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Potential of Bioactive Phytochemical Compounds of Ethno Medicinal Plants Found in India with Especial Reference to Madhya Pradesh

Annie J Cheriyan[1], Jaya Sharma[2], Naveen Dhingra[3*]

[1]*School of Sciences, Sanjeev Agarwal Global Educational University, Katara Hills Extension, Sahara Bypass, Bhopal- 462 022, Madhya Pradesh, India*

[2]*School of Agriculture, SAM Global University, Adampur Chawni, Raisen Rd, Bhopal- 462 021, Madhya Pradesh, India*

[3]*School of Sciences, Sanjeev Agarwal Global Educational University, Katara Hills Extension, Sahara Bypass, Bhopal- 462 022, Madhya Pradesh, India*

** Corresponding Author: navlifescience@gmail.com*

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Abstract

Around the world, herbal medicines have been used by humans for ages. These are used for the usage against various ailments and the traditional knowledge is recorded in ancient literature. Even though in most countries modern medicine is considered the first line of treatment, herbal medicines have become popular especially post-COVID-19. Unlike modern medicines, herbal medicines do not have after or side effects. Traditional knowledge is usually transferred to new generations from time to time and natural compounds derived from these medicinal plants have played an important role in modern preparations of herbal drugs. In India, more than 6000 species of plants are used in traditional and herbal medicines. Within India, the state of Madhya Pradesh with rich forest and tribal population is known for its rich flora of medicinal plants. Several species of plants are also used as folk medicines for diseases such as dysentery and diarrhea.

Keywords: ethno medicinal plants, bioactive compounds, traditional knowledge, India, herbal medicines.

Introduction

Wild plants are known to have various kinds of chemical compounds that have been explored by humans for medicinal value. Reports from all over the world have reported medicinal plants to be a source of natural or artificial drug discovery **(Laldingliani et al., 2022)**. In the past two decades, there has been an increase in ethnomedicinal plant research as more than 50% of clinical drugs **(Gurib-Fakim, 2006; Petrovska, 2012).** However, **Newmann and Cragg (2020)** put the proportion at 34%. This has also motivated researchers to contribute to the field by validating traditional knowledge. Approximately, 25% of the herbal drugs listed in the modern pharmacopeia are derived from medicinal plants and many are manufactured using chemical structures **(Fig. 1)**. About 85% of traditional medicines are presently used in modern healthcare treatment from medicinal plants **(Umair et al., 2017)**. Although medicinal plants are a local heritage it has importance and significance globally **(Purohit and Vyas, 2004)**. Overall, about 50,000 plants are used globally out of approximately 4,00,000 reported flowering plants **(Govaerts, 2001; Parmesan, 2006).**

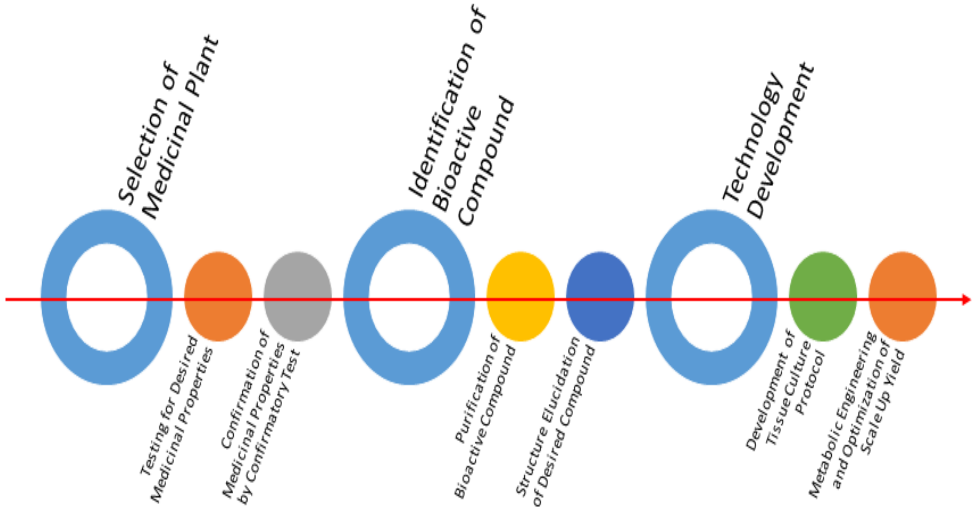

Fig. 1 A schematic representation highlighting the process of development of a product using a phytochemical bioactive compound from a medicinal plant

Like many other countries, India also has a strong tradition of using traditional formulations for healing purposes **(Kumar et al., 2022)**. Many folk healers or *Vaidhyacharya* know about traditional knowledge, collect medicinally important parts of the plant by themselves, and also prepare recipes and formulations for various ailments. Many of the plants are not in commercial cultivation and they have tried to keep the medicinal knowledge to themselves. However, some of them which are now common are now in commercial cultivation. This is an unorganized sector but a complete supply chain is present from the tribal village collector to the Ayurveda product-making industry. **Ved and Goraya (2007)** had made an inventory of approximately 1289 drugs associated with 960 plants which was 1622 herbal drugs correlated with 1178 plants. The populations of medicinal herb plants are managed through sustainable harvesting practices in their natural habitats. However, some species like Aconites,

Arnebias, Ashtavarga, etc. need to be considered for the promotion of their cultivation due to overharvesting. However, so far some tree species like Bael (*Aegle marmelos*), Imli (*Tamarindus indica*), Kachnar (*Bauhinia variegata*), Amaltas (*Cassia fistula*), Guggul (*Commiphora wightii*), Amla (*Phyllanthus emblica*), Harra (*Terminalia chebula*), Ber (*Zizyphus mauriana*), etc. have a good economic potential and could be taken up for large scale promotion as agroforestry component also. In addition, there are many Red-listed species like Musli (*Chlorophytum* spp.), Sugandmantri (*Homalomena aromaca*), etc. **(Goraya and Ved, 2007).**

Traditional Knowledge of Medicinal Plants and Phytochemical Composition

a. International

For humans, plants have been an important resource. The science of ethnobotany (including natural and social science components) **(Fig. 2)**. The bioprospecting of ethnobotany has led to the identification of bioactive compounds in plants. There are several drugs developed from ethnobotanical leads like Aspirin, Codeine and Papaverine, Colchicine, Digoxin and Digitoxin, Tetrahydrocannabinol and Cannabidiol, Vinblastine and Vincristine obtained from *Filipendula ulmaria*, *Papaver somniferum*, *Colchicum autumnale*, *Digitalis purpurea*, *Cannabis sativa*, *Catharanthus roseus* respectively **(Garnatje et al., 2017)**.

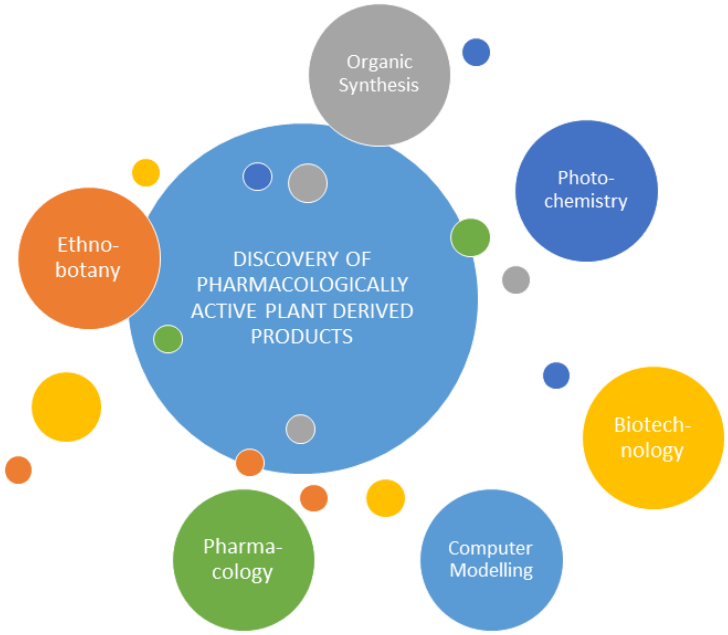

Fig. 2 Discovery of pharmacologically active plant-derived products includes amalgamation and coordination of various fields of biology

The confirmation of the anticancer properties of paclitaxel, a bioactive compound obtained from *Taxus* spp., against murine leukemia cells has been one of the successful stories of medicinal plant drugs. Relatively recently, based on traditional medicine data from China during the avian flu epidemic Oseltamivir was developed from *Illicium verum*. Ethnobotanical records also helped in the development of artemisinin as a powerful antimalarial drug from *Artemisia*

annua. Its relevance was recognized with the 2015 Nobel Prize in Physiology or Medicine **(Tu, 2011)**. Some medicinal plants are used in daily food *viz*., Pizza is seasoned with *Origanum vulgare*. Moreover, according to **Zhu et al. (2011)** about 62 of the 457 families of angiosperms and gymnosperms are used as sources of medicinal drugs**.**

Most of the developing countries extensively use herbal remedies in their primary healthcare **(Petrovska, 2012).** Much of the literature mentions them within respective countries which is still not benchmarked. COVID-19 provided an exception condition wherein it was required that many medicines from one country needed to be transported or sent to other countries. Certain drugs have also found their basis in plants like Salicin (a natural substance) which is obtained from the bark of *Salix alba* (willow tree). Morphine was commercially produced from *Papaver somnifera*-opium poppy (Duas et al., 2012). Other drugs that are obtained from medicinal plants are Artemisinin (antimalarial drug), Ephedrine (a central nervous system stimulant), Reserpine (an antihypertensive agent used for snakebite), and Vinca Alkaloids (used in chemotherapy as antimicrotubule agent from *Artemisia annua, Ephedra sinica, Rauwolfia serpentine* and *Catharanthus roseus* respectively **(Cragg and Newman, 2013).**

b. National

Approximately, 2500 species of plants are medicinally important in India and 150 species of medicinal plants are commercially cultivated **(Singh et al., 2022; Modak et al., 2007)**. For example, various species of *Dillenia* are well-known for their medicinal properties *viz., Dillenia pentagyna, P. indica, P. andamanica.* These are found to be effective against diabetes, cancer, wounds, burns, constipation, pain relief, jaundice, fever and fatigue, dysenteries, diarrhea, etc. **(Singh et al., 2022)**. In 1995, the Government of India made the Department of India Systems of Medicine and Homoeopathy (ISM&H) under the Ministry of Health and Family Welfare. However, it was reorganized in 2003 and thereafter 2014 as the Ministry of AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy) with a vision to work in the area of ancient systems and medicine. WHO and the Government of India also plan to establish an institute named Global Centre for Traditional Medicine in Jamnagar, Gujarat, India **(Kakkar et al., 2022).**

In India, the ethnomedicinal plants have been in use for the past several decades and have increased in recent times, especially post-COVID-19. In India, the traditional medicinal knowledge was mostly with tribal and local villagers that too one or two elders commonly called Vaid Acharya. Initially, traditional knowledge was restricted and was not known to the Indian scientific communities and there was a lack of scientific validation. The knowledge was passed

locally from generation to generation **(Abat et al., 2017; Dey et al., 2017)**. This traditional knowledge is also available under the medicine system of Ayurveda and Sidha systems. Their demand has increased as people have realized that they have fewer side effects than modern medicines **(Simbo et al., 2010)**. This includes WHO, which recognized many of its compositions and formulations post-COVID-19 **(Fabricant and Farnsworth, 2001; Dey et al., 2002)**. Many researchers are now working towards scientific validation of the traditional knowledge and ethnomedicinal effects of wild plants from forests **(Yazan and Armania, 2014)**. This also helped in the development of interest by many herbal industries which are now more involved in herbal drugs. These are not only old crude formulations but also products made out of purified compounds.

Six of the national laboratories of the Council of Scientific and Industrial Research viz., CSIR

- Central Institute of Medicinal and Aromatic Plants (CIMAP), CSIR- Institute of Himalayan Bioresource Technology (IHBT), CSIR–Indian Institute Of Integrative Medicine (IIIM), CSIR-North East Institute of Science & Technology (NEIST), CSIR-National Botanical Research Institute (NBRI) which are positioned in different parts of countries with different environmental conditions are motivating farmers to take up medicinal plant cultivation, processing and their value addition. Post-COVID-19, there is enhanced interest in medicinal plant cultivation and products associated with it which has resulted in a wealth of useful data and experimental leads on high-yielding and early-maturing varieties **(Table 1)**. Hence, the Government of India has launched CSIR- Aroma Mission which aims to make India a hub for opportunities for farmers and businessmen working on medicinal plants in India **(Fig. 3.)**.

Fig. 3 Medicinal plants selected under AROMA Mission for cultivation and value addition

Table 1. Various medicinal plants, their varieties, and other details of the medicinal plants cultivated and promoted under the Government of India's AROMA mission.

S. No.	Name of Medicinal Plant	Variety	Details*
1.	Lemongrass (*Cymbopogoncitratus*, *Poaceae*)	Krishna (CSIR-CIMAP)	• Release Year: 1997 • Developed as clonal variety through recurrent selection • Light green leaf with light purple leaf sheath color. • Erect Plant habits & leaves • Suitable for North Indian plains and South India (Deccan Plateau) • Herb yield: 25-30 tons/ha/year • Oil yield: 200 kg/ha/year • Citral content: 75-80%
		CIM-Shikhar (CSIR-CIMAP)	• Release Year: 2016 • 120-140 cm in height • Green to greyish green, leaf use 100-125 cm long and 1.4-1.5 cm broad • Suitable for Southern India; not for cold regions. • Herb yield: 30-35 tons/ha/year • Oil yield: 240 kg/ha/year • Citral content: Mean − 86.0%; Range − 77.4-91.3
		Jor Lab-L8 (CSIR-NEIST)	• Release Year: 2016 • Developed through: Pure Line Selection • Suitable for: North Eastern India • Herb yield: 250-320 q/ha • Oil yield: 250-320 kg/ha • Oil content: 1.0%
2.	Geranium (*Pelargonium* sp., *Geraniaceae*)	CIM-Pawan (CSIR-CIMAP)	• Release Year : 2003 • Developed through extensive in-vitro selections in somaclonal variants of • Bourbon type • Herb yield: 297 q/ha • Oil yield: 30-35 kg/ha • Oil content: 0.10-0.15%
		BIO 171 (CSIR-CIMAP)	• Release Year: 2012 • Developed through clonal selection in tissue-cultured population • Upright robust growth • Oil yield: 30-35 kg/ha • Oil content: 0.12-0.15%

3.	Palmarosa (*Cymbopogonmartini*, *Poaceae*)	PRC1 (CSIR-CIMAP)	• Release Year: 1986 • Developed through composite population breeding • Very tall, medium inflorescence • Herb yield: 400 q/ha • Oil yield: 225 kg/ha • Geraniol content : 75-80%
		CIM-Harsh (CSIR-CIMAP)	• Release Year: 2009 Suitable for North Indian plains, South India (Deccan) • Medium tall, dark green leaves, long inflorescence • Drought resistant • Herb yield: 450 q/ha • Oil yield: 300 kg/ha • Geraniol content : 94%
4.	Menthol Mint (*Menthapiperita*, *Lamiaceae*)	Kosi (CSIR-CIMAP)	• Release Year: 1999 • Developed through half progeny selection • Tolerant to leaf spot, rust and powdery-mildew • Early maturing: 90-100 days • Herb yield: 260 q/ha • Oil yield: 200 kg/ha • Oil content: 0.75% • Menthol content: 75-80%
		CIM-Kranti (CSIR-CIMAP)	• Release Year: 2013 • Developed through half-sib selection in var. Gomti • Cold tolerant • Suitable for commercial cultivation to generate extra income without any additional input and extra land use for cultivation during winter and summer season • Oil Yield: 100 kg/ha (winter) along with suckers (250-300 q/ha) 170-210 kg/ha (summer) • Menthol content: 80 %

5.	Khus (*Chrysopogonzizanioides*, *Poaceae*)	KS1 (CSIR-CIMAP)	• Release Year: 1982 • Developed through clonal selection Suitable for drought and marginal land • Tall, white color inflorescence • Dry root yield: 20-22 q/ha • Oil yield: 20.22 kg/ha
		CIM-Vriddhi (CSIR-CIMAP)	• Release Year: 2007 • Developed through selection • Suitable for one-year cultivation and drought/marginal land • Dry root yield: 27 q/ha • Oil yield: 33 kg/ha
6.	Tulsi (*Ocimumtenuiflorum*, *Lamiaceae*)	CIM-Saumya (CSIR-CIMAP)	• Release Year: 2003 • Developed through half sib selection • Short duration, dwarf, early flowering • Growth habit: Semi closed • Herb yield: 290q/ha • Oil yield: 197.2 kg/ha • Oil content: 0.68 % • Oil quality: methyl chavicol 62.54%, linalool 24.61%
		CIM-Jyoti (CSIR-CIMAP)	• Release Year: 2014 • Developed through selection • Dwarf • Early maturing • White flower • Herb yield: 200 q/ha • Oil yield: 150 kg/ha • Citral content : 68-75%
7.	Rosemary (*Salviarosmarinus*, *Lamiaceae*)	CIM-Hariyali (CSIR-CIMAP)	• Release Year: 2007 • Developed selection • Light green needle-like leaves, essential oil is rich in camphor and 1-cineol • Herb yield: 350 q/ha • Oil content: 1.03% • Oil yield: 350 kg/ ha

8.	Java Citronella (*Cymbopogonwinterianus*, *Poaceae*)	Bio13 (CSIR-CIMAP)	• Release Year: 1988 • Developed through rigorous recurrent screening in somaclones • First plant variety developed through tissue culture technology (somaclonal variation) in India • Spreading type growth habit • High tiller regeneration potential • Less incidence of yellowing leaf syndrome during rainy season • Slip establishment: 85% • Mean Tiller number: 50-55/clump • Herb yield: 300-320 q/ha • Mean oil yield: 200-250 kg/ha • Oil content: 1.2-1.8% • Oil quality: Citronellal: 35-38%; Citronellol + Geranyl acetate: 14-18%; Geraniol: 18-24% and Elemol: <2%
		CIM-Jeeva (CSIR-CIMAP)	• Release Year: 2006 • Developed through mutation breeding Vigours, long light green leaves, leaf sheath light purple Enhance field establishment quality • Suitable for Gangetic plains • Herb yield: 215 q/ha • Oil yield: 250-275 kg/ha • Citronellal content : 35%
		Jor Lab-C5 (CSIR-NEIST)	• Release Year: 2016 • Developed through mutation breeding • Suitable for North Eastern India • Herb yield: 260-340 q/ha • Oil yield: 312-408 kg/ha • Oil content: 1.2%
9.	Damask Rose (Rosa damascena, Rosaceae)	Noorjahan (CSIR-CIMAP)	• Release Year: 1992 • Developed through clonal selection • Suitable for North Indian plains and hills • Flower yield: 35 q/ha • Oil quality : l-Citronellol 20.8 %, Geraniol 25.3 %, a-damascenone 0.1% temperate in the ideally suited climate for damask rose but can be cultivated successfully in sub-tropics where the minimum temp. of 4°- 6°during winter months occurs.

		Ranisahiba (CSIR-CIMAP)	• Release Year: 2001 • Developed through clonal selection • Synchronous flowering; high flower biomass • Flower yield: 40 q/ha • Oil quality: Geraniol 30-35%, Geranyl acetate 5-7%, Trans-rose oxide 10.1%, l-Citronellol 4.6-5 %
10.	Sea Worwood	-	• *Artemisiamaritima* (Sea wormwood) is suitable for the cold desert Himalayan region and grows well at an altitude of 4000 m. • This plant is traditionally used as an insect repellent. • The potential use of its essential oil, so far, has remained unexplored. • The essential oil yield ranges between 0.3%-0.5%. • The major constituents of the oil are 1,8 Cineole and Sesquiterpene Hydrocarbons.
*** Data from CSIR- AROMA MISSION website (https://aromamission.cimap.res.in/aromamission/)**			

It not only involves increasing the area of cultivation of medicinal plants but also value addition of the products. As per the website of CSIR- Aroma Mission (https://aromamission.cimap.res.in/aromamission/vision which was accessed in January 2024), it aims to:

- Make India a leading hub for aroma products by generating opportunities for business and development and dissemination of aroma-related research and technology development. It is also making efforts to reach up to farmers, industry, and society, leading to the creation of business opportunities, rural development, and life-quality improvement. All this progress will be made along with sustainable development.
- Achieve self-sufficiency in the production and processing of major essential oils used by the domestic aroma industry (*viz*., lemongrass oil) and reduce foreign dependency.
- Transform India's reputation from a raw material producer to a consistent exporter of finished quality products.

c. Madhya Pradesh

Madhya Pradesh lies in the center of India. Even though it is not an official biodiversity hotspot, it is rich in plant and animal diversity due to diverse kinds of habitats *viz*., grassland, forest, rivers, etc. The diverse ecosystem is also rich in a lot of medicinal plants (trees, shrubs, and herbs). The rich forest areas of Mandla, Dindori, Balaghat, and Hoshangabad districts harbor a lot of plant diversity including medicinal plants. There have been some good studies on the

ethnomedicinal plants of Madhya Pradesh **(Dwivedi et al., 2008; Dahare and Jain, 2010; Sharma et al., 2010; Shukla et al., 2010; Wagh et al., 2011; Bharti, 2013; Nag and Zia-Ul-Hasan, 2013; Quamar and Bera, 2014 Agarwal and Varma, 2015; Ali et al., 2020; Ahirwar, 2021; Rahi et al., 2021; Rao et al., 2022; Soni et al., 2023; Ahirwar and Gupta, 2024)**. The tribal population of Madhya Pradesh uses medicinal plants in their day-to-day life and for medical purposes.

The forests of Madhya Pradesh are rich in several medicinal plants *viz.,* Tulsi (*Ocimum sanctum*), *Aloe vera*, Ashwagandha (*Withania somnifera*), Safed Musli (*Chlorophytum borivilianum*), Kali Haldi (*Curcuma caesia*), Giloy (*Tinospora cordifolia*), Brahmi (Bacopa monnieri), etc. **(Table 2)**. These medicinal plants are part of several Ayurvedic preparations providing a good market for Non-Timber Forest Produce (NTFP). A lot of NTFP is collected from the forests of Madhya Pradesh by national and international companies involved in herbal medicines like Dabur, Himalaya, Baidyanth, etc. Due to this, some medicinal plants had been overharvested and reduced in their population. This has not only caused a problem to the industries but also to the local people involved in the collection of medicinal plants from the forest.

Medicinal plants like ashwagandha (*Withania somnifera*), Giloy (*Tinospora cordifolia*), and Triphala, a combination of three fruits (Amla, Haritaki, and Bibhitaki) are most common in the region. Bael (Aegle marmelos), Neem (*Azadirachta indica*), Annatto (*Bixa orellana*), Palash (*Butea monosperma*), Shatavari (*Asparagus racemosus*), Satyanashi (*Argemone mexicana*) Chironji (*Buchanania lanzan*), Aloe Vera (*Aloe barbadensis*), Sweet Flag (*Acorus calamus*), Sickle Senna (*Cassia tora*), Golden Eye-Grass (*Curculigo orchioides*), Turmeric (*Curcuma longa*), False Black Pepper (*Embelia ribes*), and Golden Shower Tree (*Cassia fistula*) have been popular among the merchants of Madhya Pradesh for collection and supply.

Table 2. List of different medicinal plants studied in various districts of the state of Madhya Pradesh.

S. No.	District	Name of Plants	Reference
1	Bhopal	*Allium cepa, Aloe barbedensis, Amaranthus viridis, Argemone mexicana, Asparagus racemosus, Bauhinia racemosa, Butea monosperma, Carica papaya, Cuminum cyminum, Cynodon dactylon, Daucas carota, Dolichos biflorus, Helianthus annuus, Mimosa pudica, Momordica charantia, Moringa oleifera, Musa paradisica, Ocimum sanctum, Punica granatum, Ricinus commumis, Solanum nigrum, Solanum xanthocarpum, Sorghum vulgare, Sphaeranthus indicus, Syzygium cumini, Tridax procumbens, Tephrosia purpurea, Tribulus terrestris, Trigonella foenum graecum, Triticum aestivum*	Agarwal and Varma, 2015

2	Amarkantak	*Abrus precatorius, Abutilon indicum, Achyranthes aspera, Alpinia calcarata, Andrographis paniculata, Asparagus racemosus, Azadirachta indica, Bauhinia variegata, Boerhavia diff usa, Bryonia laciniosa, Buchanania lanzan, Butea monosperma, Cordia macleodii, Curculigo orchioides, Cuscuta refl exa, Cynodon dactylon, Cyperus rotundus, Ficus benghalensis, Ficus racemosa, Helicteres isora, Ipomea pes-tigridis, Jatropha curcas, Gloriosa superba, Ferula assa-foetida, Hedychium coronarium, Kigelia pinnata, Madhuca longifolia, Mucuna pruriens, Nyctanthes arbor-tristis, Plumbago zeylanica, Pongamia pinnata, Pterocarpus marsupium, Ricinus communis, Terminalia arjuna, Terminalia bellirica, Ziziphus nummularia*	Ahirwar, 2021
3	Jabalpur	*Fumaria indica*	Ali et al., 2020
	Vidisha	*Plumbago zeylanica, Cassia alata, Caesalpinia crista, Rubia Cordifolia*	Soni et al., 2023
	Burhanpur	*Catharanthus roseus, Tribulus terristries, Piper longum, Lawsonia innermis, Ocimum sanctum, Barbadesis mill, Allium sativum, Zingeber officinale, Salvia officinalis, Curcuma longa*	Rahi et al., 2021
4	Dindori	*Abrus precatorius, Abutilon indicum, Acacia cotechu, Acolypha indico, Achyranthes aspera, Acorus calamus, Adhatoda vasica, Aegle marmelos, Ageratum conyzoides, Auanthus excelsa, Afbizia febbeck, Albizia odoratissima, Allium sativum, Aloe vera, Amarant hus spinosus, Annona reticulota, Annona reticulota, Annona squamosa, Argemone mexicana, Asparagus racemosus, Azadirachta indica, Boerhavio diffuso, Bombax ceiba, Boswellia serrata, Butea monosperma, Carico papaya, Cassia fistula, Cossio siamea, Cassio tora, Celastrus paniculatus, Centella asiatica, Chenopodium album, Cicer arietinum, Combretum albidum, Convolvulus prostratus, Costus speciosus, Curculigo orchioides, Curcuma amada, Cynodon dactylon, Cyperus rotundus, Dalbergia sissoo, Dotura metel, Diospyros melanoxylon, Eclipta alba*	Ahirwar and Gupta, 2024

5	Shahdol	*Adansonia digitata, Adhatoda zeylanica, Andrographis paniculata, Achyranthes aspera, Abelmoschus manihot, Aegle marmelos, Aloe vera, Amorphophallus campanulatus, Anogeissus latifolia, Asparagus racemosus, Azadirachta indica, Annona squamosa, Argemone mexicana, Ailanthus excelsa, Biophytum sensitivum, Boerhavia diffusa, Bombax ceiba, Butea monosperma, Caesalpinia bonducella, Calotropis gigantea, Calotropis procera, Careya arborea, Carissa congesta, Cassia glauca, Celastrus paniculatus, Centella asiatica, Chlorophytum arundinaceum, Ziziphus mauritiana, Xanthum strumarium, Vitex negundo, Ventilago denticulate, Tridax procumbens, Tectona grandis, Solanum nigrum, Phyllanthus virgatus, Phoenix sylvestris, Ocimum americanum, Madhuca longifolia, Lawsonia inermis, Jatropha curcas, Gymnema sylvestre, Gloriosa superba, Ficus hispida, Ficus racemosa, Curcuma angustifolia, Curculigo orchioides, Croton oblongifolius, Cissus quadrangularis, Centella asiatica, Celastrus paniculatus, Cassia fistula, Calotropis gigantea*	Bharti, 2013
	Chhindwara	*Abrus precatorius, Acacia nilotica, Achyranthes apera, Actinopteris radiata, Adhatoda vasica, Aegle marmelos, Aloe - vera, Anacyclus pyrethrum, Andrographis paniculata, Azadirachta indica, Barleria prionits, Boerhavia diffusa, Bryonopsis laciniosa, Bryophyllum calycinum, Butea monosperma, Calotropis procera, Cassia fistula, Cassia tora, Catharanthes roseus, Centella asiatica, Chlorophytum tuberosum, Cissus quadrangularis, Curculigo orchioides, Cuscuta reflexa, Datura metel, Eclipta alba, Gloriosa superba, Hemidesmus indicus, Jatropha curcas, Melia azedarach, Mimosa pudica, Mukuna pruriens, Nyctanthes arbortristis, Ocimum sanctum, Opuntia dillenii, Oxalis corniculata, Phyllanthus emblica, Ricinus communis, Ruta graveolens, Solanum nigram, Terminalia bellerica, Terminalia arjuna, Terminalia chebula, Terminalia tomentosa, Tinospora cordifolia, Tylophora asthematica*	Sharma et al., 2010

	Betul	*Acacia catechu, Achyranthus aspara, Adhatoda vasica, Aegle marmelos, Allium cepa, Amaranthus spinus, Anogeissus acuminata, Argemone mexicana, Asparagus recemosus, Astercantha ulongifolia, Azadiracta indica, Balanites aegyptica, Bauhinia variegata, Blumia lacera, Bombax ceiba, Buchnania lanzan, Butea monosperma, Calotropis gigentia, Chlorophytum arundinaceum, Cissus qudrangularis, Clematis triloba, Cochlospermum religiosum, Emblica officinalis, Erythrina variegata, Ficus glomerata, Gardenia gummifera, Helicteres isora, Hemidesmus indicus, Holorrheana antidysentrica, Lannea coromandlica, Madhuca latifolia, Mallotus philipensis, Mangifera indica, Manilkara hexendra, Mitragyna parvifolia, Ocimum sanctum, Plumbago zylenicaRicinus communis, Santalum album, Semecarpus anacardium, Strychnous nuxvomica, Syzygium aromaticum, Syzygium cumini, Terminalia arjuna, Terminalia chebula, Woodfordia fruticosa, Zizyphus numularia*	Dahare and Jain, 2010
	Malwa region, Nimar region and Vindhya region	*Abrus precatorius, Achyranthes aspera, Acorus calamus, Adhatoda vasica, Aegle marmelos, Aloe vera, Andrographis paniculata, Argemone mexicana, Asparagus racemosus, Azadirachta indica, Bauhinia variegata, Boerhaavia diffusa, Bombax ceiba, Bacopa monnieri, Butea monosperma, Calotropis procera, Carica papaya, Cassia fistula, Catharanthus roseus, Centella asiatica, Cissus quadrangularis, Curcuma longa, Calonyction muricatum, Corisea spinarum, Caeselpinia crista, Convolvulus pleuricaulis, Datura stramonium, Dioscorea bulbifera, Dendrocalamus strictus, Eclipta alba, Emblica officinalis, Euphorbia hirta, Euphorbia nivulea, Ficus bengalensis, Ficus glomerata, Ficus religiosa, Gloriosa superba, Helicteres isora, Ipomoea fistulosa, Jatropha curcas, Jasminum auriculatum, Lawsonia inermis, Lathyrus aphaca, Madhuca indica, Mentha longifolia, Momordica dioica, Mucuna puriens, Morus alba, Mimosa pudica, Martynia annua, Ocimum sanctum, Phyllanthus fraternus, Portulaca olerasea, Rauwolfia serpentina, Solanum surattense, Solanum nigrum, Strychnus nuxvomica, Syzygium cumini, Tinospora cordifolia, Tridax procumbens, Withania somnifera, Xanthium strumarium, Zizyphus nummularia*	Dwivedi et al., 2008

	Anuppur	*Mangifera indica, Helicteres isora, Ficus carica, Calotropis gigantea, Cuscuta reflexa, Ampelocissus latifolia, Ricinus communis, Terminalia arjuna, Morus alba, Vanda tessellata, Lantana camara, Aegle marmelos, Cassia fistula, Solanum xanthocarpum, Semecarpus anacardium, Andrographis paniculata, Thespesia lampas, Plumbago zeylanica, Cordia macleodii, Hemidesmus indicus, Cyperus rotundus, Radermachera xylocarpa, Eclipta alba, Pterocarpus marsupium, Polygonum hydropiper, Sphaeranthus indicus, Hedychium coronarium, Mirabilis jalapa, Tinospora cordifolia, Terminalia chebula, Nyctanthes arbor-tristis, Murraya paniculata, Syzygium cumini, Urginea indica, Asparagus racemosus, Curculigo orchioides, Momordica charantia, Dillenia pentagyna, Argemone mexicana, Holarrhena pubescens, Thalictrum foliolosum, Azadirachta indica, Cissampelos pareira, Ficus infetoria, Begonia picta, Diospyros montana, Allium cepa, Boswellia serrata, Shorea robusta, Rauvolfia serpentina, Amorphophallus campanulatus, Diospyros melanoxylon, Euphorbia royleana, Cayratia trifolia, Desmodium oojeinense, Ocimum sanctum, Echinops echinatus, Leea indica, Baccharoides anthelmintica*	Rao et al., 2022
	Rewa	*Abrus precatorius, Abutilon indicum, Acacia catechu, Acacia leucophloea, Acacia nilotica, Acalypha indica, Acanthospermum hispidum, Achyranthes aspera, Adhatoda zeylanica, Aegle marmelos, Aerva lanata, Ageratum conyzoides, Allium cepa, Alternanthera pungens, Amaranthus spinosus, ,Anisomeles indica, Anogeissus latifolia, Anthocephalus chinensis, Aristolochia indica, Asparagus racemosus, Azadirachta indica, Bacopa monnieri, Balanites aegyptiaca, Barleria prionitis, Bauhinia acuminata Bauhinia variegate, Blumea lacera, Boerhavia diffusa, Buchanania lanzan, Butea monosperma, Caesulia axillaris, Calotropis gigantea, Calotropis procera, Carica papaya, Carissa carandas, Casearia tomentosa, Cassia absus, Cassia fistula, Cassia occidentalis, Cassia sophera, Cassia tora, Celastrus paniculatus, Celosia argentea, Centella asiatica, Centipeda minima, Cissampelos pareira, Cleome gynandra, Cleome viscosa, Clerodendrum phlomides, Clerodendrum serratum, Clitoria ternatea, Cocculus hirsutus, Colebrookea oppositifolia, Convolvulus arvensis, Corchorus aestuans, Corchorus olitorius,*	Shukla et al., 2010

		Curculigo orchioides, Curcuma longa, Cuscuta reflexa, Cyperus rotundus, Dalbergia sissoo, Datura metel, Desmodium triflorum, Echinops echinatus, , Eclipta prostrata, Elephantopus scaber, Euphorbia hirta, Euphorbia thymifolia, Evolvulus alsinoides, Ficus palmata, Ficus racemosa, Ficus religiosa, Ficus virens, Flacourtia indica, Garuga pinnata, Helicteres isora, Hemidesmus indicus, Hibiscus rosa-sinensis, Holarrhena pubescens, Holoptelea integrifolia, Hygrophila auriculata, Hyptis suaveolens, Indigofera astragalina, Ipomoea aquatica, Ipomoea carnea, Ipomoea eriocarpa, Ipomoea pes-tigridis, Jatropha gossypifolia, Lannea coromandelica, Lantana camara, Lepidagathis incurve, Leucas cephalotes, Limonia acidissima, Litsea glutinosa, Madhuca longifolia, Mallotus philippensis, Malvastrum coromandelianum, Mangifera indica, Martynia annua, Merremia emarginata, Mitragyna parvifolia, Moringa oleifera, Murraya paniculata, Musa paradisiaca, Nelumbo nucifera, Nerium indicum, Nyctanthes arbor-tristis	
	Jhabua	*Acacia nilotica, Alangium salvifolium, Allium cepa, Andrographis paniculata, Azadirachta indica, Bombax ceiba, Cassia tora, Cassia fistula, Citrus limon, Curculigo orchioides, Cynodon dactylon, Diospyros melanoxylon, Ficus benghalensis, Jatropha curcas, Mucuna pruriens, Punica granatum, Syzygium cumini, Terminalia bellerica, Tinospora cordifolia, Wrighitia tinctoria*	Wagh et al., 2011
	Bhopal	*Alysicarpus vaginalis, Bidens pilosa, Cardamine Hirsuta, Emilia sonchifolia, Erigeron bonariensis, Hyptis suaveolens, Rhyncosia minima, Rorippa indica, Rungia pectinata, Syndrella nodiflora, Trianthema portulacastrum, Vernonica anagallisaquatica,*	Nag and Zia-Ul-Hasan, 2013
	Hoshanga-bad	*Tectona grandis, Shorea robusta, Mangifera indica, Madhuca indica, Adina cordifolia, Mitragyna parviflora, Syzygium cumini, Terminalis bellirica, Terminalia chebula, Moringa oleifera, Schleichera oleosa, Semecarpus anacardium, Acacia catechu, Acacia leucophloea, Acacia nilotica, Anogeissus latifolia, Toona ciliata, Aegle marmelos, Azadirachta indica, Butea monosperma, Cassia fistula, Dalbergia sissoo, Ficus religiosa, Ficua racemosa, Terminalia arjuna, Terminalia alata, Holoptelea integrifolia, Diospyros melanoxylon, Bauhinia variegata, Cordia dichotoma, Flacourtia indica, Sterculia urens, Butea superba*	Quamar and Bera, 2014

Conclusion

Humans have been facing infections and immune-related problems for ages and human immune systems are known to fight against it. However, humans learned quite early that wild plants have several important properties that are highly beneficial in preventing health disorders. As the intelligence of humans improved and learned to use science and technology, humans were able to identify the natural ingredients or bioactive compounds of wild plants. Humans had started to call these plants medicinal plants. The studies that had established medicinal knowledge of medicinal plant use among tribal and rural populations are there but looking at the number of known plants (3,91,000). Therefore, there is an urgent need to study the medicinal importance of wild plants and document them including the validation of known properties including the sacred grooves. However, it needs a systematic and planned study involving academic and industrial collaboration for fast studies of structural elucidation and other biochemical studies.

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