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Review Article

The Role of Medicinal Plants in Drug Discovery across the World

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ABSTRACT

Throughout the dawn of time, medicinal plants have been crucial in minimizing human suffering from ailments, afflictions, and diseases. This study examines the pharmacological role, contributions, and value of medicinal plants in treating significant illnesses for public health, emphasizing the current strategic approaches to disease prevention. Interest in complementary therapies and the therapeutic use of plants has increased as a result of the crucial role that medicinal plants have played in the sustainable management of human health. This is because it is cheaper than manufactured, synthetic kinds of Medicine. Yet, medicinal plants are in peril because of man's intervention and unregulated wild collection. It is thus advised that purposeful domestication and cultivation efforts are crucial for ensuring a steady supply of these plant species.

Keywords: *Medicinal plants, herbal drug, pharmaceutical role, economic value, primary and secondary metabolites.*

INTRODUCTION

Nature is always a golden sign to show the major occurrences of cohabitation. Natural goods derived from plants, animals, and minerals serve as the foundation for treating human ailments (Jamshidi-Kia et al., 2018). Throughout the ages, humans have relied on nature for basic needs such as medicines, housing, nourishment, fragrances, clothes, flavours, fertilizers, and modes of transportation (Dar et al., 2017). Humans are becoming increasingly prone to sicknesses and diseases as a result of climate change and impoverished human lifestyles. High temperatures, humidity, and other environmental conditions enhance microorganism development and smash the symbiotic interaction between hosts and microorganisms, resulting in a rise in infectious illnesses such as influenza, tuberculosis, meningitis, endocarditis, and others (Ahmad 2021b). Resistance to microorganisms desires the formation of a new antibiotic composition, necessitating more expansive research and taking time.

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People are getting increasingly interested in ethnopharmacology as synthetic therapies become more harmful and antibiotic resistance increases. Medicinal plants have been employed in traditional healthcare systems since prehistoric times and are currently the primary source of treatment for the great majority of the world's population (Uprety et al., 2012). A variety of phytocompounds derived from medicinal plants are healthier and pose little or no risk. Phytomedicines are secondary bioactive plant metabolites (Faridi et al., 2012). These phytocompounds function as phytomedicines. Plant fragments or entire plants, as well as isolated active metabolites, can be utilized to create pharmaceuticals (both whole and different parts of the plant, and plant-derived bioactive metabolites can be used to make medications). Millions of people worldwide rely on medicinal plants for basic health care, revenue generation, and livelihood enhancement (Ranilla et al., 2010). According to WHO research, more than 80% of the world's population is reliant on prescription pharmaceuticals, creating a significant social burden in terms of health care (WHO, 2013).

Traditional Medicine is used extensively in China, India, Japan, Pakistan, Sri Lanka, and Thailand. Traditional tribal remedies account for around 40% of the overall medicinal intake in China (Ahmad, 2021a). Plants provide significant contributions to a wide range of sectors, including fine chemicals, cosmetics, Medicine and medications, industrial raw materials, and so on. For the discovery of novel drugs, medicinal plants play an important role (Ahmad, 2021c). Medicinal herbs have been shown to be the sole treatment for a variety of lethal diseases, including cancer and viral infections such as Hepatitis, AIDS, and others. Regular scientific research has emphasized the prominence and contribution of many plants families, including Asteraceae, Apocynaceae, Liliaceae, Rutaceae, Caesalpiniaceae, Solanaceae, Piperaceae, Ranunculaceae, Apiaceae, Sapotaceae, etc., and their bioactive components in the therapeutic arena thus establishing a very imperative part of natural wealth (Kumar et al., 2017).

Importance of medicinal plants: a global view

Medical science has expanded its efficiency and global diffusion during the previous century. Life expectancy is growing, whereas dying without treatment is falling (Ahmad et al., 2021). Several new life-saving drugs have been found to aid us in the battle against many communicable and other sorts of diseases, and technological advancements have broadened the scope of modern-day science (Tamang et al., 2017). Medicinal plants are utilized in the household by women caring for their families, in the village by medicine men or tribal shamans, and by practitioners of classical, traditional systems of Medicine such as Ayurveda, Chinese Medicine, or the Japanese Kampo system. The World Health Organization (WHO) estimates that over 80% of the world's population, or 4.3 billion people, rely on traditional plant-based systems of Medicine for basic health care (Ahn, 2017). Allopathic Medicine owes a great deal to medicinal plants; one out of every four prescriptions issued in a country like the United States is either manufactured or derived from plant ingredients. In an International Conference in 1978 known as the 'Declaration of Alma-Ata,' WHO underlined the need to achieve the aim of 'Health for All' in a step-by-step manner by addressing poor sanitation, illiteracy, and poverty. In 1998, WHO adopted a new global health strategy, "Health for All in the 21st Century," with the goal of achieving health equity, enhanced healthy life expectancy, and health security, as well as ensuring universal access to basic quality healthcare (Cheema & Singh, 2021). Despite its many accomplishments and expansion, advanced medical research is finding it difficult to reach everyone. Nonetheless, most of the world's population, primarily in underdeveloped and developing countries, lacks access to innovative healthcare treatments and relies on traditional medical systems. Several of these practices are substantially older than the allopathic media medical-wise healthcare system (Sen & Chakraborty, 2017). The traditional medical

system is based on medicinal herbs. Herbs continue to provide many medications to civilization. Some of the therapeutic properties attributed to plants have been shown to be faulty, and this therapy is based on thousands of years of scientific research (Patel et al., 2012).

Traditional Medicine, often known as Ayurveda, is gaining popularity in Europe since different chronic conditions react well to its treatments. Conventional Medicine often relies on long-term medicines on which patients rely (Ahmad, 2021d). Several drugs include negative effects and withdrawal symptoms; discontinuing the medications might be challenging for that person. Traditional Medicine has a lot to offer nowadays. Patients usually respond favourably to these drugs, reporting a decrease in, if not complete relief from, their symptoms. Most patients start taking traditional medications as soon as they are diagnosed. Therefore, Ayurveda therapies are usually used alongside or after traditional medical approaches (Gaur et al., 2015). As a result, after a patient's problem has developed, he or she is more likely to seek Ayurvedic treatment. Most of the essential drugs that have altered current medical practice in the last 50 years have been taken from plants. These chemical components exhibit the therapeutic characteristics of medicinal plants. WHO supports and encourages the inclusion of herbal remedies in national healthcare systems since they are easily available at a low cost and are consequently thought to be far more reliable than current synthetic treatments (Rita & Animesh, 2011). Previously thought to be harmful, such plants have since been shown to contain medicinally valuable pieces.

Table 1: Some medicinal plants, their parts used, therapeutic uses and secondary metabolites

Sl No	Plant Name	Common Name	Family	Parts used	Chemical constituents	Secondary metabolites	Therapeutic use	References
1.	*Saraca asoca*	Ashoka	Fabaceae	Bark and leaves	Glycosides, Flavonoids, Tannins and Saponins	Saponins, flavonoids	Internal bleeding, anti-inflammatory treatment for arthritis, haemorrhoids, infertility, insomnia	Ahmad and Ghosh, 2022
2.	*Withania somnifera*	Ashwagandha	Solanaceae	Root, flower	Sitoindosides and Withaferin A	Methanol , n-Hexane	Hypertension, asthma, diabetes, arthritis, and uterine sedative	Salmerón-Manzano et al., 2020
3.	*Emblica Officinalis*	Amla	Phyllanthaceae	Fruit	Gallic acid, Ascorbic acid, Ellagic acid, Rutin, Quercetin, and Catechol	Polyphenols and flavonoids	Antioxidant, immune-modulatory, antipyretic, analgesic, cytoprotective, anti-ulcer, immune-modulatory, anti-inflammatory, antitussive, and gastroprotective	Ahn, 2017
4.	*Aegle marmelos*	Bael	Rutaceae	Fruits, bark, leaves, seeds, and roots	Coumarin, Xanthotoxol, Imperatorin, Aegeline, and Marmeline	5-acetoxytridecane	Antidiabetic, anticancerous, antifertility, antimicrobial, immunogenic, and insecticidal activities	Ahmad and Tamang, 2020
5.	*Bacopa monnieri*	Brahmi	Scrophulariaceae	Leaves and stems	Alkaloid brahmine, nicotine, herpestine, bacosides A and B, saponins A, B and C, triterpenoid saponins, stigmastanol, β-sitosterol, betulinic acid, D-mannitol	Bacoside, bacopaside N2, luteolin, cucurbitacins, apigenin	Memory enhancing, anticancer, anti-Parkinsonian, anti-Alzheimer's antioxidant, sedative, anti-inflammatory, antipyretic, analgesic, anti-arthritic, anti-depression, antiulcer, anti-epilepsy, antitumor, anti-leprosy	Cheema and Singh, 2021
6.	*Plantago ovata*	Isabgol	Plantaginaceae	Seed husk and leaves	Flavonoids, alkaloids, terpenoids, phenolic acid derivatives, iridoid glycosides, fatty acids, and polysaccharides	Flavonoids, alkaloids, and terpenoids	Constipation, diarrhoea, haemorrhoids, and high blood pressure.	Adekunle, and Adekunle, 2009
7.	*Nardostachys jatamansi*	Jatamansi	Caprifoliaceae	Roots and the Rhizomes	Sesquiterpenes and coumarins	Terpenoids mainly, Sesquiterpenes	Epilepsy, hysteria, syncope, convulsions, and mental weakness	Aniszewski, 2007
8.	*Andropgraphis paniculata*	Kalmegh	Acanthaceae	Fresh and dried leaves	Diterpenoids, flavonoids, and polyphenols	Andrographidine A, 5-hydroxy-7,8,2',5'-tetramethoxy-flavone-5-O-beta-D-glucopyranoside	Common cold, diarrhoea, fever, jaundice, cancer, diabetes, high blood pressure, ulcer, leprosy, bronchitis	Cai et al., 2014
9.	*Chlorophytum borivilianum*	Safed Musli	Liliaceae	Root	25 alkaloids, vitamins, proteins, carbohydrates, steroids, saponins, potassium, calcium, magnesium, phenol, resins, mucilage, and polysaccharides	Stigmasterol and hecogenin	Aphrodisiac agent and revitalizer, as general sex tonic remedy for diabetes, arthritis and increasing body immunity	Ahmad et al., 2014a
10.	*Artemisia annua*	Sweet wormwood	Asteraceae	Leaves	Protein, carbohydrate, fibre, tocopherol, phytate, and tannin contents	Phenolic compounds, terpenoids, alkaloids, coumarins, acetylenes, sterols, and caffeoylquinic acids	Jaundice, bacterial dysentery, malaria, tuberculosis, and haemorrhoids	Ahmad, and Tamang, 2020
11.	*Perilla frutescens*	Beefsteak	Lamiaceae	Leaf, stem,	Apigenin, ascorbic-acid, beta-	Terpenes,	Depression, anxiety, asthma, chest	Ahmad et

		plant		and seed	carotene, caffeic-acid, citral, dillapiol, elemicin, limonene, luteolin, myristicin, perillaldehyde, perilla ketone	phenylpropanoids, polyketides, and alkaloids.	stuffiness, vomiting, coughs, colds, flu, phlegm, tumours, allergies, intoxication, fever, headache, stuffy nose, constipation, abdominal pain, and indigestion	al., 2022a
12.	*Trigonella foenum-graecum*	Fenugreek	Fabaceae	Seed and leaf	Carbohydrates, proteins, lipids, alkaloids, flavonoids, fibers, saponins, steroidal saponins, vitamins and minerals, nitrogen compounds	Alkaloids, saponins, flavonoids	Gastric stimulant, antidiabetic, antilipidemic, antioxidant, hepatoprotective, anti-inflammatory, antibacterial, antifungal, antiulcer, antilithigenic	Ahmad et al., 2022c
13.	*Nigella sativa*	Black cumin or kalonji	Ranunculaceae	Seed	Thymoquinone (TQ), thymol, nigellone, dithymoquinone, thymohydroquinone, α and β-pinene, d-citronellol, p-cymene, d-limonene, 4-terpineol, carvacrol, t-anethole, and longifolene	Polyphenols, flavonoids, alkaloids, steroids, terpenes, coumarins, tannins, and saponins	Antihypertensive, diuretics, digestive, anti-diarrheal, appetite stimulant, analgesics, anti-bacterial, anti-cancer, anti-depression, bronchitis, asthma, rheumatism, and skin disorders	Ahmad et al., 2022b
14.	*Linum usitatissimum*	Flaxseed or linseed	Linaceae	Seeds, fibers and flax lignans	L. usitatissimum are ω-3 fatty acid, phytoestrogenic-lignans, phenols, flavonoids, sterols, proteins, antioxidants	Flavonoids, catecholamines, phenylpropanoid acids, phenols, lignins and tannins	Cardiovascular disease, atherosclerosis, diabetes, cancer, diarrhoea and gastrointestinal infections, arthritis, osteoporosis, autoimmune and neurological disorders	Ahmad and Ghosh, 2020
15.	*Sesamum indicum*	Sesame seed	Pedaliaceae	Leaf, stem, and seed	Unsaturated fatty acids, mainly linoleic acid, oleic acid, palmitic and stearic acid	Polyphenols, alkaloids, flavonoids, terpenoids, and glycosides	Antioxidant, antimicrobial, anti-inflammatory, antidiabetic, anticancer, antihyperlipidemic, hepatoprotective, anthelmintic, antileishmanial, gastroprotective, larvicidal, and vasorelaxant activities	Ahmad and Ghosh, 2020
16.	*Azadirachta indica*	Neem	Meliaceae	Stem, root bark, and fruit	Nimbolinin, Nimbin, nimbidin, nimbidol, sodium nimbinate, gedunin, salannin, quercetin, ascorbic acid, n-hexacosanol, 6-desacetylnimbinene	Azadirachtin, Azadirone, Gedunin, Meliacarpin, Nimbin, Salannin, Vilasinin	Dental and gastrointestinal disorders, malaria fevers, skin diseases, insects repellent, anti-inflammatory, antiarthritic, antipyretic, hypoglycemic, anti gastric ulcer, antifungal, antibacterial, and antitumour activities	Kunle et al., 2012
20.	*Ocimum sanctum*	Tulsi	Lamiaceae	Leaves, stem, flower, root, seeds and even whole plant	Oleanolic acid, rosmarinic acid, ursolic acid eugenol, linalool, carvacrol, β elemene, β caryophyllene, germacrene	Carbohydrates, tannin, flavonoids, saponins, glycosides, terpenoids, fatty acids and phenol	Coughs, colds, asthma, bronchitis, malaria, diarrhoea, dysentery, skin disease, arthritis, eye diseases, insect bites	Srivastava (2021)
21	*Adhatoda vasica*	Basak	Acanthaceae	Leaves, roots, flowers and stem bark	Vasicine, l-vasicinone, deoxyvasicine, maiontone, vasicinolone and vasicinol	Alkaloids, sterols, terpenes, flavonoids, saponins, anthraquinones, glycosides, tannins, resins, lactones, quinines	Bronchitis, tuberculosis and other lung, bronchiole disorders, asthma, dental ailments, diarrhoea and dysentery	Aniszewski, 2007
22.	*Carica papaya*	Papaya	Caricaceae	Fruit, roots, leaves, and seeds	Caffeic acid, myricetin, rutin, quercetin, α-tocopherol, papain, benzyl isothiocyanate (BiTC), and kaempferol	Alkaloids, flavonoids, tannins, saponins and steroids	Antibacterial, antiviral, antitumor, hypoglycaemic and anti-inflammatory	Mühlbauer, and Müller, (2020)
23.	*Aloe indica*	Aloe vera	Asphodelaceae	The green part of the leaf	Vitamins, enzymes, minerals, sugars, lignin, saponins, anthraquinones, salicylic acids and amino acids	Anthraquinones, aloe-emodin and chrysophanol	Burns, allergic reactions, Rheumatoid arthritis, rheumatic fever, acid indigestion, ulcers, diabetes, skin diseases	Ahmad and Halder, 2021
24.	*Marraya koenigii*	Curry	Rutaceae	Leaf and stem	Mahanine, Mahanimbine, Isomahanine, koenimbine, Isolongifolene, Pyrayafoline D, Koenoline, 9-formyl-3-methyl carbazole	Alkaloids, terpenoids, flavonoids and phenolic	Piles, inflammation, itching, fresh cuts, dysentery, bruises, and edema	Naikoo et al., 2019
25.	*Madagascar periwinkle*	Nayantara	Apocynaceae	Root and leaf	Vinblastine, Catharanthine, Tabersonine, Vincristine, Ajmalicine	Vinblastine and vincristine	Diabetes, sore throat, lung congestion, skin infections, eye irritation	Tamang et al., 2017
26.	*Calotropis gigantea*	Akanda	Apocynaceae	Root bark and leaf	Cardenolide, Calotropin, calotropone	Cardenolides	Asthma, colds, coughs, diarrhoea, fever, indigestion, leprosy, leukoderma, neurological disorders, elephantiasis, nausea and rheumatism	Chen et al., 2016
27.	*Mentha arvensis*	Wild mint or pudina	Lamiaceae	Leaves, flower, stem, bark, and seeds	Menthone, Piperitone, Menthyl acetate, menthofuran, carvone, linalool, linalyl acetate and piperitone oxide	Menthol, Menthone and Menthyl acetate	Cold, fever, digestive and cardiovascular disorders	Kalemba and Synowiec, 2019
28.	*Cinchona officinalis*	Cinchona	Rubiaceae	Bark	Quinine, Cinchotannic acid, Cinchonidine, quinidine, cinchonine	Quinine	Increasing appetite; promoting the release of digestive juices; and treating bloating, fullness, and other stomach problems	Kala et al., 2006
29.	*Ginkgo biloba*	Ginkgo	Ginkgoaceae	Leaf	Ginkgolides A, B, C, J, bilobalide, flavonol glycosides, biflavones, proanthocyanidins, alkylphenols, phenolic acids, 6-hydroxykynurenic acid, 4-O-	Flavonoids, lactones, and ginkgolic acid	Cerebral vascular insufficiency, cognitive disorders, dementia, dizziness/vertigo, intermittent claudication, glaucoma, memory loss	Ahmad and Halder, 2021

					methylpyridoxine and polyprenols			
30.	*Psidium guajava*	Guava	Myrtaceae	Leaf and fruit	Pentacyclic triterpenoid guajanoic acid, beta-sitosterol, uvaol, oleanolic acid, ursolic acid, vitamins A, C, iron, phosphorus and calcium	Flavonoids, Tannins, glycosides, terpenoids	Diarrhea, dysentery, gastroenteritis, hypertension, diabetes, cough, oral ulcers, swollen gums wound	Chen et al., 2016
31.	*Centella asiatica*	Thankuni	Apiaceae	Whole plant	Sesquiterpenes, plant sterols, pentacyclic triterpenoids, saponins, asiatic acid, eugenol derivatives, caffeoylquinic acids, terminolic acid and flavonoids	Asiaticoside, madecassoside and sapogenins	Diarrhoea, fever, amenorrhea, mental clarity, wound healing, skin disease like leprosy, lupus, varicose ulcers, eczema,	Sharma et al., 2015
32.	*Allium cepa*	Onion	Amaryllidaceae	Leaf, stem, bulb, root	Allicin, quercetin, fisetin, other sulphurous compounds: diallyl disulphide and diallyl trisulphide	S-trans-prop-1-enyl cysteine sulfoxide (PECSO), flavonols, anthocyanin, phytosterols and saponins	Antimicrobial, antioxidant, anti-inflammatory, anti-diabetic, anti-hypertensive, bronchitis, asthma, inflammatory disorders, dysentery, ulcer wounds, scars, keloids, pain and swelling after bee or wasp stings	Teshika et al., 2014
33.	*Crocus sativus*	Saffron or Kesar	Iridaceae	Dried thread-like parts of the flower	Crocin, Safranal, Crocetin, Picrocrocin, terpenes, terpene alcohol, and their esters	Crocin, picrocrocin and safranal	Antihypertensive, anticonvulsant, antitussive, antigenotoxic and cytotoxic effects, anxiolytic aphrodisiac, antioxidant, antidepressant, antinociceptive , anti-inflammatory	Ahmad and Halder, 2021
34.	*Rauvolfia serpentina*	Sarpagandha	Apocynaceae	Root and bark	Reserpine, Serpentine Ajmalicine, Rescinnamine, Deserpidine, Strictosidine synthase	Reserpine, Rauwolfine, Serpentine, Sarpagine, Ajmaline, Yohimbine	Hypertension, insomnia, constipation, fever	Sharma et al., 2015
35.	*Asparagus racemosus*	Satamuli	Asparagaceae	Root, shoot, seed	Asparagine, arginine, tyrosine, kaempferol, quercetin, rutin, resin, and tannin	Saponins, Alkaloids, dihydrophenanthrene derivatives, flavonoids, furan derivatives	Fluid retention pain, diarrhoea, bronchitis, tuberculosis, dementia, Antioxidants, immunostimulants, anti-inflammatory, antihepatotoxic, antibacterial, anti oxytocic, and reproductive agents.	Kala et al., 2006
36.	*Eclipta prostrata*	Bhringaraj	Asteraceae	Leaf	Triterpene saponins, steroidal saponins, triterpenes, steroids, steroidal alkaloids, flavonoids, phenolic acids, thiophene derivatives	Tanin, lignin, phenol, sterol, saponin, coumarin, terpenoids	Antioxidant, antimicrobial, hepatoprotective, anti-hyperlipidemic, cerebroprotective, anti-hyperglycemic, anticancer, hair growth promoting	Tamang, 2020
37.	*Tinospora cordifolia*	Gulancha	Menispermaceae	Stem, root, bark, leaf	alkaloids, glycosides, steroids, phenolics, aliphatic compounds, polysaccharides alkaloids, glycosides, steroids, phenolics, aliphatic compounds, polysaccharides alkaloids, glycosides, steroids, phenolics, aliphatic compounds, polysaccharides Tinosporide, Palmatine, Berberine, Alkaloids, glycosides, steroids, phenolics, aliphatic compounds, polysaccharide, protein	Anthraquinones, terpenoids, and saponins	Fever, jaundice, chronic diarrhoea, cancer, dysentery, bone fracture, pain, asthma, skin disease, poisonous insect, snake bite, eye disorders	Cheema and Singh, 2021
38.	*Terminalia chebula*	Haritaki or black myrobalan	Combretaceae	Fruit	Chebulic acid, Chebulinic acid, Chebulagic acid, Gallic acid, Octadec-9-ene	Gallotannin, Ellagitannins	Antioxidant, antimicrobial, antidiabetic, hepatoprotective, anti-inflammatory, antimutagenic, antiproliferative, radioprotective, cardioprotective, antiarthritic, anticaries, gastrointestinal motility, HIV inhibition	Ahmad and Halder, 2021
39.	*Terminalia bellirica*	Bahera	Combretaceae	Dried fruit	Glucoside, Tannins, Gallic acid, Ethyl Gallate, chebulinic acid, Gallo-tannic acid, Ellagic acid, gallic acid, lignans, galloylpunicalagin, and digalloyl-hexahydroxydiphenoyl-hexoside	Corilagin, chebulagic acid, galloylpunicalagin	Hepatitis, bronchitis, asthma, dyspepsia, piles, diarrhoea, coughs, eye diseases, hypertension, and rheumatism	Sharma et al., 2015
40.	*Terminalia arjuna*	Arjun	Combretaceae	Bark and leaf	Polyphenols, flavonoids, tannins, triterpenoids, saponins, sterols and minerals	Flavonoids, phenolic acids, triterpene glycosides, sterols, gallotannins, ellagitannins	Ulcers, hypocholesterolemic, antibacterial, antimicrobial, antitumoral, antioxidant, antiallergic, antifeedant, antifertility and anti-HIV activities	Tamang, 2020
41.	*Clitoria ternatea*	Aparajita	Papilionaceae	Flowers, leaves, young shoots	Tannins, phlobatannin, carbohydrates, saponins, phenols, triterpenoids, alkaloids, flavonoids, flavonol glycosides, proteins, antharaquinone, anthocyanins, cardiac glycosides	Triterpenoids, flavonol glycosides, anthocyanins and steroids	Antimicrobial, antiparasitic, anti-inflammatory, antipyretic, anticancer, antioxidant, antidiabetic, gastrointestinal, hypolipidemic, antihistaminic	Dar et al., 2017
42.	*Syzygium aromaticum*	Lavanga or clove	Myrtaceae	Aromatic flower buds	Eugenol, β-Caryophyllene, Vanillin, Kaempferol, Stigmasterol, Carvacrol, Eugenitin, Quercetin	Eugenol, β-caryophyllene and eugenol acetate	Vomiting, flatulence, nausea, gastric problem, tooth-ache, liver, bowel and stomach disorders	Ahmad and Halder, 2021
43.	*Anethum graveolens*	Satapushpa	Apiaceae	Seed	Anethine, phellandrene, and d-limonene, tannins, steroids, terpenoids, and flavonoids	Terpenes, terpenoids, shikimates, phenylpropenes	Antimicrobial, Anti-inflammatory and analgesic, gastrointestinal, hyperlipidaemic, reproductive system.	Dar et al., 2017
44.	*Piper nigrum*	Black pepper or maricha	Piperaceae	Seeds and fruits	Piperine, piperidine, pyrrolidines, oleoresins, chavicine, amides, α-	Piperine, myrcene, alpha-phellandrene,	Indigestion, nausea, diarrhoea, arthritis, asthma, bronchitis, colic	Ahmad and Asma, 2022

					and β-pinene, limonene, myrcene, linalool	linalool	pain, cough, cold, sex drive, menstrual pain, stuffy nose, sinus infection, dizziness	
45.	*Cinnamomum zeylanicum*	Cinnamon or dalchini	Lauraceae	Leaves, bark, flowers, fruits, and roots	Cinnamaldehyde, trans-cinnamaldehyde, eugenol, β-caryophyllene, limonene,	Flavonoids, tannins, saponins, steroids, glycosides, coumarins, anthraquinones and alkaloids	Antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer, lipid-lowering, neurological disorders	Cheema and Singh, 2021

Role of primary and secondary metabolites in medicinal plants:

Metabolism refers to the entire quantity of metabolic events involved in keeping cells alive in an organism. All living creatures require energy for several critical functions as well as the production of new organic molecules (Ahmad et al., 2014b). Secondary metabolites are formed primarily during diverse stress conditions, resulting in a diverse spectrum of components that are not found in all species. Primary metabolism results in the creation of carbohydrates, proteins, lipids, and nucleic acids as primary compounds (Cai et al., 2014). Humans use secondary metabolites generated by medicinal plants for a variety of health advantages. Secondary metabolites, as opposed to universally occurring chemicals, are usually referred to as special principles due to their specific role in plant metabolism. These chemicals are typically generated during altered natural conditions by special tissues and organs to perform a specialized purpose; hence, their existence within plants is not ubiquitous (Kala et al., 2006). The capacity to synthesize a plethora of bioactive principles with therapeutic effects for humans serves as the foundation for their usage as herbal medications, in which people adopt the same molecules that plants use for themselves. For example, antioxidants generated in plants that give protection against comparable assaults in them can be employed by people to protect against oxidative or free radical damage in humans (Kunle et al., 2012).

Importance of chemical constituents in medicinal plants:

Medicinal plants exhibit a wide range of pharmacological actions, such as anti-inflammatory, antibacterial, and antifungal properties, and so have a significant impact on human health. The medicinal plants' significance is due to the presence of particular compounds that cause a physiological reaction in the human body (Ahmad & Asma, 2022). These phytochemicals are found across the plant world and serve a variety of physiological and ecological roles. The primary function of these bioactive secondary metabolites in plants is to aid them in dealing with a variety of abiotic and biotic challenges, such as chemical defence against pathogens, predators, diseases, and allopathic agents (Naikoo et al., 2019). Secondary metabolites are the medicinally significant active compounds found in medicinal plants. They are very tiny chemical compounds with widespread distribution in the plant kingdom. However, their purpose in plant life is unknown in most cases (Salmerón-Manzano et al., 2020). Oxidation, reductions, substitutions, and condensation processes are the primary chemical events involved in the production of these metabolites in medicinal plants. Medicinal plants generate and accumulate a wide range of phytochemicals, including phenolic compounds, flavonoids, alkaloids, tannins, and terpenes, which are then used therapeutically or as precursors in the manufacture of effective medications (Okwu & Omodamiro, 2005). There is a wide range of biologically active chemical compounds that have a specific physiological activity in the human body.

Conservational strategies:

Medicinal plant species are becoming increasingly under threat. It is now expected that 15.20 per cent of India's entire vascular flora (about 3,000 species) may fall into one of the IUCN categories of threatened, rare or endangered (Chen et al., 2016). While a comprehensive analysis of the status of medicinal plant species has never been carried out, it is assessed that approximately one-third of the plant species listed in the Red Data Book of India may have medicinal properties. The biggest knowledge gap is due to a lack of information on genetic diversity patterns as

well as which areas of the gene pool/distribution require attention for conservation and future development through domestication and cultivation (Adekunle & Adekunle, 2009).

The forests of Himachal Pradesh, claimed to be the home of Ayurveda, are known to supply a considerable part of India's medicinal plant requirements, with one estimate citing figures as high as 80% of all Ayurvedic medicines, 46% of all Unani drugs, and 33% of all allopathic drugs generated in India (Ahmad et al., 2014c).

People in rural regions have increasingly lost interest in the therapeutic properties of medicinal plants as a result of the growth and prominence of contemporary illness treatment systems based on the use of chemical medications (Allopath) (Sofowora et al., 2013). As a result, they do not receive adequate protection and are frequently eradicated as weeds. The rising problem of environmental contamination has also significantly contributed to the population decline of medicinally essential plant species.

Economic value:

The value of medicinal herbs to the economies of low-income countries is significant and crucial since medicines are essential to sustaining a healthy community, which stimulates and maintains the economy (Cakilcioglu et al., 2011). For such low-income countries to reach any significant level of self-reliance in terms of the availability of safe and effective medications for the control of endemic disease conditions, there must be a strategic shift from current practices. This distinction must be prioritized because of the importance of self-sufficiency in the current and future economic and political affairs of developed nations in the field of Medicine (Salako et al., 2014). To realize these, developing countries must first prioritize their goals and understand the economic value of medical plants that abound in their country. Policymakers' support and encouragement should also be a priority in order to generate and preserve financing for medicinal plant research (Teshika et al., 2018). While this would improve the economic status of such low-income countries, it will also improve healthcare delivery by making basic drugs available to the bulk of the community at affordable prices (Venugopala et al., 2013).

ISM prepares almost 25,000 effective plant-based formulations, which are typically utilized by rural people in India, and the demand for such medication is expanding among regular people (Ahmad et al., 2014d). It was also determined that > 2000 tons of medicinal plant raw material are required each year. More than 1500 herbal items are also available as dietary supplements. The domestic industry AYUSH is worth roughly INR. 80-90 billion, while the export price of medicinal herbs and allied commodities from India is worth about l10 billion. The export of AYUSH commodities was INR 24,741.2 crores in 2012-2013. However, it fell marginally in the next fiscal year (2013-2014) (Aniszewski, 2007). In 2013-2014, the percentage share of AYUSH products in India's overall business was 0.36%. The global demand for herbal treatments is rapidly expanding, and the global herbal business is expected to reach USD 7 trillion by 2050.

The future prospect of medicinal plants:

There is a bright future for medicinal herbs since nearly half a million plants in the world have not yet been studied for their therapeutic activities, and their undiscovered therapeutic potential might be critical in the practice of current and future knowledge (Ahmad & Halder, 2021). Medicinal plants, for example, have played an important role in the formation of human culture. Among the many contemporary medications, many, such as aspirin, are derived indirectly from herbs. Garlic, for example, has anti-inflammatory properties. Herb study can help to understand about plant toxicity. Herbs' therapeutic properties are attributable to secondary metabolite production by the plants (Patel et al., 2012). WHO has recognized medicinal plants' relevance and developed methods to address it. Medicinal plants are critical to preserving excellent health in rural locations. Recent studies have shown the efficacy of

traditional Indian medical systems such as Ayurveda and others (Naikoo et al. 2019). Despite the fact that efforts are necessary to overcome difficulties such as quality control, standardization concerns, etc (Dar et al., 2017). Overall, enough understanding of the system of such procedures, as well as high-quality clinical trials and their efficacy among ordinary people, are required for the growth of such Medicine.

Herbal drug delivery approaches:

Herbal drugs or plant drugs are medicines that comprise a chemical molecule or, more commonly, a mixture of chemical compounds originating from plants that operate on the human body individually or in combination to prevent disease and maintain or restore health (Sharma et al., 2017). Several drug delivery and drug targeting systems are now being developed in order to reduce drug degradation and loss, prevent harmful side effects, and enhance drug bioavailability and the fraction of the medication accumulated in the required zone. In the case of herbal extracts, many components are likely to be destroyed by the highly acidic pH of the stomach (Puneet et al., 2013). The liver may process other components before they enter the bloodstream. Several studies are being conducted to create new herbal drug delivery methods, such as mouth-dissolving tablets, sustained and extended-release formulations, mucoadhesive systems, transdermal dosage forms, microparticles, microcapsules, nanoparticles, implants, and so on (Sharma et al., 2015). Res-Q, the world's first poly-herbal mouth-dissolving tablet, a quick mouth-dissolving drug, was introduced by Asoka Life Science Limited. It employs a unique drug delivery mechanism that improves effectiveness (Cheema & Singh, 2021), (Cho & Ko, 2005). A novel stable herbal medicinal formulation in the form of sustained-release micro granules containing *Gingko biloba* extract, as well as the technique for making it, is the subject of a US patent (Sofowora et al., 2013). A patent describes the herbal-based oral composition for periodic retention within the buccal cavity of a human, comprising a mixture of herbs like *Reynoutria multiflora*, *Rhizoma drynariae*, *Rhizoma chuanxiong*, *Calculus bovis*, *Indigo naturalis*, *Ecliptae herba*, *Pericarpium trichosanthis*, *Sophora flavescens*, *Gleditsia sinensis*, *Angelica sinensis*, *Morus alba* (Rahman et al., 2021).

TCH (traditional Chinese herbs) nanoparticles aid to promote absorption and distribution in the body, hence increasing efficacy (Salmerón-Manzano et al., 2020). A novel sustained-release implant of herb extract based on chitosan has shown to be quite beneficial. Danshen (*Salvia miltiorrhiza*) extract was combined with CS-gelatin to create an implant for the enhancement of anastomosis and healing on muscles and tissues at the organic incision site in abdominal cavities (Kunle et al., 2012). Ayurvedic drugs can be used in a more effective manner by combining them into current dose forms. To promote patient compliance and minimize repetitive administration, phytotherapeutics require a scientific strategy to distribute the components in a unique manner.

CONCLUSION

Conservation is the process of managing the biosphere in order to maximize the benefit to the current generation while preserving the potential for the future. Medicinal plant-based livelihood systems are frequently mediated by market demand and provide an excellent source of employment and income to disadvantaged rural populations. Developing an adequate framework and technology for medicinal plant production is crucial to ensuring a continuous and consistent supply of medicinal plants for the pharmaceutical sector and halting the deterioration of the natural resource base. Herbal pharmaceuticals or plant drugs are medicines that comprise a chemical molecule or, more commonly, a mixture of chemical compounds originating from plants that operate on the human body individually or in combination to prevent disease and maintain or restore health. Some medicinal plants are used as adjuvant therapy in healthcare systems across the world, not only to treat diseases but

also to prevent them and preserve health. The value of medicinal plant research is realized now more than ever. Extensive study is necessary to regulate the quality of raw medications and formulations in order to justify their usage in the contemporary medicine system; following that, animal studies and clinical trials are required to utilize the advantages of these plants. Furthermore, in the creation of Medicine from medicinal plants, among other things, a practical plan for preserving these resources should be devised.

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