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Review Article

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A Review on some Medicinal Plants of North Eastern Terai Region of Uttar Pradesh

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Abstract

The North Eastern Terai region of Uttar Pradesh, India, is a significant reservoir of medicinal plants long utilized by indigenous communities. This review provides a comprehensive overview of the region's prominent medicinal flora, detailing their traditional uses, phytochemical composition, pharmacological activities, and therapeutic applications. It underscores the ecological importance of the region as a biodiversity hotspot and the crucial role of local knowledge systems in preserving and utilizing these plants. Key species like *Tinospora cordifolia*, *Centella asiatica*, *Curcuma longa*, *Ocimum tenuiflorum*, and *Withania somnifera* are discussed alongside their traditional uses in Ayurveda, Unani, and folk medicine. The phytochemical analysis reveals bioactive compounds like alkaloids, flavonoids, terpenoids, and polyphenols, which confer medicinal and nutraceutical properties. Scientific studies highlight their antioxidant, anti-inflammatory, antimicrobial, anti-diabetic, and neuroprotective effects, bridging traditional and modern healthcare practices. The review stresses the importance of scientifically validating traditional knowledge and implementing sustainable conservation measures to safeguard biodiversity and ensure the availability of these plants for future generations. Integrating traditional medicine with modern scientific approaches is emphasized for drug development and responsible resource management, highlighting the interconnectedness of natural resources and healthcare. Overall, the review serves as a valuable resource for understanding and harnessing the therapeutic potential of the region's medicinal plants while advocating for their conservation and responsible utilization.

Keywords: Medicinal plants, Nutraceuticals, Traditional knowledge, Phytochemicals, Pharmacological potential.

Introduction

The North Eastern Terai region of Uttar Pradesh, India is renowned for its rich biodiversity, encompassing diverse Ecosystems spanning from dense forests to fertile plains[1]. Within this ecological tapestry lie hidden treasures of medicinal plants which have been integral to the traditional healthcare practices of indigenous communities for centuries. The unique blend of climatic conditions, soil types, and topographical features of this region fosters the growth of a wide array of flora, many of which possess potent medicinal properties[2]. Throughout history, traditional healers, also known as Vaidyas or Hakims, have relied upon the abundant flora of the Terai region to alleviate ailments ranging from common colds to chronic diseases. However, with the rapid modernization and globalization of healthcare practices, traditional knowledge systems are facing the threat of erosion[3].

Consequently, there is an urgent need to document, preserve, and validate the traditional uses of medicinal plants through scientific research. Moreover, the burgeoning interest in natural remedies and the resurgence of traditional medicine systems worldwide underscore the importance of studying the medicinal plants of this region. Their potential to serve as sources of novel pharmacological compounds or lead molecules for drug development presents exciting opportunities for both the pharmaceutical industry and the broader scientific community[4].

This review aims to extensively explore the indigenous medicinal plants found in the North Eastern Terai region of Uttar Pradesh. By synthesizing existing literature and empirical studies, we seek to shed light on the diversity, distribution, and therapeutic potentials of these botanical resources. Understanding the medicinal flora of this region is not only crucial for conservation efforts but also holds immense promise for drug discovery and healthcare innovations.

Medicinal properties of Plants

***Allium sativum* L.,** garlic, is renowned for its potent medicinal properties (Fig.19) that have been valued for centuries. Its active compound allicin has antimicrobial properties aiding in combating infections and boosting the immune system. Garlic is also linked to cardiovascular health as it may help lower blood pressure and cholesterol levels. Its antioxidant properties offer protection against oxidative stress, potentially reducing the risk of chronic diseases. Incorporating garlic into the diet may contribute to overall well-being and longevity[5].

***Artocarpus heterophyllus* Lam.,** commonly known as jackfruit, offers various medicinal benefits. Its leaves and roots are traditionally utilized to cure skin diseases and wounds due to their antimicrobial properties. Jackfruit also contains compounds with antioxidant properties to neutralize harmful free radicals in the body. Additionally, it is rich in dietary fiber and vitamins contributing to digestive health and overall well-being. Furthermore, research suggests that jackfruit extracts possess anti-inflammatory and hypoglycemic effects making it potentially beneficial for managing conditions like diabetes and inflammation. However, further studies are needed to fully understand its medicinal potential[6].

***Azadirachta indica* A. Juss.,** Neem, is renowned for its extensive medicinal properties deeply rooted in traditional Ayurvedic medicine. Its leaves contain compounds with potent antibacterial and antifungal properties making it valuable in treating various skin conditions such as acne and eczema. Neem also exhibits anti-inflammatory effects, potentially easing conditions like arthritis and gingivitis. Its use in oral hygiene products is attributed to its ability to combat plaque and bacteria. With its broad spectrum of medicinal benefits, A. indica remains a cornerstone in natural healthcare practices[7].

***Bixa orellana* L.,** commonly known as ‘annatto, achiote or ‘Lipstick Tree’, holds medicinal significance beyond its culinary uses (fig. 9). Its seeds contain compounds with anti-inflammatory properties, potentially aiding in relieving pain and swelling. Additionally, its antioxidant properties may contribute to overall health by combating oxidative stress. Some traditional medicinal practices suggest its use in treating gastrointestinal issues and promoting digestion[8].

***Butea monosperma* (Lam.) Kuntze,** popularly known as the ‘flame of the forest’, harbors potent medicinal properties. Its extracts are renowned for antidiabetic, anti-inflammatory,

antimicrobial and many more qualities offering relief from various ailments such as arthritis and rheumatism. Rich in antioxidants, it aids in detoxification and promotes overall well-being. Traditional medicine utilizes its bark and seeds for their antimicrobial properties, combating infections effectively[9].

***Calotropis procera* (Aiton) Dryand.,** "giant milkweed", boasts a plethora of medicinal applications. Its latex, which has potent antifungal properties, is employed in indigenous healing practices to address skin conditions. The plant's extracts have been investigated for their potential in managing conditions like rheumatism and arthritis owing to their anti-inflammatory effects. Furthermore, *C. procera* is valued for its ability to aid in wound healing and alleviate pain. However, caution is advised as certain parts of the plant can be toxic if ingested[10].

***Cannabis sativa* L.,** is employed medicinally due to its capacity to relieve chronic pain, neutralize inflammation, and manage symptoms associated with certain neurological disorders like epilepsy. Its compounds, including THC and CBD, show promise in relieving nausea, stimulating appetite, and easing muscle spasms. Additionally, cannabis extracts have investigated for their potential in treating mental health conditions such as anxiety and depression[11].

***Catharanthus roseus* L. (G.) Don,** commonly known as 'Madagascar periwinkle', possesses remarkable medicinal properties (Fig. 2). Its alkaloids, vincristine and vinblastine, are potent anti-cancer agents used in chemotherapy treatments for leukemia and other cancers. Additionally, extracts from *C. roseus* exhibit anti-diabetic properties, aiding in the management of blood sugar levels. Traditional medicine also utilizes this plant for its anti-hypertensive and anti-inflammatory effects, contributing to its widespread therapeutic significance[12].

***Centella asiatica* (L.) Urb.,** "Brahmi", has a rich history in ancient healing practices due to its diverse medicinal properties. It is revered for its capacity to enhance cognitive function and memory retention. Additionally, *C. asiatica* is utilized to promote wound healing and alleviate symptoms of skin conditions such as psoriasis and eczema. Its adaptogenic properties contribute to stress reduction and anxiety management. However, pregnant or nursing women should consult healthcare professionals before using it due to potential side effects[13].

***Clerodendrum infortunatum* L.,** known as "Hill glory bower," holds a rich history in folk remedies (Fig. 17). Its leaves are utilized for treating respiratory ailments like bronchitis, asthma etc. The plant's anti-inflammatory properties are harnessed to reduce pain and swelling. Additionally, it is esteemed for its efficacy in managing skin disorders such as eczema and dermatitis. However, caution is advised due to potential toxicity in large doses[14].

***Colebrookea oppositifolia* Sm.,** known as 'Indian squirrel tail' in fig. 4, exhibits remarkable medicinal properties. Alternative healing practices utilize its extracts for antimicrobial, analgesic and anti-inflammatory effects, giving relief from various ailments. Rich in antioxidant biomolecules it aids in scavenging free radicals, promoting overall health and well-being. It shows potential in managing respiratory conditions, making it valuable in treating coughs and asthma. The varied pharmacological actions highlight its importance as a promising subject for further pharmaceutical research[15].

***Curculigo orchioides* Gaertn.,** 'Kali Musli', has a rich history in ethnomedicine for its diverse medicinal properties (Fig.18). It is esteemed for its potential as an aphrodisiac, believed to enhance libido and sexual performance. Additionally, it contains compounds that exhibit adaptogenic qualities, aiding in stress

management and overall vitality. Some studies suggest its potential in supporting male

reproductive health by improving sperm count and motility[16]. Two novel phenolic glucosides curculigoside J and curculigoside K were obtained from the methanolic root extract of *C. orchioides*. Evaluation of their cytotoxicity along with seven other isolated compounds revealed moderate inhibition (IC_{50} values of 50.0 to 94.4 µM) against HepG2 (hepatocellular cancer) and MCF7 (human breast cancer) cell lines[17].

***Curcuma longa* L.,** known as turmeric (Fig. 13), is renowned for its potent medicinal properties. Its active compound, curcumin, is a powerful anti-inflammatory and antioxidant biomolecule offering relief from various inflammatory conditions. Turmeric has been traditionally used to aid digestion and alleviate digestive issues such as indigestion and bloating. It also exhibits antimicrobial properties preventing infections and promoting overall immune health. Its therapeutic potential extends to support liver function and cardiovascular health making it a versatile and valuable herb in natural medicine[18].

***Cynodon dactylon* (L.) Pears.,** Doob grass or Bermuda grass, holds several medicinal properties. It is applied in folk medicine for its antidiabetic and anti-inflammatory activities aiding in pain relief. Additionally, it exhibits antipyretic properties making it useful for reducing fever. Bermuda grass also shows potential in promoting wound healing and managing gastrointestinal issues due to its astringent properties. However, caution is advised as excessive consumption may lead to adverse effects[19].

***Dalbergia sissoo* Roxb. ex DC.,** Indian rosewood, has a rich history of its use in various folkloric systems for healing human ailments. Every plant part boasts medicinal properties rendering it highly valuable in traditional medicine. Research has highlighted its diverse therapeutic potentials including antidiabetic, antioxidant, analgesic, antipyretic, anti-termite, anti-spermatogenic, anti-inflammatory, anthelmintic, antidiarrhoeal, molluscicidal, antinociceptive, neuroprotective, and osteogenic activities. These findings underscore the plant's significance in addressing a wide range of health issues making it a valuable asset in natural medicine[20].

***Datura stramonium* L.,** the Jimson weed, possesses various medicinal properties. It is traditionally used to alleviate asthma symptoms due to its bronchodilator effects. Additionally, it exhibits analgesic properties making it useful for pain relief. *D. stramonium* also contains compounds with antispasmodic properties making it beneficial for treating muscle spasms and gastrointestinal disorders. However, its potency requires caution in usage due to potential toxic effects. It has been investigated for its capacity in treating certain neurological conditions like Parkinson's disease[21].

***Desmostachya bipinnata* (L.) Stapf,** commonly called "kush grass", has been employed in ethnomedicine for various purposes. Its roots are utilized to treat urinary disorders and mitigate symptoms of dysuria. The plant's aerial parts are used in antidiabetic potentials supporting management of blood sugar levels. Additionally, it is known to possess antimicrobial properties contributing to its use in treating infections[22].

***Dioscorea bulbifera* L.,** or ‘air potatoes’, offers various medicinal benefits (fig. 6). It is ethnomedicinally used in folk medicine to treat gastrointestinal disorders like dysentery, diarrhoea etc. showing its antidiarrheal properties. *D. bulbifera* also demonstrates anti-inflammatory properties making it beneficial for alleviating pain and swelling. Furthermore, it has been researched for its capacity in managing diabetes, and its extracts showed hypoglycemic

activity. However, proper dosage and caution are necessary to avoid potential toxic effects[23]. The ethanolic extract, its ethyl acetate fraction and isolated compound diosbulbin B from D. bulbifera exhibited significant anti-tumor effects *in vivo*, particularly in reducing tumor weight and impacting immune parameters suggesting their potential as anti-tumor agents. Furthermore, diosbulbin B served as the notable bioactive component responsible for these effects[24]. Another study examined *D. bulbifera* tuber methanolic extracts showed antidiabetic effects across 30%, 50%, and 70% methanol concentrations, finding the 70% metanolic extract most potent due to its higher saponin content outperforming metformin at 200 mg/kg in treating hyperglycemia induced by alloxan in mice[25].

***Diospyros melanoxylon* Roxb.,** [Tenduphal or Tenua (fig. 7)], holds several medicinal properties. In traditional medicine, it is employed for its ability to tighten tissues and reduce inflammation, assisting in wound recovery and relieving diarrhea. Ebony is also esteemed for its antimicrobial attributes and making it beneficial in managing infections. Its leaves possess ursolic acid which showed antimicrobial effects against Staphylococcus aureus (Zone of inhibition 20.5 ± 0.15 mm) and Enterococcus faecalis (zone of inhibition 18.7 ± 0.34 mm) and some fungal strains. Its leaves are rich source of ursolic acid (0.625 %). Additionally, it shows potential in regulating diabetes due to its hypoglycemic activity. However, cautious use is advised as excessive consumption may lead to adverse effects[26,27].

***Equisetum arvense* L.,** or 'common horsetail', has been harnessed in folk remedies for its wide-ranging medicinal advantages. Rich in silica, it is well-known for promoting healthy bones, teeth, and nails. Its diuretic properties have been employed to support urinary tract health and alleviate fluid retention. *E. arvense* is thought to have antioxidant potential helping in combating oxidative stress and supporting overall well-being. Some herbalists also recommend it for its potential to soothe skin conditions like eczema and minor wounds when used externally[28].

***Euphorbia pulcherrima* Willd. ex Klotzsch,** the 'poinsettia or lalpatti', boasts medicinal potential beyond its festive allure (Fig. 5). Rich in phytochemicals, it holds promise for treating skin conditions shows antimicrobial activity and helps in alleviating pain. Traditional medicine employs its extracts for managing fever and respiratory ailments[29].

***Ficus racemosa* L.,** also known as the cluster fig tree, holds medicinal significance in Ayurvedic texts. Various components of F. racemosa such as its fruits, bark, and roots are utilized in ethnomedicine to address a wide array of ailments including diabetes mellitus. Experimental investigations have revealed the plant's potential in alleviating inflammation, protecting the liver, and lowering blood sugar levels[30].

***Gloriosa superba* L.,** is a significant medicinal plant (fig. 10) in Asia and Africa, utilized for ailments like cancer, gout, and as antipyretic and purgative agents. It is valued for its colchicine and colchicoside content highly demanded by pharmaceutical industries. However, due to extensive use, it faces extinction necessitating urgent efforts from botanists, biotechnologists, policymakers, and conservationists to preserve it31. n-butanol fraction of methanolic extract from *G. superba* shade dried rhizome exhibited antifungal activity while chloroform fraction demonstrated potent antibacterial activity. 90% inhibition of *Candida albicans* and *C. glaberata* occurred when butanol fraction was applied32. Encapsulated silver nanoparticles prepared by using Colchicine rich *G. superba* methanolic leaf extract have cytotoxic activity against DLA cancer cell lines. In vivo studies on DLA challenged Swiss albino mice also supported

anticancer activity of encapsulated silver nanoparticles from *G. superba* leaf extracts[33].

***Helminthostachys zeylanica* (L.) Hook**., Kamraj, has been utilized in alternative medicine for its medicinal properties (fig. 3). It is revered due to its capacity to treat various gastrointestinal disorders, including dysentery, diarrhea and several abdominal issues. The plant's rhizomes are valued for their astringent properties, aiding in the management of bleeding disorders. Additionally, *H. zeylanica* is used externally to treat lesions and dermatitis because of its antimicrobial activity. However, proper dosage and consultation with a healthcare professional are recommended for safe use[34]. Also, its rhizomes are potent source of many flavonoids that possess anti-inflammatory activities. Ugonin V, Ugonin Y, Ugonin J, Ugonin K, Ugonstilbene A, benzoic acid and many quercetin derivatives have been characterized from H. zeylanica rhizomes. Ugonin J, K, M, O, X, Ugonstilbene A, and quercetin derivatives demonstrated potent inhibition of nitric oxide production in LPS challenged microglial cells[35].

***Hyptis suaveolens* (L.) Poit.,** or Pignut, contains unique terpenoid and phenolic compounds such as suaveolic acid, suaveolol, and ursolic acid which exhibit potential as therapeutic agents against resistant bacterial and viral pathogens. Ursolic acid, a pentacyclic triterpenoid present in the plant, demonstrates effective antiviral activity against SARS-CoV2 and HIV by modulating the activity of the main protease crucial for viral replication and assembly[36].

***Lygodium flexuosum* (L.) Sw.,** climbing fern, possesses medicinal properties applied in ethnomedicine. It is esteemed for its anti-inflammatory properties beneficial for alleviating pain and swelling. Climbing fern also exhibits antioxidant potential, promoting neutralizing free radicals and preventing cellular damages[37].

***Madhuca longifolia* (L.) J. F. Macbr.,** commonly known as “Mahua”, harbors diverse medicinal properties. Its flowers, seeds, and bark are rich sources of bioactive compounds, exhibiting anti-inflammatory and antioxidant activities. Traditional medicine utilizes Mahua extracts for treating various ailments including coughs, colds, and skin disorders. Furthermore, its anti-diabetic properties make it valuable in managing blood sugar levels. Research suggests potential applications in liver protection and wound healing highlighting Mahua's significance in natural medicine[38].

***Marsilea quadrifolia* L.,** ‘European water clover’ or ‘water fern’ (fig. 15), harbors several therapeutic potentials in traditional practices. Research has delved into the potential of its extracts for managing respiratory conditions such as asthma and bronchitis, attributed to their alleged bronchodilator effects. It contains compounds with anti-inflammatory properties, offering relief from conditions such as arthritis. Some cultures utilize it for its diuretic properties aiding in urinary tract health. M. quadrifolia exhibits promising potential in botanical medicine[39].

***Mimosa pudica* L.,** commonly known as "sensitive plant", harbors the toxic alkaloid mimosine which exhibits antiproliferative and apoptotic properties. Mucilage obtained from M. pudica seeds is composed of D-glucuronic acid and D-xylose[40].

***Moringa oleifera* Lam.,** the "miracle tree", possesses an array of medicinal properties. Rich in nutrients and antioxidants, it supports immune function and promotes overall health. Studies suggest its leaves and seeds possess anti-inflammatory and anti-diabetic properties, aiding in managing chronic conditions. Moringa's high

vitamin and mineral content also contribute to its folkloric use in managing malnutrition and promoting lactation in nursing mothers[41]. Deep eutectic solvents were used to extract flavonoids from M. oleifera leaves and it was found that Choline chloride/lactic acid was most effective in extracting flavonoids. The extracted flavonoids were found to be effective against pathogenic bacterium and cancer cells and also demonstrated antioxidant activity[42].

***Murraya koenigii* (L.) Spreng.,** curry leaf, boasts significant medicinal value. Its leaves are prized for their role in ethnic medicine (fig. 21), particularly in Ayurveda. Rich in antioxidant bimolecules they aid in digestion, help to manage diabetes, and promote hair health. The leaves are applied to reduce symptoms of stomach upset and intestinal discomfort. Moreover, their antimicrobial properties contribute to overall wellness[43].

***Ocimum tenuiflorum* L.,** commonly referred to as Holy Basil or Tulsi, is renowned for its extensive medicinal benefits. Rich in antioxidants and essential oils, Tulsi exhibits potent antimicrobial activities helping in the treatment of infections and promoting overall health. It is recognized in Ayurveda for its adaptogenic properties, helping the body to resist stress and improve resilience. Tulsi also supports respiratory health providing relief from coughs, colds, and asthma. Furthermore, its anti-inflammatory activities make it valuable in managing inflammatory conditions and promoting general well-being[44].

***Ophioglossum vulgatum* L.,** "adder's tongue fern", has been used traditionally for its medicinal properties. It is thought to have anti-inflammatory attributes, assisting in the treatment of various inflammatory conditions. The fern is also noted for its potential to support digestion and alleviate gastrointestinal discomfort. Additionally, some herbalists suggest that *O. vulgatum* may have antifungal properties contributing to fungal infection management. Moreover, it is thought to contain compounds that could promote wound healing when applied topically[45].

***Phyllodium pulchellum* (L.) Desv.,** 'fine-leaf wattle', exhibits medicinal properties (fig. 12) valued in folk medicinal practices. It is recognized for its anti-inflammatory potential, providing relief from conditions like arthritis and muscle soreness. Rich in antioxidants, it may contribute to combating oxidative stress and supporting immune function. Some traditional herbalists suggest its use for alleviating respiratory issues such as coughs and bronchitis. Additionally, *P. pulchellum* is believed to aid digestion and promote alimentary and digestive tracts health[46].

***Rauvolfia serpentina* (L.) Benth. ex Kurz,** the Indian 'snakeroot' fig. 8, is popularised for its potent medicinal properties. Its alkaloids are key in treating hypertension and anxiety disorders by regulating blood pressure and calming the nerves. Traditional medicine also harnesses its sedative effects for insomnia and mental health issues. However, dosage control is critical due to its potential side effects[47]. Another study explored the potential of *R. serpentina* compounds in managing hypertension through molecular docking simulations against human angiotensin receptor. Significant binding affinities were observed, highlighting the therapeutic promise of these constituents as antihypertensive agents[48].

***Shorea robusta* C.F. Gaertn.,** The 'Sal tree', contains a wealth of medicinal properties within its bark and resin (fig. 1). Traditional medicine hails its bark decoctions for combating fever and gastrointestinal disorders. Rich in antioxidants and antimicrobial agents, it aids wound recovery and fights infections. Its resin is highly valued for its anti-inflammatory properties offering relief from arthritis and rheumatism[49].

***Solanum torvum* Sw.,** "turkey berry" or "devil's fig", is prized in ethnomedicine for its therapeutic benefits. Its fruits are utilized for their potential antidiabetic properties aiding in blood sugar regulation. The plant's leaves and roots are utilized to overcome symptoms of respiratory ailments. *S. torvum* also shows analgesic and anti-inflammatory properties making it useful in managing ache and swelling.

However, caution is advised as excessive consumption may lead to adverse effects[50].

***Syzygium cumini* (Linn.) Skeels** is utilized in Unani and Chinese medicinal practices to address digestive issues and additionally yields vinegar and wine from its fruits after processing. Rich in both vitamin A and C, it also serves as a beneficial source for managing diabetes[51]. Methanolic extracts prepared from its seeds showed antidiabetic, cardioprotective and hepatoprotective activities. It was reported that 200 mg/kg dose of methanolic extracts ameliorated alloxan induced markers of cardiac and liver injury in diabetic rat model[52].

***Tectona grandis* L.f.,** commonly known as Teak or locally as Sagwan, belongs to family Lamiaceae. Renowned for its exquisite appearance and remarkable resilience against termite and fungal attacks, Teak is considered among the highly valued types of timber worldwide. Its durability and aesthetic appeal make it a preferred choice for crafting long-lasting and visually appealing furnitures[53].

***Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.,** belonging to the Combretaceae family, showcases extensive medicinal potential and is traditionally employed to address various health issues. It demonstrates hypercholesteraemic, hypolipidemic, anticoagulant, antihypertensive, antithrombotic, antiviral, antifungal, and antibacterial properties. Researches have explored the phytoconstituents and pharmacological activities of different plant parts, with triterpenoids primarily responsible for cardiovascular benefits while tannins and flavonoids contribute to its anticancer effects[54].

***Tinospora cordifolia* (Willd.) Miers ex Hook.f. & Thomson,** Guduchi or Giloy, holds significant medicinal importance in traditional Indian medicine systems. It is revered for its immunomodulatory properties enhancing the body's natural defense mechanisms against infections and diseases. Studies have shown its efficacy in managing various conditions including fever, respiratory disorders, and gastrointestinal ailments. *T. cordifolia* is also valued for its anti-inflammatory and free radical scavenging effects, contributing to overall health and well-being. Its adaptogenic properties make it a versatile herb in promoting longevity and vitality[55]. The *T. cordifolia* stem possesses many immunomodulatory compounds, *viz*., cordifolioside A, syringin, magnoflorine, tinocordiside etc.[56]. Similarly, Bala et al. isolated 8 compounds from *T. cordifolia* stem and evaluated their anticancer property against different cancer cell lines. It was demonstrated that palmatine was effective against KB (oral squamous cancer) and HT-29 (colon cancer) while tinocordiside was potent against KB and CHOK-1 cancer cell lines. Besides, yangambin also showed anticancerous activity against KB cell lines[57].

***Typha latifolia* L**., cattail, possesses vast therapeutic properties (fig. 20) with roots in traditional herbal medicine. Its rhizomes contain mucilage offering potential relief for gastrointestinal issues such as diarrhea and dysentery. Additionally, extracts from the plant exhibit diuretic properties supporting elimination of toxins from the body. Cattail has also been used topically for wound healing and its poultices are believed to have antiseptic properties. While further research is warranted, *T. latifolia* remains a notable botanical in herbal remedies[58].

***Withania somnifera* (L.) Dunal,** commonly known as 'Ashwagandha', boasts remarkable medicinal importance in Ayurvedic and traditional medicine practices. It is renowned for its adaptogenic properties aiding the body in coping with stress and promoting overall resilience. Ashwagandha exhibits potent antioxidant effects, scavenging free radicals and supporting cellular health. Its anti-inflammatory properties make it valuable in managing conditions like arthritis and inflammatory disorders. Additionally, Ashwagandha is prized for its role in enhancing cognitive function, reducing anxiety, and supporting overall mental well-being[59]. Hydroalcoholic extracts prepared from *W. somnifera* dried leaves and roots was found to be immunomodulatory in a double-blinded and placebo-controlled clinical trial (CTRI/2018/07/014792). In the test group, the extract increase immunoglobulins (IgA, IgM and IgGs), cytokine production and TBNK cells. It was concluded that *W. somnifera* extract had positive impact on immune system of tested individuals[60].

***Ziziphus mauritiana* Lam.,** is used in folk remedies for its potentiality to treat insomnia, anxiety, and digestive issues. It also exhibits antioxidant and anti-inflammatory properties, contributing to its medicinal value. Additionally, *Z. mauritiana* extracts have been studied for their potential in improving sleep quality and managing diabetes[61].

Table 1. Active biomolecules of Medicinal Plants.

Sl. no.	Plants Name	Botanical Name	Parts used	Family	Active Biomolecules	Ref.
1	Neem	*Azadirachta indica*	Leaf, Bark	Meliaceae	Azadirachtin Limonoids Flavonoids Saponins	7
2	Peepar	*Piper longum*	Fruit	Piperaceae	Piplartine Piperlonguminine	62
3	Kadamb	*Neolamarckia cadamba*	Fruit	Rubiaceae	Cadmbagenic acid Neolarmarckine A-E Angustine Harmane Naulafine	63
4	Papita	*Carica papaya*	Fruit, Leaves	Caricaceae	Quercetin, kaempherol	64
5	Candle Bush	*Senna alata*	Leaves	Leguminosae	Cardenolides, dienolides	65
6	Satawar	*Asparagus africanus*	Whole	Asparagaceae	Steroidal saponins Flavonoids	66
7	Chitchita	*Achyranthes aspera*	Leaves, stem, seeds	Amaranthaceae	Alkaloids, Oleanolic acid	67
8	Bitter gourd	*Momordica charantia*	Fruits	Cucurbitaceae	Flavonoids	68

					Alkaloids	
9	Kalmegh	*Andrographis paniculata*	Leaves, stem	Acanthaceae	Andrographolide	69
1	Hadjod	*Cissus quadrangularis*	Stem, Leaves	Vitaceae	Friedelin Quercetin, Genistein, Daidzein	71
1	Kali musli	*Curculigo orchioides*	Tuber	Hypoxidaceae	Curculigoside Curculigine	17
1	Sarpgandha	*Rauvolfia serpentina*	Root	Apocynaceae	Reserpine Serpentine Ajmalicine Strictosidine synthase	47
1	Sahjan	*Moringa oleifera*	Whole	Moringaceae	Quercetin polyphenol Isothiocyonates Saponins	41
1	Bhang	*Cannabis sativa*	Leaves	Cannabaceae	Phytocannabinoids Cannabinoids Terpenoids	11
1	Aswagandha	*Withania somnifera*	Whole	Solanaceae	Withanine Withanolide D Withaferin A Saponins Phenolics Flavonoids	59
1	Mahua	*Madhuca longifolia*	Fruits	Sapotaceae	Quercetin β-sitosterol Dihydroquercetin	38
1	Sadabahar	*Catharanthus roseus*	Whole	Apocynaceae	Vincristine Vinblastine Vinflunine Vinorelbine Vindesine	12
1	Giloy	*Tinospora cordifolia*	Whole	Menispermaceae	Glycosides Steroids Sesquiterpenoid Phenolics Amritosides	55
1	Tulsi	*Ocimum sanctum*	Leaves	Lamiaceae	Eugenol Limatrol Methyl carvicol Estragol	44
2	Ratalu	*Dioscorea bulbifera*	Tubers	Dioscoreaceae	Diosgenin Dioscorine Saponin Flavonoids	23

1. ***Shorea robusta*** **(seed)**

2. ***Catharanthus roseus***

3. ***Helminthostachys zeylanica***

4. ***Colebrookea oppositifolia***

5. ***Euphorbia pulcherima***

6. ***Dioscorea bulbifera***

7. ***Diospyros melanoxylon***

8. ***Rauvolfia serpentina***

9. ***Bixa orellana***

10. ***Gloriosa superba***

11. ***Andrographis paniculata***

12. ***Phyllodium pulchellum***


13. *Curcuma longa*


14. *Piper longum*


15. *Marsilea quadrifolia*


16. *Cannabis sativa*


17. *Clerodendrum infortunatum*


18. *Curculigo orchioides*


19. *Allium sativum*


20. *Typha latifolia*


21. *Murraya koenigii*

Conclusion

The review emphasizes the abundant biodiversity and indigenous knowledge existing in this region, shedding light on the documented medicinal properties of these plants and their potential to address various health concerns. The diverse therapeutic benefits, including anti-inflammatory, antioxidant, pain-relieving, and antimicrobial properties, underscore the relevance of these plants in traditional medicine and highlight the need for further scientific investigation.

Moving forward, future research should prioritize several key areas. Firstly, comprehensive phytochemical and pharmacological studies are essential to identify the active compounds responsible for the observed medicinal activities, enabling the development of new drugs and treatments. Secondly, it is imperative to explore sustainable methods for the utilization of these medicinal plants, considering the threats of habitat loss and climate change. Conservation efforts are crucial to ensure the availability of these valuable resources for future generations.

Moreover, collaborative research involving traditional healers, local communities, and scientific institutions can facilitate knowledge exchange and promote sustainable utilization practices. This interdisciplinary approach can bridge the gap between traditional wisdom and modern science, leading to culturally appropriate and effective healthcare solutions. Urgent interdisciplinary collaborations between botanists, pharmacologists, ethnobotanists, and traditional healers are vital for leveraging the full potential of medicinal plant diversity in the North Eastern Terai Region of Uttar Pradesh to improve global health. The review underscores the immense potential of medicinal plants in this region and emphasizes the importance of preserving traditional knowledge. By harnessing the therapeutic properties of these plants through rigorous scientific inquiry and community engagement, we can enhance healthcare access and promote biodiversity conservation in the region.

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Conflicts of interest

Not Applicable.

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