Plants as Immunity Enhancers: A Review

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ABSTRACT

It is an evident from ancient times that herbs and medicinal plants have the potential to cure a variety of diseases. Some plants boosts our immunity and make our immune system more powerful to fight againt various diseases. The medicinal effects shown by the plants are due to active principle compound present in them and they work in the same manner as the conventioal drugs. Indian herbs and medicinal plants show miraculous effects against wide variety of diseases and disorders in humansand can be better called as “elixers of life”. Currently, the interest is increasing with high pace in the use of active constituents of medicinal plants as modulator or enhancer of complex immune system. From the literature of various studies carried out in the research area , it is culminated that many of the chemicals in the form of alkaloids, flavanoids, anti-oxidants, tannins, terpenes, and glycoside products are responsible to empower the immunmodulator effect. Keeping in mind , the appreciating potential of active constituents of medicinal plants and their derived drugs, present review is an attemptto globally popularize the herbal plants with Immunomodulator Activity.

Keywords- Immunity, Immunomodulators, Immunostimulants, Immunosuppressor, Medicinal Plants

INTRODUCTION

Immunity may be defined as the abiltiy of an animal’s body to react to a foreign antigen and elimenate it,in the interest of the safety of the animal[1]. It is also defined as the ability of the body to fight againt pathogens(foreign particulates matter that may be virus, fungi, bacteria etc.). It can also be defined aa a complex biological syatem with the capacity to recognize and reject what is foreign (non-self)[2,3,4]

The different types of immunity are:

1. **Innate Immunity:-** It is not dependent on prior antigen exposure (priming), is primitive and termed as non- specific.It is in-born immunity i.e it is present since birth.It is said non-specific because it works against wide variety of pathogens. It provides quick response.
2. **Adaptive Immunity:-** This immunity is of very high affinity depends on antigen priming , hence it is antigen- specific.[7]
3. **Active Immunity:-** This type of immunity can be natural and species specific and is due to development of antibodies by the individual himself.Example: The relative immunity of horses, dogs and rats to TB can be acquired by the introduction of an antigen.
4. **Passive Immunity:-** This type of immunity can be acquired naturally by the transfer of antibodies from a donor to a recipient. Example- By a fetus recieving maternal antibodies across the placenta, or artificially by the administration of anti-serum containing Ig antibodies. [8,9]

IMMUNOMODULATORS

These are substances of natural or may be of synthetic origin that improves the response of Immune system and “Immunomodulation is the process of this resistance providence.[10]

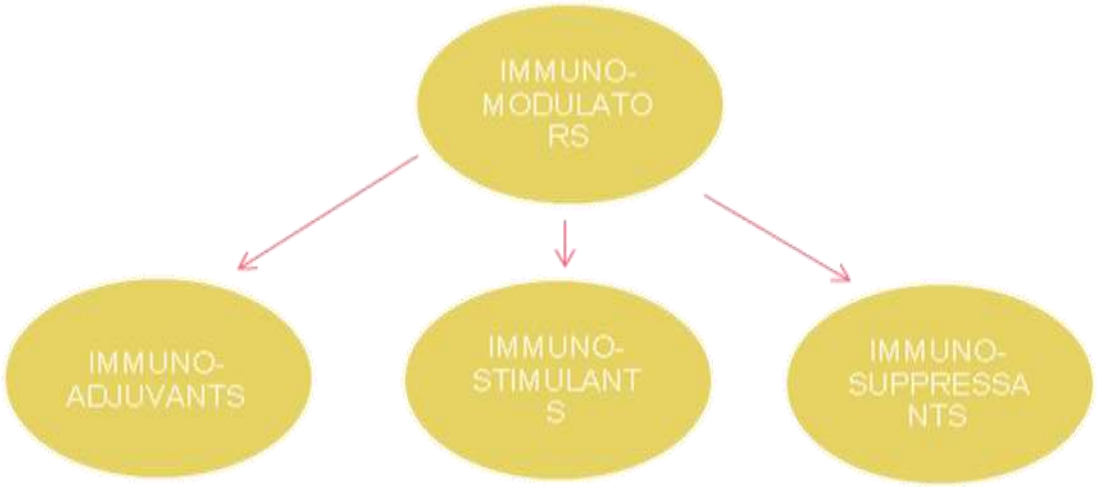


Figure 1: Categories of Imunnomodulators

Immunoadjuvants:
These are class of drugs whichprovoke the action of vaccines and resistance to a particular foreign matter will be attained soon and uktimately body will be protected from being damaged.[11]

Immunostimulant Drugs:
As the name suggests Immuno-stimulants means these are the drugs which stimulates our Immune system to fight against pathogens which are further responsible for causing allergy , cancer and infections[12,13] as well. They can act upon either of the two immunities (adaptive or innate) that is why their action is non-specific.
Interferons and certain vaccines are beleieved to stimulate the Immune system.[14]

Immunosuppressant Drugs:
These are the agents which are used to deminish the activity of immune system when hyper active. For example- when organ transplantation is carried out in any patient the immune system considers that organ as a pathogen and starts providing resistance against it and then the body of patient remains in the tendency to reject that organ in such case the need of the hour is to suppress the immune system & this is carried out by giving Immunosuppressant drugs like cyclosporin, Azathioprine, Basiliximab.[15,16,17]

Immunodeficiency:
When the body is unable to provide resistance due to some reason and as a result immunity is lost and this is called as Immunedeficiency[18]This happens when the components that are required to produce immunity are inactive or damaged. Immunedeficiency occurs at either any age that may be childhood, adoloscence or in old age.Excessive alcolhol intake, More weight,drugs, malnutrition,loss of thymus gland at early stage can cause immunedeficiency[19]

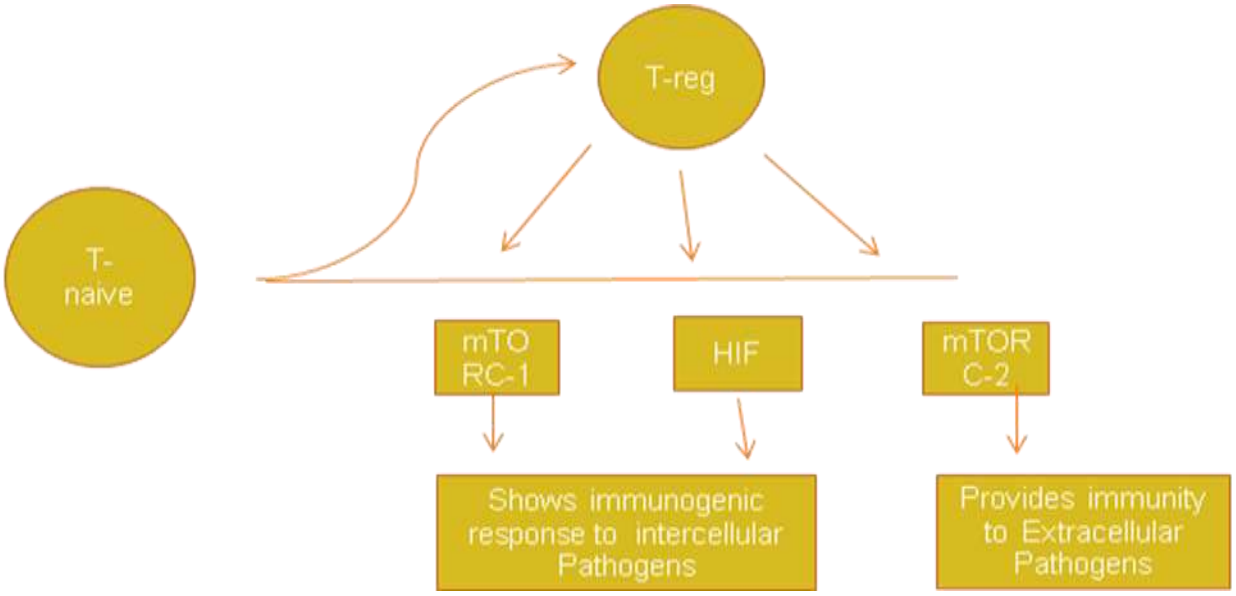


Figure 2: Role of T-lymphocytes in Acquired Immunity

T-naive : Naive forms of helper T cells,T-reg. : Regulatory T cells (which suppress Immune response), mTORC1 : Mammalian target of rapamycin complex-1, mTORC2 : Rapamycin Insensitive protein complex-2, HIF : Heterdimeric complex with alpha,beta-subunits,Th1,Th17,Th12 : T-helper types 1,17 and 12 respectively

The lymphocytes selectively start producing response against pathogens.And at the same time the various cytokines are released by the T-helper lymphocytes. These cytokines thus released are now capable of producing immune cells. The effector subsets depend on glycolysis process while the Th subsets rely on signaling pathways. As all cells are glycolytic except the T cells which are non-glycolytic cells[20].

Table 1: List of Plants Showing Immunomodulatory Effect

Sr. No.	**Plant With Biological Name**	**Family**	**Active Phytoconstituent**	**Action**	Reference
1	Black cumin (*Elwendia persica)*	Apiaceae	Cuminaldehyde, gamma-terpinrne, limonene, carvone (Alkaloidal)	Kill intestinal worms, relieve digestive troubles, anti-inflammatory .	[21]
2	Turmeric (*Curcoma longa)*	Zingiberacae	Curcumin, curcuminoid Zingiberene, (Alkaloidal)	Conjuctivitis, skin cancer, rheumatoid arthritis, small pox, chicken pox	[22]
3	Garlic (*Allium sativum)*	Amaryllidaceae	Allicin, Ajoene, Allin Cysteine (Alkaloidal)	Improves blood pressure, decreases the level of cholesterol,atherosclerosis	[24,25]
4	Ginger (*Zingiber officinale)*	Zingiberacae	Gingerol, Zingiberene, Zingirone, paradol. (Alkaloidal)	Anti- inflammatory, reduce oxidative stress, weight loss by burning calories	[26]
5	Amalaki (*Embilica officnalis)*	Phyllanthaceae	Tanins, Alkaliods, phenolic compounds (Alkaloidal)	Gastrointestinal and rejuvenative treatment, cancer, liver treatment, ulcer	[27]
6	Ashwagandha (*withania somnifera)*	Solanaceae	Withanolide, withaferin-A[28] , Ergostane, Tropine (Alkaloidal)	Helps to combat anxiety & stress conditions, it also enhance fertility-rate &Sperm count in males	[28]
8	Tulsi *(Ocimum tenuiflorum)*	Lamiaseae	Beta-caryophylline, Eugenol, ursolic acid,linalool, Rosmarinic acid (Glycosidal)	Antibacterial, antiviral, antifungal, antiprotozoal, analgesic, antipyretic	[29,30]
9	Neem (*Azadirachta indica)*	Meliaceae	Azadirachtin, nimbolin, nimbin, nimbidin, quercitin (Alkaloidal)	Antimicrobial, free radical scvanging property, leprosy, eye disorders, bloody nose, stomach upsets	[31]
10	Moringa(*Moringa oleifera)*	Moringaceae	Beta-carotene, Polyprenol, chlorophyll, Triglycerols, fatty acids & alcohols. (Tannins)	Rich in antioxidants, lowers blood sugar levels, reduces inflammation, lower cholesterol, Protect against arsenic toxicity	[32]

11	Sunflower seeds (*Helianthus annuus)*	Asteraceae	Oleic acid, linoleic acid, Palmitic acid, Stearic acid, Threonine (Glycosidal)	Cardiovascular disease, blood pressure, cholesterol, blood sugar level	[33]
12	Papaya (*Carica papaya)*	Caricaceae	Papain, beta-carotene, lycopene, carpaine , chymopapain (Tannins)	Prevents and treats GIT disorders, intestinal parasite infections, & as a sedative and diuretic, nerve pain (neuralgia)	[34]
13	Onion (*Allium cepa)*	Amaryllidaceae	Quercetin, Sulfoxide, Anthocyanin, kaempferol (Alkaloidal)	Antibacteial, Antioxidant property, boosts bone density & digestive health.	[35]
14	Cranberry (*Vacciniumsubg. oxycoccus)*	Ericaceae	Peonidin, Flavan-3-ol, Quinic acid, Procyanidin, Mannose (Tannins)	Prevention & treatment of urinary tract infections (UTIs), kidney stone, enlarged prostate, common cold	[36]
15	Spinach (*Spinacia oleracea)*	Amaranthaceae	Beta-carotene, oxalic acid, oxalate, Lutein, lipid, Neoxanthin (Alkaloidal)	Improves stomach & intestinal complaints and fatigue, as a blood-builder, appetite stimulant, promotes growth in childern and recovery from illness	[37]
16	Red bell peppers (*Capsicum annuum)*	Solanaceae	Capsanthin, dihydrocapsanthin, capsorubin, Homocapsaicin. Glycosides	Used to treat Numbness in hands & feets, pain in bones, to overcome painful reashes due to reactivation of chicken pox.	[38]
17	Green Tea (*Camellia sinensis)*	Theaceae	Catechin, caffeine, epigallocatechin gallate,Flavan-3-ol, Theaflavin. (Saponins,Tannins,Flavanoids)	Improves brain function, increases fat burning, anti-cancer activity due to antioxidants, protect brain from aging, reduce bad breath, help in preventing type 2 diabetes, prevents CV disease.	[39]
18	Almonds (*Prunus dulcis)*	Rosaceae	Beta-sitosterol, Amygdalin,Stigmasterol, Campesterol, Palmitoleic acid. (Alkaloidal)	Lowers the level of sugars and cholesterol, also promotes weightloss by depressing the hunger.	[40]
19	Citrus fruits *(Citrus aurantium.)*	Rutaceae	Limonene, beta-myrcene, alpha-pinene (Glycosides)	High blood pressure, stroke prevention, common cold, kidney stones	[41]
20	Brocolli (*Brassica oleracea var. Italica)*	Brassicaceae	Glucoraphanin, Isothiocyanate, Sulforaphane, Indole-3-carbinol, Myrosinase (Tannins)	Hepatic protective effects, bioactive compounds reduces inflammation, protect from certain types of cancer.	[42]

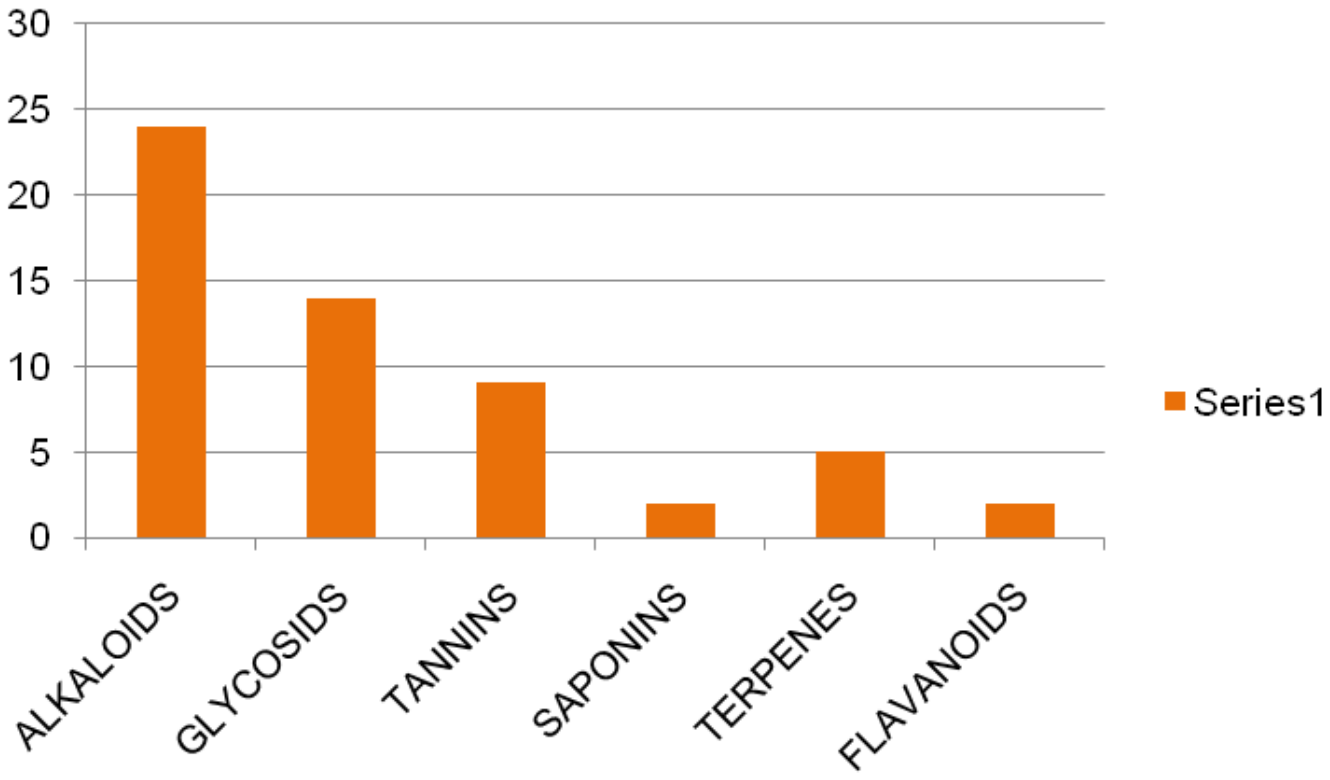
21	Dogrose *(Rosa canina)*	Rosaceae	Linoleic, oleic , linolenic,palmitic, stearic and arachidonic acid (Glycosides).	Rheumatism, hemorrhoids, diarrhoea, cardiac disorders, hypoglycaemia and infection.	[43]
22	Ginko *(Ginkgo biloba)*	Ginkgoaceae	Bilobalide, lactobe, Flavones, Ginkgotoxin, Ginkgoic acid, bilobol (Alkaloidal)	Used to treat fear due to height and the associated symptoms, Memory disprders, Faint sleep (dizziness), glaucoma	[44]
23	Ginseng *(Panax ginseng)*	Araliaceae	Dammarane, ginsenosides, Protopanaxatriol, Ginsenoside Rb 1,Ginsenoside Rh2 (Alkaloidal)	Benefits against some cancers, strenthens immune system, enhance brain function, fight fatigue and improves symptoms of eractile dysfunction	[45]
24	Lemon grass *(Cymbopogon citratus)*	Poaceae	Terpenes, nerol, getaniol, citronellal, Myrecene, Terpinolene, Citral – alpha & beta. (Terpenes)	Used to treat digestive tract spasms, stomachache, high blood pressure, convulsions, pain, vomiting, cough, achy joints, fever, common cold, mild astringent	[46]
25	Picrorhiza *(Picrorhiza kurrooa)*	Scrophulariaceae	Piceroside I,II ; d-mannitol, kutkiol, Kutkistrol and apocynin (Alkaloidal)	Used in liver ailments, Infection of upper Respiratory tract, fever, treats dyspesia, chronic diarrhoea, and scorpian sting.	[47]
26	Maca (*Lepidium meyenii)*	Brassicaceae	Glucosinolates, macamides, macaenes, Thiohydantoins, and alkaloids. (Glycosides& alkaloids)	Increases libido in men and women, increases fertility in men, relieve symptoms of menopause, improves mood, boost sports performance and energy	[48]
27	Red root (Ceanothus americanus)	Rhamnaceae	Lignin, ceanothine, Clinch, tannin , gallic acid, mucilage, calcium oxalate. (Tannins)	Astringent, expectorant,Antispasmodic, Antisyphilitic, used in gonorrhoea, dysentary,asthma, whooping cough.	[49]
28	Shitake Mushroom (*Lentinula edodes)*	Marasmiaceae	Lentinan, Eritadenine, Lenthionine, Ergothioneine (Saponins)	Boosts the immune system and to treat HIV/AIDS, common cold, flu(influenza), and many other condition	[50]
29	Echinacea *(Echinacea purpurea)*	Asteraceae	Alkamides, caffeic acid derivatives, Echinacodide, chicoricacid (Alkaloids)	Used to supress the flu symptoms,, coughs, bronchitis,UTIs and inflammation	[51]
30	Holy Basil (*Ocimum tenuiflorum)*	Lamiaceae	Isothymusin, ursolic acid, eugenol, sinapic acid. (Glycosides)	Used yo tackle stress, anxiety, and inflammation, antioxidant properties	[52]

31	Reishi *(Ganoderma lingzhi)*	Ganodermataceae	Ganoderic acid, ganodermanontriol, Ganodermadiol (Terpenes)	Enhances immune system, improves sleep, and lessen fatigue, maintain blood pressure	[53]
32	Gotu – kola *(Centella asiatica)*	Apiaceae	Asiatic acid, madecassic acid, asiaticode, asiaticoside A & B (Glycosides)	Used to treat syphilis, hepatitis, epilepsy, diarrhea, fever and asthma, chronic vein insufficiency	[54]
33	Rhus tox *(Toxicodendron radicans)*	Anacardiaceae	Chrorphyll, starch, rhustannic acid, volatile oiland alkaloid (Alkaloidal)	Used to pain due to cramps, painful rashes and several infections due to virus	[55]
34	Elder Berry (Sambucus nigra)	Adoxaceae	Flavonols, quercetin-3-glucoside, quercetin-3-rutinoside, anthocyanins (Alkaloidal, Flavanoids)	Common cold, swine flu, for HIV/AIDS, boosts immune system, sinus pain, led pain (sciatica) , nerve pain, chronic fatigue syndrome	[56]
35	Oregano *(Origanum vulgare)*	Lamiaceae	Carvacrol, beta-fenchyl alcohol, thymol and gamma-terpinene (Terpenes)	Mainly to treat problems associated with respiration like cough and sometimes asthma, Effective in inflammation of bronchii	[57]
36	Astragalus Root *(Astragalus propinquus)*	Fabaceae	Compounds Ⅰ, Ⅱ,V, VIandVII amino acids , sucrose, glucoronic acid , trace folic acid,chaline,betaine. (Glycosides)	**I**mmune-boosting,anti-aging, anti-inflammatory, ailments such as fatigue, allergies and common cold also treated, heart diseases, diabetes	[58]
37	Watermelon *(Citratus lanatus)*	Cucurbitaceae	Lycopene, beta-carotene, citrulline, Arachidic acid, malic acid. (Glycosides)	Keep hydrated, prevents cancer, lowers inflammation & oxidative stress	
38	Kale *(Brassica oleracea var. sabellica)*	Brassicaceae	Antioxidants, carotenoids, Glucosinolates, lipid-soluble tocopherols, ascorbic acid, mineral nutrients and dietary polyphenols. (Glycosides)	Antioxidants, lower cholesterol, excellent source of vitamin C	[59]
39	Cinnamon *(Cinnamomum verum)*	Lauraceae	Cinnamaldehyde, eugenol, (Alkaloidal)	Anti-inflammatory property, cuts the risk of heart disease, lower blood sugar level, improve hormone insuline senstivity	[60]
	Angelica root	Apiaceae	Terpenes, alpha-pinene, beta-	Used for heartburn, stomach upsets), loss	

40	(*Angelica archangelica)*		phellandrene, cyclopentadecanolide,camphene, myrcene,carvone (Terpenes)	of hunger (anorexia), bed- wetting, stroke, demantia, Joint pain	[61]
41	Cardamom Seeds (*Elettaria cardamomum)*	Zingiberaceae	1,8-cineole, terpenes,esters, flavanoids (Terpenes)	Respiratory disorders, sore throat, gallbladder problems, colic, ailments and relieve tension	[62]
42	Dried Chamomile (*Matricaria chamomilla)*	Asteraceae	Bisabolol, Farnesene,Apigenin, Azulene, chamazulene, Matricin, Bisabolene (Alkaloidal)	Hay fever, inflammation , muscle spasms, menstrual disorders,loss of sleep, ulcers, wounds, GI disorders, rheumatic joint pain	[63]
43	Burdock (*arctium lappa)*	Asteraceae	Sterols, tannins, polyacetylenes, volatile and fatty oils, xyloglucan (Tannins)	Increaes urine flow, kill germs, reduce fever, colds, cancer, anorexia, nervosa GI complaints, gout, bladder infections,acne & psoriasis	[64]
44	Cloves *(Eugenia caryophyllus)*	Myrtaceae	Eugenol, caryophyllene,Eugenin, Rhamnetin, Eugenitin, Bicornin (Alkaoidal)	Kills bacteria, antioxidants, protect against cancer, improve liver health, reduce stomach ulcer, promote bone health, regulate blood sugar	[65]
45	Kiwi (Actinidia deliciosa)	Actinidiaceae	Actinidain, folate, vitamin E, Thaumatin, Papain,1-methylcyclopropene (Glycosides)	Improves digestion, treats asthma, boost immune system, prevent sickness, manages blood pressure, reduces blood clotting.	[66]
46	Oysters *(Pleurotis ostreatus)*	Ostreoidea	Amino acid, protein polysaccheride, minerals like iron, nickel, strontium (Alkalodal)	Cholesterol loweing, anti-oxidant, anti-cancer	[67]
47	Pecans (*Carya illioinensis)*	Juglandaceae	Vitamin E, omega-3 fattyacids, resveratrol (Alkaloidal)	Provide energy , lower cholestrol, prevents heart attack, anti-inflammatory, phytoestrogen	[68]
48	Black Cutch *(Acacia catechu)*	Leguminosae	Catechin, epicatechin, epicatechin gallate, tannins, procatechinicacid, quercitin , kaempferol (Tannins)	High blood presure, dysentary, colitis, gastric problems, bronchial asthma, cough, leprosy	[69]
	Mulberry	Moraceae	Linoleic acid, palmiticacid,	Lower cholesterol levels, prevents fatty	

49	*(Morus rubra)*		potassium, phenol,alkaloids (Alkaloidal)	liver and improve blood sugar control, decrease oxidative stress, reduce cancer risk	[70]
50	Dioscorea *(Dioscorea Japonica)*	Dioscoreaceae	3,4-dihydrobenzoic acid, myricetin, hyperin,myricetin**,** galactoside&glucoside (Glycosides)	Used in treatment of piles, dysentary, syphilis, ulcers, cough, leprosy, diabetes, asthma, and cancer	[71]

Table 2: Number of medicinal plants as immunity enhancers.



Conclusion:

At the end, we have concluded that Medicinal Plants contains huge diversity of Phytoconstituents and these phytoconstituents are often used as natural drugs for their well marked remedial & inherent property of boosting the Immunity. The phytoconstituents chiefly includes Alkaloids, Glycosides, Tannins, Flavanoids, Terepenes etc. for enhancing the immunity. There are many plant parts that have been reported to exhibit the immunity providing property as focussed in my review.

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