Curry leaves contain proteins, carbohydrates, fibre, minerals, carotene, nicotinic acid, vitamin C, oxalic acid, crystalline glycosides. The biocative compound are present like mahanine, koenine, koenigine,koenidine, girinimbiol, girinimibine, pinene, sabinene, caryophyllene, cadinol andcadinene. The plant has been reported to exhibit various pharmacological activities such as anti-oxidative, cytotoxic, antimicrobial, antibacterial, antiulcer, positive inotropic and anti- obesty, hepatoprotective, antispasmodic, anti-amoebic and anti- tumour. Also the plant has been exploredfor their traditional claims in preclinical studies. *Murraya koenigii* holds a great potential to be emerged as chemically potential medicine.

Keywords: *Murrayakoenigii*, Traditionaluses, Phytochemistry, Biological activity.

Introduction

Murraya koenigii (L.) Spreng, commonly known as curry leaf tree or Karipatta, is a well-known aromatic plant belonging to the family Rutaceae. It is a small evergreen tree or large shrub valued for its characteristic aroma and extensive use in traditional medicine as well as culinary practices. The plant typically attains a height of up to 6 m with a trunk diameter ranging between 15 and 40 cm. It possesses a short trunk with profuse branching, contributing to its bushy appearance [1].

M. koenigii is native to the Indian subcontinent and is widely distributed throughout India, including the Andaman Islands. Owing to its medicinal importance and culinary demand, the plant has been introduced and cultivated across several regions of Central and Southeast Asia. With human migration, particularly by South Asian communities, the plant has also spread to countries such as Malaysia, South Africa, and Reunion Island [2]. Traditionally, various parts of the plant—especially the leaves—have been employed in indigenous systems of medicine for the management of metabolic disorders, infections, inflammation, and gastrointestinal ailments. The present review focuses on providing a comprehensive overview of the morphological and microscopic characteristics of *M. koenigii*, supporting its identification and pharmacognostic relevance [3], [4].

Macroscopic Characters

The macroscopic characteristics of *Murraya koenigii*

reveal it to be a perennial, aromatic shrub or small tree with a distinctive fragrance. The entire plant emits a strong, pleasant aroma, particularly when the leaves are crushed [5]. The flowers are white in colour, funnel-shaped, sweetly scented, and borne on stalks. They are complete and ebracteate, with an average diameter of approximately 1.2 cm, and are arranged in terminal or axillary clusters [6].

The leaves are compound, pinnate, and spinach green in colour, exhibiting a glossy and smooth upper surface with comparatively paler undersides. The leaflets are ovate-lanceolate in shape, aromatic in nature, and arranged alternately along the rachis. Each leaflet typically measures about 0.80–1.56 inches in length and 0.38–0.78 inches in breadth, with an entire to slightly serrated margin and an acute apex [7], [8].

The stem is strong, woody, and cylindrical, varying in colour from brown to dark green. Mature branches are covered with dark grey bark, which may show fissures upon aging. The overall plant height ranges from as small as 16 cm in young plants to about 6 m in fully mature specimens, while the stem diameter varies between 4 cm and 15 cm depending on age and growing conditions [9], [10].

The fruits are small, ovoid to sub-globose berries borne in compact clusters. They are green during the immature stage and gradually turn deep purple or black upon ripening. The fruits are aromatic and measure approximately 2.5 cm in length and 0.3 cm in diameter. Each fruit encloses one or two seeds surrounded by a thin pericarp. The seeds are spinach green in colour and are considered toxic, rendering them unsuitable for consumption [11], [12], [13].

Microscopy

Microscopical examination of *Murraya koenigii* leaves shows them to be ovate to rhomboid in shape with an irregularly dentate margin and an acute apex. The leaf surface exhibits a well-developed reticulate venation pattern. Both the upper and lower epidermis consist of compactly arranged cells covered with a thick cuticle. The stomata are of the anomocytic type and are predominantly distributed on the abaxial surface of the leaf [14], [15].

Trichomes are present on both surfaces of the leaf and are uniseriate, multicellular, and elongated with distinctly ridged walls. These trichomes contribute to the protective and aromatic properties of the plant. The mesophyll tissue is differentiated into palisade and spongy parenchyma, with palisade cells rich in chloroplasts facilitating photosynthesis. Parenchymatous cells are oval to polygonal in shape and frequently contain starch grains [16].

The stem microscopy reveals a single-layered epidermis composed of elongated, unicellular cells covered by a thick cuticle. Beneath the epidermis lies a parenchymatous cortex, followed by well-developed vascular tissues arranged in a continuous ring. Calcium oxalate crystals are commonly observed within the parenchymatous cells and occur in sandy as well as prismatic forms. Fresh leaves also show the presence of abundant unicellular trichomes, further supporting the diagnostic microscopic features of the plant [17], [18].

Figure 1 illustrates the macroscopic features of *Murraya koenigii*, highlighting the characteristic pinnate leaves and clustered fruits. The leaves are bright to spinach green, glossy, ovate-lanceolate in shape, and arranged alternately along the rachis, reflecting the plant's aromatic nature [19]. The fruits are borne in compact clusters, appearing green at the immature stage and turning dark purple to black upon ripening, which is a key diagnostic feature for identification of the plant [20], [21].

Figure1: Leaves and fruit parts of *M.koenigii.*

Traditional Uses

Murraya koenigii has been extensively used in traditional systems of medicine for its wide range of therapeutic properties. The plant is traditionally valued as an analgesic, febrifuge, stomachic, and carminative, and has long been employed in the management of gastrointestinal disorders such as dysentery, indigestion, and flatulence. Its leaves are commonly used to alleviate skin-related conditions, including eruptions, itching, and inflammation, owing to their soothing and antimicrobial properties [22].

Fresh leaves, dried leaf powder, and the essential oil of *M. koenigii* are widely used as flavouring agents in culinary preparations such as soups, curries, fish and meat dishes, egg-based foods, and various traditional recipes. Beyond culinary applications, the essential oil is extensively utilized in the soap, cosmetic, and aromatherapy industries due to its pleasant aroma and bioactive properties [23], [24].

In traditional hair care practices, curry leaves are boiled in coconut oil to prepare a herbal formulation that is applied as a hair tonic. This preparation is believed to strengthen hair roots, stimulate hair growth, prevent premature greying, and improve scalp health. The bark and roots of the plant are used as stimulants and are applied externally for the treatment of skin eruptions, insect bites, and bites from poisonous animals [25].

An infusion prepared from roasted leaves is traditionally administered to control vomiting. Tender green leaves are sometimes consumed raw for the treatment of dysentery. In Ayurveda, powdered dry leaves mixed with honey and betel nut juice are used as an antiperiodic remedy. Fresh juice of curry leaves, when combined with lime juice and sugar, is traditionally used to manage morning sickness, nausea, and vomiting associated with indigestion or excessive intake of fatty foods [26], [27].

Additionally, the leaves and roots are used as bitter tonics, anthelmintic agents, and analgesics. They are traditionally recommended for conditions such as piles, inflammation, leucoderma, and blood-related disorders. Root juice is used in folk medicine to relieve kidney-associated pain. While the fruits of *M. koenigii* are edible and consumed in some regions, the seeds are considered toxic. The wood of the plant is also utilized for making small agricultural tools and implements [28], [29], [30].

Table 1 provides a comprehensive overview of the phytochemical composition, traditional uses, and pharmacological relevance of *Murraya koenigii*. The table systematically correlates different plant parts, including leaves, roots, bark, stem, fruits, seeds, and the whole plant, with their major chemical constituents and associated ethnomedicinal applications. The leaves emerge as the most pharmacologically significant part, being rich in carbazole alkaloids, flavonoids, tannins, essential oils, vitamins, minerals, and dietary fibre, which collectively account for their widespread use as digestive tonics, anti-inflammatory agents, antioxidants, and nutritional supplements [31], [32].

The table further highlights the therapeutic relevance of non-leaf plant parts. Roots and bark are shown to contain alkaloids, sterols, and triterpenoids, supporting their traditional use in the management of pain, inflammation, skin disorders, and parasitic infections. The fruits contribute nutritional and antioxidant benefits due to the presence of carotenoids, flavonoids, sugars, and organic acids, whereas the seeds are noted for their alkaloid content and associated toxicity, emphasizing the importance of proper plant-part selection in traditional medicine [33], [34].

Additionally, Table 1 underscores the holistic medicinal potential of *M. koenigii*, as the whole plant is reported to possess essential oils, polyphenols, minerals, and bioactive peptides linked to antioxidant, immunomodulatory, and central nervous system–relaxant effects [35]. By integrating phytochemistry with ethnomedicinal knowledge and pharmacological relevance, the table clearly demonstrates how the chemical diversity of *M. koenigii* underpins its wide range of traditional and therapeutic applications [36]. This consolidated representation supports the plant's significance as a valuable source of bioactive compounds and provides a scientific rationale for its continued use and future pharmacological exploration [37], [38].

Table 1: Phytochemical Constituents and Traditional Medicinal Uses of *Murraya koenigii.*

S. No.	Plant Part	Major Chemical Constituents	Traditional / Ethnomedicinal Use	Pharmacological Relevance	References
1	Leaves	Carbazole alkaloids	Digestive tonic	Antioxidant, gastroprotective	[39]
2	Leaves	Flavonoids	Anti-inflammatory remedy	Anti-inflammatory	[40]
3	Leaves	Tannins	Treatment of dysentery	Antidiarrheal	[41]
4	Leaves	Essential oils	Flavoring agent	Antimicrobial	[42]
5	Leaves	β-carotene	Nutritional supplement	Antioxidant	[43]
6	Leaves	Vitamin C	Immunity booster	Free radical scavenging	[44]
7	Leaves	Nicotinic acid	Metabolic support	Antihyperlipidemic	[45]
8	Leaves	Dietary fiber	Digestive health	Laxative	[46]
9	Leaves	Calcium	Bone health	Anti-osteoporotic	[47]
10	Leaves	Iron	Blood disorders	Hematinic	[48]
11	Leaves	Oxalic acid	Digestive stimulant	Mild astringent	[49]
12	Leaves	Glycosides	Cardiac tonic (folk use)	Cardioprotective	[50]
13	Leaves	Chlorophyll	Detoxification	Hepatoprotective	[51]
14	Leaves	Volatile oils	Aromatherapy	Anxiolytic	[52]
15	Leaves	Terpenoids	Skin ailments	Anti-inflammatory	[53]
16	Leaves	Phenolic compounds	Anti-aging	Antioxidant	[54]
17	Leaves	Proteins	Nutritional support	Tissue repair	[55]
18	Leaves	Carotenoids	Eye health	Vision protection	[56]
19	Leaves	Alkaloids	Analgesic	Pain modulation	[57]
20	Leaves	Minerals (Mg, K)	Metabolic balance	Electrolyte regulation	[58]
21	Roots	Alkaloids	Kidney pain relief	Analgesic	[59]
22	Roots	Sterols	Anti-inflammatory use	Anti-inflammatory	[60]
23	Roots	Triterpenoids	Piles treatment	Venotonic	[61]
24	Roots	Bitter principles	Anthelmintic	Antiparasitic	[62]
25	Bark	Alkaloids	External eruptions	Antimicrobial	[63]
26	Bark	Tannins	Wound healing	Astringent	[64]
27	Bark	Steroidal compounds	Skin disorders	Anti-inflammatory	[65]
28	Stem	Lignans	Structural support	Antioxidant	[66]
29	Stem	Phenolics	Anti-infective	Antimicrobial	[67]
30	Fruits	Carotenoids	Nutritional use	Antioxidant	[68]
31	Fruits	Sugars	Energy source	Nutritional	[69]
32	Fruits	Organic acids	Digestive aid	Digestive stimulant	[70]
33	Fruits	Flavonoids	Liver support	Hepatoprotective	[71]
34	Seeds	Alkaloids	Not consumed (toxic)	Toxicological relevance	[72]
35	Whole plant	Essential oils	Aromatherapy	CNS relaxant	[9]
36	Whole plant	Polyphenols	Chronic disease prevention	Antioxidant	[73]
37	Whole plant	Minerals	General health tonic	Metabolic support	[74]
38	Whole plant	Bioactive peptides	Traditional immunity use	Immunomodulatory	[75]
39	Leaves + Roots	Alkaloids + flavonoids	Diabetes management	Antidiabetic	[76]
40	Leaves (paste)	Phenolics + oils	Boils, burns, bruises	Wound healing	[77]

Chemical structure of constituents present in *M. koenigii*

The chemical structures illustrated in the figure represent some of the major bioactive constituents isolated from *Murraya koenigii*, which collectively account for its diverse pharmacological and therapeutic properties. These compounds belong to different phytochemical classes, including alkaloids,

terpenoids, phenolic acids, flavonoids, coumarins, and vitamins, highlighting the chemical diversity of the plant [78].

Carbazole alkaloids such as mahanimbine, girinimbine, and murrayamine are characteristic constituents of *M. koenigii* and are considered key contributors to its biological activity. These alkaloids are reported to exhibit antioxidant, anti-inflammatory, anticancer, antimicrobial, and antidiabetic properties. Their unique tricyclic carbazole framework is associated with strong free radical scavenging activity and modulation of various cellular signaling pathways [79].

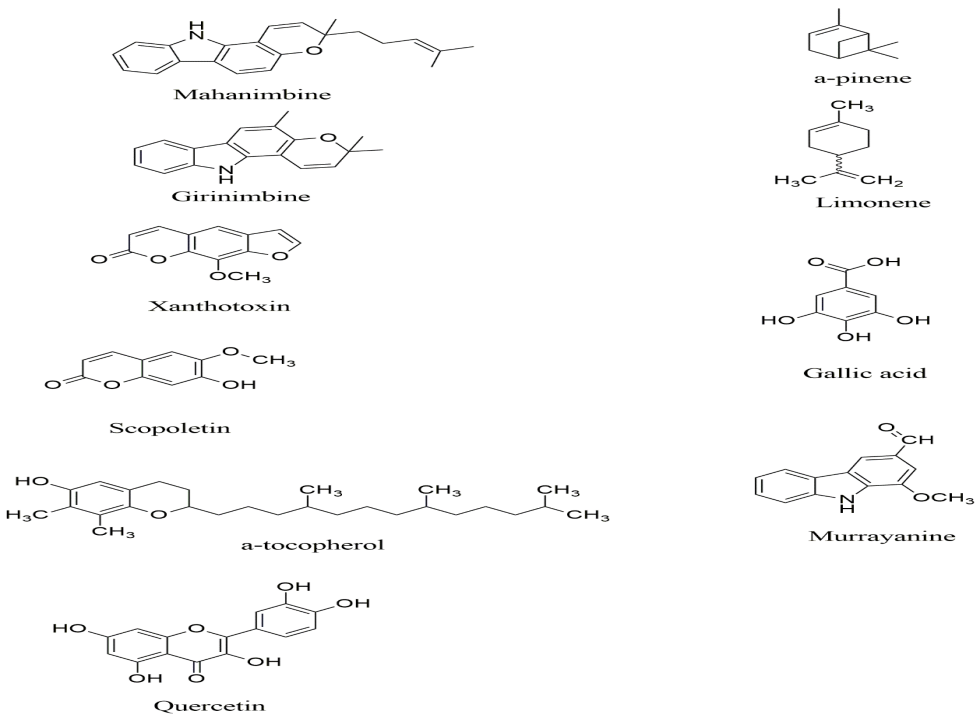
The presence of α-pinene and limonene, which are monoterpenes commonly found in the essential oil of curry leaves, explains the plant's characteristic aroma and its use in aromatherapy and cosmetic formulations. These volatile constituents are known for their antimicrobial, anti-inflammatory, and anxiolytic effects and play a significant role in the therapeutic potential of the essential oil [80].

Phenolic and polyphenolic compounds such as gallic acid and quercetin contribute substantially to the antioxidant capacity of *M. koenigii*. Gallic acid exhibits strong free radical scavenging, antimicrobial, and anti-inflammatory activities, while quercetin is well recognized for its antioxidant, cardioprotective, anti-inflammatory, and neuroprotective effects. These compounds support the traditional use of curry leaves in the management of chronic inflammatory and metabolic disorders [81].

Coumarin derivatives including xanthotoxin and scopoletin are also present and are associated with anti-inflammatory, hepatoprotective, antimicrobial, and photobiological activities. These constituents further enhance the therapeutic spectrum of the plant, particularly in skin-related and liver disorders [82].

Additionally, α-tocopherol (vitamin E) present in *M. koenigii* contributes to its nutritional and antioxidant value. As a lipid-soluble antioxidant, α-tocopherol protects cellular membranes from oxidative damage and supports skin health, immune function, and overall metabolic balance.

Overall, the chemical constituents depicted in the figure demonstrate the multifaceted phytochemical profile of *Murraya koenigii*. The synergistic action of alkaloids, terpenoids, phenolics, flavonoids, coumarins, and vitamins provides a scientific basis for the extensive traditional and modern medicinal applications of the plant and underscores its potential as a valuable source of bioactive compounds for pharmaceutical and nutraceutical development [83].



Pharmacological activities

Extensive pharmacological investigations have been carried out on *Murraya koenigii* to scientifically validate its long-standing traditional and ethnomedicinal uses. Experimental studies using in vitro and in vivo models have demonstrated that various extracts and isolated constituents of the plant possess a broad spectrum of biological activities, confirming its therapeutic versatility [84].

M. koenigii has shown pronounced anti-inflammatory and antinociceptive activities, which support its traditional use in the management of pain, inflammation, and inflammatory disorders. These effects are primarily attributed to the presence of carbazole alkaloids, flavonoids, and phenolic compounds that inhibit inflammatory mediators and reduce oxidative stress. The plant has also exhibited significant antianxiety and central nervous system–modulating effects, suggesting its potential role in managing stress-related and anxiety disorders, as reflected in traditional practices [85].

The antibacterial and antifungal activities of *M. koenigii* have been widely reported against a range of pathogenic microorganisms. Essential oils and solvent extracts of the leaves demonstrate strong antimicrobial effects, supporting their traditional application in treating skin infections, wounds, and gastrointestinal infections. These properties are largely attributed to monoterpenes, alkaloids, and phenolic constituents present in the plant [86].

Hepatoprotective activity of *M. koenigii* has been demonstrated in experimental models of liver injury, where the plant extracts effectively reduced liver enzyme levels and improved histopathological features. This protective effect is associated with the antioxidant and free radical–scavenging properties of flavonoids, carbazole alkaloids, and phenolic acids, reinforcing the traditional use of curry leaves in liver-related ailments [87].

The plant has also been extensively studied for its antidiabetic potential. Leaf extracts have been shown to reduce blood glucose levels, improve insulin sensitivity, and modulate carbohydrate metabolism. These effects validate its traditional use in managing diabetes and metabolic disorders. In addition, antiprotozoal activity has been reported, indicating its effectiveness against certain parasitic infections and supporting its folkloric use in gastrointestinal disorders [88].

M. koenigii exhibits strong antioxidant activity, which plays a central role in many of its pharmacological effects. The high content of polyphenols, flavonoids, vitamin C, and vitamin E contributes to effective scavenging of free radicals and protection against oxidative damage. This antioxidant potential underpins its role in preventing chronic diseases and age-related disorders [89].

Furthermore, anticancer activity of *M. koenigii* has gained increasing attention, with studies demonstrating the ability of its extracts and isolated carbazole alkaloids to inhibit cancer cell proliferation, induce apoptosis, and modulate signaling pathways involved in tumor progression. These findings highlight the plant's potential as a source of novel anticancer agents [90].

The antidiarrhoeal activity of *M. koenigii* further supports its traditional use in the treatment of dysentery and gastrointestinal disturbances. The presence of tannins and alkaloids is believed to reduce intestinal motility and secretion, thereby alleviating diarrhoeal symptoms. Overall, the wide range of pharmacological activities exhibited by *Murraya koenigii* provides strong scientific support for its traditional medicinal uses. The diverse bioactive constituents present in the plant act synergistically to produce therapeutic effects, making *M. koenigii* a valuable candidate for further pharmacological investigations and drug development [91].

Conclusion

M. koenigii is widely distributed from India, Central and Southeast Asia, Malaysia, South Africa and Reunion Island by immigrants of South Asia and used traditionally as analgesic, anthelmintic, anti-inflammatory, curing piles, itching, leucoderma and blood disorders. A thorough survey of literature reveal that the plant has been explored for their traditional claims in preclinical studies. *Murraya koenigii* holds a great potential to be emerged as chemically potential medicine.

References

[1] N. R. Thythottathil, S. Thattaril, and K.

Manniledam, "Sustainable Green Synthesis of Leaf Extract-Stabilized Silver Nanoparticles: Catalytic, Antimicrobial Properties and Colorimetric Sensing of Hg2+," *Asian J. Chem.*, 2025, doi: 10.14233/ajchem.2025.33253.

[2] S. A. Ali, S. Ali, and S. Shamim, "Role of Artificial Intelligence in Transforming Diagnosis, Treatment, and Patient Care: A Review," *Curr. Pharmacogenomics Person. Med.*, vol. 23, 2025, doi: 10.2174/0118756921404728251019182202.

[3] A. Idris Ali, V. Paul, A. Chattree, R. Prasad, A. Paul, and D. Amiteye, "EVALUATION OF THE USE OF DIFFERENT SOLVENTS FOR PHYTOCHEMICAL CONSTITUENTS AND ANTIOXIDANTS ACTIVITY OF THE LEAVES OF MURRAYA KOENIGII (LINN.) SPRENG. (RUTACEAE)," *PLANT Arch.*, 2021, doi: 10.51470/plantarchives.2021.v21.no1.137.

[4] K. Singh *et al.*, "Emerging Applications and Innovations in Emulgel Technology for Enhanced Topical Drug Delivery," *Drug Deliv. Lett.*, vol. 15, pp. 1–16, 2025, doi: 10.2174/0122103031384904250930153320.

[5] I. Jahan, S. Ali, J. Hak, S. Shamim, M. Kumar, and T. Ali, "Emerging Trends in Magnetic Nanoparticle Delivery, Synthesis and Applications in Biomedicine," *Drug Deliv. Lett.*, vol. 16, pp. 1–17, 2025, doi: 10.2174/0122103031400035251014115919.

[6] P. Muthumani *et al.*, "Pharmacological studies of anticancer, anti inflammatory activities of Murraya koenigii (Linn) Spreng in experimental animals," *J. Pharm. Sci. Res.*, 2009.

[7] T. D. Patil, R. K. Deshmukh, and K. K. Gaikwad, "Microbial Exopolysaccharide-Based Flexible Bioactive Film with Murraya koenigii Berries' Extract for Food Packaging: Physico-Chemical, Microstructural, Antioxidant, and Antimicrobial Properties," *ACS Food Sci. Technol.*, 2025, doi: 10.1021/acsfoodscitech.4c00848.

[8] R. Singh, S. Shamim, S. Ali, R. Kumar, and T. Ali, "A Global Public Health Review of the Mumps Virus: Epidemiology, Pathogenesis, and Advances in Vaccination," *Anti-Infective Agents*, vol. 24, 2025, doi: 10.2174/0122113525412555250922164155.

[9] D. . Bansode and M. . Chavan, "Phytochemical screening and antibacterial activity of curry (Murraya Koenigi) leaf extracts against enteric pathogens," *World J. Pharm. Sci.*, 2014.

[10] M. R. Bhise, V. Trivedi, S. Devi, A. Kumar, T. Jayendra, and K. Sunand, "Graphene Quantum Dots in Cancer Diagnostics and Therapeutics : Advances in Biosensing , Imaging , and Treatment Applications," *Curr. Med. Sci.*, no. 0123456789, 2025, doi: 10.1007/s11596-025-00155-8.

[11] S. V. Jayakumar, S. M. K. Ganesh, A. J. Plant, and S. Res, "The efficacy of aqueous methanolic extract of Murraya koenigi (L.) Spreng in alloxan induced diabetic albino rats," *Pelagia Reserach Libr.*, 2012.

[12] P. Vishvakarma *et al.*, "Nanocarrier Mediated Delivery of Gepotidacin : A Novel Triazaacenaph- thylene Antibiotic Targeting Drug-Resistant Bacterial Infections," *Anti-Infective Agents*, pp. 1–18, 2026, doi: 10.2174/0122113525430497251211145738.

[13] P. Chandel, S. Shamim, and S. Ali, "A Comprehensive Review on Nanoemulsions for Improved Bioavailability and Therapeutic Efficacy in Gastrointestinal Disorders," *Drug Deliv. Lett.*, pp. 1–18, 2021, doi: 10.2174/0122103031410345251205075031.

[14] A. P. Singh *et al.*, "Revolutionizing Drug and Gene Delivery: Cutting-Edge Smart Polymers for Precision Release," *Curr. Gene Ther.*, pp. 1–19, 2025, doi: 10.2174/0115665232390238251121074917.

[15] J. Kumar *et al.*, "CFTR mRNA-Based Gene Therapy for Cystic Fibrosis: A Mutation-Agnostic Strategy to Restore Ion Transport Function," *Curr. Gene Ther.*, pp. 1–18, 2025, doi: 10.2174/0115665232413980251103133741.

[16] H. Sharma, A. P. Singh, D. Pathak, D. Taumar, and V. Chaudhary, "The Role of approved Kinase Inhibitors in Cancer

Treatment : Medicinal Chemistry and Pharmacological Insights," *Med. Chem. (Los. Angeles).*, pp. 1–18, 2025, doi: 10.2174/0115734064404334251024112120.

[17] R. Ahmad *et al.*, "Mechanistic insights into the neuroprotective effects of Radix Astragali (Huang Qi): Bridging Traditional Chinese Medicine and modern pharmacology," *Pharmacol. Res. - Mod. Chinese Med.*, vol. 17, no. July, p. 100711, 2025, doi: 10.1016/j.prmcm.2025.100711.

[18] Rani Khan *et al.*, "Formulation and Characterisation of Herbal Ethosomal Gel of Luliconazole and Clove Oil for Modified Drug Diffusion to the Skin," *World J. Adv. Res. Rev.*, vol. 18, no. 4, pp. 488–501, 2025, doi: 10.1016/j.jaim.2024.100947.

[19] A. Shrivastava *et al.*, "Heart Failure Management in the Modern Era: A Comprehensive Review on Medical and Device-based Interventions," *Curr. Cardiol. Rev.*, vol. 21, no. 6, pp. 1–14, 2025, doi: 10.2174/011573403x338702250226075044.

[20] S. et al. Singh, K., Gupta, J. K., Chanchal, D. K., Khan, S., Varma, A., Shanno, K., Kumar, S., & Shamim, "Deciphering the Genetic Landscape: Exploring the Relationship Between HLA-DQA1, HLA-DQB1, and HLA-DRB1 Genes in Diabetes Mellitus," *Curr. Pharmacogenomics Person. Med.*, vol. 21, no. 3, pp. 1–11, 2024, doi: 10.2174/0118756921310081240821065036.

[21] A. Anand *et al.*, "Neuroprotective Efficacy and Complementary Treatment with Medicinal Herbs: A Comprehensive Review of Recent Therapeutic Approaches in Epilepsy Management," *CNS Neurol. Disord. - Drug Targets*, vol. 24, no. 1, pp. 60–73, 2024, doi: 10.2174/0118715273332140240724093837.

[22] P. Kumar *et al.*, "Fused Deposition Modeling 3D-Printed Scafolds for Bone Tissue.pdf," *Appl. Biochem. Biotechnol.*, vol. 12, no. 22, pp. 1–11, 2024, doi: 10.54085/ap.2023.12.2.19.

[23] S. Chawla, R. Gupta, S. K. Jha, and K. T. Jha, "Stereoisomerism in Chemistry and Drug Development: Optical, Geometrical, and Conformational Isomers," *Med. Chem. (Los. Angeles).*, 2025, doi: 10.2174/0115734064366389250923044201.

[24] A. et al. Kumar, J., M., T., Musayev, "Stimuli-responsive Hydrogels for Targeted Antibiotic Delivery in Bone Tissue Engineering," *AAPS PharmSciTech*, vol. 26, no. 217, pp. 1–23, 2025, doi: https://doi.org/10.1208/s12249-025-03218-0.

[25] S. A. Ali, S. Ali, S. Rastogi, B. Shivhare, and M. Muztaba, "A Comprehensive Review on Advancements in Nanocarriers-Based Peptide Delivery for Cancer Therapeutics," *Micro Nanosyst.*, vol. 17, no. 4, pp. 283–297, 2025, doi: 10.2174/0118764029358553250325040749.

[26] Shamim, S. Ali, T. Ali, H. Sharma, B. N. Kishor, and S. K. Jha, "Recent Advances in Monodisperse Gold Nanoparticle Delivery, Synthesis, and Emerging Applications in Cancer Therapy," *Plasmonics*, no. 0123456789, 2025, doi: 10.1007/s11468-024-02732-4.

[27] M. R. Khan, D. Kumar, S. Shamim, K. Sunand, S. Sharma, and G. Rawat, "Ethnopharmacological relevance of Citrus limon (L.) Burm. f. as adjuvant therapy," *Ann. Phytomedicine An Int. J.*, vol. 12, no. 2, pp. 169–179, 2023, doi: 10.54085/ap.2023.12.2.19.

[28] A. K. Jaiswal *et al.*, "Multi-targeted therapeutic exploration of Tamarix gallica flowers for anti-ulcer activity and associated complications," *J. Ayurveda Integr. Med.*, vol. 15, no. 4, p. 100947, 2024, doi: 10.1016/j.jaim.2024.100947.

[29] T. Ali, "Chromatography and Spectroscopic Characterization of Nano-Carrier Pharmaceuticals," *Pharm. Nanotechnol.*, vol. 14, no. 2, pp. 176–190, 2024, doi: 10.2174/0122117385319695240911115239.

[30] K. Singh *et al.*, "Recent Advances in the Synthesis of Antioxidant Derivatives: Pharmacological Insights for Neurological Disorders," *Curr. Top. Med. Chem.*, vol. 24, no. 22, pp. 1940–1959, 2024, doi:

10.2174/0115680266305736240725052825.

[31] P. Kumar *et al.*, "Trends of Nanobiosensors in Modern Agriculture Systems," *Appl. Biochem. Biotechnol.*, vol. 197, no. 1, pp. 667–690, 2024, doi: 10.1007/s12010-024-05039-6.

[32] K. Singh *et al.*, "Deciphering the Genetic Landscape: Exploring the Relationship Between HLA-DQA1, HLA-DQB1, and HLA-DRB1 Genes in Diabetes Mellitus," *Curr. Pharmacogenomics Person. Med.*, vol. 21, no. 3, pp. 1–11, 2024, doi: 10.2174/0118756921310081240821065036.

[33] Shalini Rana, Suhail Ahmad Mir, Abu Rafee Sohil, and Bhumi Ruhil, "Exploring the Role of Herbal Remedies and Alternative Therapies in Managing Vitiligo: A Comprehensive Review," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 338–347, 2025, doi: 10.63785/cpr.2025.1.3.338347.

[34] H. Rani, Navdeep Singh`, and Anjana Devi, "Targeting Metabolic Liver Disorders with Sodium Orthovanadate: A Novel Therapeutic Strategy," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 274–284, 2025, doi: 10.63785/cpr.2025.1.3.274284.

[35] N. Singh, Abhinoor Jassal, and Harinder Singh, "Navigating the Cellular Maze: Innovative Strategies for Targeted Drug Delivery in Cervical Cancer," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 285–295, 2025, doi: 10.63785/cpr.2025.1.3.285295.

[36] P. Chandel, T. Singh, A. Sharma, F. Sahib, and M. Gobindgarh, "Emerging Biomarkers for Early Detection of Alzheimer ' s Disease : Progress and Challenges," *Curr. Pharm. Des.*, vol. 1, no. 3, pp. 364–372, 2025.

[37] D. Sharma, K. Jeet, A. Devi, V. Sharma, and V. Sharma, "Rutin Nanoparticles : Pioneering New Frontier skincare," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 348–363, 2025.

[38] S. K. Kushwaha, P. Chandel, T. Singh, M. Thakur, and U. Pradesh, "Formulation and Evaluation of a Multicomponent Herbal Shampoo for Enhanced Hair and Scalp Health," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 373–383, 2025.

[39] S. Rana, B. Pratap, P. S. Jadaun, and U. Pradesh, "Development and Evaluation of Liquorice Root Extract-Based Cream for the Management of Hyperpigmentation," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 384–392, 2025.

[40] M. N. Singh, Ummer Farooq, and Sajad Ahmed Gani, "Innovative Nasal Drug Delivery Systems for Effective Brain Targeting and Blood-Brain Barrier Overcoming," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 296–307, 2025, doi: 10.63785/cpr.2025.1.3.296307.

[41] D. Kumar, Rohan Kumar, Harsh Raj Singh, Rajni Tanwar, and Vrinda Gupta, "Duvyzat (Givinostat) in Duchenne Muscular Dystrophy: Mechanisms, Clinical Impact, and Future Directions," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 308–322, 2025, doi: 10.63785/cpr.2025.1.3.308322.

[42] S. Rana, Vipin Kumar, Firoz Khan, and Achla Sharma, "Clinical Aspects, Epidemiology, and Management of Hepatitis Viruses: A Comprehensive Review," *Curr. Pharm. Res.*, vol. 1, no. 3, pp. 323–337, 2025, doi: 10.63785/cpr.2025.1.3.323337.

[43] Murari Kumar Maharaj, Aman Kumar, Tawqeer Shaf, and Shafkat Hussain Malik, "Mouth-Dissolving Films: A Novel Approach for Oral Drug Delivery in Diabetic Management," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 80–87, 2025, doi: 10.63785/cpr.2025.1.2.193199.

[44] Riya Chandel, Firoz Khan, and Taranvirinderdeep Singh, "The Expanding Role of Sphingolipids in Liver Fibrosis and Disease Progression," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 88–104, 2025, doi: 10.63785/cpr.2025.1.2.200214.

[45] Abhishek Kumar Singh and Fayyaz Husain, "Advancements in Endoscopic Techniques: Revolutionizing Patient Care and Surgical Precision," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 53–67, 2025, doi: 10.63785/cpr.2025.1.1.171183.

[46] Shukar Singh, Gursewak Singh, Tawqeer Shafi, and Shafkat Hussain Malik, "Overview

of Peptic Ulcer Disease: Epidemiology, Causes, Pathophysiology, and Clinical Importance," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 68–79, 2025, doi: 10.63785/cpr.2025.1.2.184192.

[47] Imanshu, Mohita Thakur, and Deepika Bhatia, "Gingko biloba Herbal Plant Used for Treating Dementia and Alzheimer's Disease," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 105–115, 2025, doi: 10.63785/cpr.2025.1.2.215224.

[48] Mohita Thakur, "Importance of In-Process Quality Control for Product Safety and Integrity in Pharmaceutical Packaging," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 116–124, 2025, doi: 10.63785/cpr.2025.1.2.225232.

[49] Abhinay Tiwari, Anshu, Chirag Kumar, and Moh. Zaid, "Unravelling the Herbal Formulation of Floating Microspheres for Gut Microbiome Modulation: Current Challenges and Future Prospects," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 144–162, 2025, doi: 10.63785/cpr.2025.1.1.144162.

[50] Manisha Dev and Pallavi Chandel, "Nanostructured Lipid Carriers in Pulmonary Drug Delivery: Progress and Prospects," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 131–143, 2025, doi: 10.63785/cpr.2025.1.1.131143.

[51] Rinki Vishwas, "Peptide-Based Therapeutics in Fungal Infections: Challenges and Innovations," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 98–115, 2025, doi: 10.63785/cpr.2025.1.1.98115.

[52] Shadab Ali and Sayad Ahad Ali, "Hydrogel Nanostructures for Targeted Drug Delivery in Inflammatory Diseases: A Comprehensive Review," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 116–130, 2025, doi: 10.63785/cpr.2025.1.1.116130.

[53] Navdeep Singh and Talit Masood, "Berberine in Breast Cancer Management: Molecular Mechanisms, Therapeutic Applications, and Future Directions," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 29–41, 2025, doi: 10.63785/cpr.2025.1.1.150160.

[54] P. Das, D. Kumar, V. Gupta, S. Gupta, R. Tanwar, and K. Behmani, "Sphingosomes: Advancements and Emerging Applications in Advanced Drug Delivery Systems," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 199–208, 2025, [Online]. Available: https://cpr.org.in/index.php/files/article/view/134/83

[55] Sawood Alam *et al.*, "Overview of the Vital Role of Vitamin D: Functions, Deficiency Syndromes, and Impact Throughout Life," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 1–12, 2025, doi: 10.63785/cpr.2025.1.1.125136.

[56] Shadab Ali, Sayad Ahad Ali, Mukesh Kumar, Iram Jahan, and Jiyaul Hak, "Emerging Strategies for Targeted Drug Delivery across the Blood–Brain Barrier in Neurological Disorder," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 1–14, 2025, doi: 10.63785/cpr.2025.1.1.114.

[57] Shivmohan, Gurpreet Kaur, Shivam Kumar, and Nisha, "Neuroprotective Effects of Seaweeds in Alzheimer's Disease: A Review," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 13–28, 2025, doi: 10.63785/cpr.2025.1.1.137149.

[58] Mukesh Kumar, Shadab Ali, and Smriti Gohri, "Microsponge Drug Delivery Systems: Advancing Methotrexate Delivery for Rheumatoid Arthritis Management," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 15–29, 2025, doi: 10.63785/cpr.2025.1.1.1529.

[59] Robin Singh, "Revolutionizing Antimicrobial Therapies Through Biofilm-Targeted Nanomedicine," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 78–97, 2025, doi: 10.63785/cpr.2025.1.1.7897.

[60] Bhanu Pratap and Pankaj Singh Jadaun, "Hydrogel Microneedles: A Breakthrough in Disease Treatment and Drug Delivery Systems," *Curr. Pharm. Res.*, vol. 1, no. 2, pp. 60–77, 2025, doi: 10.63785/cpr.2025.1.1.6077.

[61] Tarmeen Ali, "Nanomedicine Approaches to Overcome Barriers in Pulmonary Drug Delivery for Respiratory Diseases," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 30–44, 2025, doi: 10.63785/cpr.2025.1.1.3044.

[62] Shadab Ali, Smriti Gohri, Sayad Ahad Ali,

and Mukesh Kumar, "Nanotechnology for Diabetes Management: Transforming Anti-diabetic Drug Delivery Systems," *Curr. Pharm. Res.*, vol. 1, no. 1, pp. 45–59, 2025, doi: 10.63785/cpr.2025.1.1.4559.

[63] M. Sharma, R. Khatri, and S. Kumar, "A Review of Allergic Conjunctivitis , Pathophysiology , Conventional and New Emerging Techniques for Treatments," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 509–523, 2025.

[64] R. Das, N. Bhowmik, P. Debnath, and I. Dhiman, "Herbal Approaches for the Treatment of Hypertension : A Literature Review," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 498–508, 2025.

[65] N. Satheeshkumar *et al.*, "Neurobehavioral and Antioxidant Activity of Crassula ovata Extract in Haloperidol- Induced Alterations in Albino Rats," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 491–497, 2025.

[66] N. Satheeshkumar *et al.*, "In-Vitro Antioxidant Evaluation of Crassula ovata Leaf Extract Using DPPH Radical Scavenging Assay and Phytochemical Profiling," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 486–490, 2025.

[67] F. Khan, T. Singh, N. Singh, S. Husain, and R. B. Yadav, "Metabolic Syndrome : Pathophysiology , Clinical Implications , and Management Strategies," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 473–485, 2025.

[68] R. Kapil, T. Singh, A. Sharma, H. P. Colleges, H. Pradesh, and M. Gobindgarh, "Advances in Asthma Management : From Inflammatory Mechanisms to Clinical Therapies," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 458–472, 2025.

[69] R. R. Mahto *et al.*, "Diabetes and Erectile Dysfunction : Exploring the Ayurvedic Understanding of Madhumehaj Klaibya All India Institute of Ayurveda (AIIA), Government of India , New Delhi - 110076 , India," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 446–457, 2025.

[70] H. Raj *et al.*, "Integrative Oncology : A Comprehensive Comparative Analysis of Herbal and Allopathic Medicine in Cancer Treatment National Forensic Science University , Curti , Ponda , Goa , India," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 427–445, 2025.

[71] I. Antil, S. K. Jha, M. Negi, H. Sharma, and S. K. Tiwari, "Baicalein from Scutellaria baicalensis as Natural Therapeutic Agent for Glioblastoma," *Curr. Pharm. Des.*, vol. 1, no. 4, pp. 411–426, 2025.

[72] K. Jha *et al.*, "Harmonizing Traditional Ayurvedic Knowledge with Modern Science : A Comprehensive Review," *Curr. Pharm. Res.*, vol. 1, no. 4, pp. 393–410, 2025.

[73] A. R. Sahibin *et al.*, "Heavy Metal Uptakes by Curry Leaf Tree (Murraya koenigi) in Ultrabasic Soils from Felda Rokan Barat, Kuala Pilah, Negeri Sembilan, Malaysia," *Sains Malaysiana*, 2013.

[74] A. K. Verma and S. Singh, "Phytochemical analysis and in vitro cytostatic potential of ethnopharmacological important medicinal plants," *Toxicol. Reports*, 2020, doi: 10.1016/j.toxrep.2020.02.016.

[75] N. Gambhire Manoj, R. Juvekar Archana, and S. Sakat Sachin, "Evaluation of anti-inflammatory activity of methanol extract of Murraya Koenigi leaves by in vivo and in vitro methods," *Pharmacologyonline*, 2009.

[76] A. R. Sahibin *et al.*, "Pengambilan logam berat oleh pokok daun kari (murraya koenigi) dalam tanih ultrabes dari felda rokan barat, kuala pilah, negeri sembilan, malaysia," *Sains Malaysiana*, 2013.

[77] R. Jamil, N. N. Nasir, H. Ramli, R. Isha, and N. A. Ismail, "Extraction of essential oil from murraya Koenigii leaves: Potential study for application as natural-based insect repellent," *ARPN J. Eng. Appl. Sci.*, 2016.

[78] I. J. Chibueze, "MURRAYA KOENIGI -A BOON IN DIFFERENT PATHOLOGICAL CONDITIONS," *Univers. J. Pharm. Res.*, 2016, doi: 10.22270/ujpr.v1i2.rw5.

[79] A. R. Sahibin, I. Wan Mohd Razi, L. Tukimat, A. . Jalaludin, H. Azman, and M. I. Nur Diyana, "Heavy metals uptakes by curry leaf tree (Murraya koenigi) in ultrabasic soils

from Felda Bukit Rokan, Kuala Pilah, Negeri Sembilan, Malaysia," *Sains Malaysiana*, 2013.

[80] M. F. Mahomoodally and K. Mooroteea, "A comparative ethno-religious study of traditionally used medicinal plants employed in the management of cardiovascular diseases," *J. Herb. Med.*, 2021, doi: 10.1016/j.hermed.2020.100417.

[81] M. Muhammad, H. T. Daulay, and L. Maulinda, "EKSTRAKSI MINYAK ATSIRI DARI DAUN KARI MENGGUNAKAN OPTIMASI PROSES RESPONSE SURFACE METHODOLOGY (RSM)," *J. Teknol. Kim. Unimal*, 2020, doi: 10.29103/jtku.v9i1.3031.

[82] A. katkale, R. Jadhav, and S. Sonawane, "Formulation and Evaluation of Polyherbal Antidandruff Shampoo," *Res. J. Top. Cosmet. Sci.*, 2024, doi: 10.52711/2321-5844.2024.00011.

[83] M. Farooq *et al.*, "Investigating the therapeutic potential of aqueous extraction of curry plant (Murraya koenigi) leaves supplementation for the regulation of blood glucose level in type 2 diabetes mellitus in female human subjects," *Pak. J. Pharm. Sci.*, 2023.

[84] S. Vishwakarma and M. Gupta, "Formulation and Evaluation of Antifungal Herbal Gel Containing Ethanolic Extract of Senna Alata, Murraya Koenigii and Aloe Vera," *J. Drug Deliv. Ther.*, 2019, doi: 10.22270/jddt.v9i4.3095.

[85] S. A. Deepak, G. Oros, S. G. Sathyanara, H. S. Shetty, and S. Sashikanth, "Antisporulant Activity of Watery Extracts of Plants against Sclerospora graminicola Causing Downy Mildew Disease of Pearl Millet," *Am. J. Agric. Biol. Sci.*, 2007, doi: 10.3844/ajabssp.2007.36.42.

[86] S. Vijayanand and E. G. Wesely, "Phytochemical studies of Melia azadirachta & Murraya koeingi.," *Int. J. Pharm. Sci. Res.*, 2011.

[87] K. T. Yee *et al.*, "Bioactive compounds screening, antimicrobial activities of leave extract from two palatable plants: Piper betle and Murraya koenigii (Curry leaves)," *Res. J. Pharm. Technol.*, 2023, doi: 10.52711/0974-360X.2023.00239.

[88] V. N. Kadali, S. R. Pola, T. Ramesh, and B. V Sandeep, "Anti Diabetic Plants Present In West Godavari District Of Andhra Pradesh India- A Short Review.," *Int. J. Pharma Sci. Res. Anti*, 2016.

[89] S. Rani and M. S. N. L. Amma, "HPLC Quantification and Stability Study of Antilipidemic Polyherbal Formulation," *J. Nat. Remedies*, 2022, doi: 10.18311/jnr/2022/29013.

[90] D. Sandeep *et al.*, "Developing Anti-dandruff Shampoo Formulations using different Indian plant Herbs-An Eco-friendly Hair care Cosmetic," *J. Xi'an Shiyou Univ. Nat. Sci. Ed.*, 2021.

[91] H. R. Gurjar, A. H. Munde, D. T. Bornare, and K. P. Babar, "Effect of drying on curry leaves using different drying methods," *Int. J. Innov. Res. Creat. Technol.*, 2018.

*****