



Cultivation of Medicinal Plants: Special Reference to Important Medicinal Plants of India

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8.1 Introduction

Herbal medicine and medicinal plants are playing an integral role in the modern healthcare system. Acceptance and utilization of herbal medicine are increasing day by day for their better compatibility, lesser side effect, and economic health management. Herbal sources are mainly used as medicine, cosmetic and supplement (Sen and Chakraborty 2017; Sen et al. 2011). The growing interest towards the herbal medicines made this a prime area of research and development. India is a rich repository of codified and folk knowledge of medicinal plants as well as differences in climatic condition, attitude, and rainfall makes this land a gold mine of medicinal plants. The word “herb” taken from the Latin word, “*herba*” and an old French word “*herbe*” (Rajak and Singh 2017). The market of traditional medicinal plants and herbal formulations are also lucrative and increasing day by day. Indian traditional medicine is well-established traditional medicinal system and received global acceptance particularly Ayurveda. The demand for Ayurvedic and other herbal medicine is increasing day by day. A number of herbal formulations are presently available in market equally competing allopathic medicines. Codified medicinal texts like Ayurveda, Unani, Siddha are the main sources of information for the preparations of marketed herbal products. World Health Organization (WHO) estimated that about 80% world population rely on herbal medicines mainly in their primary healthcare needs. It is estimated that 300,000 plant species exist globally and only 15% have been screened to find their possible therapeutic potential (De Luca et al. 2012). Ministry of Environment and Forests, Government of India, documented more than 9500 plant species based on their importance in the pharmaceutical industry. Medicinal and aromatic plants MAP species are collected from wild sources and comparatively a few are grown in farmland (Maiti and Geetha 2007). Maximum herbal industries are collection the medicinal plants/plant parts from the forest source. The excessive or irrational collection may also result in threat to the availability of medicinal plants. Loss of biodiversity, industri-

alizations are became a big threat to medicinal plants species (Kala et al. 2006; Sen and Chakraborty 2017). Therefore, conservation of medicinal plants and commercial harvesting of medicinal plants could be useful for sustainable availability of medicinal plants. Collection of forest source in different season and different area may vary the phytochemical content which may ultimately effect in the biological activity of the plant. Commercial herbal garden is one of the very effective solutions to overcome these problems. Scientific research and science tools developed a number of isolated phytochemicals with prominent biological activity. A number of drugs are inspired from the isolated phytochemicals and successfully used in the management of modern healthcare. Recent era, the growing market of herbal medicine has an important aspect of economic growth of the country. This article deals with majorly deals cultivation with some very common and commercially important medicinal plants of India.

8.2 Important Medicinal Plants of India

8.2.1 Yam

Botanical Name: *Dioscorea* spp.

Family: Dioscoreaceae.

The chemical present in the yam is diosgenin, which is obtained from tubers root of dioscorea and important chemical for several steroid hormones including sex hormones, cortisone, and various corticosteroids and is the major ingredient in the oral birth control pill. The growing necessity for steroidal drugs and the high expenditure of obtaining them from animal sources led to an extensive search for plant sources of steroidal sapogenins; which eventually led to the identification of the Genus *Dioscorea* as the most promising one. This genus *Dioscorea* with more than 600 species is broadly distributed in the tropical world. The species like *Dioscorea alata* and *Dioscorea esculenta* are also cultivated for their edible tuber and time of cultivation time is longer. About 15 *Dioscorea* species contain

diosgenin. Among them, *Dioscorea floribunda*, *Dioscorea villosa*, *Dioscorea composita* etc. are extensively grown for diosgenin production. The

diosgenin content ranges from 2% to 7% based on the age of the tuber (Das et al. 2013; Bhattacharjee et al. 2015).

Cultivation details of *Dioscorea* spp.:

Climate and soil	Varieties	Propagation	Planting	Harvesting and yield
Subtropical warm humid weather and light soil; pH 5.5–6.5	FB(c)-I, Arka Upkar	Tubers 250–300 gm/ piece/pit	60 cm × 30 cm (R-R × P-P) for 1 year crop 60 cm × 45 cm (R-R × P-P) for 2 year crop	February-March 50–60 tonnes/ha

8.2.2 Sarpagandha

Botanical Name: *Rauvolfia serpentina*.

Family: Apocynaceae.

Rauvolfia (Sarpagandha) or Serpentine root is one of the vital crude drugs used in present medicine and known since 3000 years (Dey and De 2010). Roots are prominent, tuberous, usually branched, 0.5–2.6 cm girth, 40–60 cm long into

soil. The bark of root, which constitutes 40–60% of total root volume, is rich in alkaloids known for their usefulness in lowering high blood pressure and as a sedative or tranquilizing agent. The fresh roots give a unique acrid aroma and are very astringent in taste. The root contains high alkaloid concentration. In allopathic means of medicine, reserpine is the most active principle used for hypertension for life-saving drug.

Cultivation details of Sarpagandha:

Climate and soil	Variety	Propagation	Planting	Harvesting, processing and yield
Well suited at 10–30 °C and sandy alluvial loam to red lateritic loam and pH –4.6 to 6.5.	Wild and R.S-1	Seed and also by vegetative means like root stumps, and stem cutting.	Seedlings of 40–50 days and 30 cm × 30 cm spacing, 80,000–1,00,000/ha	After 30 months of planting (during winter months), the roots are cleaned, washed and cut into 12–15 cm pieces for drying and storage. Dry root 2000–2500 kg/ha.

8.2.3 Opium

Botanical Name: *Papaver somniferum* L.

Family: Papaveraceae.

Papaver somniferum is an outstanding medicinal plant. Opium and codeine are the products of opium that used for their analgesic and hypnotic property (Dhakad et al. 2017). A semi-synthetic morphine known as heroin has led to worldwide

social problem. But morphine and another opium alkaloid still have important and non-replaceable role in the healthcare sector. Poppy is a strait, rarely branched, annual, growing to a length of 0.60–1.20 m. With operation of lancing on fruits (capsular) latex known as opium is obtained. In nature, all parts of the poppy plant have milky white latex, but large amount contains on unripe capsules.

Cultivation details of Sarpagandha:

Climate and soil	Variety	Propagation	Planting	Harvesting and yield
Cool climate favors high yield and light black or loam soil with highly fertility, pH around 7.0.	Ranghatak, Talia, Dhola Chota, Sujatha, NBRI-3 and Shubhra	Seed rate is 4–5 kg/ha for line and 7–8 kg/ha for broadcast.	broadcast or in lines, 30 cm × 30 cm	95–115 days after sowing and 50–60 kg/ha.

8.2.4 Periwinkle

Botanical Name: *Catharanthus roseus* (L) G. Don.

Family: Apocynaceae.

It is one of the important medicinal plant's mentions in the literature of folk medicinal. The plant has been extensively used as a purgative, abortifacient, antidiabetic, hemorrhagic antimarial, diuretic, antidysenteric and against skin

diseases by the antique people (Devi et al. 2017). Modern studies have shown that periwinkle contains more than 100 alkaloids found in various parts of the plant. Periwinkle gained additional importance after the separation of vinblastine and vincristine alkaloids which having importance in cancer (Moudi et al. 2013). Other alkaloids like rovidine, leurosovine and leurosidine isolated from the plant and acquired medicinal importance for their preclinical anticancer properties.

Cultivation details of Periwinkle:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Tropical and subtropical and deep sandy loam to loam soils	No improved variety	Periwinkle or Vinca is propagated by seeds	45 × 30 cm	After 6, 9 and 12 months of sowing. Yield- 4 t/ha of leaves, 1.5 t/ha of stem, and 1.5 t/ha of roots.

8.2.5 Aloe/Gheekumari

Botanical Name: *Aloe spp* (L) G. Don.

Family: Liliaceae.

It is commonly called as healing plant, miracle plant, fountain of youth and plant of immortality. Out of the 275 species, only three species are commercially vital which are the majorly used in pharmaceutical industries or medicinal purpose. They are: *A. barbadensis*, Mill. (*A. vera* Linn) which yields Indian aloe or Curacao aloe or Barbados aloe or Jaffarabad aloe, and *A. ferox* and yield Cape aloe, and *A. perryi* (socrine aloe). Other aloe species (*A. africana* and *A. spicata*) yield aloes of lesser importance. Aloe gel or *A. vera* gel derived from the leaves, and the yellow, bitter juice present in specific cells underneath the bulky epidermis yields the

drug aloe and the parenchymatous tissue in the leaf center found to contains a mucilaginous gel; at present it is obtained from *A. barbadensis*. Aloe contains cathartic anthraglycosides as its lively principles; are mostly C-glucosides, notably barbaloin (glucoside of aloe emodin) (Patel et al. 2012). The concentrations glucosides may differ with the types of aloe varying from 4.5% to 25% of aloin. Aloe gel is well known for domestic medicinal importance. For this cause, *Aloe vera* is also called first-aid for burn or medicine plant. When newly obtained, the gel has the property of relieving sunburn and thermal burns, also wound healing; it has moisturizing and emollient properties. As a food, aloe extracts are used as a flavor ingredient mainly in non-alcoholic and alcoholic beverages.

Cultivation details of Aloe:

Climate and soil	Variety	Propagation	Planting	Harvesting and yield
Warm, humid or dry climate and sandy coastal to loamy soils of the plains with a pH of up to 8.5	Non	By root-suckers or rhizome cuttings	60 cm × 30 cm or 60 cm × 45 cm	Harvested eight months after planting and around 10,000–12,000 kg/ha

8.2.6 Guggal

Botanical Name: *Commiphora wightii* (Arn.) Bhandari syn. *Commiphora mukul*.

Family: Burseraceae.

The gum is acrid, bitter, thermogenic, astringent, expectorant, aromatic, anthelmintic, digestive, anti-inflammatory, antiseptic, anodyne, nervine tonic, alterative, aphrodisiac, stimulant, antispasmodic, liver tonic, hemostatic, emmenagogue,

rejuvenating, diuretic, general tonic (Joy et al. 1998), and is useful in scrofula, gout, sciatica, facial paralysis cough, diplegia, asthma, pectoral,

bronchitis and hepatic, otorrhoea, disorders, fever, epilepsy, stangury, dysmenorrhoea, hemorrhoids, wounds, amenorrhoea and ulcers.

Cultivation details of Guggal:

Climate and soil	Variety	Propagation	Planting	Harvesting and yield
Warm, humid or dry climate and sandy to silt-loam or rocky soils	No	Semi-wood stem cuttings	Rainy season	After 8–10 years ready for tapping of the gum by shallow incision on bark during December and March and 500–800 g gums per plant.

8.2.7 Belladonna

Botanical Name: *Atropa belladonna* L.

Family: Solanaceae.

Atrops is commonly called as ‘Deadly night Shade’. The commercial drug is obtained from the roots, leaves and flowering tops of *A.belladonna*. Belladonna leaves are extensively

used for the produce of tinctures and plasters. The drug serves as a sedative, anodyne, stimulant, antiasthmatic, antidiuretic, antispasmodic and anti-inflammatory. It is found beneficial in treatment of stomach, renal disorders, biliary colic, and to stop sweating. The roots are mainly used in the external treatment of rheumatism, gout and other affiliations.

Cultivation details of Belladonna:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Perennial in temperate climates and deep fertile soils of medium texture.	Gurguva	Seeds and May to the end of autumn	March–April or October–November	3 months after planting and average of 1000 kg of dry herb, 1500 kg per hectare during second and third years and dry roots will vary from 170 to 335 kg/ha.

8.2.8 Nux Vomica

Botanical Name: *Strychnosnux-vomica* Linn.

Family: Strychnaceae (Loganiaceae).

Dried seeds or beans, and occasionally its bark (called *nux vomica*) are used in herbal remedies (Akbar et al. 2010). The seeds contain organic substances, brucine, and strychnine. Dried seeds of kuchila are stomachic, nervine, and aphrodi-

siac, cardio-tonic, and respiratory stimulant. It is used as a remedy in paralytic, chronic dysentery and neuralgic disorders, rheumatic arthritis, epilepsy, and hydrophobia. It is an important drug in all systems of medicine. *Strychnos* species is a deciduous tree, medium-sized, with fairly long and cylindrical bole and dark-grey or yellowish-grey bark with minute tubercles.

Cultivation details of Nux vomica:

Climate and soil	Variety	Propagation	Planting	Harvesting & Yield
Dry or humid tropical and laterite, sandy, and alluvial soil.	no	Seeds, also through cuttings	Onset of South-west monsoon in May or early June and 5 m × 5 m.	50–75 kg of dry seeds per tree per year.

8.2.9 Medicinal Solanum

Botanical: *Solanum spp.*

Family: Solanaceae.

Species include *S. indicum*, *Solanum anguivi* Lam. (Poison berry), *Solanum nigrum* Linn.

(Black night shade), *Solanum torvum* (West Indian turkey berry), *Solanum surattense* Burm, *Solanum khasianum* C.B. Clarke. It is source of low cost steroidal drugs, due to its quick growth and low first investment in its commercial cultivation. It yields a solasodine, glyco-alkaloid, a

nitrogen analogue of diosgenine. Solasodine through 16-dehydro-pregnenolone (16 DPA) is converted of compounds like methyl testosterone and testosterone and corticosteroids like hydrocortisone and prednisolone (Sunitha and

Swapna 2014). These steroidal compounds have anabolic, anti-inflammatory and antifertility properties, due to which they find huge-scale use in family and health planning programs through the world.

Cultivation details of Medicinal Solanum:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Moderate climate red lateritic soil with a moderate quantity of organic matter.	Arka Sanjeevini, Arka Mahima, Pusa-1, RRL 20-2	Seed	June to September or October, 50 cm × 50 cm, 75 cm × 75 cm and 90 cm × 120 cm.	6 months to be ready for harvesting and 2500 kg/ha of dried.

8.2.10 Aonla/Amla

Botanical Name: *Embllica officinalis* Gaertn., Syn. *Phyllanthus emblica*,

Family: Euphorbiaceae.

Amla is an antioxidant with the free radical scavenging quality, which may be presence of high

levels of super oxide dismutase (Hazra et al. 2010). It is efficient in the treatment of dyspepsia, peptic ulcer and diabetes. Further reported are antioxidant, hepatoprotective, cytoprotective, antimutagenic, antimicrobial and anti-tumor (Deori et al. 2017).

Cultivation details of Medicinal Amla:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Tropical plant and medium heavy soil except purely sandy	NA-7, NA-6, NA-10 and Chakaiya	Generally propagated by shield budding.	May–June and 4.5 m × 4.5 m.	After 4–5 years, harvested during February and 50–70 kg of fruit.

8.2.11 Senna

Botanical Name: *Cassia angustifolia* Vahl.

Family: Leguminaesae.

Senna is used in medicine as a cathartic and habitual constipation. It increases the peristaltic

movement of the colon (Balasankar et al. 2013). Senna on storage, lose biological action faster than revealed by chemical estimation. The leaves/pods as such or in powder form do not lose potency easily (Sreeramu 2004).

Cultivation details of Medicinal Senna:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Sun-loving crop and tropical climate. Red loam, alluvial loam and the rich clayey rice-fields.	Thenkalam local type, 'ALFT -2' Sona and KKM 1	Seeds	Seeds are broadcast or 30 cm × 30 cm.	50–70 days, 90–100 days and 130–150 days after sowing. 15 q/ha of dry leaves and 7 q/ha of pods.

8.2.12 Isubgol

Botanical Name: *Plantago ovata* Forsk.

Family: Plantaginaceae.

Isabgol (*Plantago ovata* Forsk.) is key medicinal plants used widely that have originated

from arid and semi-arid zones and widely used by traditional medicinal industries. It is an annual herb and cultivated in Gujarat, Rajasthan, Madhya Pradesh and Haryana (Meena et al. 2015).

Cultivation details of Isabgol:

Climate and soil	Variety	Propagation	Planting	Harvesting and yield
Cool and dry weather, that is, from November–December to March–April and sandy loam to rich loamy soil with a pH of 7–8 is ideal	Gujarat Isabgol-1 Gujarat Isabgol-2, Gujarat Isabgol-3, Jawahar Isabgol-4, Hariyana Isabgol-5 and Niharika	Seed (4–6 kg/ha)	November–December	110–130 days after sowing and 800–1000 kg/ha.

8.2.13 Stevia

Botanical Name: *Stevia rebaudiana*.

Family: Asteraceae.

Stevia is a subtropical perennial that produces sweet steviol glycosides in the leaves for which it is also known as ‘Mou Tulsi’ or ‘Cheeni Tulsi’. Plants grown-up at higher latitudes generally has

a higher percentage of sweet glycosides (Mathur et al. 2017). Origin of Stevia is North Eastern Paraguay. Stevia uses include regulating blood sugar, treatment of skin disorders, preventing hypertension and prevention decay of tooth. The compound obtains from stevia is consider to be the best alternate source of sugar for diabetic patient.

Cultivation details of Stevia:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Semi-humid subtropical plant and well-drained fertile sandy loam or loam soil and prefers acidic to neutral (pH 6–7) soil	S.R.B-123, S.R.B-512 and S.R.B-128	Stem cuttings @ 75,000/ha	March to mid- May and distance of 40 cm × 30 cm	4 months after planting during mid to late September. About 15,000 kg/ha of green herb is obtained which on drying gives about 4166 kg/ha.

8.2.14 Coleus

Botanical Name: *Coleus forskohlii* Syn: *Coleus barbatus* Brig.

Family: Lamiaceae

Coleus is used as an emmenagogue, expectorant and diuretic. Interestingly its foliage is employed

for intestinal disorders treating, and it has been utilized as a condiment for a long time before in India. The tuberous roots of the plant similar to a carrot in shape and brown in color are the economical parts.

Cultivation details of Coleus:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Crop of the tropics, 10–25 °C and 100–160 cm rainfall and porous and well-drained soils pH from 5.5 to 7.	Garmai, Manganiper, Maimul and Selection K-8	Terminal cuttings (10 cm) or rooted cuttings..	June–July, 60 cm × 45 cm spacing (37,030 plants/ha).	4.5–5 months after planting. Fresh tubers: 15–20 t/ha Dry tubers: 2000–2200 kg/ha.

8.2.15 Acorus

Botanical Name: *Acorus calamus*.

Family: Acoraceae (Araceae).

Acorus calamus is a semi-aquatic, perennial and smelly plant, habituated in both sub-temperate and temperate zones (Meena et al. 2010). It is

very well known for the remedies of cold and cough and also like bronchitis. It is considered as a useful aid to the digestive system as it helps against colic, flatulent, dyspepsia and vomiting. It is composed in the formulation for psychosomatic disorders like epilepsy and it roots having insect repellent characters.

Cultivation details of Acorus:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Sub tropical climate and shallow water or in a very moist loamy soil and pH 5.5–7.5	No	Roots/rhizomes and seeds.	–	Early spring before new growth, or late autumn and 1–1.5 tons of dry rhizome per acre

8.2.16 Ocimum (Holy Basil/Tulsi)

Botanical Name: *Ocimum sanctum* Linn.

Family: Lamiaceae/Labiatae.

Tulsi is one of the important medicinal plants of India, which has its medicinal and religious importance since ancient time. Essential oil of

tulasi has various medicinal importance. It is extensively used as an herbal tea, commonly used in Ayurveda. It is widely used in various aspects drugs, flavouring insecticide, culinary purposes and perfumery. The plant possesses mainly phenols, tannins, aldehydes, saponin, and fats (Ansari 2015).

Cultivation details of Ocimum:

Climate and soil	Variety	Propagation	Planting	Harvesting and Yield
Fairly high rainfall and humid conditions. Rich loam to poor laterite, saline and alkaline to moderately acidic soils.	Sri Tulsi (green type) and Krishna Tulsi (second type)	Seed (200–300 g/ha)	Nursery- third week of February and transplanting-middle of April. 40 cm × 40 cm, 40 cm × 50 cm, 50 cm × 30 cm.	First harvest at full bloom i.e. 90–95 days after planting and harvested at every 65–75 days. About 5 tonnes/ha of fresh harvest can be obtained twice or thrice a year.

Yam, sarpagandha, opium, periwinkle, aloe, guggal, belladonna, nux vomica, medicinal solanum, aonla/amlam, senna, isubgol, stevia, coleus, acorus, and ocimum are medicinally important plants. Researches on

these plants isolated different important phyto-molecule and investigated for their therapeutic potential. Table 8.1 included the major phytochemicals and pharmacological activity of these plants.

Table 8.1 Major phytoconstituents and pharmacological activity of selected medicinal plants of India

Name	Major bioactive phyto-molecules	Pharmacological properties
Yam (<i>Dioscorea</i> spp.; Family: Dioscoreaceae)	Diosgenin, dioscorin, dioscoreanoside A-K, dioscin, diosbulbin, diosbulbisides, bafoudiosbulbin, quercetin and its derivatives, kaempferol and its derivatives, hyperoside, neoxanthin, auroxanthin, violaxanthin, cryptoxanthin, daucosterol, β -sitosterol, 3-o- β -d-glucopyranosyl-b-sitosterol, stigmasterol, catechin, protocatechuic acid, (+) epicatechin, (–) epicatechin, vanillic acid, isovanillin acid, protodioscin, protoneodioscin (Galani and Patel 2017; Sautour et al. 2007)	Anti hypertensive, antioxidant, anticancer, antimicrobial, immunomodulatory, antidiabetic, hypolipidemic and hypocholesterolemic, analgesic and anti-inflammatory, anti-HIV activity, diuretic, gastro protective, cardioprotective Activity (Kanu et al. 2018; Galani and Patel 2017)
Sarpagandha (<i>Rauvolfia serpentina</i> ; Family: Apocynaceae)	Reserpine, serpentinine, ajmalicine, ajmaline, ajmalimine, reserpiline, deserpidine, indobidine, rescinnamidine, rescinnamine, serpentine, yohimbine, indobinine, serpentinine etc. (Chauhan et al. 2017; Kumari et al. 2013).	Antihypertension activity, inhibition of ACE, antivenom activity, antioxidant activity, antimicrobial activity, hypolipidemic activity, hepatoprotective activity, hyperglycemic activity, antivenom activity, anti-diarrheal activity (Chauhan et al. 2017; Kumari et al. 2013).

Table 8.1 (continued)

Name	Major bioactive phytomolecules	Pharmacological properties
Opium (<i>Papaver somniferum</i> ; Family: Papaveraceae)	Morphine, codeine, narcotine, thebaine, papaverine, narceine, cryptopine, pseudomorphine, protopine, hydrocatarnine, laudanosine, meconidine, laudanine, rhoeadine, codamine, meconidine, nascopine, xanthaline, lanthopine, apocodeine, apomorphine, thebamine, desoxycodine, catarnine, prophyroxine (Mani and Dhawan 2014; Chalise 2015)	Poppy latex and poppy alkaloids exerted number of activities like hypnotic and sedative, expectorant, astringent, diaphoretic, antispasmodic, antitussive, antispasmodic, analgesic, sedative, narcotic, antiperistaltic, anticonvulsant etc. (Mani and Dhawan 2014).
Periwinkle (<i>Catharanthus roseus</i> ; Family: Apocynaceae)	Vindoline, vinblastine, vincristine, vindolidine, vindolicine, vindolinine, ibogaine, lochnerine, yohimbine, raubasine, leurosine, catharanthine, leurosine, lochnerine, catharanthine, vindoline, ajmalacine, serpentine, reserpine, lochnerine, alstonine, tabersonine, horhammericine, echitovenine, tricin, vingramine, methylvingramine (Renjini et al. 2017). Zeatin ribosyl, zeatin, zeatin-9-riboside, vinaphamine vinaspine, vincaline, vincathicine, vinosidine, vinsedicine, vinsedine, yohimbine, vanillic acid, syringic acid, quercetin, isovincoside, kaempferol, catharine, catharosine, cathenamine, cathindine (Nisar et al. 2016)	Antioxidant, antimicrobial, antiulcer, antidiabetic, hypotensive, wound healing, anticancer, memory enhancing activity, anti-diarrheal, anthelmintic, biopesticidal (Das and Sharangi 2017; Renjini et al. 2017).
Aloe (<i>Aloe vera</i> , Family: Liliaceae)	It contain high level of water (99%–99.5%) and small amount of solid contents (0.5%–1%). Aloin; Barbaloin; Isobarbaloin; Emodin; Anthracene; Anthranol; Emodin; Aloetic acid, Resistannol (Minwuyelet et al. 2017; Maan et al. 2018).	Anti-microbial activity (antibacterial, antifungal, antiviral), anti-inflammatory, antioxidant, wound healing, antidiabetic, antiulcer, immunomodulatory, antitumor, hepatoprotective, antihyperlipidemic, laxative, anthelmintic, antiseptic, detoxifying effect, moisturizing and anti-aging effect. Aloe or its component can enhance drug absorption. <i>Lactobacillus brevis</i> were observed in naturally fermented <i>A. vera</i> . Juice of <i>A. vera</i> used in skin care and tooth and gum protective products. It also used in infection caused by genital herpes, asthma, HIV infection (Minwuyelet et al. 2017; Radha and Laxmipriya 2015; Sharma et al. 2014a, b; Maan et al. 2018). Aloin is a major component of <i>A. vera</i> that possesses antidiabetic, antimicrobial, antioxidant, hypotensive, anti-inflammatory and anticancer activity (Patel and Patel 2013)

(continued)

Table 8.1 (continued)

Name	Major bioactive phytomolecules	Pharmacological properties
Guggal (<i>Commiphora wightii</i> syn. <i>Commiphora mukul</i> ; Family: Burseraceae)	Guggulsterol I-VI; <i>E</i> and <i>Z</i> -guggulsterone; <i>Z</i> -guggulsterol; guggulsterone M and Y; α -camphorene; cembrene-A; cembrene; mukulol; isocembrol; 4-epiisocembrol; dimyrcene; oleic acid; linoleic acid; palmitic acid; stearic acids, sitosterol; eugenol; ellagic acid; (8R)-3 α ,8-dihydroxy-polypoda-13E, 17E, 21 triene, 20S-acetyloxy-4-pregnene-3,16-dione; 4,17(20)-(<i>trans</i>)-pregnadiene-3,16-dione; 16 β -acetyloxy-pregn- 4,17(20)- <i>trans</i> -dien-3-one; 4,17(20)-(<i>cis</i>)- pregnadiene-3,16-dione; (1E, 4E, 8E)-4,8,14-Trimethyl-11-(1-methylethyl)4-methoxycyclotetradeca-1,4,8-triene; 3 α -acetyloxy-5 α - pregnan-16-one; (2E, 12E)-2,7,13-trimethyl-9-(1-methylethyl)-15-oxabicyclo [12.1.0] pentadeca-2,12-diene-7-ol; (4Z, 6E)-4,7,12,15,15-pentamethylbicyclo [9.3.1] pentadeca-4,6-diene-12-ol; myrrhanone A; myrrhanone B; myrrhanone A acetate; commiphferol; commiphferin; pelargonidin-3,5,di- <i>O</i> -glucoside; quercetin-3- <i>O</i> - β -L-arabinose; quercetin 3- <i>O</i> - β -D-glucuronide; quercetin-3- <i>O</i> - β -D-galactoside; quercetin-3- <i>O</i> - β -L-rhamnoside, (Kalshetti et al. 2014; Sarup et al. 2015)	Hypolipidemic activity, antiatherosclerotic activity, platelet aggregation and fibrinolytic activity, thyroid stimulatory activity, anti-inflammatory activity, antiarthritic activity, cardioprotective activity, antioxidant activity, antitumor and anticancer activity, antifertility activity, antihyperglycemic activity, antimicrobial activity (Kalshetti et al. 2014; Sarup et al. 2015)
Belladonna (<i>Atropa belladonna</i> ; Family: Solanaceae)	Atropine, scopolamine, norhyoscyamine, δ -N-methylornithrine, atroposide (A,B,C,D,E,F, G and H), 3- <i>O</i> - α -D-galactopyramoside, 3- <i>O</i> - β -D-glucopyranosyl (1-- > 4)- β -D-galactopyramoside (Paul and Dutta 2011)	Treatment of colitis, irritable bowel syndrome, diverticulitis, colic, peptic ulcer, diarrhea, asthma, extreme sweating, nighttime incontinence, headaches, migraines, muscle pains and spasms, motion sickness and vertigo, Parkinson's disease, Biliary colic, colic of liver or gallbladder (Long 2005)
Nux vomica (<i>Strychnosnux-vomica</i> ; Family: Strychnaceae)	Strychnine; brucine; vomicine; α & β - colubrine; <i>n</i> -methyl pseudostrychnine; 7-hydroxy coumarin; kaempferol-7-glucoside; kaempferol 3-rutinoside; quercetin-3-rhamnoside; rutinbrucine; mavacurine; strychnochrysin; vomicine; strychnoflavine; icajine; salidroside; stryvomicine; stryvomitine; α -colubrine-chloromethochloride; igasuric acid; pseudostrychnine; pseudobrucine; lupeol; loganin; β -colubrine; icajine; 16-hydroxy- α -colubrine; vomicine; novacine; pseudostrychnine; isostrychnine; isobrucine; 3-methoxy icajine; 15-hydroxy strychnine (Behera et al. 2017; Patel et al. 2017).	Anticancer activity, antitumor activity, antimicrobial activity, antidiarrhoeal activity, anti HIV effect, neuropharmacological activity; anti-anesthetic activity; antiallergic and immunomodulatory property; analgesic and anti-inflammatory activity, antipyretic effect, hepatoprotective and anticholestatic activity, antisnake venom activity (Behera et al. 2017; Patel et al. 2017).

Table 8.1 (continued)

Name	Major bioactive phytomolecules	Pharmacological properties
Medicinal Solanum (<i>Solanum spp.</i> ; Family: Solanaceae)	<p><i>S. indicum</i>: Indiosides (A to F), protodioscin, carpersterol, isoanguivine, solanidine, solasodine, solamargine, solavetivone, isofraxidin, fraxetin, trilinolein, arteminorin a, indicumin (Sharma et al. 2017)</p> <p><i>S. virginianum</i> (Syn. <i>S. xanthocarpum</i>): Solasonine, solasonine, solanocarpidine solamargine, sitosterol, solanocarpine, β-solamargine, isochlorogenic acid, neochronogenic acid, chronogenic acid, caffeic acids, cycloartanol, sitosterol, cycloartenol, stigmasterol, stigmasterol glucoside, solamargine, beta-solamargine, khasianine (Rane et al. 2014).</p> <p><i>S. nigrum</i>: Solamargine, Solasonine, α and β-solanigrine, degalactotigonin, nigrumnins I and II. Tigogenin, spirosestanol glycoside, furostanol glycoside, ascorbic acid, ethyl b-D-thevetopyranosyl-(1-4) b-D-oleandropyranoside, ethylb-D-thevetopyranosyl-(1-4)-a-D-oleandropyranoside (Saleem et al. 2009; Nyeem et al. 2017).</p>	<p><i>S. indicum</i>: Antibacterial, antioxidant, anthelmintic, antiplasmodial, hepatoprotective, anticancer, laxative, cardiotoxic activity, CNS depressant and anti hypertensive activity (Sharma et al. 2017).</p> <p><i>S. virginianum</i> (Syn. <i>S. xanthocarpum</i>): Anthelmintic, antipyretic, anti-inflammatory, anti-asthmatic, laxative, aphrodisiac effect, hypoglycemic, antiasthmatic, hepatoprotective antibacterial, anticancer and insect repellent properties. Treatment of epilepsy, pain, migraine, head ache, hair fall, bronchial asthma, skin problems, cough, cough, asthma, rheumatism and chest pain and as tonic (Rane et al. 2014; Subharani 2016).</p> <p><i>S. nigrum</i>: Antimicrobial, antioxidant, hepatoprotective, anticancer, antidiabetic, antiulcer, cardiotoxic activity, CNS depressant and anti hypertensive activity, immunostimulant, anti-HCV, anti gastritis, antihyperlipidemic, anti diarrhoeal, cytotoxic, antioxigenic, anti-inflammatory (Saleem et al. 2009; Nyeem et al. 2017).</p>
Aonla/Amla (<i>Emblica officinalis</i> Syn. <i>Phyllanthus emblica</i> , Family: Euphorbiaceae)	<p>Apigenin, ellagic acid, gallic acid, quercetin, chebulagic acid, chebulinic acid, corilagin, isostrictiniin, methyl gallate, luteolin, emblicanin A, emblicanin B, phyllaemblicin B, phyllantine, phyllantidine, punigluconin, pedunculagin (Hasan et al. 2016).</p>	<p>Antibacterial, antifungal, antiviral, insecticidal, larvicidal and mosquitocidal, radioprotective, hypolipidemic, immunomodulatory activity, antimutagenic and wound healing, antidepressant activity, anticancer, HIV-reverse transcriptase inhibitory, hepatoprotective, anti ulcerogenic activity. It also use in piles, jaundice, gout, respiratory disorders, migraine, urinary problems. (Hasan et al. 2016; Kulkarni and Ghurghure 2018; Gaire and Subedi 2014).</p>
Senna (<i>Cassia angustifolia</i> ; Family: Leguminales)	<p>sennoside A, sennoside B, sennoside C, sennoside D, rhein-anthrone- 8-diglucose, rhein-8-glucoside, rhein-8-diglucoside, aloe-emodine-8-glucoside, aloe-emodine-anthrone diglucoside, rhein, aloe emodine, palmidine A, kaempferol, isorhamnetin, sennacrol, sennapicrin, cathartomannite, mannitol, sodium potassium tartrate, myricyl alcohol, salicylic acid, phytosterolin, mucilage, resin, chrysophanic acid, calcium oxalate, beta sitosterol (Tripathi 1999; Ganapaty et al. 2002).</p>	<p>Laxative, anticancer, purgative, anthelmintic, antipyretic, cathartic, antimicrobial, anti-inflammatory activity, body detoxing, vermifuge, diuretic (Tripathi 1999; Balasankar et al. 2013).</p>

(continued)

Table 8.1 (continued)

Name	Major bioactive phytomolecules	Pharmacological properties
Isibgol (<i>Plantago ovate</i> ; Family: Plantaginaceae)	Psyllium husk contains hemicelluloses, a xylan backbone attached with arabinose, rhamnose, and galacturonic acid units (arabinoxylans); iridoids; phenols; fatty acids; luteolin-7-O- β -glycoside; polysaccharides; sterols. Among two poly saccharine fractions one fraction soluble in cold another one in hot water. Cold water soluble fraction on hydrolysis produces xylose, aldobiouronic acid, arabinose. Hot water soluble fraction on hydrolysis yields xylose, arabinose, aldobiouronic acid, galactose (Sarfraz et al. 2017; Haddadian et al. 2014; Deokar et al. 2016).	Laxative activity, wound healing activity, anti-diarrheal and anti-constipation activity, anti-inflammatory activity, hypocholesterolemic activity, hypoglycemic activity, hypolipidemic activity, hypocholesterolemic activity, antibacterial activity, anticancer activity (Sarfraz et al. 2017; Deokar et al. 2016; Haddadian et al. 2014).
Stevia (<i>Stevia rebaudiana</i> ; Family: Asteraceae)	Stevioside, steviolbioside, steviolmonoside, rebaudioside (A to F), dulcoside A, austroinullin, β -carotene, dulcoside, nilacin, rebaudi oxides, riboflavin, steviol, stevioside, thiamine, isosteviol, 4-methoxybenzoic acid, p-coumaric acid, 4-methylcatechol, caffeoylquinic acid, dicaffeoylquinic acid, 4-caffeoyl-5-feruloylquinic acid, 4-methoxybenzoic acid, 4-coumaric acid, 4-methylcatechol, sinapic acid, caryophyllene, β -caryophyllene, β -pinene (Momtazi-Borojeni et al. 2017; Wolwer-Rieck 2012)	Anti-diabetic, antihypertensive, antimicrobial, antiviral, antifungal, antitumor, anti-inflammatory, hepatoprotective, immune stimulating activity. It is also used as natural sweetener (Momtazi-Borojeni et al. 2017).
Coleus (<i>Coleus forskohlii</i> Syn: <i>Coleus barbatus</i> ; Family: Lamiaceae)	Forskolin (E, F, G, H, I, J, L); 6-acetyl-1,9-dideoxy forskolin; 6-acetyl-1-deoxyforskolin; deactylforskolin; 1, 9-deoxyforskolin; 9-deoxyforskolin; 1,9-dideoxy-7-deacetylforskolin; 1,6-diacetoxy-9-deoxyforskolin; 1-acetyl forskolin; isoforskolin; 1,6-di-O-acetylforskolin; forskoditerpenoside A and B; forskoditerpenoside C, D and E; forskoditerpene A; coleonol E and coleonol F; coleol; coleosol; 3-hydroxy forskolin; 3-hydroxyisoforskolin (Bhowal and Mehta 2017).	Antiasthmatic, antiglaucoma, antidiabetic, antiobesity, antiplatelet, antimicrobial, anti-inflammatory, hypotensive, anticancer and antiproliferative, antidepressant, antidyspeptic, antioxidant, antiulcer, antimycotic, hepatoprotective activity. It also possesses relaxative, immune system enhancement and vasculogenic property, and found useful in UTI, psoriasis, thyroidism (Bhowal and Mehta 2017).
Acorus (<i>Acorus calamus</i> ; Family: Acoraceae/ Araceae)	β -asarone, α -asarone, caryophyllene, eugenol, methyl isoeugenol, pinenes, myrcene, cymene, cisisoelemicine, calamen, calameon, clamenol, camphene, α -selinene, elemicine, <i>cis</i> and <i>trans</i> isoeugenol, camphor, calarene, P-cymene, bgurjunene, β -cadinene, camphor, terpinen-4-ol, aterpineol, calacorene, acronone, acorone, acoragermacrone, linalool, shyobunones, preisocalamendiol, acoradin, galangin, calamendiol, sitosterol, spathulenol, (E)- β -ocimene, α -selinene, s-cadinol, isoshyobunone, bsesquiphellandrene, preisocalamendiol, acorone (Sharma et al. 2014a, b; Imam et al. 2013).	Antibacterial activity, antifungal activity, anti-inflammatory activity, analgesic activity, antioxidant activity, antidiabetic activity, anticancer activity, antimutagenic activity, Radioprotection and DNA Repair Activity, Wound-healing Activity, Immunosuppressive Activity, antidiarrhoeal activity, antiulcer activity, antispasmodic activity, anti-asthmatic activity, anti-convulsant activity, Antidepressant activity, Anti HIV Activity, Antihypertensive activity, as tranquiliser (Imam et al. 2013; Sharma et al. 2014a, b).

Table 8.1 (continued)

Name	Major bioactive phytomolecules	Pharmacological properties
Ocimum (<i>Ocimum sanctum</i> ; Family: Lamiaceae/Labiatae)	Eugenol, euginal, urosolic acid, carvacrol, linalool, limatrol, caryophyllene, methyl carvicol, fatty acids, sitosterol; rosmarinic acid, apigenin, vallinin, vitexin, cirsimaritin, isothymusin, isothymonin, orientin, stigmsterol, vicenin, camphor, <i>cis</i> - α -terpineol, cubenol, D-limonene, cardinene, eucalyptol, eicosane, eugenol, farnesol, farnesene, limonene, <i>n</i> -butylbenzoate, oleic acid, sabinene, veridifloro, selinene, α -camphene, α myrcene, α -pinene, α -thujene, β -pinene, β -gurjunene, β -guaiene, caffeic acid, chlorgenic acid, gallic acid, galuteolin, isovitexin, luteolin, isorientin, procatechuic acid, urosolic acid, (Pattanayak et al. 2010; Kulkarni and Advairao 2018).	Antibacterial activity, antifungal activity, antiviral activity, antimalarial activity, antiprotozoal activity, anthelmintic activity, anti-diarrheal activity, as mosquito repellent, anti-oxidant activity, anti-inflammatory activity, anti-cataract potency, chemopreventive and radioprotective effect, anticancer activity, hepatoprotective effect, neuroprotective activity, cardioprotective effect, hypoglycaemic effect, anti-hypercholesterolemic and hypolipidemic activity, anti-hypertensive activity, analgesic effect, anti-pyretic activity, anti-allergic activity, immunomodulatory activity, anti-fertility, Anti-psychotic, CNS depressant activity, memory enhancement effect, antiasthmatic activity, anti-tussive potency, diaphoretic activity, antiulcer activity, anti-thyroid activity, anti-fertility activity, anti-emetic activity, anti-spasmodic activity, stress reducing activity, anti-arthritis activity, adaptogenic activity, as anti-coagulant effect (Cohen 2014; Kulkarni and Advairao 2018).

8.3 Conclusion

Our lifestyle is becoming modernized as we are becoming more dependent on technology, adopting unhealthy lifestyle and moving away from nature. Herbs are important to maintain our health and discover of new medicine. Traditionally, we are gifted by our ancestors with medicinal knowledge and nature since its existence providing lot of herbs used for the ailments related to different seasons. Loss of biodiversity is huge problem or unscientific collection of medicinal plants from wild source will create a problem in future related to the sustainable availability of plant sources. Cultivation outside their natural habitat will be useful for sustainable availability of medicinal plants, preservation of medicinal plants and to promote economic development.

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