The Beneficial Effect of Traditional Herbal Medicine

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Abstract

Traditional herbal medicine has a long and rich history in India. The plant world is an important source for traditional medicinal system and drug development, which is evidenced by the ancient literature. It is based on countless generations of knowledge gained from the experiences of our ancestors. To acquire the highest values of the traditional medicine, the various critical factors such as precise location, part used, cultivation technique and collection time, harvesting procedures etc. are considered. Medicinal plants not only provide a significant amount of productive capacity to the traditional medicine and Ayurveda sectors, but they also provide a source of income to a large portion of the Indian population. Indian Medicinal Plants Database is prepared from the published sources, containing all the information about the pharmacological significance of the medicinal plants. It is available on the National Medicinal Plants Board (NMPB) Portal for "practitioners" of Indian Systems of Medicine like Ayurveda, Siddha, Unani, Homeopathy, herbal industries, academicians, researchers, resource managers and policymakers to use. Recent advances in genomics, bioinformatics, analytical chemistry and synthetic biology

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Anu Books, India
Medicinal Plants: Ethnomedicine, Pharmacognosy and Therapeutic Values
DOI: https://doi.org/10.31995/Book.AB220-A22.Chapter6

have created new avenues for recognising, utilising, and enhancing plant therapeutic properties. The advancement of Novel Drug Delivery Systems (NDDS) has also created a broad platform for Ayurvedic drugs to improve their clinical efficacy and to increase their bioavailability. Therefore, the modern medicine practice should be merged with the traditional herbal medicinal system. The present book chapter reviews about the significance of traditional herbal medicine with the help of various examples of important medicinal plants.

Keywords

Traditional herbal medicine, Drug development, Ayurveda, Indian Medicinal Plants Database, National Medicinal Plants Board, Herbal industries, Novel Drug Delivery Systems, Clinical efficacy

1. Introduction

The plants originally emerged on earth approximately 500 million years ago and since then, they have spread to nearly every habitable ecological niche. The precise number of land plant species is unknown, approximately 4,00,000 have been identified and classified so far. Plants have shaped human lives since primitive times. Humans are dependent on the plants for various purposes such as food, forage, medicine etc. Available records of early civilization talk about the significance of plants in treating prevalent illnesses during that period. For example, The Egyptian Papyrus Ebers dates from 1500 BC and documented over 800 plant remedies (Aboelsoud 2010).

Due to various abiotic and biotic stresses, plants adapt and develop novel strategies to thrive under challenging conditions. Plants have evolved to produce a wide array of chemical compounds which aid them in attracting pollinators, defending against herbivores, communicating with each other, and much more. Hence, the plant world is an important source for drug development and traditional medicinal system. It is based on countless generations of knowledge gained from testing and experimentation by our ancestors. It just needs to be re-discovered by using modern scientific approaches.

1.1. Traditional Herbal medicine

WHO defines traditional medicine (TM) as "the total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health, as well as in the prevention, diagnosis, improvement or treatment of physical and mental illnesses". India, being a country strongly rooted in the medicinal practice of Ayurveda, has strong communal traditions. Such traditions have foundations and reasonings towards using the medicinal properties of plants and herbs towards disease control and general well-being (World Health Organization 2013).

India is one of the world's 12 mega-biodiverse countries because it has 47,000 species of plants and 15,000 medicinal herbs across 15 different agroclimatic zones. Approximately 7000 plants are used in Ayurveda, 700 in Unani, 600 in Siddha, and 30 in modern medicine (World Health Organization 2007). The efficacy of traditional medicine has been unquestionable for most of the history. It takes a hit in the last two centuries mainly due to long lasting negligence arising from various factors like political instability, hostile invasions, rapidly changing technology, etc. But despite the same, around 65% of the population still depend on traditional medication for alleviating both major and minor ailments and also to keep themselves healthy (Abbott 2014).

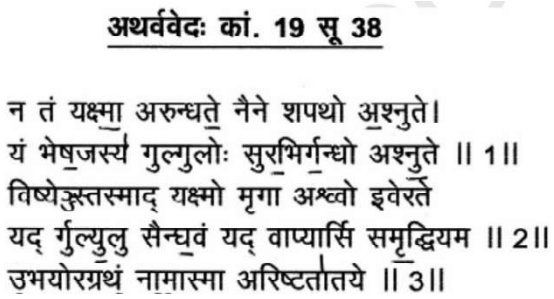
1.2. History of Traditional Herbal medicine

Traditional herbal medicine has a long and rich history in India. Ayurveda is an ancient Indian branch of medicine which is intended to prevent illness as well as treat it. The Vedas like Rig Veda have been some of the oldest Hindu works of literature (5000-1000 BC) that make use of plants and natural resources for therapeutic purposes (Mukherjee et al. 2017). Ancient literature such as the Ramayana and the Mahabharata has several examples of medical prowess including the usage of plants. However, Ayurveda became a full-fledged medical system during the "Samhita" period, around 1000 BC. During these times, the Charaka and Sushruta Samhitas were written (Mukherjee et al. 2017). A lot of other authors and historical figures added their publications to the vast pool for the next few thousand years. Thus it bolstered the ayurvedic knowledge from primordial local practice to a full-fledged science-based practice and experimental evidence. It should also be noted that the information and practices were updated and augmented continuously through a vast network of information exchange.

Ayurveda was taught in Takshashila and Nalanda Universities at that time. Jivaka, a famous Buddhist physician who treated Gautam Buddha, had studied Ayurveda at

Takshashila University. During the year 200 BC, students from all over the world came to Takshashila to study Ayurveda. During 200 and 700 AD, medical students from China and Japan came to the University of Nalanda to study Ayurveda. Many medicinal systems including Chinese traditional medicines and Tibetan were nourished by Ayurveda, which spread through Buddhism (Mukherjee et al. 2017). Ayurveda flourished during the rules of Hindu Kings until the Mughal rulers arrived (Jaggi 1973). After the British rule, Ayurveda had been significantly affected by the encounters with Western Medicine at the end of the nineteenth century (Bastos 2009). It is evident from the publications on Ayurveda in different languages from Sanskrit to English by the end of the 19th Century (Panikkar 2002). In present-day, Goverment of India recognizes Ayurveda practice and also as an educational system with the highest levels of qualifications being achievable by students (Mukherjee et al. 2017). *Commiphora wightii*, often known as guggul in Hindi, is a member of the Burseraceae family. Its therapeutic benefits have been mentioned in the 'Atharva Veda' (Figure 1). Guggul-gum has been shown to be hypolipidaemic, hypocholesterolaemic, and anti-obese, as well as astringent and antiseptic, anti-arthritic, antibacterial, anti-inflammatory, and anti-cancerous (Rastogi et al. 2016).

Ayurveda has a wealth of knowledge about ethnic folklore traditions and traditional features of medicinally significant drugs. Ayurveda intended to both prevent disease and increase patient awareness of disease causes. Ayurveda addresses the complete person, not just the ailment. This medical system stresses the individuality of each person's bio-identity, socioeconomic situation, biochemical, and physiological circumstances, all of which can contribute to a specific form of ailment (Mukherjee et al. 2017).



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न तं यक्ष्मा अरुन्धते नैने शपथो अश्नुते।
यं भेषजस्य गुल्गुलोः सुरभिर्गन्धो अश्नुते ॥ 1॥
विष्वेञ्चस्तस्माद् यक्ष्मो मृगा अश्वो इवेरते
यद् गुल्गुलु सैन्धवं यद् वाप्यार्सि समृद्धियम ॥ 2॥
उभयोरग्रथं नामास्मा अरिष्टतातये ॥ 3॥

Figure 1: The medicinal properties of *Commiphora wightii* are described in Sanskrit 'Shloka' in the Atharva Veda

2. Traditional Herbal Medicine in Modern Life

In Ayurveda, plant material collection is critical for maintaining the quality and effectiveness of any therapeutic plant due to innumerable considerations that must be made before collection. To acquire the highest values of medicine, the precise location, portion, technique, and time for collection are extremely crucial. While collecting plant materials, crucial factors affecting medicine quality such as Guna (quality), Desha (habitat), Pakva-apakva avastha, and rayojyanga must all be considered. Because phytochemical constituents of a medicinal plant are only obtainable through properly executed harvesting procedures. Plant gathering methods mentioned in Ayurveda include land selection (Bhumi pariksha), drug selection (Sangrahaniya dravyas), and cultivating methods (Sangrahaniya Vidhi) (Tavhare and Nishteswar 2014). The role of seasons known as Ritu in the plant germination and development of herbs is described by Charaka (Mukherjee et al. 2017).

Modern science also emphasizes that the collection phase influences the drug's efficacy because of many variables. Climate, temperature, rainfall, length of daylight, altitude, cultivation methods, soil constituents, method of plant collection, their processing, and final storage procedures all these have considerable impact on plant phytochemicals. The ideal collection process aims to obtain the purest and most authentic medication possible, thereby enhancing the quality and pharmacological efficacy of traditional Ayurvedic medicines (Tavhare and Nishteswar 2014).

3. Traditional Medicinal Plants of India

Medicinal plants provide a significant amount of productive capacity to the traditional medicine and Ayurveda sectors. They also provide a source of income and health security to a large portion of the Indian population. There are 1178 medicinal plant species in trade, with 242 species consuming more than 100 metric tonnes per year (www.nmpb.nic.in 2021). The selected Indian medicinal plants have been listed along with their ethnomedicinal uses in Table 1.

Table 1: A list of selected Indian medicinal plants and their ethno-medicinal uses

S. No.	Botanical Name	Family	Common Name	Plant Parts Used	Ethno-medicinal Uses
1.	*Dicliptera bupleuroides*	Acanthaceae	Soriul	Seed, Leaf	Leaves and seed decoction in water is highly beneficial in UTIs and dysentery, liver ailments, digestive disorders, sexual issues, skin infections, blood vomiting, wound healing, epilepsy, malaria, piles, jaundice, round worms, gummosis, and hepatitis (Shah et al. 2013)
2.	*Justicia adhatoda*		Bhasma	Leaf, Flower	Cough, fever, coryza, and respiratory issues are treated using leaf and flower juice (Rahmatullah et al. 2010)
3.	*Acorus calamus*	Acoraceae	Baj	Root	It's used to treat headache, asthma, fever, bronchitis, cough and digestive problems (like gas, bloating, colic etc.). It also has anti-bacterial, anti-helminthic properties (Balakumbahan et al. 2010)
4.	*Allium cepa*	Amaryllidaceae	Pyaj	Bulb	It has antioxidant and anti-microbial properties. It is used in treatment of diarrhea and malaria (Okusa et al. 2007)
5.	*Buchanania cochinchinensis*	Anacardiaceae	Chironji	Leaf	When gargled twice daily, the juice is quite efficient in relieving tooth discomfort. Used to treat cancer and asthma (Carmeliet and Jain 2011)
6.	*Lannea coromandelica*		Gunjhinganj	Bark	Bark paste is applied to injuries to halt bleeding and promote wound healing, while juice is used to treat jaundice and liver discomfort (Rahmatullah et al. 2011)

7.	*Calotropis gigantea*	Apocynaceae	Aak	Leaf	Wounds, toothaches, earaches, epilepsy, diarrhoea, and mental illnesses are all treated with warmed fresh leaves (Kumar et al. 2010)
8.	*Carissa spinarum*		Karunda	Root	It is used in rheumatism and because of its powerful purgative properties, it is utilized as one of the constituents in various purgative medicines (Sharma et al. 2017)
9.	*Hydrocotyle sibthorpioides*	Araliaceae	Brahmni	Leaf	It is used to treat dysentery, diarrhea, piles, rheumatism, digestive, diuretic, vermifuge, and menstrual issues (Das and Pathak 2013)
10.	*Asparagus curillus*	Asparagaceae	Safed Musli	Root	Powder of root is used to treat diabetes, dysuria, and dysentery. It is also used as a sexual tonic (Negi et al. 2010)
11.	*Asparagus racemosus*		Shatavar	Rhizome	Oral administration of root powder acts as an aphrodisiac. It is also utilized for stomachaches, urinary problems, nervous system problems, inflammation, liver problems, infectious infections, ulcers, and cancer (Gautam et al. 2009)
12.	*Adenostemma lavenia*	Asteraceae	Jangli-jeera	Flower, Leaf	Its flowers are used to treat mouth dryness as it increases saliva production. Leaves have wound healing properties (Joshi and Pant 2012)
13.	*Ageratum conyzoides*		Goat Weed	Leaf	It is used for treating diarrhea, rheumatism fever, leprosy and intestinal colic (Kamboj and Saluja 2008). Wound healing paste is made from leaves (Joshi and Pant 2012)

14.	*Anaphalis triplinervis*		Bakal	Leaf	It is used for fever, infections of eye and flu (Kamboj and Saluja 2008)
15.	*Berberis aristata*	Berberidaceae	Kambal	Root	Eye illnesses, jaundice, diarrhea, syphilis, skin diseases, urinary disorders, chronic rheumatism, diabetes and gastro intestinal problems are all treated with root extract (Uniyal et al. 2006)
16.	*Corylus colurna*	Betulaceae	Bhotia badam	Nut	Direct application of the nut or its tonic usage as a diuretic and aphrodisiac (Ozturk et al. 2013)
17.	*Cordia myxa*	Boraginaceae	Lasura	Fruit	Fruits are quite beneficial in the treatment of common colds and coughs (Joshi and Pant 2012)
18.	*Boswellia serrata*	Burseraceae	Sallai	Bark	Hot bark decoction is used to treat wounds, chronic inflammatory illnesses and diarrhea (Siddiqui 2011)
19.	*Celastrus paniculatus*	Celastraceae	Malkangani	Fruit, Seed	A boiled solution of fruits and seeds with oil is used to treat rheumatism, piles, leprosy, snake bite, dysentery, wound, anti-spasmodic, carminative, and anthelmintic properties, as well as mental illnesses, epilepsy, bronchial catarrh, chronic diarrhea, dysentery, intermittent fevers, tumors, pneumonia and leucorrhea (Singh et al. 2010)
20.	*Cleome viscosa*	Cleomaceae	Kumkum	Leaf	The juice of the leaves is beneficial for ear infections, anthelmintics, antiseptics, carminatives, antiscorbutic, sudorific's, febrifuges, and heart difficulties (Mali 2010)

21.	*Commelina benghalensis*	Commelinaceae	Kanchara	Leaf	Leaf paste is used to treat inflammation caused by honeybee stings (Joshi and Pant 2012)
22.	*Commelina paludosa*		Kankowa	Whole plant	A plant decoction mixed with water is used to cure sexual impotency (Joshi and Pant 2012)
23.	*Kalanchoe pinnata*	Crassulaceae	Sanjwanboata	Leaf	Wound healing is aided with leaf paste (Dwivedi et al. 2019)
24.	*Juniperus communis*	Cupressaceae	Hapusha	Green wood	Green wood smoke is used to treat tuberculosis and respiratory diseases. It has antioxidant and antibacterial properties as well (Miceli et al. 2009)
25.	*Butea monosperma*	Fabaceae	Dhak, Palash	Flower, Gum	The floral extract with water is beneficial in the treatment of gastritis. Bengal Kino gum, derived from bark, has anti-ulcer, anti-inflammatory, hepatoprotective, and anti-cancer properties (Joshi and Pant 2012)
26.	*Lablab purpureus*		Chimi	Whole plant	Fresh juice is used to treat earaches and has antibacterial properties (Al-Snafi 2017)
27.	*Geranium wallichianum*	Geraniaceae	Laljari	Root	Root extract can help with back pain, gout, bone strength, hepatitis, liver disorders, and preterm birth (Qureshi et al. 2009)
28.	*Hypericum japonicum*	Hypericaceae	Chhingewali	Whole plant	Snuff made from plant powder is used to treat nasal illness. It also possesses hepatoprotective properties, preventing liver damage and toxicity (Wang et al. 2008)

29.	*Anisomeles indica*	Lamiaceae	Catmint	Leaf	Cough and cold, chronic rheumatism, psoriasis, and snake bites are all treated using volatile oil found in the fresh leaves and other green plant parts (Joshi and Pant 2012)
30.	*Callicarpa macrophylla*		Daya	Fruit	Urinary problems, skin issues, diarrhoea, and hair care can all benefit from it (Sharma et al. 2003)
31.	*Litsea glutinosa*	Lauraceae	Maida	Bark	The bark is used to ease pain, enhance sexual desire, soothe the body, and stop bleeding (Joshi and Pant 2012)
32.	*Lilium polyphyllum*	Liliaceae	Kakoli	Root	The root's tonic and decoction are used as a refrigerant, galactagogue, expectorant, aphrodisiac, diuretic, and antipyretic (Dhyani and Garhwal 2007)
33.	*Bombax ceiba*	Malvaceae	Semul	Leaf, Root	Leaf paste helps to relieve wound pain and to alleviate gynecological diseases (Patil and Bhaskar 2006)
34.	*Melia azedarach*	Meliaceae	Dekrain	Root	The root paste is used to treat headaches; it also contains anthelmintic, antilithic diuretic, astringent, stomachic, anticancer, antimalarial, analgesic, and anti-inflammatory properties (Sen and Batra 2012)
35.	*Ficus auriculata*	Moraceae	Timil	Whole plant	Drinking 50-100 ml fresh leaves juice every day for up to 10 days can help with gastrointestinal issues. The bark and root are hypoglycemic and anthelmintic (Mazumder et al. 2009) Anti-tumor activities are found in fruit extracts.

36.	*Ficus benghalensis*		Bargad	Fruit	The milky latex of fruit laced with sugar is used to cure sexual impotency (Joshi and Pant 2012)
37.	*Boerhavia diffusa*	Nyctaginaceae	Punarnava	Root	Fresh root juice is used as eye drops and is an antibacterial tonic for liver problems, jaundice, and asthma (Kumar et al. 2014)
38.	*Grevillea robusta*	Proteaceae	Silver Oak	Leaf	Fresh leaf paste with vegetable ghee and coconut oil is particularly effective in treating burning and burning sensations (Joshi and Pant 2012)
39.	*Amelanchier canadensis*	Rosaceae	Indian wild pear	Fruit	Fruit Juice is used for treatment of diarrhea (Sharma et al. 2017)
40.	*Aegle marmelos*	Rutaceae	Bel	Fruit, Root	It has antipyretic, antidiarrheal, antidysentery, demulcent, and laxative properties. It is also used as astringent (Kesari et al. 2006)
41.	*Glycosmis pentaphylla*		Ban Nimbu	Seed	Plant seeds are used to treat vomiting (Joshi and Pant 2012)
42.	*Aesculus indica*	Sapindaceae	Panker	Fruit	Warm paste is used to treat rheumatism (Rajasekaran and Joginder 2009)
43.	*Bergenia ciliate*	Saxifragaceae	Sirparha	Root	Root powder is quite beneficial in the treatment of ulcers and kidney stones (Qureshi et al. 2009)
44.	*Datura stramonium*	Solanaceae	Dhatura	Flower	Flower juice is used to treat earaches because it has analgesic and antiasthmatic properties (Soni et al. 2012)
45.	*Hedychium spicatum*	Zingiberaceae	Kapurkachari	Root	Root powder is beneficial for neuromuscular diseases and bodily discomfort, as well as anticancer and antibacterial properties (Giri et al. 2010)

On November 24, 2000, the Government of India deputed the National Medicinal Plants Board (NMPB) to strengthen the medicinal plant sector. The board is now accommodated in the Ministry of AYUSH of the Indian government (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy). NMPB aims at developing appropriate means for smooth communication and cooperation among India's various ministries, departments, and organisations. The Board also focuses on the expansion of the medicinal plant sector on a domestic and international level by enacting policies or programmes to that end. NMPB also contributes to quality assurance and standards development programmes by creating Good Agricultural and Collection Practices (GACPs). These practices describes in detail quality, safety, and efficacy standards, agricultural, and a plausible mechanism for certifying the quality of fresh drugs, seeds, and imbedding material (www.nmpb.nic.in 2021).

There are different estimations as to the overall number of plant species used for medicinal purposes in India. The number of species varies between 3000 and 8000. The only way to solve the problem with these statistical data is to create a "referenced" dataset from "published" sources. Ayurvedic, Siddha, Unani, Homeopathy, and Sowa-Rigpa Materia Medica publications, and also floras and published books and articles on Ethnobotany, should also be included among all these published sources. Hence, this led to the development of "Indian Medicinal Plants Database". The database is in electronic form and was created by FRLHT (Foundation for Revitalisation of Local Health Traditions) with financial assistance from NMPB. It is now available on the NMPB Portal for "practitioners" of Indian Systems of Medicine, herbal industries, academics, researchers, resource managers, and policymakers to use. It includes 7263 botanical titles of Indian medicinal plants that have been linked to nearly 150,000 alternative names in 10 different Indian languages. It also contains over 5000 original images of Indian medicinal plants that have already been matched to the botanical entities. The medicinal plant species in the database have been collected and arranged in accordance with the six Indian Systems of Medicine: Ayurveda, Unani, Siddha, Homeopathy, Sowa-Rigpa, in addition to Folk (www.medicinalplants.in 2021). The database is a beautiful example of bringing traditional knowledge to modern life by developing an electronic database, all the traditional knowledge brought at the tips of our fingers. Here, significance of few medicinal plants has been mentioned along with their pictures (Figure 2).

3.1. *Abutilon indicum*

In Sanskrit, *A. indicum* is known as 'Atibala,' and its medical properties as well as therapeutic applications have also been documented in Indian ancient medicine practices. It is an aromatic herb of Malvaceae family. It has antispasmodic, anti-asthmatic, anti-pyretic effects, anti-microbial, antifertility, anti-inflammatory effects. The plant and its parts, have been used to treat diabetes, ulcers, swellings, pains, gastrointestinal difficulties, diarrhoea, and wounds (Khare 2010). Green synthesis of nanoparticles is fascinating researchers due to its biocompatibility and efficacy in treating a variety of illnesses. Gold and Silver nanoparticles of *A. indicum* (AI-Au-NPs and AI-Ag-NPs) have antibacterial, antioxidant and catalytic properties. They induce cell death by apoptosis in COLO 205 cells straight at small concentrations (IC 50 values 3 and 4 g/mL) via boosting intracellular reactive oxygen species production, which causes DNA breakage and therefore cell cycle arrest (Mata et al. 2016). After 24 and 48 hours, the gold nanoparticles of *A. indicum* (AI-Au-NPs) demonstrated cytotoxicity in the colon cancer (HT-29) cell line (IC 50 values of 180 and 210 g/mL). Mata et al. (2018) demonstrated the nontoxicity and biocompatibility of Ag and Au nanoparticles of *A. indicum* (concentrations of 5 mg/kg and 10 mg/kg equivalent to body weight given orally, respectively) in rats, specifying their potential biological applications.

3.2. *Hibiscus sabdariffa*

In ancient Indian medicinal texts, *H. sabdariffa* is referred to as 'Ambasthika.' It is widely known as sorrel and in Hindi it is called 'Gongura' and has been used in traditional medicines and also in food. Traditional uses for their medicinal properties include the use of calyces, leaves, petals, or entire flowers. *H. sabdariffa*, in folk medication, has been used by way of a mild laxative, diuretic, and for the management of liver, heart, and renal disorders. Various parts of plant are utilised to treat conditions such as pyrexia, hypertension, and inflammations of the skin (Singh et al. 2015). In South India, parts of the plant like thick sepals, petals, and leaves are used to make sour dishes and pickles with therapeutic properties. In North-Eastern India, the Zeliang tribe of Nagaland has long utilised fruits and calyces to cure gastrointestinal problems, as a hair tonic, and blood purifying agent (Gautam 2004). Sorrel juice is advised for cold, cough, and malaria treatment in Jharkhand (Tayade and Patil 2006). The tribes of Maharashtra's Nandurbar district utilise calyx soup to cure poisons (Abat et al. 2017). It is also utilised as a generic antidote for chemical and food

poisoning by the Assamese 'Karbis' tribe (Sumeet and Shefali 2008). In Tamil Nadu's Salem District, distillations of the fleshy part of calyx are used as a pleasant drink, while the leaves are used as a diuretic (Gairola et al. 2013). In Northern India, in Dehradun district, Uttarakhand, the Bhoxa community uses powdered seed to cure diarrhoea and dysentery (Lokendrajit et al. 2011). In Northeast India, the tribals in Manipur utilise leaves to cure problems related to kidney, particularly kidney stones (Laddha and Kunjalwar 2016). In Western India, Tribes of Bhiwapur Tahsil, Nagpur refer to this plant as 'ambadibhaji', and use it to cure acidity problems by making a liquid flower extract mixture having black pepper and sugar. Externally, crushed seeds are used to bruises and aches, and the leaves are used as a laxative (Silja et al. 2008).

3.3. *Sida acuta*

Many ethnic communities in India have reported using *S. acuta* (Sanskrit name: Balapatta) for ethnomedicine. Tribal populations in Southern and North-Eastern India have long used various portions of the plant to cure rheumatism, dandruff, kidney stones, liver issues, mental disorders, elephantitis, and testicular enlargement (Gairola et al. 2013; Silja et al. 2008; Tayade and Patil 2006). Fresh leaf extract is used to treat helminthic, anti-vomiting, and gastrointestinal problems (Venugopalan et al. 2012). Boils and abscises are treated with a paste of crushed roots mixed in juice of lemon. Root infusion is administrated to cure respiratory problems and rheumatism. The extract of the whole plant with hot water is administrated as a diuretic and to induce foetal abortion. Tribes in Tamil Nadu (Southern India) utilize the plant to cure bronchitis, dysentery, diarrhoea, and skin disorders (Ignacimuthu and Ayyanar 2006). Aside from India, this ethnomedicinal plant is used in other countries like Taiwan, Cuba, Colombia, Guatemala, Togo, Nigeria, Kenya and Mexico to treat dysentery, haemorrhoids, renal inflammations, malaria, ulcers, asthma, fever and venereal diseases (Dinda et al. 2015).

3.4. *Abelmoschus manihot*

Abelmoschus manihot (L.) is one of the noteworthy medicinal plants in the Malvaceae family. For hundreds of years, this plant has been widely used as traditional medicines in many parts of the world. It is mainly found in India, New Caledonia, China and Papua New Guinea (Pan et al. 2018). There are antioxidant and analgesic activities reported in leaves extract and anti-inflammation effects in stem extract (Pan et al. 2018). Its medicinal activities have been shown to protect against heart ischemia

and ischemic brain damage, enhance renal function, and treat diabetic mellitus. It is a key constituent of Huang Kui Capsule, China's most significant medication for treating diabetic nephropathy and chronic glomerulonephritis (Mabona et al. 2013).

3.5. *Thespesia populnea*

Thespesia populnea (L.) (Malvaceae) is commonly known as "Indian tulip tree". In India, it may be found in both tropical and coastal areas. Its pharmacological effects are documented in early Ayurvedic literature (Dravyaguna). Its different plant parts have been used to treat skin diseases like psoriasis, ring worms, liver disorders, dysentery, and cholera. It is used to cure gonorrhoea and urethritis by combining its bark oil with vegetable oil. In addition, the oil is employed as an herbal medicine to heal wounds, ulcers, and boils (Vasudevan and Parle 2006). The plant has antiviral and anti-cancer properties mainly because of gossypol, which is the main component. It has been shown to reduce inflammation and increase fertility in rats as well as humans. It is being studied as a potential drug for anti-cancer treatment in patients with advanced stage cancer because of its strong affinity towards proteins like Bcl-xL and Bcl-2, which are common apoptotic proteins (Viswanatha et al. 2011). Aqueous extracts of *T. populnea* fruits exhibit wound healing effects, accelerating healing and decreasing re-epithealization time (Nagappa and Cheriyan 2001). One study showed that the ethanolic extracts of *T. populnea* bark improved memory in mouse models after administering orally for 7 days and also protected the mice from memory deficits caused by conventional medicines like diazepam and scopolamine. The findings showed that *T. populnea* bark has the potential to improve memory and hence, may be useful in the treatment of Alzheimer's disease (Nagappa and Cheriyan 2001).

3.6. *Datura metel*

It is a member of Solanaceae. It grows in tropical and subtropical areas and is widespread in India. It is frequently utilised in treating many disorders like convulsions, catarrh caused by inflammation of the mucous membrane, hysteria, heart and skin diseases (Alabri et al. 2014). *D. metel* seeds have been shown to have a hypoglycemic role as evident from investigations with rats where the blood sugar levels were dropped in both control as well as alloxan induced diabetic rats. This discovery suggested that *D. metel* seeds possibly have anti-diabetic properties (Mai et al. 2017). Modern pharmacological investigations have revealed a variety of therapeutic actions such as anti-proliferative, anti-inflammatory and anticancer. Fruit pulps and seeds from *D. metel* have high antioxidant activity (Mai et al. 2017). *D.*

metel leaf extracts have anti-bacterial properties as the leaf extracts in organic solvents like chloroform and methanol inhibited the growth of microbes such as *Pseudomonas syringae, Fusarium oxysporum, Aeromonas hydraophylla,* and *Erwinia caratovara* (Vadlapudi and Kaladhar 2012).

3.7. *Solanum surattense*

Solanum surattense is a perennial Solanaceae herbal plant. It is common in India's tropical areas. It is commonly known as an Indian nightshade and has been used to treat a wide range of ailments, including asthma, diabetes, fever, and cough, notably in Southern India (Thirumalai et al. 2012). It is frequently used in the treatment of leprosy and constipation. It also possesses anti-malarial and free radical scavenging properties (Mickymaray et al. 2016). In diabetes-induced rats, *S. surattense* fruits were found to have a significant anti-diabetic effect. *S. surattense* ethanolic and methanolic extracts showed antibacterial efficacy against *Pseudomonas aeruginosa*, wound healing activities etc. (Thirumalai et al. 2012). Antibacterial efficacy of the plant extract against *Streptococcus* sp., *Staphylococcus aureus, Bacillus subtilis, Vibrio cholera, Escherichia coli,* and *Salmonella typhi* has been reported (Sheeba 2010).

3.8. *Mucuna pruriens*

Mucuna pruriens (L.) is a leguminous plant of Fabaceae family, often known as velvet bean. In Tamil, it is called 'poonaikalli'. It is mainly used for food, cover crop and as a cattle fodder. Traditional remedies make use of the seed, leaf, and root (Tan et al. 2009). *M. pruriens* possesses a wide range of pharmacological activities, including anti-diabetic, anti-inflammatory, aphrodisiac, analgesic, antioxidant and neuroprotective abilities (Ulu et al. 2018).

Different formulations of the plant have been used in Ayurveda as a first line therapy for Parkinson's disorder because the seeds are rich in Levodopa an alkaloid and precursor for many neuro-transmitters i.e., dopamine (DOP), adrenaline, and noradrenaline. As the dopamine concentration in the brain decreases, neuro-transmission becomes blocked. Once the L-dopa (LD) passes the blood-brain barrier, it is converted into dopamine, which corrects neuronal conduction (Misra and Wagner 2004). The concentration of LD in dried *M. pruriens* seeds was approximately 5.289% (Cassani et al. 2016). Methanolic extract of *M. pruriens* foliage has been shown to have anti-sickling (membrane stabilizing) properties in the treatment of sickle cell anaemia (Kuppusamy et al. 2018). The effect of the seeds on infertility in male was

studied, and the results suggested that the seed powder administered in dosage of 5 gm per day with milk for 3 months increased the concentration of sperms in oligo-zoospermic men increased from $8.31 \pm 2.82 \times 10^6$ per ml (before treatment) to $56.2 \pm 6.69 \times 10^6$ per ml (Shukla et al. 2009).

3.9. *Senna auriculata*

It is a member of Fabaceae family which may grow upto 3 meters. Different plant parts are recognised to treat a variety of illnesses. Diabetes, rheumatism, eye disorders, gonorrhoea, gout, worm infestation, diuretic, diarrhoea, pittam disease, pharyngitis, and nocturnal emissions are all treated with the bark. Leprosy, chyluria, ulcers, dysentery, throat irritation, ophthalmic, swellings, chronic purulent conjunctivitis, gastrointestinal disorders, and skin issues are all treated with the leaves. *S. auriculata* roots and leaves are used to treat asthma. *S. auriculata* plant constituents are utilised in the making of kalpa, a natural tea that helps in reliving constipation, UTIs and diabetes. It has antibacterial, antipyretic, anthelmintic, hepatoprotective, and antihyperlipidemic properties (Khader et al. 2017). The phyto-constituents of *S. auriculata* like anthracene derivatives, flavonoids, alkaloids, polysaccharides and tannins have now been characterised to have pharmacological potential in the treatment of asthma, conjunctivitis, diabetes mellitus, ulcers, skin problems, cancer and disorders of liver and kidney (Sharmila et al. 2016).

3.10. *Eclipta alba*

This plant belongs to Asteraceae family. It is a common weed and may be found in both tropical and sub-tropical locations. It shows a variety of biological activity, which is used to treat snake venom poisoning, hepatitis and other viral diseases. The plant has been considered to offer shielding properties to cells of liver in Ayurveda, and it is thus utilised to restore liver function (Singh et al. 1993; Umemoto and Koyama 2007). *E. alba* extract showed anti-viral properties by preventing replication of virus and resulting in lower viral load as it inhibits the RNA dependent RNA polymerase protein activity (RdRp) of Hepatitis C Virus (Umemoto and Koyama 2007).

3.11. *Picrorhiza kurroa*

Picrorhiza kurroa belongs to the Plantaginaceae family. Popularly the plant is also referred to as "Indian gentian", "Kurro" and "Kutki". In the Northern Himalayas, it may be widely found at heights of 3000 to 5000 metres (Pandit et al. 2013). This perennial plant is well-known for its ability to treat liver and respiratory diseases. It is commonly used to treat diarrhoea, scorpion bites and persistent fever. The active

iridoid glycosides, a type of monoterpenoids occurs inside the plant body. Therefore, it has pharmacological applications such as hepato-protective, antioxidant, anti-inflammatory, and anti-cancerous action (Pandit et al. 2013).

3.12. *Scoparia dulcis*

Scoparia dulcis belongs to Plantaginaceae family that is extensively spread in both subtropical and tropical areas. It is used to treat blennorrhagia, diabetes, gastrointestinal issues, and tooth pain (Ahsan et al. 2012). Over 50 chemicals have successfully been discovered from this plant, including glutinol, which has analgesic and anti-inflammatory properties, and scopaducilic acid B and scopadulin, which have anti-viral activity. Noradrenaline and adrenaline both have sympathomimetic effects (Wu et al. 2012). Scopadulin and scoparic acid A from *S. dulcis* have demonstrated strong antiviral efficacy against the Herpes Simplex Virus. The plant extract also has diterpenes derived from labdane, which have been demonstrated to have cytotoxic action against 6 distinct human stomach cancer cell lines (Murti et al. 2012).

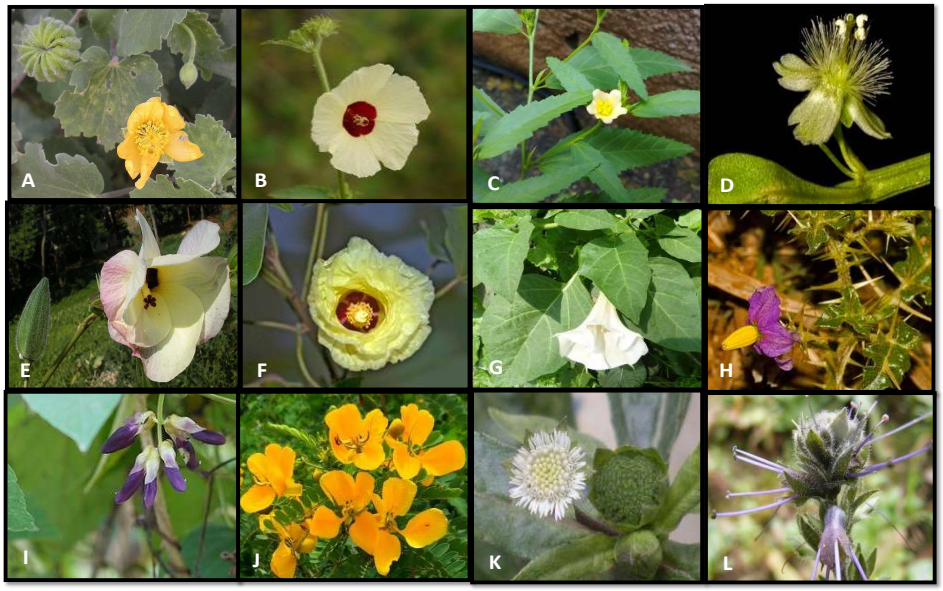

Figure 2. Photographs of selected medicinal plants (Source: Eflora of India)

(A) *Abutilon indicum*; (B) *Hibiscus sabdariffa*; (C) *Sida acuta*; (D) *Scoparia dulcis*; (E) *Abelmoschus manihot*; (F) *Thespesia populnea*; (G) *Datura metel*; (H) *Solanum surattense*; (I) *Mucuna pruriens*; (J) *Senna auriculata*; (K) *Eclipta alba*; (L) *Picrorhiza kurroa*

4. Future Aspects of Traditional Herbal Medicine

In the early nineteenth century, research into novel therapeutic compounds derived from medicinal plants aided in the establishment of the modern pharmaceutical industry. Plant natural products account for 25% of all novel molecular entities (NMEs) authorized by the Food and Drug Administration (FDA) from natural sources. Morphine was the first plant-derived NME, a benzylisoquinoline alkaloid painkiller derived from the opium poppy (*Papaver somniferum*) that was approved for use in 1827 (Patridge et al. 2016). Since then, plants have produced a plethora of new drugs. Paclitaxel, a diterpene alkaloid derived from *Taxus brevifolia* (Pacific yew) (Wani et al. 1971), as well as the indole alkaloids vinblastine and vincristine obtained from *Catharanthus roseus* (Madagascar periwinkle) (Neuss et al. 1959), are pertinent cancer chemotherapy medications used within treatment centres.

All of the ancient medicines mentioned in the history books of Ayurveda and the traditional Indian approach of medicine may be investigated and confirmed using modern scientific techniques. Ayurvedic medicine's therapeutic efficacy can be increased to a high degree by assessing its identity, quality, safety, stability, biological and physical properties. The use of chemo-profiling, standardization, and biological studies is critical for assessing product quality and maintaining scientific documentation for Ayurvedic medicine's validity (Mukherjee et al. 2017). Innovative formulation techniques are getting popular as a means of enhancing medicinal effectiveness by increasing bioavailability (Rahman et al. 2013). In this case, Novel Drug Delivery Systems (NDDS) can help to mitigate several of the disadvantages of Ayurvedic medicine. As a consequence, pharmaceutical formulation for phytoconstituent administration is vital. The advancement of NDDS has created a broad platform for Ayurvedic drugs to improve their clinical efficacy (Mukherjee et al. 2015).

Recent advances in genomics, bioinformatics, analytical chemistry and synthetic biology have created new avenues for recognising, utilising, and enhancing plant therapeutic properties. For example, Bioinformatic techniques were used to investigate whole-genome gene expression in cell (human) lines exposed to a small molecule library. It leads to the discovery of celastrol and withaferin A, plant triterpenoids with the potential to act as leptin sensitizers. Withaferin A is derived from the Ayurvedic herbal plant *Withania somnifera* (Ashwagandha), and celastrol is derived from the traditional Chinese medicinal plant, *Tripterygium wilfordii*. Both plants are powerful anti-diabetic and anti-obesity agents (Lee et al. 2016).

To sum up, the process of re-examining traditional herbal medicine systems is both exciting and challenging. Future research should focus on removing at least four major roadblocks that currently obstruct the field:

1. Novel mathematical and computational measures are crucial for speeding up the verification of the specific molecular components responsible for defined bioactive components in crude extracts.
2. Major steps ought to be taken to understand how monoherbal products or combinations of herbal products relate with their mammalian protein aims to deliver pharmacological properties.
3. Metabolic engineering methodologies for long-term manufacturing of these high-value molecules should be constructed when first bioactive natural products have been correctly identified from their native plant hosts.
4. Investigators try to find the least number of single-plant natural products that can effectively replicate the efficacy of previously developed multigradient herbal medications.

Rather than foregoing the vast knowledge collected and compiled for over 4000 years, the aim should be to merge the same with understanding of modern medicine. Drawing parallels and improving upon the efficacy of treatments can be the solution to the state of the modern world where the socio-economic structure prevents the highest level of medical care from reaching all the rungs of our society effectively. The ease of access a common citizen has to the plants found in the local area is more which might allow for a radical impact on healthcare if the understanding of the same could be effectively utilized.

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