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Herbal Drugs Used as Immunomodulators



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ABSTRACT

The herbal Immunomodulators is a substances which stimulates or suppresses the component of immune system including both innate and adaptive immune response. The modulation by the immune system by various medicinal plant product has become subject for scientific investigation currently worldwide. Indian and worldwide medicinal studies have reported a large number of plants included to promote the physical, mental, and defense mechanism in the body. Medicinal plants which are used as immunomodulatory effect to provide alternative potential to conventional chemotherapy for a variety of diseases, especially in relation to host defense mechanism. Immunity is the ability of the body to protect against all types of foreign bodies like bacteria, virus, toxic substances, etc. which enter the body. The immune system is one of our most complex biological system in the body. Immunization may be active or passive. The active immunization involves stimulation with an antigen to develop the immunological defense against a future exposure and passive immunization involves administration of performed antibodies to an individual who is already exposed to an antigen. There is a growing interest to use herbal medicines as multi-component agents to modulate the complex immune system in the prevention of infections rather than treating immune-related diseases. Many therapeutic effects of plant extracts have been suggested to be due to their wide array of immunomodulatory effects and influence on the immune system of the human body. Phytochemicals such as flavonoids, polysaccharides, lactones, alkaloids, diterpenoids and glycosides, present in several plants, have been reported to be responsible for the plants immunomodulating properties. The drug affecting the immune system is termed as immunomodulatory or adaptogenic. Immunomodulators plays a key role in Immunity of each animal in this world. This review focuses on the use of variety of natural products/drug in the enhancement and suppression of impaired immune system.

INTRODUCTION:

According to the World Health Organization (WHO), about three-quarters of the world population relies upon traditional remedies (mainly herbs) for the health care of its people. In fact, herbs and/or plants are the oldest friends of mankind. They not only provided food and shelter but also served to cure different ailments. Herbal medicine, sometimes called traditional or natural medicine has always existed in one way or another in different cultures and civilizations, such as Ayurvedic (India), Egyptian, Western, Chinese, Kampo (Japan) and Greco-Arab or Unani-Tibb (South Asia).

Traditional medicinal plants have been virtually used since ancient times as immunomodulators for the treatment of many ailments. Immunity provides protection to the individual and has the ability to neutralize and eliminate pathogenic micro-organism and their toxic products [1].

Immunity is the body's natural defense system against various infectious diseases. The factors which trigger immunity include previous infection, immunization, and various external stimuli (Baxter, 2007). Besides, immunity is capable of discriminating among body's own proteins/cells and foreign entities. As soon as the foreign particle is identified, the collective and coordinated response of specific cells and mediators against strange substances constitutes the immune response (Baxter, 2007).

Immunity is a complex, multicellular homeostatic process that allow an individual to recognize foreign material and eliminate the foreign matter [2].

Based on the function, immune system has been categorized in two broad categories, i.e., innate immune system (non-specific immune system) and adaptive immune system (specific or acquired immune system; Vesely et al., 2011).

(A) Innate or Natural or Nonspecific Immunity (L. innatus = inborn):

Innate immunity is inherited by the organism from the parents and protects it from birth throughout life. As its name nonspecific suggests that it lacks specific responses to specific invaders. Innate immunity consists of four types of barriers— physical, physiological, cellular and cytokine barriers.

the main mediators of immune system which deliver instant defense include cytokines, acute phase proteins, macrophages, monocytes, complement, and neutrophils.

(B) Acquired Immunity (= Adaptive or Specific Immunity):

The immunity that an individual acquires after birth is called acquired or adaptive or specific immunity. It is specific and mediated by antibodies or lymphocytes or both which make the antigen harmless.

Acquired (= Adaptive) Immunity is of two types: active immunity and passive immunity.

1. Active Immunity:

In this immunity person's own cells produce antibodies in response to infection or vaccination. It is slow and takes time in the formation of antibodies. It is long lasting and is harmless.

2. Passive Immunity:

When ready-made antibodies are directly injected into a person to protect the body against foreign agents, it is called passive immunity. It provides immediate relief. It is not long lasting. It may create problems.

Immunity is also called disease resistance. The lack of immunity is known as susceptibility. Herbal drugs are known to stimulate both specific and nonspecific immunity and thereby possess immunomodulatory property [3].

Mechanisms of immunomodulation activity occur mainly via stimulation of phagocytes, macrophages, lymphoid cells, increasing circulating total white cell counts and interleukin-2 levels [4]. Immunological defense is a constant interplay between nonspecific and specific, cellular and humoral immune responses, stimulation and suppression of immunocompetent cells, and the influence of endocrine and other mechanisms. Primary targets of the Immunostimulant are T or B lymphocytes and play a central role in immunostimulation [5].

Activation of macrophages is the second most important role in the stimulation of T lymphocytes, which can be achieved either directly or indirectly, via macrophages [6].

Immunotherapy: Immunotherapy or biological therapy is the treatment of disease by activating or suppressing the immune system.

Immunomodulators:

Immunomodulators are medications used to help regulate or normalised the immune system. e.g: one class of Immunomodulators which is used as an add one therapy to treats hereditary angioedema. A number of Indian medicinal plant and various Rasayana have been claimed to process Immunomodulators activity.

Drugs:

1. Curcumin:

Synonyms: curcuma longa, turmeric, Curcuma Domestica, Indian saffron, Haldi.

Biological source: Turmeric consist of the dried, as well as fresh rhizome of plant known as *Curcuma longa* linn.

Geographical source: West Pakistan, India, Malaysia and China.

Chemical constituents: Volatile oils, resinous matter, starch, curcuminolds.

Family: Ginger Plant Rhizome of longa in Zingiberaceae family

Chemical formula: C₂₁H₂₀O₆

Appearance: Bright yellow-orange powder

Molar mass: 368.385 $g \cdot mol^{-1}$



Other activities:

Curcuminoids, a group of phenolic compounds isolated from the roots of *Curcuma longa* (Zingiberaceae), exhibit a variety of beneficial effects on health and on events that help in preventing certain diseases. The most detailed studies using curcumin include antiinflammatory, antioxidant, anticarcinogenic, antiviral and antiinfectious activities. In addition, the wound healing and detoxifying properties of curcumin have also received considerable attention[7].

2. Resveratrol:

Synonyms: Japanese knotweed extract, Polygonum cuspidatum, red wine extract, trans-3,5,4'-trihydroxystilbene, trans-Resveratrol, cis-resveratrol

Source: Polygonum cuspidatum roots

Family: Polygonaceae family

Botanical source: 1. Japanese knotweed plant Polygonum cuspidatum 2. red wine 3. red grape extracts

Molecular Formula: C₁₄H₁₂O₃

Molecular weight: 228.24

Appearance: white powder with slight yellow

Solubility in water: -0.03 g/L

Structure:







Other activities:

KEY BENEFITS: Anti-aging, Anti-Cancer, cardiovascular support, regulate estrogen level, weight loss[8]

3. Epigallocatechin-3-gallate:

Synonyms: Epigallocatechin gallate

Family: polyphenol

Biological source: extracted from green tea, ester of epigallocatechin and gallic acid.

Molecular Formula: C22H18O11

Molecular Weight: 458.4 g/mol

Molar mass: 458.372 g/mol

IUPAC ID: [(2R,3R)-5,7-dihydroxy-2-(3,4,5-trihydroxyphenyl)chroman-3-yl] 3,4,5-trihydroxybenzoate

Soluble in: Water

Structure:





Other activities:

Antioxidant

Anti-inflammatory

Epigallocatechin gallate (EGCG) is a unique plant compound that gets a lot of attention for its potential positive impact on health. It's thought to reduce inflammation, aid weight loss, and help prevent heart and brain disease.

4. Quercetin:

Synonyms: Quercitroside; Quercimelin; Quercitin – 3-L-rhamnoside; Thujin; Quercitin

Family: Hippocastanaceae (polyphenols).

Biological source: Biological Sources Quercetin occurs in the bark of Quercus tinctoria and some other species of Quercus. It is also obtained from *Alsculus hippocastarum*.

Formula: C₁₅H₁₀O₇

Molar mass: 302.236 g/mol

Solubility in water: Practically insoluble in water; soluble in aqueous alkaline solutions

Appearance: yellow crystalline powder

Melting point: 316 °C (601 °F; 589 K)

Structure:



Other activities:

Quercetin has been found to exert anti-mutagenic, anti-oxidative, anti-inflammatory, anticancer/chemopreventive, neuroprotective, antihypertensive and blood glucose-lowering activities[9,10].

5. Colchicine:

Synonyms: Autumn crocous corm, Meadow saffron corm.

Family: Liliaceae

Trade names: Colcrys, Mitigare.

Biological source: autumn crocus (Colchicum autumnale)

Geographical source: England, South Europe

Formula: C₂₂H₂₅NO₆

Molar mass: 399.437 g/mol

CAS ID: 64-86-8

Elimination half-life: 26.6-31.2 hours

Structure:



Other activities:

Colchicine is an immunosuppressive drug widely used in the treatment of gout, weakens the immune system, rendering the patient prone to pneumonia infection[11].

6. Andrographolide:

Synonyms: Andrographis paniculata, Andrographolide, Indian echinacea, Bhunimba, Bidara, Carmantina,

Family: Acanthaceae

Biological source: Andrographis paniculata plant

Geographical source: India and Sri Lanka.

Chemical formula: C₂₀H₃₀O₅

Solubility in water: Sparingly soluble

Melting point: 230 to 231°C (446 to 448°F; 503 to 504 K)

Molar mass: 350.455 g·mol-1

Structure:



Other activities:

Andrographis paniculata is the major active constituent and has various pharmacological effects, including anti-inflammation[12], anti-tumor[13], antidiabetic[14] and cardioprotective activities[15]. In clinic, andrographolide has being applied as an anti-inflammatory remedy for upper respiratory tract infection and bacterial dysentery. Andrographolide was reported to have immunoregulatory activities.

7. Genistein:

Synonyms: NPI 031L

Family: Soy family

Biological source: lupin, fava beans, soybeans, kudzu.

Geographical source:

IUPAC name: 5,7-Dihydroxy-3-(4-hydroxyphenyl)chromen-4-one

Chemical formula: C₁₅H₁₀O₅

Structure:



Other activities:

Biological effects: such as antioxidant, antiangiogenic, anthelmintic, and anticancer activity[16,17].

8. Crocus sativus

Synonyms: saffron, hay saffron, Kesar

Botanical name: Autumn Crocus,

Family: Iridaceae (syn - Kesar)



Biological source: dried stigmas of plant

Geographical source: Iran and other countries such as India and Greece.

Chemical constituents: terpenes, terpene alcohol, and their esters.

Structure:



Other activities:

- Antidepressants
- -Anti-inflammatory
- -Anticancer

-It is also used for sleep problems (insomnia).

-depression, Alzheimer's disease, fright, shock, spitting up blood (hemoptysis), pain, heartburn, and dry skin. Women use saffron for menstrual cramps and premenstrual syndrome (PMS).

The main bioactive metabolites of the saffron spice are coming from the carotenoids [18,19]. Recently, several in vitro and in vivo modern studies have clearly documented that saffron has multiple putative biological activities, such as anti-cancer [20,21], anti-inflammatory [21,22,23], antioxidant, radical scavenging [24,25], antidepressant [26,27], anti-allergic [28], anti-arthritic [29], anti-genotoxic, anti-aging, antihypertensive [30,31], anti-angiogenesis [32,33], anti-atherogenic [34], antibacterial [35,36], anti-diabetic [37,38] anti-obesity [39], neuroprotective [40,41], hepatoprotective [42,43], nephroprotective [44], cardioprotective [45,46] and beneficial effects on reproductive system [46].

9. Ginger

Synonyms: Gingerin-Zingiber officinale Roscoe,

Kingdom: Plantae

Family: Zingiberaceae

Species: Z. officinale

Genus: Zingiber

Order: Zingiberales

Molecular Formula: C23H31NO6

Molecular Weight: 417.5 g/mol

Active constituents: phenolic and terpene compounds

Biological source: fresh or dried peeled or unpleeled or coated rhizomes of Zinzibera officinale

Geographical source: southeastern Asia

Structure:



Structure of: 6 Gingerols

Other activities:

Anti-inflammatory

Antioxidant

The ginger rhizome is widely used for the treatment of diseases and conditions, such as inflammatory and respiratory ailments, which are prevalent in smokers. This study is the first study of the effects of an aqueous ginger extract on the immune system cells and antibodies, thyroid hormones, and hematology in smokers compared to non-smokers.

10. Cumin

Synonyms: Cumin cyminum, also know Jeera

Scientific name: Cuminum cyminum

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms



Order: Apiales

Family: Apiaceae

Genus: Cuminum

Species: C. cyminum

Active constituents: volatile oil (3-4%), cumin aldehyde

Molecular Formula: C₁₀H₁₂O

Structure:



Structure of: Cuminaldehyde

Biological source: dried seed of the herb Cuminum cyminum

Geographical source: It is cultivated in Morocco, Sicily, India, Syria, and China. In India, except Assam and West Bengal, it is cultivated in all states. About 90% of the world production is from India, and most of it comes from Rajasthan and Gujarat.

Other activities:

Anti-inflammatory, antioxidant

In particular, children need iron to support growth and young women need iron to replace blood lost during menstruation [47].it may increase the activity of digestive enzymes, potentially speeding up digestion.

Cumin also increases the release of bile from the liver. Bile helps digest fats and certain nutrients in your gut.

11. Cardamom

Synonyms: cardamom fruit, cardamom seeds, Elettaria cardamomum. Elettaria Cardamomum.

Kingdom: Plantae

Family: Zingiberaceae

Order: Zingiberales

Biological source: Dried ripe fruit of Elettardia cardamom

Geographical source: Indian, Indonesia, Guatemala, Malaysia and Tanzania

Chemical constituent: Cineole, the major active component of cardamom oil, is a potent antiseptic that kills the bacteria in bad breath and treats other infections.

Structure:



Structure of: p-Menth-1-en-4ol

Other activities:

The fragrant spice comes in two forms - green and black. Both of them are very effective in boosting immunity, but according to Bangalore-based nutritionist, Dr. Anju Sood, black cardamom has been specifically known to alleviate colds and cough and certain respiratory problems. You can steep cardamom pods in tea, have them with water, chew them raw, or use

cardamom oils that are available in market. In addition to keeping you warm and immune, cardamom oil is also excellent to give you a soft and supple skin.

12. Cinnamon

Synonyms: Cinnamomum zeylanicum, Ceylon cinnamon. Cinnamon bark, kalmi- dalchini

Scientific name: Cinnamomum aromaticum, Cinnamomum cassia

Family: Laurasease

Chemical constituents: Eugenol, cinnamic acid, cinnamic aldehyde

Biological source: dried inner bark of the shoots of coppiced trees of Cinnamomum zeylanicum Nees.

Geographical source: Sri Lanka and Malabar Coast of India.

Uses: Flavouring agents, germicide

Chemical constituent: cinnamaldehyde, cinnamate, cinnamic acid, and numerous essential oils

Structure:





Structure of: Cinnamaldehyde

Other activities:

The delightful spice has been widely used in Chinese and Indian medicine to treat variety of conditions. Various studies say that cinnamon has compounds that could help manage diabetes and facilitate weight loss. Another prominent health benefit of cinnamon is its ability to relieve cold and soothe sore throat. It is rich in antioxidant polyphenols and

proanthocyanidins that boost your immunity naturally. It is also packed with antiviral, antibacterial and antifungal properties. According to Dr. Ashutosh Gautam, having cinnamon stick soaked warm water with few drops of honey about two-three times a day can help clear a sore throat and cold.

13. Black Pepper

Synonyms: white pepper, Madagascar pepper, Piper nigrum, true pepper, pepper vine.

Scientific name: Piper nigrum

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Order: Piperales

Family: Piperaceae

Genus: Piper

Species: P. nigrum

Biological source: peppercorn

Geographical source: Western Ghats region of India.

Chemical constituent: piperine (C17H19NO3)

Structure: piperine





Structure: Piperine

Other activities:

Black pepper is replete with many nutrients like vitamin C, flavonoids, antioxidants and antibacterial properties - all of which can do wonders for your immunity and relieve cough and cold.

14. Ocimum tenuiflorum:

Kingdoms: plantae

Synonyms: Geniosporum tenuiflorum, Ocimum Sanctum L.[48].

Common name: holy basil (English name), Tulsi (Hindi).

Biological name: Ocimum tenuiflorum.

Family: Lamiaceae

Biological source: Entire plants

Geographical source: India, Southeast Asian.

Genus: Ocimum

Species: O. tenuiflorum.

Chemical constituents: Phytoconstituents such as oleanolic acid, ursolic acid, rosmarinic acid, eugenol, carvacrol, linalool & beta caryophyllene (about 8%).[49].





Structure: eugenol.



Structure: carvacrol.

Other activities:

In the Ayurveda, system tulsi is often referred to as an "Elixir of Life" for its healing powers and has been known to treat many different common health conditions. In the Indian Materia Medica tulsi leaf extracts are described for treatment of bronchitis, rheumatism, and pyrexia [50]. Other reported therapeutic uses include treatment of epilepsy, asthma or dyspnea, hiccups, cough, skin and haematological diseases, parasitic infections, neuralgia, headache, wounds, and inflammation [51] and oral conditions [52]. The juice of the leaves has been applied as a drop for earache [52], while the tea infusion has been used for treatment of gastric and hepatic disorders [53]. The roots and stems were also traditionally used to treat mosquito and snake bites and for malaria [54].

15. Withania somnifera:

Kingdoms: plantae.

Synonyms: physalis somnifera L. Withania kansuensis kuang & A.M. Lu.[55].

Common name: Ashwagandha, Indian ginseng, poison gooseberry or winter cherry.

Biological name: Withania somnifera (L).Final.

Part used: powdered root extract.

Geographical source: many of the drier region of India, also found in Nepal, China & Yeman.[56].

Family: Solanaceae.

Genus: Withania

Species: w.somnifera

Chemical composition:

Laboratory analysis has revealed over 35 chemical constituents contained in the roots of Withania somnifera [57]. The biologically active chemical constituents are alkaloids (isopelletierine, anaferine), steroidal lactones (withanolides, Withaferin), saponins containing an additional acyl group (sitoindoside VII and VIII), and withanolides with a glucose at carbon 27 (sitoindoside XI and X). Withania somnifera is also rich in iron.

Much of Ashwaganda's pharmacological activity has been attributed to two main withanolides, withaferin A and withanolide D. [58].



Structure: Withaferin A

Other activities:

Centuries of Ayurvedic medical experience using Withania somnifera have revealed it to have pharmacological value as an adaptogen antibiotic, abortifacient, aphrodisiac, astringent, anti-inflammatory, deobstruent, diuretic, narcotic, sedative, and tonic. Ashwagandha has been found to: Provide potent antioxidant protection [59]. Stimulate the activation of immune system cells, such as lymphocytes and phagocytes [60]. Counteract the effects of stress and generally promote wellness [61].

16. Aloe:

Kingdoms: plantae

Synonyms: Aloe barbadensis mill, Aloe barbadensis Var. Chinensis Haw.

Binomial name: Aloe vera

Family: Asphodelaceae (Liliaceae).

Colour: pea- green colour.



Geographical source: dry region of Africa, Asia, Europe & America. In India, it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra & Tamilnadu.[62]

Biological source:

Chemical constituents: Aloe Vera contains 75 potentially active constituents: vitamins [vit- A (beta- Carotene), Vit- C & E, vit- B12, folic acid and choline], Enzyme (aliases, alkaline phosphatase, carboxypeptidase, catalase, cellulose, lipases, peroxidase and Brady kinase), Mineral (calcium, chromium, copper, selenium, magnesium, magnas, potassium, sodium and zinc), sugar, Anthraquinone (Aloin and emodin), fatty acids, Hormones (Auxins and Gibberellins) and amino acid.[63,64]



Structure of: Aloin

Other activities:

Aloe Vera also has a healing properties, anti inflammatory action, laxative effects, antiviral and antitumor activity, moisturizing and anti-aging effect and antiseptic effects.[62]. It also reduces the production and release of skin keratinocyte derived immunosuppressive cytokines such as interleukin-10(IL-10) & hence prevent UV- induced suppression of delayed type hypersensitivity.[65]

17. Camellia sinensis:

Kingdoms: plantae

Synonyms: Camellia Angustifolia Hung T. Chang, Camellia arborescens Hung T. Chang & F. L. Yu, Thea Sinensis L.[66].

Common name: "tea plant", "tea shrub", and "tea tree"

Binomial name: Camellia sinensis

(L.) Kuntze.

Family: Theaceae.

Part used: leaves

Geographical source: Tea (Camellia sinensis L.), a cultivated evergreen plant, is native

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45

to China, later spread to India and Japan, then to Europe and Russia.

Genus: Camellia

Species: C. Sinensis.

Chemical composition:

The chemical components of tea leaves include polyphenols

(catechins and flavonoids), alkaloids (caffeine, theobromine, theophylline, etc.), volatile oils, polysaccharides, amino acids, lipids,

vitamins (e.g., vitamin C), inorganic elements (e.g., aluminium,

fluorine and manganese), etc.



Structure: Catechin Structure: caffeine

Other activities:

The health benefits derived through the con-

Assumption of tea is summarized below:

Acts as antioxidant, Fights against variable forms of cancer, Reduces risk of cardiovascular diseases, Treat respiratory diseases, Corrects skin disorder, Prevents diabetes, Aids in indigestion, Improves oral health, Keeps away from liver disease, Gives a boost to immunity, & Treats arthritis etc.[67]

18. Eclipta alba L.

Kingdoms: plantae

Synonyms: Verbesina prostrata L.

Eclipta undulata Willd.

Eclipta patula Schrad. ex DC.

Common name: false Daisy, Karisilakanni and bhringraj.

Binomial name: Eclipta prostrata

(L.) L.[68]

Family: Asteraceae.

Geographical source: India, Nepal, China, Thailand, and Brazil.

Genus: Eclipta

Species: e.prostrata

Part used: leaves.

Chemical composition:



Eclipta alba (L.) contains wide range of active principles which includes coumestans, alkaloids, flavonoids, glycosides, polyacetylenes, triterpenoids. The leaves contain stigmasterol, β -terthienyl methanol wedelolactone, demethylwedelolactone and demethylwedelolactone-7-glucoside43.[69]



Structure: stigmasterol.

Structure: wedelolactone.

Other activities: The herb has been known for its curative properties and has been utilized as

antimytotoxic, analgesic, antibacterial, antihepatotoxic, antihaemorrhagic, antihyperglycemic, antioxidant, immunomodulatory properties and it is considered as a good rejuvenator.[70].

19. Asparagus racemosus:

Kingdom: plantae

Synonyms: Asparagus rigidulus Nakai

Protasparagus racemosus (Willd.) Oberm.

Common name: Satawar, Satamuli.

Binomial name: Asparagus racemosus

Willd.[71]

Family: Asparagaceae

Geographical source: Sri Lanka, India and the Himalayas.

Genus: Asparagus

Species: A. racemos.

Part used: dried roots.

Chemical composition: Asparagamine A, Steroidal saponins, shatavaroside A, shatavaroside

B, filiasparoside C, shatvarins, immunoside.[72,73]





Other activities:

A study of ancient classical Ayurvedic literature claimed several therapeutic attributes for the root of A. racemosus and has been specially recommended in cases of threatened abortion and as a galactogogue. Root of A. racemosus has been referred as bitter-sweet, emollient, cooling, nervine tonic, constipating, galactogogue, and aphrodisiac, diuretic, rejuvenating, carminative, stomachic, antiseptic and as tonic. Beneficial effects of the root of A. recemosus are suggested in nervous disorders, dyspepsia, diarrhoea, dysentery, tumors, inflammations, hyper dipsia, neuropathy, hepatopathy, cough, bronchitis, hyperacidity and certain infectious diseases.[74,75]

20. Morus alba Linn:

Kingdom: plantae

Synonyms: Morus atropurpurea Roxb.

Morus chinensis Lodd. ex Loudon[76].

Common name: white mulberry,

Binomial name: Morus alba

Family: Moraceae

Geographical source: morus alba is native of India, China and Japan. It is occasionally cultivated elsewhere in Europe, North America and Africa.

Genus: Morus L.

Species: Morus alba L.

Part used: fruit, roots and leaves.

Chemical composition: the plant is a very good source of ascorbic acid, of which over 90% is present in a reduced form, and also contains carotene, Vitamin B1, folic acid, folinic acid, isoquercetin, quercetin, tannins, flavonoids and saponins. The plant is reported to contain the phytoconstituents tannins, phytosterols, sitosterols, saponins, triterpenes, flavonoids, benzofuran derivatives, morusimic acid, anthocyanins, Anthraquinone, glycosides and oleanolic acid as the main active principles[77,78]. Morus alba leaves contain rutin,



quercetin and apigenin as bioactive constituents[79]. The one of major constituent of Morus alba is 1-deoxynojirimycin[80].



Structure: sitosterol.

Other activities:

This widely grown plant has been in use by tribals of this country for ailments such as asthma, cough, bronchitis, edema, insomnia, wound healing, diabetes, influenza, eye infections and nosebleeds[77]. It has been used in the indigenous system of medicine for cooling, acrid, purgative, diuretic, laxative, anthelmintic, brain tonic, antibacterial, hepatopathy properties. They are useful in vitiated condition of vata and pitta, burning sensation[81].it also have anthelmintic, anti-stress, antimicrobial, anti-cancer, antimutagenic and antioxidant activity.

21. Emblica officinalis

Kingdom:-Plantae

Order:-Malpighiales

Synonyms:-

- Cicca emblica (L.) Kurz
- Diasperus emblica (L.) Kuntze
- Emblica arborea Raf.
- Phyllanthus mairei H.Lév.

Common name:-

emblic, emblic myrobalan, myrobalan, Indian gooseberry, Malacca tree, or amla from Sanskrit amalaki[82,83].

Biological name:-Phyllanthus emblica.

Family:- Phyllanthaceae[82].

Geographical source:-

The plant species is native to India, also growing in Sri Lanka, Uzbekistan, South East Asia, and China nowadays (Baliga and Dsouza, 2011).

Genus:- Phyllanthus

Species:-P. emblica[82].

Chemical constituents:-

This herb has many bioactive compounds including apigenin, gallic acid, ellagic acid, chebulinic acid, quercetin, chebulagic acid, corilagin, isostrictiniin, methyl gallate, luteolin and so on. Emblicanin A, emblicanin B, phyllaemblicin B, punigluconin and pedunculagin are tannins present in Emblica officinalis (Table 4). Glutamic acid, proline, aspartic acid, alanine and lysine are 29.6%, 14.6%, 8.1%, 5.4% and 5.3% respectively of the total amino acids.

Structure of: Apigenin



Gallic acid:



Other activities:-

Most important plants in the traditional Ayurvedic medical system as well as in other traditional health systems.

◆Antioxidant activity.

♦immunomodulatory

♦ anti-inflammatory

♦antiulcer

♦ hepatoprotective

♦ anticancer actions.

◆Analgesic/Antipyretic

◆ Antitussive

♦ Cardiac effects

◆CNS[84].

22. Allium sativum

Kingdom: Plantae

Synonyms:-.



4Ľ

•Allium longicuspis Regel

•Allium ophioscorodon Link

Common name:-Garlic

Biological name:-Allium sativum L[85].

Biological source:-Allium sativum is a perennial flowering plant growing from a bulb, it has a tall, erect flowering stem that grows up to 1 m[86].

Family: Amaryllidaceae

Subfamily: Allioideae

Geographical source:-It is native to Central Asia and northeastern Iran.

Genus:-Allium

Species:-A. sativum[85].

Chemical constituents:-Sulfur compounds are the main chemical constituents responsible for Allium sativum's taste, smell, and likely for its biological effects. When a garlic clove is intact, glutamyl cysteins are the primary sulfur components (Powolyny and Singh 2008). These are hydrolyzed to form alliin. When garlic is crushed by chewing, chopping, etc[87].

Structure: Glutamyl cysteins:



Other activities:-

- ◆Antibacterial activity
- ◆Antiviral activity
- ◆Antifungal activity
- ◆Anti- Diabetic activity
- ◆Antihypertensive activity
- ◆Alzheimer' Disease Protective activity
- ◆Cardioprotective activity
- ♦ Anti-cancer Activity
- ◆Diuretic and Digestive activity
- ♦Anti-tumor Effects.
- 23. Citrus
- Kingdom:-Plantae
- Order:-Sapindales
- Synonyms:-
- •Eremocitrus
- Microcitrus
- •and see text
- Common name:-sweet orange.
- Biological name:-Citrus limon (L.) Osbeck
- Family:-Rutaceae
- Subfamily:-Aurantioideae [88].



Geographical source:-South Asia, East Asia, Southeast Asia, Melanesia, and Australia[88,89].

Genus:-Citrus L.

Species:- Ancestral species:

See♦Citrus maxima – Pomelo

◆Citrus medica – Citron[88].

Chemical constituents:-

Some Citrus species contain significant amounts of the phytochemical class called furanocoumarins[90].

Furanocoumarins :



Chemical components of citrus fruit which include sugars, polysaccharides, oraganic acids, nitrogenous constituents and lipids; carotenoids which contribute to color; vitamins and minerals, and flavonoids; limonoids, some of which impart bitterness to the juice; and the volatile components which contribute to aroma have been reviewed[91].

Other activities:-

- ◆Anti-oxidant activity
- ◆Antiulcer activity
- ◆Anthelmintic and insecticidal activity
- ◆Anticancer and cytotoxic activity

- Antimicrobial action
- ◆Anti-inflammatory and analgesic action
- ◆Anti-hyperglycemic action
- ◆Hypolipidemic activity
- ◆Estrogenic activity
- ◆Hepatoprotective action.

CONCLUSION:

As we all know that plant is an important source of medicine and plays a key role in world health organisation. Medicinal herbs or plants have been known to be an important potential source of therapeutics or curative aids. The reasons for this is because of their better cultural acceptability, better compatibility and adaptability with the human body and pose lesser side effects. The use of medicinal plants has attained a commanding role in health system all over the world. Several plant derived compounds have been identified over the years for their immunomodulatory characteristics. The special significance of medicinal plants in treatment of diseases relates to the phytochemical present. The study showed that all the medicinal plants contain bioactive components known as phytochemicals. Numerous illnesses can be alternatively treated by immunomodulation using medicinal plants, instead of chemotherapy. The discovery and isolation of more specific immunomodulatory agents from plant origin possesses potential to counteract the side effects and high cost of synthetic compounds.

This review focuses on importance of different medicinal herbs and natural remedies and also clears that immunomodulation using medicinal herbs can provide an alternative to conventional chemotherapy for a variety of diseases.

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466