

Immunity Booster Herbs and their Conservation-A Review

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Abstract—Medicinal plants are the most important source of life saving drugs since ancient times. The World Health Organization estimated that even today, 80% of people in developing countries depend mainly on traditional remedies. Nowadays medicinal plants are in great demand because they are effective, inexpensive and convenient in managing our health without any side effect.

Immune system of human body has adequate biological defense mechanism to fight infections, diseases or other unwanted biological invasions. However, in certain cases immunity is lost and individual becomes susceptible of developing infections and diseases. There are some immunity booster plants in nature which are capable of boosting our immunity and help us in fighting against infections and diseases. The immunity booster herbs work wonders in managing our health by augmenting our immune system. Most of the herbs are generally working as immune system stimulators; they increase body resistance by mobilizing the “effector cells” which act against all foreign particles rather than just one particular disease or antigen. Commonly used immunity booster herbs are Aloe vera, Panax ginseng, Glycyrrhiza glabra, Allium sativum, Zingiber officinale, Citrus sinensis, Capsicum annuum, Ginkgo biloba, Curcuma longa, Phyllanthus emblica, Ocimum sanctum, Withania somnifera, Tinospora cordifolia etc.

Diversity of these medicinal herbs is lost due to extensive harvesting from the wild habitat. Some of these plants have become rare and threatened with local extinction. Propagation of medicinal plants by conventional method is difficult because some of these medicinal plants either do not produce seeds or seeds are too small, inviable and dormant. Review of literature reveals that micropropagation can serve as a tool for conservation of such medicinal herbs, by mass propagation. In addition to this genetically identical plants can be produced within a short time span and stock of germplasm can be maintained for many years. Further, a high quality plant based medicine can be produced by this technique that does not alter the medicinal property of plant and keep the bioactive components (alkaloids, glycosides, saponin, sterols, tannins etc.) intact.

1. INTRODUCTION

Medicinal plants play an important role in world health care system. Globally plant products are used in medicines, health supplements and in beauty and toiletry products. Currently herbal products are in great demand since they are effective, inexpensive and convenient in managing our health and well being without any side effect. Health care system based on herbal products can only be successful when these products

are available on sustainable basis. In order to maintain a continuous supply of high quality herbal products there is a need to conserve the biodiversity of medicinal plants, which are prime ingredients of these herbal products.

Nowadays people prefer using Ayurvedic medicines in contrast to Allopathic medicines to elevate the physical and mental health, longevity and vitality. Medicinal herbs were earlier used as Ethanomedicines, later transformed to organized system e.g. Ayurveda, Unani, Sidha etc [1]. With the advancement in Phytochemistry and Pharmacology active principles of medicinal plants were isolated and formulated as valuable drugs [2].

Human body has an adequate biological defence (immunity) to fight infections, diseases or other unwanted biological invasions. However this property is lost in certain cases and the individual is susceptible of developing infections and diseases [3]. There are some plants in nature which are capable of boosting our immunity and help us in fighting against infections and diseases [4], these plants are called as “immunity booster plants”. These plants boost our immune system by activation and suppression of immune specialized cells, interfering in several pathways that eventually leading to improvement in immune responses and defense system. Furthermore, some of these plants also carry free radical scavenging and anti-inflammatory properties that are helpful in providing protection against cancer [5]. Immunity booster plants work wonders in managing our health by augmenting our immune system and thus preventing many ailments in an effective, inexpensive and convenient way. Recent studies on the phytochemistry of medicinal plants has helped us in finding out more and more plants with immunity boosting properties [5].

The present paper is an attempt to categorize and list some of the “immunity booster plants”. A detailed account of these plants along with the plant part used, bioactive compounds and their activity is given in Table 1 (see Table 1). The information provided in this paper will be helpful in promoting the use of herbal medicines to enhance immunity and improve the general health.

Table 1: Commonly used Immunity Booster Plants

Common/ Hindi name	Botanical name and (Family)	Part used	Bioactive compound/Active principle	Activity
Gritkumari	<i>Aloe vera</i> (Liliaceae)	Leaves	Polysaccharides, Saponins, Flavonoids	Laxative, wound healing, skin burns and care, diuretic, treatment of ulcer
Cone flower	<i>Echinacea</i> (Asteraceae)	Fresh or dried aerial parts & leaves	Echinacoside, Chicoric acid, Isobutylamides	Prevents colds, flu and other infection, eczema, toothaches, inflammation, tonsillitis, anti-inflammatory, anti-cancer
Elderberry	<i>Sambucus</i> (Adoxaceae)	Bark, Leaves, Flowers & Berries	Viburic acid, Sambucine, Sambunigrin	Reduces inflammation, lower fever, sooth the respiratory tract
Ginseng	<i>Panax ginseng</i> (Araliaceae)	Roots & leaves	Ginsenoides, Gginsenosides, Ggintonin	Improves fatigue syndrome, heals bronchial disorder, chronic fatigue, boosts immune system, anti-cancerous
Mulathi	<i>Glycyrrhiza glabra</i> (Fabaceae)	Roots	Glycyrrhizinic acid, glabranin A&B, glycyrrhetol, glabrolide, isoflavones, coumarins, triterpene sterols.	Treats asthma, athlete's foot, baldness, body odor, canker, sores, chronic fatigue, depression, colds and flu and coughs
Stinging nettle	<i>Urtica dioica</i> (Urticaceae)	Leaves	Histamine, acetylcholine, choline, serotonin, oleanol acid, steryl glycosides	Used to treat hay fever and other seasonal allergies
Garlic	<i>Allium sativum</i> (Amaryllidaceae)	Cloves	Allicin,ajoene, thiosulfinate, alliin, ajoene, diallylpolysulfides, vinyldithiins, S-allylcysteine,saponins, flavonoids	Fights infection , disinfect wounds, fights fungal infection, anti-microbial, anti-cancer
Ginger	<i>Zingiber officinale</i> (Zingiberaceae)	Rhizomes	zingerone, shogaols, andgingerols, volatile oils, sesquiterpenoids, β -sesquiphellandrene, bisabolene, and farnesene	Reduce inflammation, improves cardiovascular condition, blood clots and cholesterol
Orange	<i>Citrus sinensis</i> (Rutaceae)	Fruit	Vitamin C betacarotene	Boots immunity, antioxidant properties
Bell peppers	<i>Capsicum annuum</i> (Solanaceae)	Fruit	Carotenoid (Lycopene), Vitamins A,C,B,E and K, carotenoid antioxidants, alpha and beta carotene, zeaxanthin antioxidants and vitamin C, para-coumaric acid.	Anticancerous, boosts immune system and keeps skin youthful, anti-inflammatory, relief from pain and eases inflammation,helps renew cells
Maiden hair tree	<i>Gingko biloba</i> (Ginkgoaceae)	Leaves	Bilobalides and gonkgoles	Treat blood disorders, dementia (including Alzheimer's disease) enhance memory, reduces brain damage
Turmeric	<i>Curcuma longa</i> (Zingiberaceae)	Rhizome	Curcumin,curcuminoids, curcumin, demethoxycurcumin&bisdemethoxycurcumin.	Antibacterial, anti-inflammatory and stomach soothing effect, neutralize oxygen free radicals
Amla	<i>Phyllanthus emblica</i> (Phyllanthaceae)	Fruit, Seed, Leaves, Root, Bark and Flowers	Vitamin C, ellagitannins- (emblicanin A& B,punigluconin, pedunculagin), flavonoids, kaempferol, ellagic acid and gallic acid	Boosts immunity, promote longevity, enhance digestion, treat constipation, reduce fever, purify the blood, reduce cough,alleviate asthma, strengthen the heart, enhance intellect
Tulsi	<i>Ocimum sanctum</i> (Lamiaceae)	Entire plant	Ursolic acid, apigenin and luteolin	Cures allergies and asthma, anabolic, hypoglycemic , muscle relaxant,immunomodulator, antibacterial, antifungal, antiviral properties, anti-allergic and promote longevity

Ashwagandha	<i>Withania somnifera</i> (Solanaceae)	Root & Leafs	Cuscohygrine, anahygrine, tropine, pseudotropine, anaferine, isopelletierine, withananine, pseudo-withanine, somnine, somniferine, Withaferin A, withanolide D & E , steroidal lactones, glycowithanolides	Restorative tonic, increases stamina, relieve stress; treats nerve disorder, aphrodisiac.
Brahmi	<i>Bacopa monnieri</i> (Scrophulariaceae)	Whole plant	Alkaloids-brahmine and herpesaponin, acid A, monnierin, betulic acid, stigmastanol, beta-sitosterol, bacosides and, bacosapaponins, triterpenoidsaponins, sterols	Nervous, Memory enhancer, mental disorder.
Bael	<i>Aegle marmelos</i> (Rutaceae)	Fruit & Bark	Marmelosin, alloimperatorin, marmelide, tannic acid, marmin, umbelliferone, marmesin, marmesinin, fatty acids, beta-sitosterol	Cures diarrhoea, dysentery, Constipation, decreases plasma insulin and liver glycogen in diabetic patients; anti-viral, reduces the blood sugar level & oxidative stress
Asana	<i>Pterocarpus marsupium</i> (Fabaceae)	Heartwood, Leaves & Flowers	Pterostilbene , Alkaloids, Tannins	Manage diabetes, heart problems, skin diseases, fractures, bruises, leprosy, leucoderma, constipation, hemorrhages and rheumatoid arthritis.
Harad	<i>Terminalia chebula</i> (Combretaceae)	Seed	Chebulagic acid, chebulinic acid, corilagin, beta-sitosterol, gallic acid, ellagic acid, ethyl gallate, tannic acid, galloyl glucose & chebulaginic acid.	Useful in gastropathy, flatulence inflammations, wounds, ulcers, jaundice, dysentery, urinary tract infections and immunological disorders
Giloe	<i>Tinospora cordifolia</i> (Menispermaceae)	Stem	Tinocordifolin, tinocordifolioside, tinosponone, tinocordioside, cordioside, picoretine, colombine, and columbin.	Used in burning sensation, hyperdipsia, intermittent and chronic fevers, inflammations, gout and skin diseases, flatulence, vomiting and stomach problems, diabetes, cardiac debility, jaundice
Vasa	<i>Adhatoda vasica</i> (Acanthaceae)	Whole plant	Vasicine, 2'-hydroxy -4-glucosyloxychalcone, vasicol, adhatodine, vasicinone, vasicinol, arachidic, cerotic, behenic, lignoceric, linoleic and oleic acids.	Treats cold, cough, chronic bronchitis, asthma, nervous disability, haemoptysis and rheumatic pains
Satavari	<i>Asparagus racemosus</i> (Asparagaceae)	Tuber & Roots	Saponins, viz. Shatavarin I to IV, asparagosides, sarsasapogenin, asparagamine, racemosol, mucilage and starch.	Useful in ammenorrhoea, dysmenorrhea, menopause and pelvic inflammatory disease, burning sensation, inflammations and hyperdipsia, ophthalmopathy, nephropathy and hepatopathy
Dalchini	<i>Cinnamomum zeylanicum</i> (Lauraceae)	Bark & Leaves	Cinnamaldehyde, Eugenol	Treats bronchitis, asthma, cardiac disorder, diabetes
Kaharati	<i>Sida cordifolia</i> (Malvaceae)	Root	Ephedrine, Ephedrine, hypaphorine, vasicinone, choline, betaine, phytosterol etc.	Improve strength of bones, muscles and joints, Immunomodulatory effects
Bhuiamla	<i>Phyllanthus niruri</i> (Euphorbiaceae)	Whole plant	Quercetin, rutin, gallic acid	Prevent jaundice, diabetes, dyspepsia, ulcers, sores, swellings, ophthalmia and chronic dysentery, useful in liver disorders, cough, asthma, jaundice, spleen disorders
Punarva	<i>Boerhavia diffusa</i> (Nyctaginaceae)	Roots	Punarnavine, boeravinone, hypoxanthine 9-Larabinofuranoside, ursolic acid, punarnavoside, lirodendrin and glycoprotein	Cures pain in joints, relieves constipation., cures renal diseases, rejuvenate liver and detoxifies system

Chitraka	<i>Plumbago zeylanica</i> (Plumbaginaceae)	Root, Bark & Leaves	naphthoquinones, binaphthoquinones, coumarins, diphenyl sulfone, carboxylic acids, esters, meroterpenes, triterpenoids, anthraquinones, steroids, steroid glucosides,	Antiatherogenic, cardiotoxic, hepatoprotective, anti-inflammatory neuroprotective; effective against rheumatic pain, sprains, scabies, skin diseases, and wounds; stimulates central nervous,
Pipli	<i>Piper longum</i> (Piperaceae)	Fruit & Root	Piperine, rutin, beta-caryophyllene piperlyne, piperoleines, piperamine, sabinene, chavicin, pinene, phellandrene, pentadecane, beta-bisabolene, linalool and limonene.	Treats flatulence, gout, laryngitis, paralysis, abdominal tumors, enlarged spleen, bronchitis, cold, gastric ulcers; improves the digestive system, enhances the immune system
Kesar	<i>Crocus sativus</i> (Iridaceae)	Dried Stigma	Picrocrocin, hydroxy-trimethylcarboxaldehyde-cyclohexene (HTCC) and kaempferol, Safranal	Useful in fever, cough, depression, enlargement of liver, flatulence, colic, insomnia, rheumatism, neuralgia, leucorrhoea, headache, sores, hemorrhoids and snakebite
Laung	<i>Syzygium aromaticum</i> (Myrtaceae)	Flower bud	Acetylugenol, beta-caryophyllene and vanillin, crategolic acid, tannins, sesquiterpenes., gallotannins, triterpenes, flavonoids, and phenolic acids.	Soothe and relax the inner lining of the intestines, aiding in digestion, quieting upset stomach, analgesic properties, effective for tooth pain, antimicrobial agent, relieve pain from rheumatism, arthritis, or other inflammations
Black pepper	<i>Piper nigrum</i> (Piperaceae)	Fruit	Piperine, alkalamides, piptigrine, wisanine, dipiperamide D, and dipiperamide E	Relieves pain, rheumatism, chills, flu, colds, exhaustion, muscular aches, stimulates appetite & digestive tonic
Jeevanti	<i>Leptadenia reticulata</i> (Asclpiadaceae)	Root	Stigmasterol, a-amyrin, tocopherols, hentriacontanol, leptadeno and sitostero. The plant is also rich in Flavonoids like diosmetin, luteolin, rutin and hyperoside.	Cure eye-diseases, cough, dyspnoea, constipation, sore throat, and gonorrhoea, antibacterial and anti-fungal agent; galactagogue, stimulant, diuretic

The table above lists both cultivated as well as wild plants. The medicinal properties of these plants is attributed to the bioactive compounds present in them viz. alkaloids, glycosides, essential oils, fatty acids, resins, mucilage, tannins, gums and vitamins etc. Nowadays, due to high consumer demand many of the wild medicinal plants are excessively harvested from their natural habitat. Over-exploitation along with habitat destruction poses a serious threat on the very existence of some of these medicinal plant species. The conventional method of propagation through seeds is also not feasible for many of these medicinal plant species as either they do not produce seeds or seeds are too small and do not germinate in the soil. As a result some of these plants are becoming rare and threatened with local extinction. Therefore management and conservation of such traditional medicinal plant resources is a matter of great urgency.

Conservation by Micropropagation

Review of literature on micropropagation of medicinal plants confirms that they can be conserved by mass propagation using plant cell and tissue culture techniques. Mass propagation of uniform plantlets of genetically pure elite

population can be done in a short time period by this method. Plant multiplication can be continued throughout the year irrespective of the season and stock of the germplasm. Moreover, this technology does not alter the chemical nature of the plants and keeps the bioactive compounds intact; which are essential for maintaining their medicinal properties. Thus, micropropagation can serve as a tool for conservation as well as production of high quality medicinal plants that can be used in both traditional as well as modern health-care system [6]. Chaturvedi and Kidwai [7], in their review have reported successful conservation of a number of medicinal plants by micropropagation. Sharma et al [8], has reported conservation of biodiversity by using tissue culture protocol for endangered, rare and threatened plant species. Medicinal uses, chemical constituent and aspects of micropropagation of some of the medicinal plants have also been reviewed by Malik et al [9].

In the present paper we have listed the successful micropropagation protocols for four threatened immunity booster plants viz. *Pterocarpus marsupium*, *Ginkgo biloba*, *Panax ginseng* and *Echinacea sp.* (see Table 2).

Table 2: Micropropagation protocols for some of the threatened immunity booster plants

Botanical name	Explant used	Response	Reference
<i>Pterocarpus marsupium</i>	Nodal segments Cotyledonary nodes Cotyledonary nodes of immature seeds	Multiple shoots & plantlets Multiple shoots & plantlets Plantlets	Tiwari et al 2004 [10] Husain et al 2007 [11] Porika et al 2009 [12]
<i>Ginkgo biloba</i>	Lateral buds, stem pieces, pith Apical shoot meristem & nodal segments Shoot tips, leaf, petiole Nodal segments Young leaves, buds	Somatic embryos & shoots Multiple shoots & plantlets Callus Shoots Callus	Johnson 1994 [13] Tommasi&Scaramuzzi 2004 [13] Tolyat et al 2009 [14] Rodamir&Todor 2011 [15] Csaba et al 2012 [16]
<i>Panax ginseng</i>	Root pith Flower buds Cotyledons	Plantlet Somatic embryos & multiple shoots Callus, somatic embryos, shoots	Wang 1990 [17] Kishira et al 1992 [18] Zhou & Brown 2007 [19]
<i>Echinacea angustifolia</i> <i>E. pallid</i> & <i>E. purpurea</i> <i>E. purpurea</i> <i>E. angustifolia</i> <i>E. purpurea</i>	Nodal segments & excised embryo Leaf explants Leaves & flower stalks Leaf explants	Multiple shoots & plantlets Plantlets Callus & shoots Shoot buds & plantlets	Harbage 2001 [20] Jones et al 2007 [21] Lucchesini et al 2009 [22] Koul et al 2010 [23]

The above table suggests that successful micropropagation protocols have been developed for some of the threatened species of immunity booster plants. However, for effective conservation and bulk production of many such threatened species of medicinal plant more research is required in this area.

Conclusion

The present review clearly suggests that medicinal plants play an important role in boosting the immunity of our body. Plants listed in this paper are important constituents of herbal products like, Chyawanprash and health tonics which are used to enhance immunity, stamina and mental health. However, due to over-exploitation and habitat destruction some of these plants have become threatened, endangered and are at the risk of extinction. Micropropagation protocols for some of these threatened immunity booster plants are listed in the present work. Micropropagation not only serves a means to conserve the biodiversity of medicinal plants but it also allows their continuous supply to pharmaceutical companies. The present paper certainly promotes the traditional health-care system like Ayurveda, Unani and Sidha, which are based on age-old healthcare traditions where plants and plant products are the source of health and vitality.

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