AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 09 (September, 2026)
Available online at http://www.agrimagazine.in

Nature's Green Pharmacy: The Amazing Health Potential of the Curry Leaf

*Saikat Gantait and Jayoti Majumder Sarkar
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal-741252, India
*Corresponding Author's email: saikatgantait@yahoo.com

Eastern Asia is home to the curry leaf tree (*Murraya koenigii* (L.) Spreng), (family: Rutaceae), and its therapeutic benefits are well known in Ayurveda and Unani systems of medicine. It has been shown via methodical investigation and pharmacological assessment that various plant extract components have a variety of pharmacological actions. A number of carbazole alkaloids from fruit, root, bark, and leaf, etc., have been shown to be the main bioactive ingredients in plant extracts, out of a variety of other chemical components. Scientific proof of strong antihyperglycemic properties of these carbazole alkaloids comes from both in vitro and in vivo investigations. In order to analyze information on the recent relevant research outcomes that may give directions to future research, the main purpose of this review is to illustrate the geographical distribution, key botanical and phytochemical characteristics, and research data on pharmacological effects against diabetes. Additionally, this review offers a well-organised synopsis and possible suggestions on previous research.

Introduction: Exploring the Healing Power

Murraya koenigii (L.) Spreng, commonly known as the 'curry leaf' tree, belongs to the Rutaceae family. It is largely distributed in the tropical and subtropical zones of the world. The importance of curry leaf is attributed to its wide range of traditional medicinal properties. In the Ayurveda literature, this tree found its significance and was registered as "krishnanimba". A number of biological activities are reported to be stimulated by almost all the parts of this tree, i.e., fruit, root, bark, and leaf, etc. Leaves of this tree harbor a number of aromatic compounds, and even after drying of leaves, the flavor and other qualities remain preserved. The leaves of this tree are weakly acidic, taste somewhat bitter, and smell pungent. Indian culinary system utilizes its leaves as an appetizer, digestives, and analgesic (Bhandari, 2012). Traditionally, the raw leaves are utilized for the treatment of oedema, bruises, dysentery, fresh cuts, itching, inflammation, and piles. Roots are marginally purgative and are utilized to reduce regular body aches, whereas the bark revealed its potential during the treatment of snakebites. Curry leaf-derived essential oil (EO) is described to have nephroprotective, hepatoprotective, antimicrobial, anti-inflammatory, and anti-oxidative activities. An array of carbazole alkaloids, including several other phenolics, flavonoids, terpenoids, and secondary metabolites, along with multiple vitamins, carotenoids, and nicotinic acid from leaf, root, bark, fruit, etc., contributes to the well-known medicinal uses of this tree. Likewise, the grounded leaf and the extracted EO are commonly used for flavoring ready-to-eat and cooked food items. Traditionally, the EO is applied as perfume as well. Steamed green leaves and coconut oil blend serve as a special hair vitalizer to improve hair growth and maintain a standard tone. The leaves are also used in the traditional medicine system as antidepressant, antifungal, antidiarrheal, and blood-purifying agents. Different parts of this tree have the potential to be used as tonics to improve the digestive system and can be used as a thirst quencher, body heat reducer, and remedy for piles, dysentery, leukoderma, and blood disorders, apart from inflammation and itching reduction, etc. (Balakrishnan *et al*., 2020).

The use of curry leaf in home remedies and traditional medicines has received more attention in recent years. However, there aren't many studies assessing the pharmacological and therapeutic effectiveness of this tree in providing health advantages against diabetes. In order to provide information about the current reports that can guide future research, this review examines the traditional medicinal use of curry leaf and its bioactive compounds, emphasising their pharmacological effects against diabetes. It also presents a well-organized summary and potential recommendations on reported research outcomes. Our hypothesis is that the current overview, which focused on distribution, description, phytochemistry, and antihyperglycemic effects, may lead to clearer future views.

Origin and distribution: From World Heritage to Kitchen Spice

Although curry leaf is commonly grown across South-East Asia, as well as in certain regions of the US and Australia, it is native to eastern and southern India, Pakistan, Sri Lanka, China, and Hainan. Despite being indigenous to the Indian subcontinent, this tree was brought to other parts of the globe (Fig. 1) by Indian migrants, and it is now found in places like Réunion Island, South Africa, and Malaysia (Singh *et al*., 2014). This tree is 500–1600 meters tall and found in the wet forests of Asia, particularly in S. Hainan, Guangdong, Xishuangbanna, Vietnam, Thailand, Laos, Bhutan, Nepal, and Sri Lanka. It grows throughout the Andaman Islands and all across India, reaching elevations of 1500–1655 m above sea level. The leaves, which are widely grown, are especially connected to South Indian dishes. With the exception of the higher regions of the Himalayas, such as the Western Ghats, Assam, Sikkim, etc., curry leaf trees have been acclimatized in forests and wasteland throughout the Indian subcontinent.

Botanical description: Unlocking the Plant Architype

Curry leaf is a small tree or shrub (Fig. 2A), which usually reaches a height of 2.5–6 m. This tree has luxuriant leaves and a short, greyish or brown stem (with grey bark) that is 15–40 cm in diameter. The compound leaves, which have a unique scent, are bipinnately arranged (Fig. 2B) and are 15–30 cm in length. On the rachis, there are 11–25 leaflets, each of which is 2–4 cm long and 1–2 cm wide (Fig. 2C). The bisexual flowers are tiny, white, stalked, funnel-shaped, cyme-terminal, ebracteate, regular, actinomorphic, pentamerous, hypogynous, and include around 60-90 flowers with an inflorescence diameter of 1.12 cm when completely opened. They are also pleasantly scented and complete. The calyx is persistent, inferior, green, and has five lobes; the corolla is white, polypetalous, inferior, and has five lanceolate petals (5 mm long); the androecium is polyandrous, inferior, and has ten stamens that are dorsifixed and arranged in circles of five each; the gynoecium is 5—6 mm long; the stigma is bright and sticky; the style is short; and the ovary is superior. The oblong to sub-globose fruits (Fig. 2D), which range in size from 32 to 80 and have a diameter of 1.0–1.2 cm and a length of 1.4–1.6 cm, are wrinkled with Wistaria blue flesh that becomes purplish-black (Fig. 2E) when mature. The spinach-green seeds (Fig. 2F) weigh around 445 mg and measure about 11 mm long and 8 mm in diameter. Large cruciferous stomata, parenchymatous pith in the petiole, long pericyclic fibre in the midrib, unicellular trichomes with obliterated lumen, and prismatic calcium oxalate crystals are all seen in curry leaves (Debosree *et al*., 2012). There are concentric grains of parenchyma; phelloderm fibres are missing, and the root exhibits a tetrarch to pentarchy stele. This tree thrives in red sandy loam soil with temperatures between 26 and 37 °C on average. The leaves may be picked every two to three months, with a mean yield of 20 to 25 tonnes/ha, and fruiting occurs from July to August.

Phytochemistry: Healing Secrets of the Curry Leaf

A wide array of bioactive compounds has been isolated from various parts of the curry leaf tree, including the leaves, roots, and stem bark. Extracts from the leaves, stem bark, roots, and fruits of curry leaf have yielded diverse classes of phytochemicals such as polyphenols, terpenoids, alkaloids, and flavonoids. Among the crude components, the leaves are abundant in substantial amounts of proximate nutrients. The composition includes 39.4% carbohydrates, 6.15% fat, 63.2% moisture, 8.8% protein, 18.92% total sugars, 1.15% total nitrogen, 14.6% starch, and 6.8% crude fibre (Balakrishnan *et al*., 2020). The leaves serve as the primary reservoir of active ingredients in the plant. They have been reported as a significant source of various essential vitamins and minerals. Notably, the leaves contain vitamin A (β-carotene) at 6.04 ± 0.02 mg/100 g, vitamin B3 (niacin) at 2.73 ± 0.02 mg/100 g, and vitamin B1 (thiamin) at 0.89 ± 0.01 mg/100 g. In terms of mineral content, the leaves provide calcium (19.73 ± 0.02 mg/100 g), magnesium (49.06 ± 0.02 mg/100 g), and sodium (16.50 ± 0.21 mg/100 g) (Bhandari, 2012). Leaves are the major home of different flavonoids like Apigenin, Catechin, Kaempferol, Myricetin, Quercetin, Rutin, 1-propanone, 4-*O*-β-d-Rutinosyl-3-methoxyphenyl, 8-Phenylethyl-*O*-β-d-rutinoside, 1-*O*-β-d-Rutinosyl-2(*R*)-ethyl-1-pentanol (Balakrishnan *et al*., 2020).

Like any other plant species, curry leaf produces a wide array of bioactive compounds, known as secondary metabolites, primarily as a defence strategy against environmental stresses and pathogenic threats. Importantly, they have been widely recognized for their pharmacological potential in humans and animals. Based on their biosynthetic pathways and structural characteristics, secondary metabolites are generally sorted into three major groups: alkaloids, phenolic compounds, and terpenes.

This subtropical shrub is renowned for its high concentration of carbazole alkaloids, along with a complex blend of other therapeutically potent phytochemicals. The earliest discovery of a carbazole alkaloid in curry leaf was made by Chakraborty *et al.* (1965), who isolated and characterized murrayanine from the bark of the plant. Subsequent studies led to the identification of several major carbazole alkaloids (Fig. 3) from the leaves of curry leaf tree, including mahanimbine, mahanin, and murrayanol as was found. A few years later, additional novel carbazole alkaloids were identified, including biskoenigine, which was isolated from the leaves of curry leaf tree. Tan *et al*. (2015) also reported six novel carbazole alkaloids from bark and leaves of curry leaf tree, namely, murrayatanine-A, bismahanimboline, murrastinine-B, murrastinine-C, murrastanine-A, and murrastinine-A. Next year, four additional carbazole alkaloids were identified and reported, viz. murrayakonine-A, murrayakonine-C, murrayakonine-B, and murrayakonine-D. Among them, Murrayakonine-A and -B were extracted from the stem, whereas murrayakonine-C and -D were obtained from the leaves of the curry leaf tree. To date, a total of 77 distinct carbazole alkaloids have been identified from different parts of the curry leaf, many of which have recently been highlighted for their impending therapeutic uses.

Antihyperglycemic properties: Science Behind Controlling Blood Sugar

Diabetes mellitus is a globally prevalent metabolic disorder, frequently associated with serious complications such as nephropathy, atherosclerosis, and retinopathy. The pathogenesis of diabetes involves a complex interplay of metabolic disruptions that ultimately result in persistent hyperglycemia—often due to impaired insulin action, reduced insulin secretion, or both. The inability of the body to efficiently regulate glucose leads to long-term damage and dysfunction in multiple organ systems.

One of the lesser-known complications of diabetes is its impact on the central nervous system, which is mediated by lipid dysregulation. Dysregulated lipid metabolism in diabetic patients alters the functioning of peroxisome proliferator-activated receptors (PPARs), key nuclear receptors involved in maintaining metabolic homeostasis (Iid *et al*., 2020). Their impaired activity contributes to insulin resistance and chronic inflammation. Additionally, glucose auto-oxidation is another metabolic pathway implicated in hyperglycemia. It triggers non-enzymatic glycation of proteins, nucleic acids, and lipids, leading to the generation of reactive oxygen species, oxidative stress, and subsequent cellular damage. The leaf extract of the curry leaf tree exhibited stronger α-amylase inhibitory activity than that of *Aegle marmelos*, highlighting its promising potential in managing postprandial hyperglycemia and contributing to diabetes resistance (Sangilimuthu *et al*., 2020). Given the multifaceted pathophysiology of diabetes, there has been growing interest in plant-based therapeutics, particularly those offering antioxidant, insulin-mimetic, and enzyme-inhibitory effects. Curry leaf, a commonly used culinary tree in South and Southeast Asia, has emerged as a promising candidate due to its rich composition of bioactive compounds, notably carbazole alkaloids, flavonoids, and coumarins.

Several studies have highlighted the antidiabetic potential of alkaloids isolated from curry leaf. These phytochemicals exhibit inhibitory effects on aldose reductase—an enzyme implicated in diabetic complications—as well as modulate key enzymes involved in glucose metabolism. Moreover, curry leaf has demonstrated strong α-glucosidase inhibitory activity. Inhibition of this enzyme delays carbohydrate breakdown and glucose absorption, effectively controlling postprandial blood sugar spikes, which is especially beneficial for type 2 diabetic patients. Ethanolic extracts of curry leaf have demonstrated significant hypoglycemic effects in animal studies. The extract was found to reduce malondialdehyde levels, a marker of oxidative stress, while elevating glutathione levels and decreasing the HOMA-IR (homeostatic model assessment for insulin resistance) index. These findings support the role of curry leaves in improving insulin sensitivity and countering oxidative stress in rats. Among the bioactive constituents, carbazole alkaloids like koenimbin and mahanimbine have been shown to enhance peripheral glucose uptake, indicating their influence on insulin-mimetic pathways. In addition to alkaloids, phenolic compounds such as coumarins play a pivotal role. Umbelliferone and osthole, for example, have been widely studied for their antidiabetic mechanisms. Umbelliferone has been shown to upregulate the expression of PPARγ and the glucose transporter GLUT4 in adipose tissues, thereby increasing insulin sensitivity and peripheral glucose uptake. Osthole, similarly, activates PPARγ and facilitates lipid metabolism, further supporting glycemic balance. These compounds also enhance the biosynthesis of endogenous antioxidants like superoxide dismutase (SOD) and glutathione, improving cellular resilience to oxidative stress. Interestingly, umbelliferone has also demonstrated the ability to reduce hydroxyproline levels, which may be linked to decreased production of misfolded collagen—a contributing factor in diabetic nephropathy. This suggests that coumarins may offer protective effects beyond glycemic control, addressing long-term diabetic complications. Culturally and traditionally, curry leaf has been an integral part of Ayurvedic and Siddha medicine, where it is not only valued for its flavor but also for its role in managing lifestyle disorders. Modern pharmacological research supports these claims with scientific evidence. Mahanimbine, one of the most abundant carbazole alkaloids in curry leaves, has demonstrated significant antidiabetic activity. Studies have observed differential responses based on diabetes severity. A clinical trial on humans was conducted in the rural region of Medavakkam, Chennai (India), to evaluate the efficacy of curry leaf powder in managing blood glucose levels among 60 type II diabetic patients, with 30 participants each in the experimental and control groups. The intervention involved administering 10 g of leaf powder daily for 14 days alongside regular meals. Results demonstrated a significant reduction in both pre- and post-prandial blood glucose levels in the experimental group compared to baseline. Similarly, another clinical study reported a statistically significant improvement ($p < 0.05$) in average fasting and post-prandial blood glucose levels following the administration of leaf powder of curry leaf tree among diabetic patients.

In other animals, such as streptozotocin-induced diabetic Wistar rats, oral administration of mahanimbine at doses of 50 mg/kg and 100 mg/kg led to a marked reduction in blood glucose levels. This compound appears to stimulate insulin secretion from β-cells and promote glucose uptake in peripheral tissues, alongside inhibiting digestive enzymes like α-amylase. The aqueous extracts of curry leaves administered at a dose of 300 mg/kg resulted in a 27.96% reduction in blood glucose levels in mildly diabetic rabbits, with efficacy comparable to the standard drug tolbutamide. These findings support the potential of curry leaves as a natural alternative for blood glucose control, particularly in early or mild stages of diabetes. Despite the rich phytochemical profile of curry leaf, only a handful of compounds have undergone thorough pharmacological scrutiny. In a study integrating both in vitro assays (L6-GLUT4myc myotubes) and in vivo models (streptozotocin-induced rats), six major carbazole alkaloids—murrayazoline, koenidine, mahanimbine, koenimbine A, O-methylmurrayamine, and koenidine—were evaluated. Among these, koenidine showed the most promise in enhancing insulin sensitivity and mitigating insulin resistance. These effects were attributed to the presence of carbazole alkaloids, particularly koenidine (Aba and Asuzu, 2018). Thakur *et al*. (2024) reported that an alkaloid-enriched fraction (AEF) derived from curry leaf exhibited notable anti-obesogenic activity. Complementing these findings, Husna *et al*. (2022) observed significant alterations in hepatic enzyme activities in diabetic rats treated with curry leaf. Specifically, there was a decrease in the activities of hexokinase and glucose-6-phosphate dehydrogenase, alongside an increase in glucose-6-phosphatase and phosphoenolpyruvate carboxykinase-1. These enzymatic modulations suggest a potential role for curry leaf in improving glucose homeostasis and reducing the risk of diabetes. From a functional food perspective, the therapeutic value of curry leaf extends beyond its pharmacological potential. Its affordability, wide availability, and culinary versatility make it an attractive candidate for nutraceutical development. As more compounds are identified and their mechanisms elucidated, the integration of curry leaf into tailored dietary regimens could serve as a cost-effective strategy for managing diabetes and its complications.

Conclusion and outlook

Curry leaf exhibits therapeutic properties that support its role as a valuable dietary adjunct in diabetes management. The therapeutic efficacy of the shrub is largely due to its diverse phytonutrient composition, which substantiates its potential as a cost-effective and potent nutraceutical agent. Over the past decade, extensive research has highlighted the therapeutic potential of different parts of the curry leaf tree as functional food components for managing diabetes. This growing body of evidence has sparked increased scientific interest and consumer use of the shrub, a trend that is expected to continue expanding in the coming years. However, to enhance its acceptance as a commercial therapeutic agent, it is essential to identify specific functional phytoactive compounds and determine their minimum effective doses for targeting diabetic disorders through well-designed clinical studies and comprehensive documentation. This review opens avenues for both scientific research and product development to design targeted herbal food formulations with improved nutritional profiles, functional efficacy, and cost-effectiveness. In light of curry leaf's potential as both a popular flavoring agent and a source of valuable functional compounds, the present review has been compiled to provide a comprehensive overview of its culinary and therapeutic significance. It highlights the role of key phytonutrients in modulating metabolic pathways for overall health management and outlines future research directions for scientific advancement in this domain.

Fig. 1. Geographical distribution of *Murraya koenigii* (L.) Sprengel around the globe (*Source*: https://www.gbif.org)

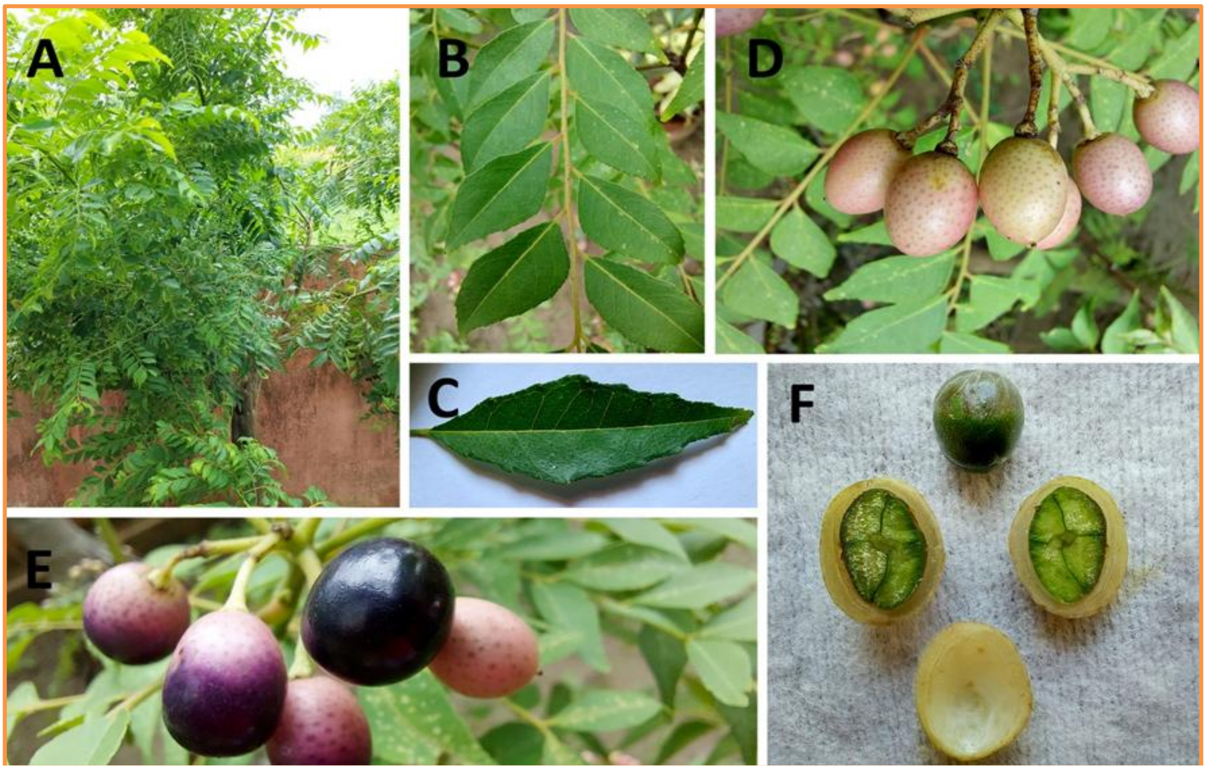

Fig. 2. Salient botanical traits of *Murraya koenigii* (L.) Sprengel. A. full-grown tree, B. leaf morphology, C. leaflet morphology, D. fruit formation, E. fruit maturation, F. fruit and seed morphology, shape, and color (Source: unpublished photographs of Saikat Gantait)

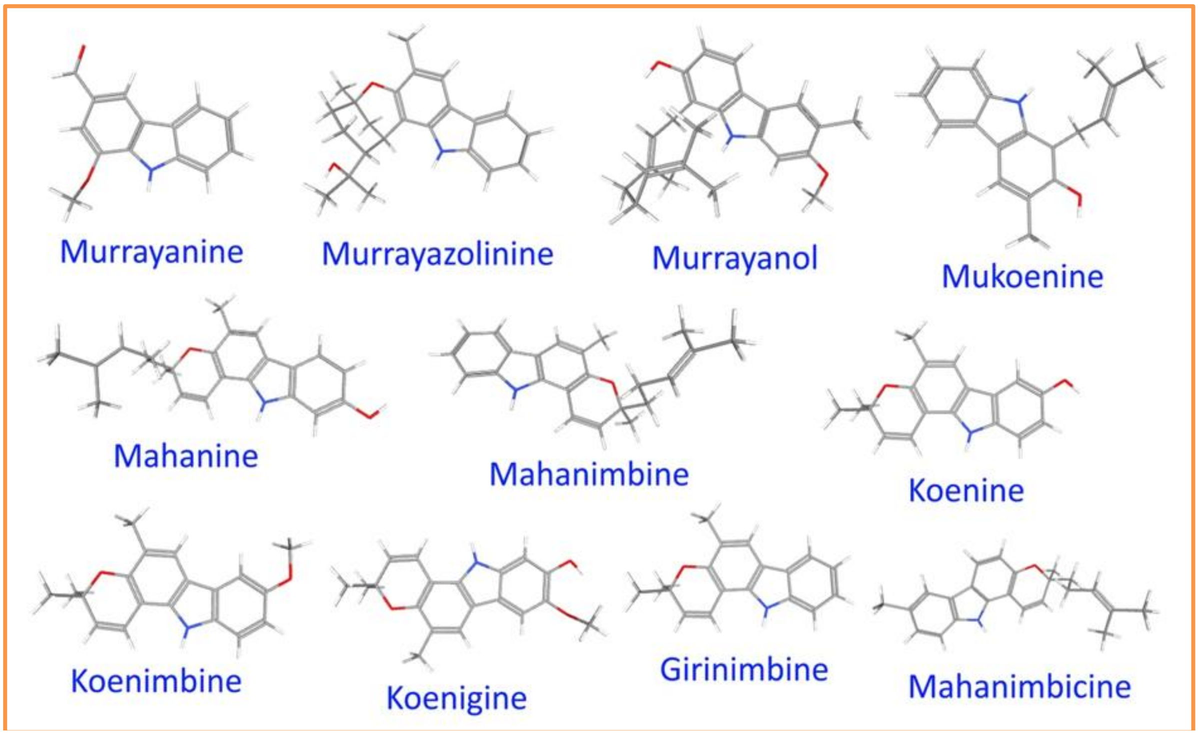

Fig. 3. Some of the key phytochemicals found in different parts of *Murraya koenigii* (L.) Sprengel. known for their antihyperglycemic properties (Structure source: https://pubchem.ncbi.nlm.nih.gov/)

References

1. Aba, P.E., & Asuzu, I.U. (2018). Mechanisms of actions of some bioactive antidiabetic principles from phytochemicals of medicinal plants: A review. Indian Journal of Natural Products and Resources, 9, 85–96.
2. Balakrishnan, R., Vijayraja, D., Jo, S.H., Ganesan, P., Su-Kim, I., & Choi, D.K. (2020). Medicinal profile, phytochemistry, and pharmacological activities of *Murraya koenigii* and its primary bioactive compounds. Antioxidants, 9, 101. https://doi.org/10.3390/antiox9020101

3. Bhandari, P. (2012). Curry leaf (*Murraya koenigii*) or cure leaf: Review of its curative properties. Journal of Medical and Nutraceuticals, 2, 92–97.
4. Husna, F., Suyatna, F.D., Arozal, W., Purwaningsih, E.H., Hanafi, M., Razali, R., & Asrizal, C.W. (2022). Murraya koenigii extract improving rate-limiting enzymes on carbohydrate metabolism and GLUT-4 expression of hyperglycemic rats. Journal of Applied Pharmaceutical Science, 12, 143–149. https://doi.org/10.7324/JAPS.2022.121215
5. Iid, I.I., Kumar, S., Shukla, S., Kumar, V., & Sharma, R. (2020). Putative antidiabetic herbal food ingredients: Nutra/functional properties, bioavailability and effect on metabolic pathways. Trends in Food Science & Technology, 97, 317–340. https://doi.org/10.1016/j.tifs.2020.01.017
6. Sangilimuthu, A.Y., Sivaraman, T., Chandrasekaran, R., Sundaram, K.M., & Ekambaram, G. (2020). Screening chemical inhibitors for alpha-amylase from leaf extracts of Murraya koenigii (Linn.) and Aegle marmelos L. Journal of Complementary and Integrative Medicine, 18, 51–57. https://doi.org/10.1515/jcim-2019-0345
7. Singh, S., More, P.K., & Mohan, S.M. (2014). Curry leaves (Murraya koenigii Linn. Sprengal)—A miracle plant. Indian Journal of Scientific Research, 4, 46–52.
8. Tan, S.P., Ali, A.M., Nafiah, M.A., Awang, K., & Ahmad, K. (2015). Isolation and cytotoxic investigation of new carbazole alkaloids from Murraya koenigii (Linn.) Spreng. Tetrahedron, 71, 3946–3953. https://doi.org/10.1016/j.tet.2015.04.041
9. Thakur, M.S., Deshmukh, K.N., Dey, A., Ranjan, D., Goyal, A., & Jachak, S.M. (2024). An alkaloid enriched fraction from Murraya koenigii (L.) Spreng. leaves ameliorate HFD-induced obesity and metabolic complexities in C57BL/6J mice. Journal of Ethnopharmacology, 333, 118423. https://doi.org/10.1016/j.jep.2024.118423