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REVIEW ARTICLE

Potential Natural Immunity Enhancers Against Covid-19 Pandemic

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ABSTRACT

Immune system is the organization of different oragans and cells in human body. It's function is to protect and to fight against the host from any non-self particles like viruses, microbes, fungi, parasites, etc. Our body requires vast variety of micro (i.e. vitamins and minerals) as well macro(carbohydrates, proteins, fats) nutrients synthesize different kinds of immune cells. Viral disease like the Covid-19 can be prevented by a strong immune system. In terms of Covid-19 and it's origin, transmission, clinical aspects and diagnosis. However here, we have formulated the novel concept hitherto ancient means of traditional medicines or herbal plants to beat this pandemic. In this paper we studied the literature on the immune supportive properties, finding revealed that a variety of natural herbs like Spirulina, Tulsi, Neem, Triphala, Garlic, Clove, Turmeric, Ginger, Black pepper, etc. are some of proven ancient herbs that enhance the immunity.

KEYWORDS

Potential, immunity, mechanism, natural herbs and immunity enhancer

INTRODUCTION

The world experienced coronavirus for the first time in 2002–2003 through severe acute respiratory syndrome (SARS), and in 2011, Middle East Respiratory Syndrome (MERS) for the first time. The causative agents for both cases (SARS-CoV and MERS-CoV) were newly identified coronaviruses of zoonotic origin in the genus Beta-coronavirus [1]. The present coronavirus (SARS-CoV-2) Covid-19 appeared for the first time in Wuhan, China, at the end of 2019. People are being affected by human-to-human transmission due to close contact [2,3], and people affected by Covid-19 suffer from severe respiratory illness [4].

Nearly, 213 countries of all continents have been affected in less than three months by this pernicious virus. After studying its clinical characteristics, experts affirmed that it is quite similar to pneumonia and therefore, named as Novel Coronavirus. However, in the second week of March, 2020, Covid-19 was stated as the pandemic by World Health Organization(WHO) [5]. In essence, it has been known to transmit through droplets such assaliva or nose or even through air-borne transmission [6]. SARS-CoV-2 infection is often categorized into three stages: first, asymptomatic phase; second, non-severe symptomatic phase; and third, severe respiratory symptomatic phase. Usually, a small number of patient's progress to the severe stage and develop ARDS and/or multiorgan failure.

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SAR-COV-2 include fever, cough, fatigue and sputum production. Symptoms shortness of breath, myalgia, headache this are common it includes gastrointestinal symptoms such as vomiting, diarrhoea, anosmia.

As no specific therapy is available for SARS-CoV-2, the proposed therapy is based on the previous experience from SARS or Middle East Respiratory Syndrome (MERS) coronavirus. These therapeutic molecules, for example viral methyltransferase inhibitors, nitazoxanide, protease inhibitors (such as lopinavir/ritonavir), interferon, therapeutic peptides, RNA synthesis inhibitors (such as ribavirin, flavirapivir, and remdesivir), anti-inflammatory drugs, [7] but the remdisivir had many side effects such as hepatotoxicity, respiratory toxicity, cardiovascular toxicity, nephrotoxicity, reproductive toxicity, [8,9] so it's risky to treat.

At this time, prevention is more necessary than cure, in this pandemic immunity plays a key role by[10]

• Washing hands regularly for 20 seconds with soap and water or alcohol-based hand rub. • Cover nose and mouth when sneeze or cough with a disposable tissue.

• Avoiding close contact with people who are sick. • Stay at home and self-isolate from others if feel unwell.

People in certain previous sicknesses like diabetes, hypertension, cardio vascular disease and respiratory issues are at a higher danger of having Covid-19 entanglements, it likewise with age as the immunity decreases as you get older. In the younger age with no prolonged severe disease, Covid-19 can bring about minor symptoms on the individuals who have stronger immunity [10].

Mechanism of immunity against Covid-19 :-

The immune system is the best defense because it supports the body’s natural ability to defend against pathogens (eg. Viruses, bacteria, fungi, protozoan and worms) [11,12] and resists infection. As long as the immune system is functioning normally, infections such as Covid-19 go unnoticed. There are three type of immune system innate immunity (rapid response), adaptive immunity (slow response) and passive immunity. There are two types of passive immunity natural immunity, this recieve from maternal side, and artificial immunity recieve from medicine. The innate, passive and adaptive immune response could be triggered in response to the SARS-COV-2 infection. Blood sample of sympathomimetic hospitalised patients with mild to moderate SARS-COV-2 infection, immunological changes such as increase the number of activated CD4+ helper T cell and CD4+ killer cells, follicular helper T cells, IgE, IgM were detected. No registered the medicine or vaccine against Covid-19 immune system is the best defense because it support the body's natural immunity to defence against the pathogens [11,12], begins the inflammatory response of skin when body is affected [13,14]. Our immune system is essential for our survival. Without immune system, our body would be open to attack from bacteria, viruses, parasites and other microbes. It is immune system that keep us healthy as we drift through a sea of pathogens. The immune system is spread throughout the body and involves by many type of cells, organs, protien and tissues. It can distinguish our tissue from foreign tissue i.e., form non self. Dead and faulty cells are also recognised and cleared away by the immune system. If the immune system is encounter a pathogens, for instance, a bacterium, virus or parasite, it means so called immune response. An antigen is any substance that can spark an immune response. Once B lymphocytes spot the antigens. Antibodies are special protein that lock on specific antigen. Antibodies are part of a large family of chemical called immunoglobulins, which play many roles in the immune response: IgG, IgM, IgD, IgA, IgE [13,14]. But when the immune system response is low, weak open the invitation for infection, overall gut microbiom health which makes up to 85% of the body's immune system. Patients of coronavirus must have plenty of water that will keep the mucous membrane moist which can lower the chances of cold and flu [15]. Although drinking water does not ensure that you not contract the coronavirus, remaining hydrated can improve your health and make

sure the immune system can defect the virus. The drinking water is work to help your cells to oxygenated. All cells of our body compete at their best if they get enough oxygen that helps them protect the body from any infections agent that enter, if they do fight against them(16).

Medicinal herbs are 'Gifted Gods' for supporting, healing and rehabitating the patients. No any type of substantiation is present, but different studies on herbal plant are that have the ability enhance, boost or strengthen the immune system. Some phytocompounds are being recognised the characterised the herbs in mitigating the incidence of various type of infections. There are various type of traditional medicinal plants- Ayurveda, Unani, Siddhi, Homeopathy Romanian, Persian, Chinese. Examples of traditional medicinal plant currently check the effectiveness this virus [17,18]. Various type of herbal plant utilized conventual medicine and in aboriginal health services to combat disease. Herbal medicine enhance immune system increasing potential against Covid. More than 25,000 herbal formulations used In folk remedies in Ayurveda alone. About plant sources and their usage is chiefly indispensable employe it under right condition [19, 20]. Medicinal herbs are life saving drugs. These days are research is being conducted on them and promote usage in treatment of Covid-19 patients due to their potential possessing anti-inflammatory, antioxidant and antiviral property. It is necessary to maintain the hygiene sorrounding [21]. There are various type of traditional herb medicine Tulsi, Amla, Neem, Bhringraj, Triphala, Turmeric, Ginger, Aloe, Ashwagandha, Peppermint, Eucalyptus, Green tea, Night flowering Jasmin, Ginsang, Gulvel, Clove. They help for the increase or enhance the immunity and our body potential. Various active constituents help to enhance the potential. example garlic, ginsang they participate in cytokinin secretion modulation. Above traditional herb drive have their own immunomodulatory action. All herbal medicines have less side effects. Various type of traditional herb and food play important role in boost the potential and immunity [22].

Various herbal plants which enhance the immunity

1. Spirulina

Introduction-

Botanical name is Spirulina platensis or Spirulina maxima belongs to family oscillatoriaceae. Spirulina is a high quality source of pigments, minerals and vitamins. The beneficial effect of Spirulina as a nutritional and dietary supplement. Several research studies recommended that Spirulina can be a potential alternate therapy against virus diseases due to the possible synergistic effect of many bioactive compounds present in the whole cell. It has major beneficial activity i.e.,immunomodulatory and antioxidants. Spirulina has the potential to enhance immune components and reduce physiobiochemical stress, and therefore could be used as a supplement along with treatments or prevent Covid-19 infection and related symptoms[23,24].

History

The term Spirulina remains in use is because of historical reasons (Vonshak, 1997). In sixteenth century, S.platensis was first isolated from Lake Texcoco by the Aztecs and they devised the term “tecuitlatl” for Spirulina (Habib M. et.al., 2011). It has a long history of use as food and it has been reported that it has been used during the Aztec civilization[25].In America, spirulina is sold in health food stores as a powder or tablet. In Russia, it has been approved to treat symptoms of radiation sickness, because the carotenoids it contains absorb radiation[26].The first documented report on spirulina dates back to the 16th century and spirulina is believed to have been a nutritional source for the Aztecs and Mesoamericans[27].

Chemical Constitute-

Spirulina is a protein-rich food product(approximately 55-70% dry weight), with a relatively low carbohydrate content of around 15% dry weight. It also contains several trace of minerals, vitamins and pro- and pseudo- vitamins. It contains phycocyanin-

containing phycobiloproteins which are active ingredient[28,30].

(Fig. 1) Spirulina species

Fig. 2 Spirulina as immunity booster

How to administer-

One tablespoon, which is around gram of dried spirulina powder contains protein (4 grams), Vitamin B1 (11% RDA), Vitamin B2 (15% RDA), Vitamin B3 (4% RDA), Copper (21% RDA) and Iron (11% RDA). 7 grams of powdered spirulina has around 20 calories and 1.7 grams of digestible carbs.

Mechanism of action-

The aqueous extract of spirulina was found to have a major impact on the immune system by increasing the phagocytic activity of macrophages, stimulating the NK cells[28,29]. For decades, users have anecdotally reported a decrease in colds and flu from spirulina use. Several pre-clinical animal studies have shown good immunostimulatory effects in a variety of species. Extracts from spirulina biomass have also been found active against herpes virus, cytomegalovirus, influenza virus, etc. Spirulina extracts have also been shown capable of inhibiting carcinogenesis[30,31].

Role against Covid 19-

Spirulina (LED Spirulina), at a concentration of 0.1 μg/mL, decreases macrophage and monocyte-induced TNF-a secretion levels by over 70% and 40% respectively. The administration of spirulina could enhance nonspecific preventive measures, such as the activation of CD4+ cells, which further enhance the production of IFN-y in humans, for the prevention of viral infections[32,33].

Pharmacological action of phytocostituent-

Name of phytocostituent	Biological activity	Reference
Ca-Sp	Immune enhancing, anticancer, antiviral	30,31
Beta- carotene	Source of vitamin A, anticancer, antiviral, anti-oxidant	31
GLA	Precursor of prostaglandin, heart disease, obesity, mania, depression	32,33
Phycocyanin	Reduce toxicity, immuno-enhancing, induce hematopoiesis, anti-viral	33
Cyanovinin-N, Sulpholipid	Antiviral	32,33

Therapeutic uses-

In diabetes mellitus, anticancer properties, in radioprotective, antiviral properties, immunomodulatory properties, antioxidants, also as cardiovascular benefits[32,35,36].

Antiviral property-

The researchers concluded that aqueous spirulina platensis extracts contain antiretroviral activity that may be of potential clinical interest. Calcium Spirulana inhibited the replication of enveloped viruses such as Herpes simple type 1, human cytomegalovirus, measles, mumps, influenza A and HIV-1[12]. Calcium was seen to play an essential role in a dose-dependent manner for inhibiting the cytopathic role of such viruses.[23] In addition, in undernourished children spirulina has been found to improve weight gain and correct anemia in both HIV-infected and HIV-negative cases[35,36].

Side effects-

Although few adverse effects are associated with the use of spirulina, consuming spirulina may cause headaches, allergic reactions, muscle pain, sweating, and insomnia in some cases. People with allergies to seafood, seaweed, and other sea vegetables should avoid spirulina.

2. Tulsi

Introduction-

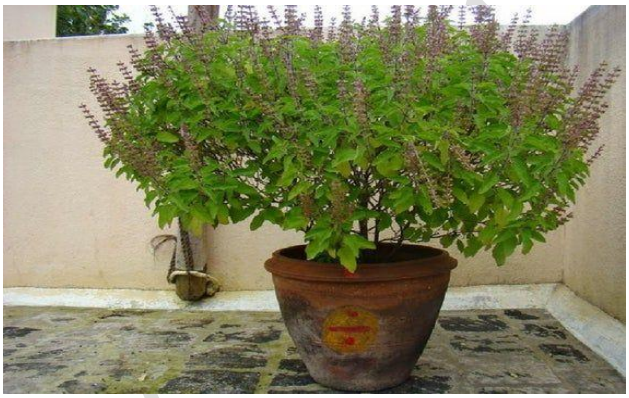
Botanical name Ocimum sanctum belongs to family lamiaceae. Tulsi commonly known as holy basil. It has been used for treatment of wide range variety of ailments in many parts of world. Tulsi tea or kadha is commonly used for relieving bronchitis and asthma. It is an essential ingredient in preparation of ayurvedic cough syrup[37]. Leaves of Ocimum sanctum contains water soluble phenolic compounds and various constitute such as eugenol, methyl eugenol, caryophyllene that may acts as immunostimulant. Ayurveda consider tulsi as one of most enriching herbs and 'queen of herbs' and reverse as an 'elixir of life' that is equal for both medicinal and spiritual properties[38].

History-

Tulsi has been used for thousands of years in Ayurveda, a Hindu form of medicinal science for its diverse healing properties. It is mentioned in Charaka, Samhita and ancient Ayurvedic text. If one make a paste of tulsi leaves and smears it over his body and worship Vishnu, it is worth several ordinary Pujas and Lakhs of Godan (Donation of cows)[39].

Chemical constituents-

It contains volatile oils. The oils contain about 70% eugenol, 20% methyl eugenol, beta caryophyllene, carvacol, cineole, linalol. Active ingredients are eugenol, thymol, beta caryophyllene, rosamarinic acid and carvacol[40].



(Fig.3) Ocimum sanctum

(Fig.4)Tulsi kadha

Extract use-

-Tulsi is rich in vitamin C and zinc. It act as natural immunity booster and keeps infection at away. It is abundant in antioxidants and micronutrients that provides powerful immune protection from free radical damage and increase body capacity to fight against disease and infection[41,42].

How to administer-

It can be administered in different way. To prepare kadha there is a method of preparation is given:- 10-15 tulsi leaves, 1 inch ginger, 1 inch raw turmeric, 4 stick mulethi, 10 black

peppercorn, 10 cloves, 3-4 cinnamon sticks, 8 cups of water. Pour water in deep pan and add above ingredients. Boil water for a hour in low medium flame. After a hour, switch off stove, allow it for cooling and take it for boosting immune system[41,46].

Mechanism of action-

Tulsi leaves are natures best antibiotics. Chewing tulsi leaves purifies blood and help several coomon elements. Kadha of tulsi useful to boost immunity. It is best home remedies to boost immunity by Ministry of health GOI [43].

Role against Covid-19

Tulsi extremely useful for treating bacterial and fungal infection as well as immunological disorders like allergies and asthma. Tulsi has natural essential oils like camphene, cinolene and eugenol which will reduce cold congestion in chest. It contain bioflavonoids and antioxidants compound such as Rosamarinic acid which is good for antimicrobial agents for treating infection in the respiratory tract. Tulsi leaves extract increase the T-helper cells and natural killer cells activity, boosting immune system[44].

Pharmacological action of phytocostituent-

Name of phytocostituent	Biological activity	Reference
1. Eugenol	Antiseptic, anaesthetic, used in perfumes, flavouring and essential oils, in antidiabetic	43
2. Thymol	Strong antimicrobial attributes	43
3. Beta caryophyllene	Relief of anxiety and depression	40
4. Carvacol	Protective effect for liver, antioxidants activity against harmful organisms	40
5. Rosamarinic acid	Antioxidants	48

Therapeutic uses-

In bronchitis asthma, anticancer activity, anti-oxidant, antidiabetic, antimicrobial, immunomodulatory, anti-inflammatory, antistress activity, hepatoprotective, analgesic, antiarthritic, radioprotective, anti-aging effect[37,43].

Antiviral property-

All extract of Ocimum sanctum (crude extract, terpenoid and polyphenols) shows significant virucidal activity. Depending upon type of extract, the antiviral activity of Ocimum sanctum has been assessed against many important viral agent as fish pathogenic viruses viz., Infectious hematopoietic necrosis viruse (IHNV), Herpes virus (HSV), Adenoviruses, etc[44,45,46,47].

Side effects-

Not suitable in pregnant women, may not good for diabetics patients, Interfere with blood thinning medicine, may stain your teeth[48].

3. Neem

Introduction-

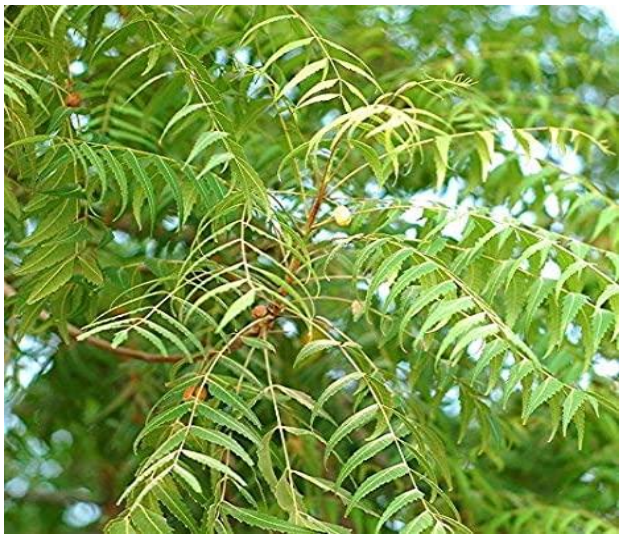
Botanical name Azadirachta indica belong to family meliaceae. Neem is one of the most useful traditional medicinal plant in India. Azadirachta indica is fast growing, evergreen tree and it is native in India, America and Africa. As Covid-19 is responsible for severe Cytokine Storm induced complications and coagulopathies[49]. The neem can be useful as a Single Silver Bullet in Covid-19 in both prophylactic and curative aspects and also useful in post Covid complications. Neem has called the wish fulfilling tree and pinchumada or destroyer of leprosy.

History-

The Vedas called Neem as "SARVA ROGA NIVARINI" which means, one that cures all ailments and ills. This tree considered to be divine origin. The ancient Indian found many therapeutic uses of tree and also observed that tree could survive and grow almost anywhere as long as it warm and dry. Ayurvedic Text described neem tree by associating its remarkable healing properties from as for back as 5000 BC[50].

Chemical constituents-

Leaf- Quercetin, nimbosterol, nimbin
Flower- Nimbosterol, kaempferol, melicitrin
Bark- Nimbin, nimbidin, nimbosterol, margosine
Seed- Azadirachitin, azadiradione, nimbin, vepinin, vilasinin, fraxinellone[51,52].



(Fig.5) Fruits bearing branch of Azadirachta indica

(Fig.6) Neem kadha

Extract use-
According to Exam research, an aqueous plant extract from Azadirachta indica and it's chromatographic fraction F1(neem extract) exerted immunomodulating of antimetastatic activities in BALB. Neem extract can be regarded immunomodulating and antimetastatic substances which holds promise for further experimental and clinical condition[53].
How to administer-
Take Some neem leaves and soaked in water for 5 minutes. Put these soaked neem leaves in grinder. Then add some water, lemon and sugar. Churn it well. This drink will freshen and cleanse your body.
Mechanism of action-
It helps to boost your immune system by cooling your body internally. It also purifies blood. It has proinflammatory, cytokine inhibitor and immunomodulator effects[54].
Role against Covid-19
It was shown that 20+ compounds in neem leaves show high inhibition against Covid-19. The main protease (6 LU7) with value ranging-14.3Kcal/mol to a minimum of -9.1Kcal/mol and in addition to compound there are other components from neem leaves which exhibit minimum binding affinity with Covid-19 protease(6LU7). Research suggest ethanol extract of neem leaves show in vitro antibacterial activity against Staphylococcus aureus and MRSA[54].

Pharmacological action of phytocostituent-

Name of phytocostituent	Biological activity	Reference
1. Azadirachitin	Repellent, antihormonal and amtifeedant properties	51
2. Nimbin	Anti-inflammatory, antipyretic, antihistamines and antifungal	52,54,55
3. Nimbodol	Antitubercular, antipyretic	54,55
4. Querecetin	Antiprotozoal, antioxidants, anti-inflammatory and antibacterial	54,55

Antiviral properties-
The evidence suggested that presence of a battery of compound beside flavonoids, triterpenoids and their glycoside in NCL-11 have antiviral action for Coxsackie B group of in vitro. Neem leaves extract powder/crude

leaves contents might inhibit Covid-19 virus by prevent from replicating[55,56].

Side effects-

Vommiting, diarrhoea, drowsiness, blood disorders and contraindicated during pregnancy [54].

4. Triphala

Introduction-

Emblica officinalis (Family euphorbiaceae), Terminalia bellerica (Family combretaceae), and Terminalia chebula (Family combretaceae). It is one of important rasayanas in Ayurveda. It is used in traditional Indian system of medicine. It is three fruits together so called Triphala. Its synonyms are Vara, Phalatrikam and Sresthatmam. The three ingredients are Amalaki (Phyllanthus emblica), Bibhitaki (Terminalia bellirica), and Haritaki (Terminalia chebula). It contains Vitamin C[57]. The immunomodulatory activity of Amalaki, Haritaki and Bibhitaki was proved by experimental study so that it would be used in various ayurvedic formulation. It is widely used in many disorders due to its various pharmacological activities. It is natural remedy for a variety of health condition. The relationship between the pre- and post-symptoms of COVID-19 and the therapeutic activity of 'Triphala' gives us a ray of hope to use Triphala as an anti-corona therapeutic supplement during the pandemic as well as in near future[58].

History-

Triphala is used in Ayurveda over 2000 years. Reference to the use of Triphala can be found in the Sushruta Samhita, which is dated to 1500BC. As both Ayurveda and western medicine agree that health and disease begin in the gut, Triphala represents an essential foundational formula as it promotes efficient digestion, absorption, elimination and rejuvenation. According to Charak, taking Triphala Rasayana (Triphala with honey and ghee) daily has potential to make a person live for one hundred years devoid of old age and diseases. The 'Triphala' have been acting as 'one formula therapy' since the time of the Ayurveda, and the Covid-19 is not an exception[59].

Chemical constituents-

It contains major four chemical constitutes such as galic acid, tannic acid, syringic acid and epicatechin along with ascorbic acid. The composition of triphala is rich in various antioxidants such as ascorbic acid, ellagic, gallic as well as chebulinic acid and several classes of flavonoids like (querecetin, luteolin), saponin, anthraquinone, amino acid, fatty acids and various carbohydrates[57,59].

(Fig.7) Triphala

(Fig.8) Herbal remedies of Triphala

Extract use-

Administration of the fruits/methanol extract of the leaves/compounds isolated from the fruits showed protective effects against cognitive deficits, biochemical abnormalities, apoptosis

induced by aluminum chloride, and tau hyperphosphorylation cadmium-induced neurotoxicity in mice CCl 4-induced oxidative injuries and tissue damage of lungs of rats, peroxide-induced injury in PC12 cells and chemical-induced liver injuries in several animal models. The fruit extract reversed the immunosuppressive effect of Cr (VI), enhanced white blood cell count an % lymphocyte distribution in mice, and also activated macrophages and the isolated compounds, geraniin and isocorilagin, stimulated splenocyte proliferation[60,61].

How to administer-

Triphala churna is more effective than using the individual herb's to boost immunity and improve overall health.

Triphala is available in the form of churna (powder), rasa (juice), tablet and capsule.

Triphala churna: Take 1/2–1 teaspoon of triphala churna/powder with honey twice a day after meals. Use it at least for 1-2 months for effective results.

Triphala tablet: You can take 1-2 tablets with water after meal to reap its benefits.

Triphala capsule: To boost immunity take one capsule each after lunch and dinner with water.

Triphala juice: Take 15–20 ml of triphala juice in a glass and add equal amount of water to dilute it and have it on an empty stomach[60].

Role against Covid-19

The role of Triphala and its extract has been emphasized in stimulating neutrophil function. Under stress condition such as noise, Triphala significantly prevents elevation of IL-4 levels as well as corrects decreased IL-2 and IFN-γ levels. Under the condition of inflammatory stress its immunosuppressive activity is attributed to its inhibitory action on complement system, humoral immunity, cell mediated immunity and mitogen-induced T-lymphocyte proliferation. The aqueous and alcoholic extracts of the individual constituents reportedly enhance especially the macrophage activation due to their free radical scavenging activity and the ability to neutralize reactive oxygen species. This study thus concludes the use of Triphala and its three individual constituents as potential immunostimulants and/or immunosuppressants further suggests them to be a better alternative for allopathic immunomodulators[61,62].

Pharmacological action of phytocostituent-

Name of phytocostituent	Biological activity	Reference
1. Amalaki	Rich in antioxidants, reduces inflammation and regulate blood glucose	59
2. Bibhitaki	Act as mild and safe laxative, detoxify body and cleanses the colon	59
3. Haritaki	Highest antioxidants value of all of the TLP constitute, support health liver function and GI tract.	59,60

Therapeutic uses-

Hypercholesteramic effect, Antiinfammatory effects, Gastrointestinal effect, Strees reducing effects, Antiobesogenic effect, Antidiabetic effects, Antineoplastic effect, Immunomodulating effect, Analgesic effect, Bronchodilator effect[59,60].

Antiviral property-

THL can play an antiviral role by regulating immunity. As a potential immune stimulant and/or immunosuppressant, it can significantly prevent the increase in interleukin-4 (IL-4), increase the decrease in interleukin-2 (IL-2) and interferon γ (IFN-γ) levels, and inhibit cellular immunity, mitogeen-induced T lymphocyte proliferation and humoral immunity under inflammatory stress[62].

Side effects- Mild laxative, depending on preparation used, side effects like these may occur with even smaller doses, triphala might

interact with others medication, it cause gastrointestinal side effects.

5. Clove:-

Introduction-

Botanical name Syzygium gromaticum belongs to family myrtaceae [63]. That grows in tropical climates and has been widely used in Ayurveda and Chinese traditional medicines for over 2000 years. Cloves are currently used in three different forms, as whole dried buds (commonly referred to as "cloves"), ground spice, and essential oil. Though all forms share similar biomedically relevant properties, they differ in the degree of potency, with the oil showing the highest potency and thus, often being dilute CBC, the spice generally losses most of the essential oil [64].

History-

Clove is an ancient spice, which is believed to be originated in the first century, before Christ. The first clue Hussain et al., 2017A.D. The origin and source of clove was a mystery, until the discovery of Indonesia or Moluccas Island, by Portuguese, in 16th century. In 17th and 18th century in India East India Company introduced clove in 1800A.D.

Chemical constituent-

Clove buds contain 15–20% essential oil, which is dominated by eugenol (70–85%), eugenyl acetate (15%) and β-caryophyllene (5–12%). Other essential oil ingredients of clove oil are vanillin, crategolic acid, tannins, gallotannic acid, methyl salicylate, flavonoids eugenin, kaempferol, rhamnetin, eugenitin and triterpenoids like oleanolic acid. The constituents of the oil also include methyl amyl ketone, methyl salicylate, α and β-humulene, benzaldehyde, β-ylangene and chavicol. The minor constituents like methyl amylketone, methyl salicylate etc., are responsible for the characteristic pleasant odour of cloves. Gopalakrishnan et al. (1984) characterized six sesquiterpenes, namely: α-cubebene (1.3%), α-copaene (0.4%), β-humulene (9.1%), β-caryophyllene (64.5%), γ-cadinene (2.6%) and δ-cadinene (2.6%) in the hydrocarbonfraction of the freshly distilled Indian clove bud oil [65].

(Fig-9) Syzygium gromaticum

(fig-10) clove extract

Extract-

Clove extract and clove oil may increase the production of gastric mucous and help protect against stomach ulcers.

How to administer-

Hot clove tea is common way to use cloves for respiratory disorders like coughs, colds, asthma, bronchitis, and sinusitis [64]. To chew cloves for treating soreness of throat and inflammation of the pharynx [64]. In mixtures with honey, it helps in the case of chronic coughs and is mentioned to be specifically useful in the case of shortness of breath [65].

Mechanism of action-

Clove extract and clove oil may increase the production of gastric mucous and help protect against stomach ulcers. Clove extract could suppress the T- cell cellular immunity and enhance humoral immune response. In clove affection cytokine pattern shifted toward

modulatory and Th2 response and accelerator for humoral immunity cytokine.

Role against Covid-19

The traditional therapeutic use of clove in respiratory disorders and its activity against different types of viruses, alongside its anti-inflammatory, immunostimulatory, and antithrombotic properties, are all attractive features highlighting its potential in the fight against the Covid-19 disease. To prevent and control the SARS-CoV-2 associated disease, together with Eucalyptus globulus, Cymbopogon citratus, Zingiber officinale, and other plants endowed with the advantage of being inexpensive and abundantly available around the globe [66]. More than 93% of the interviewed Indian people believed that spices are helpful in curing Covid-19 or other viral infections and can help in boosting the immunity[67].

Pharmacological action of phytoconstituent-

Name of phytocostituent	Biological activity	Reference
1. Eugenol	Antimicrobial, Analgesic, Antioxidant, Anthelmintic, Anticancer, Anti-cytomegalovirus inflammatory, Antidepressants, bone preserving, Antipyratic, Antithrombotic.	68
2. Beta-caryophylline	Antitumor, Anti-apoptotic, anti-inflammatory, Anti-lishmanial, antibiotic.	69
3. Vaniline	Antimicrobial, Antioxidant, Antidepressants.	70
4. Crategolic acid	Antitumor	71
5. Kaempferol	Antimicrobial, antioxidant	72
6. Rhamnetin	Anti-inflammatory, antioxidant, cardio-protective, antifungal.	73

Therapeutic use

Anesthetic, antimicrobial, antiviral, antifungal, antioxidant, antimutagenic, antithrombotic, anti-inflammatory, antiseptic, gum infections and burns, respiratory and digestive disorder, anticancer, antiparasite [68-73].

Antiviral property

Eugenol being the major constituent of cloves, was investigated for its antiviral activity by several research groups. The above-mentioned Tragoolpua and Jatisatienr [74] used pure eugenol as the reference compound in their anti-HSV studies and found that it exerted a higher antiviral activity than the ethanol extracts of whole clove buds. Similar finding where obtained by benencia and courregescourreges[75]. Same study, eugenol was virucidal, whilst no compound-associated cytotoxicity was revealed at the concentrations tested [76]. Eugenol also showed antiviral activity against the influenza A virus (IAV), being able to inhibit IAV replication [77]. Finally, it was also found active as an inhibitor of the Ebola Virus in vitro [78].

Side effects-

Lactic acidosis, muscle pain, nausea, upper stomach pain, dizziness, fever sore throat, jaundice, erection problems, itching, rash, mild skin irretation.

6. Garlic:-

Introduction-

Garlic has the botanical name *Allium sativum* belongs to family *lillaceae*. Garlic contains numerous compounds that have the potential to influence immunity [79,80]. In recent reports, garlic and its complex constituents have been investigated as promising candidates for improving immune system. *Allium sativum* seems to counteract most of the negativities caused by Covid-19 infection. The administration of this plant will contribute to the immune system elements during the fight against this pathogen. This functional food may contribute to the prevention and treatment of pathologies such as obesity, metabolic syndrome, cardiovascular disorders, gastric ulcer, and even cancer [81,82].

History-

Historically, it is believed that Louis Pasteur described the antibacterial effect of garlic in 1858 for the first time, although no reference is available. More recently, garlic has been proven to be effective against a plethora of gram-positive, gram-negative, and acid-fast bacteria. garlic extract showed in vitro activity against influenza A and B [83], cytomegalovirus [84], rhinovirus, HIV, herpes simplex virus 1 [85], herpes simplex virus 2 [86], viral pneumonia and rotavirus.

Chemical constituents-

Allicin- active against malaria parasites, cytomegalovirus, protozoan parasite [79,87].

Alitridin- fight against cytomegalovirus [87]

Allin (s-allyl cystein sulfoxide) [79]

Diallyl sulfide (DAS) , E/Z ajoene, S- allyl cysteine (SAC) [79].

(Fig:-11)Allivum sativum

(Fig:-12) Aged garlic extract

Extract-

Age garlic extract might be used as a herbal medicine against Covid-19. Aged garlic extract suppresses the production of proinflammatory cytokines such as TNF-α and CRP in the liver [88]. In the hypothalamus, aged black garlic (ABG) treatment induced a decrease in leptin receptor (LepR) mRNA levels.

How to administration-

According to megha krishna, clinical Ntritionalist- the main ingredient of garlic which fight against germ cells is allicin best way to use as an immune booster eat it raw. Chewing garlic releasing the alicin in mouth which is absorbed by body, but when it taken with food or in the form of pills it's effectiveness is very less.

Mechanism of action

Garlic participates in cytokine secretion modulation, which may provide a mechanism of action for many of its therapeutic effects.

Alliin is the main organosulfur compound in garlic and has been shown to induce a decrease in the expression of proinflammatory cytokines[81,82]. The increasing hemoglobin production and increasing hemoglobin availability for oxygen binding [89]. It is also hypothesized that patients with severe Covid-19 infection. It stimulates macrophages, lymphocytes, NK cells, DC and eosinophils, by mechanisms including modulation of cytokine secretion [90].

Role against Covid-19

1. Prevention and treatment of obesity.
2. To reserve some sign and symptoms observed in Covid patients.
3. Reincraese or regain the decrease or lost gustatory sence.
4. Increase the number of T- cells [89,90].
5. To increase cytotoxic and helper T- cells [89,90].
6. Decrease the level of leptin and increase appetite [89,90].
7. To decrease interleukin-6 concentration [89,90].
8. Stimulate NK cells [89,90].
9. Prevent this viral agent from spreading all over the body.
10. Suppress TNT-alpha and c- reactive protein [89,90].

Pharmacological action of phytoconstituent-

Name of phytocostituent	Biological activity	Reference
1.Allicin	Antibacterial, antifungal, antimalarial, antiprotozoal, anti-cytomegalovirus , anticancer.	79,87
2.Alitridine	Anti-cytomegalovirus	87

Antiviral property-

Garlic and it's sulphur constituents verified antiviral activity against coxsakie virus species, herpes, simplex type 1 and 2, influenza B, parainfluenza virus type-2 vaccinia virus, rhinovirus type 2, immunodeficiency type.

Side effects-

Have few side effects as compared to chemotherapy in treating cancers caused by substances like aflatoxin B1 [91].

7. Turmeric:

Introduction:

Turmeric (Curcuma longa) belonging to the family zingiberaceae. Medicinal plants have provided a reliable source of preparation of new drug as well as combating diseases, from the dawn of civilization. The extensive survey of the literature revealed that curcuma longa L. or turmeric is highly regarded as a universal panacea in the herbal medicine with a wide spectrum of pharmacological actvity. The coloring principle of turmeric is called curcumin which has yellow color and essential components of this plant [92]. Some experts warn that turmeric may interfere with the body's response against Covid-19. There is also good data to supporting using turmeric for Covid-19. Follow healthy lifestyle choices and proven prevention methods instead[93].

History :

Turmeric has been used in Asia for countries and is a major part of ayurveda, siddha medicine, traditional Chinese medicine, unani and the animistic ritual of austronesian peoples. It was first used as a dye and then later for it's supposed properties in folk medicine. From Indian it spread to Southeast Asia along with Hinduism and Buddhism, as the yellow dye used to color the robes of monks and priests turmeric has also been found in Tahiti, Hawaii and eastern islands before European contact. Turmeric was found in farmana, dating to between 2600 and 2200 BCE and in a merchant's tomb in megiddol Israel dating from the second millennium BCE.In medieval Europe turmeric was called "Indian saffron "[94].

Chemical constitutes:

Curcumin, demethoxycurcumin(DMC), bisdemethoxycurcumin(BDMC), Eugenol, dihydrocurcumin, azulene, Borneo, d-champagne, acrylic acid, turmerone[95].

(Fig-13) curcuma longa

Fig-14 turmeric tea

Extract use:

Turmeric, the bright yellow spices extracted from the tuberous rhizomes of the plant curcuma longa, has been used in traditional Indian and Chinese systems of medicine for centuries to treat a variety of ailments, including jaundice and hepatic disorders, rheumatic, anorexia, diabetes wound, and menstrual difficulties. Immunomodulators effects of curcumin on various facets of the immune response and cytokine production[96].

How to Administer:

Turmeric paste is 1/4 to 1/2 Tsp of the water 1 cup, ginger of pinch grated, lemon juice is 5ml and honey as per your taste. Place a pan on medium heat and add grated ginger and water. Then add the turmeric paste and allow to boil. Finally add lemon juice and honey and mix well. Strain it in a glass and serve.

Mechanism of action:

Turmeric is one of the most widely used spices ingredients, derived from *Curcuma longa* of the zingiberaceae plant family. Curcumin, known for its therapeutic effects especially in cancer, also recognized as a potent modulators of the immune system curcumin has been shown to exert immunomodulators effects on several cells and organs of the immune system. The immune system has evolved to various specialized cells and soluble molecules that are organized into a number of organs tissue including bone marrow and thymus as the central lymphoid organ and lymph spleen nodes spleen as well as mucosal lymphoid tissue as peripheral ones [97,98].

Role against Covid-19:

Turmeric has been used for centuries with a good safety profile. It is shown promising efficacy against influence A viral infection by regulating immune response to prevent injury to pulmonary tissue well defined randomized studies should be performed to evaluate the efficacy of turmeric derivative against SARS-COV-2 and assess its value as a possible treatment for this deadly virus [99].

Pharmacological action of phytoconstituent:

Name of phytocostituent	Biological activity	Reference
Curcumin	Management of oxidative and inflammatory conditions anxiety.	99
Cymene	Incough , as a flavoring agent.	99
Tumerone, atlantone	Active constitutes of volatile oil.	101

Therapeutic uses:

Improve skin health, boost immune system, improve digestion, help control diabetes.

Antiviral properties:

Turmeric may be alternative antimicrobial agents against bacterial infections. The utilization of essential oil of turmeric leaves significantly inhibit fungal growth, as well as aflatoxin B1 and G1 production [102].

Side effects:

Turmeric usually doesn't cause serious side effects, some people can experience mild side effect such as stomach upset, nausea, dizziness or diarrhea [103].

8. Ginger:

Introduction:

Ginger (*Zingiber officinale*) is the herbaceous plant native to south Asia belonging family of *zingiberaceae.* The characteristic pungent flavor of ginger rhizome is used extensively in food and beverages[104]. Ginger is a common Indian spice and traditional medicinal plants have important pharmacologic activities such as antioxidant, analgesic and antipyretic properties. Fresh ginger possesses anti-viral activity against human respiratory syncytial virus due to presence of bioactive phenolic phytocompound 6-gingerol[105]. Hence, the present study aims to examine phytocompound 6-gingerol from the ginger plant (Zingiber officinale) that could act as a promising drug against Covid-19 protein and screened through in to silico approach.

History:

Ginger an herbaceous perennial plant of the family *zingiberaceae* probably native to southeastern Asia, or its aromatic pungent, rhizome is used as a spice flavouring food and medicine. It generic name zingiber is derived from the greek zingiberies, which comes from the Sanskrit name of the spice singabera. Its use in India and China has been known from ancient times, and by the first century, traders had taken ginger into the mediterranean region by the eleventh century it was well known in England. The Spaniards brought it to west indies and mexico soon after the conquest, and by 1547 ginger was being exported from Santiago to spain[106].

Chemical Constituents:

The ginger rhizome contain 0.6 to 3.3% essential oil, comprising more than 150 secondary metabolites. Around one quarter is 6-gingerol. Ginger rhizome further contains organic acids, fats around 50% sugar and slimes[107].

(Fig-15) Zingiber offficinale

Fig-16 extract of ginger

Extract use:

Ginger extract may be more efficient and convenient because of its small usage in diet compared with ginger root powder. This trial

was designed to investigated the effect of ginger extract on production performance, antioxidant capability, immunity and also inflammation of laying hens, trying a find a natural and effective feed additive in poultry production[108].

How to Adiminister:

1.Firstly, consuming 4 tsp ginger juice with 4 tsp honey and 2 tsp lemon juice with water reduce cold. 2. Sun dry the peeled and cut ginger pieces in a covered bottle for 12 days. Consuming 2-4 pieces everyday solves digestive issues. 3. Also dried ginger mixed with little jiggery and 1 glass of milk. Consumed every morning cures stomach ache and increases digestion[109].

Mechanism of action:

Ginger has been used for medicinal purposes, due to its rich nutritional properties. Even in several Ayurvedic medicines ginger has been used as an active ingredient and this is due to the presence of Gingerol, an active compontent that makes ginger a perfect immunity booster. Apart from that, ginger has antibacterial and anti-inflammatory properties, which help keeping several ailments at and help fighting infection[110].

Role against Covid-19:

Since the onset of the Covid-19, people have shifted to healthier, nutritional option to fight the virus and boost immunity. Health has becomes a top priority and many of us are trying to find home remedies to fight the deadly virus[111].

Ginger a modulates genetic pathway, acts on tumor suppression of genes, good anti-platelet and cyclooxygenase-I inhibitory propertie, anti-inflammatory action on prostaglandin synthesis also help in relieving menstrual cramps antimicrobial effect.

Pharmacological action of phytocostituent-

Name of phytocostituent	Biological activity	Reference
Gingerol , shogaol, paradol	Antioxidant, antitumor, antiinflammatory	113
Zingiberine	Help infection causes by virus , antioxidant	114
zingiberol	Used as essential oil	115

Therapeutic uses:

Treat hair loss, boost digestion, control nausea , fight infection.

Antiviral properties:

Due to the presence of some phenolic compound in it, ginger has shown great antimicrobial activities and effectiveness in controlling certain viral, bacterial and fungal diseases. Ginger is used in many countries for the preservation of food [113].

Side effect:

Ginger can cause mild side effect including heartburn, diarrhea, burping, and general stomach discomfort(114).

9. Tinospora cordiofolia (Guduchi ,Gilly)

Introduction-

It consists of biological source *Tinospora cordiofolia* and family *menispermaceae*. Tinospora cardifolia (Willd.) Miers. (Menispermaceae) is one of the most glabrous, succulent, woody found throughout India. It is known as Guduchi in Sanskrit and Giloe or Amrita in Hindi[115,116]. It is designated as Rasayana in traditional system Ayurveda. It is recommended that it enhances general body resistance[117]. Different type of active constitute form from the plant such as alkaloids, glycosides, steroids and diterpenoid lactones has been isolated from the different parts of the plant, such as root, stem and whole plant[118].

History -

Research from center for advanced studies Pune published a paper titled "immunomodulatory effect" of tinospora cordiofolia on macrophages activation. This reaserch prove that guduchi can sharpen and hasten ones immunity response to invading bacteria and virus and help combat such threats from pathogens faster and better. A paper by Cornell university submitted on may 29, 2020, titled "in silico investigation of phytoconstituent from Indian medicinal herb "tinospora cordiofolia"as potential inhibitor against SARS-CoV-2 tried to throw light on this[119].

Chemical constituents

Fig-17 Tinspora cardiofolia

It contains effective chemical constituents in stem and root contain berberine, tinosporin, palmatine, tetrahydropalmatine it's alkaloid type. Tinosporon, colymbin, tinocordiofolin, heptacosanol contain in whole plant is diterpenoid type. It containt various elements Cl, k, Ca, Cr, Mn, Fe, Ni, Cu, Zn, Br, etc [120].

Fig-18 giloy extract powder

Extract use_

It's extract is very effective, it contains methanol, antimicrobial effectiveness against virus strains- which are staphylococcus aureus, Klebsiella pneumoniae, Echericha coli, Shigella flexneri, Salmonella typhi, Enterobacter aerogene, Psedomonas aeruginosa, Seratia marcesenses, Proteus vulgaris, etc. Mix of extract giloy+Tulsi(6leaves), ginger1/2tsp+Kali Mirch(4-6seeds) all crush and grind them together and use as herbal tea or mix it with honey and consume it[121].

How to administer

Extract(juice) of guduchi be taken orally.

Mechanism of action-

It's have effective mechanism of action dry stem crude extracts of Tinospora cordifolia with a polyclonal B cell mitogen, G1-4A on binding to macrophages have been reported to enhance immune response in mice by inducing secretion of IL-1, together with activation of macrophages. Tinospora cordifolia in prevention of oxidative damage[122].

Role against Covid 19-

Active compounds in aqueous extracts of Tinospora cordiofolia like alkaloids, di-terpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds or polysaccharides[123]in experimental rat model have been reported for their cytotoxic action. Dry stem crude extracts of Tinospora cordifolia with a polyclonal B cell mitogen, G1-4A on binding to macrophages increase immune response in mice by inducing secretion of IL-1, together with activation of macrophages[124]. The (1,4)-alpha-d-glucan (alpha-d-glucan) derived from the Tinospora cordifolia activate human lymphocytes and downstream synthesis of the pro- and anti-inflammatory cytokines, in vitro[125]. Tinospora cordifolia it's contain large active

constituent responsible for the boost the immunity.

Pharmacological action of phytocostituent-

Name of phytocostituent	Biological activity	Reference
1.tinocordiside	Immunomodulatory	133
2. Berberin	Antioxidant, anticancer, antidiabetic.	134
3. Heptacosanol	Modulating the pro-inflammatory cytokines, inhibit the proliferation of endothelial cell	133,134

Action Anti-microbial activity.

The methanol extracts of Tinospora cordifolia have potential against microbial infections[126]. The anti-bacterial activity of Tinospora cordifolia extracts has been effective against Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus vulgaris, Salmonella typhi, Shigella flexneri, Salmonella paratyphi, Salmonella typhimurium, Pseudomonas aeruginosa, Enterobacter aerogene, and Serratia marcesenses (Gram-positive bacteria)(127). In models of mice, TCE has been bacterial clearance and improved phagocytic and intracellular bactericidal capacities of neutrophils(128). TCE has been proved it's immunostimulant properties on macrophages.

Immunomodulatory action

Active compounds 11-hydroxymustakone, N-methyl-2-pyrrolidone, N-formylannonain, cordifolioside A, magnoflorine, tinocordiside and syringin[129]. Have potential immunomodulatory and cytotoxic effects[130]. There function is effective by boosting the phagocytic activity of macrophages, production of reactive oxygen species (ROS) in human neutrophil cells[131], increase nitric oxide (NO) production by stimulation of splenocytes and macrophages indicative of anti-tumor effects[132]. Aqueous Tinospora extracts is effective and influence the cytokine production, mitogenicity, stimulation and activation of immune effector cells it helps to boost the immunity. Tinospora cordifolia extracts has been shown effective result in up-regulation of IL-6 cytokine, resulting in acute reactions to injury, inflammation, activation of cytotoxic T cells, and B cell differentiation[133].

Uses

Antimicrobial, antidaibetic, antioxidant, anti-inflammatory, antiperiodic, antipasmodic, anti-arhythmatic, antitoxic, antistress, wound healing, cardiotonic, bittertonic, blood purifier, improve digestion, boost immunity, reduces stress and anxiety, detoxification of blood, treat type DM2, fight against respiratory issue, improve eye vision, treat asthma and arthritis, help in chemotherapy, etc[134].

Side effects

Pregnant women shall avoid regular intake of giloy.

10. Panax quinquefolius L. (Ginseng):

Introduction

It consists biological source obtained from the dried roots of *panax ginseng* and family *araliaceae.* Ginseng (the root of Panax ginseng Meyer, Family araliaceae), well-known oriental medicinal herbs. It's used as an herbal remedy for various disorders [135]. Natural-dried ginseng is known as white ginseng and red ginseng is prepared by steaming fresh ginseng root priority to drying on the purpose of enhancing it's efficacy, safety, and preservation[136]. Different types of ginseng panax ginseng, panax quinquefolius, panax

trifollius, panax notoginseng, panax japonicas, etc.

History

A 2018 report examined accuracy of calm improve thinking process and cognition. A 2016 study effect of Korean and ginseng on cognitive function in patient with Alzheimer's disease. Ginseng reduces inflammation according to 2020 study[137].

Chemical constituents

It contains large active constituent tetracyclin triterpenoid saponins (ginsenoids), polyacetylenes, polyphenolic compound, phytosterols, sesquiterpenes, Alkaloids, flavonoids. Active constitute effective against the boost the immunity[138].

Extract use

In ginseng ginsenoids Rg3 enriched this exhibited immunity mediated antitumor effect invitro and invivo. Anticancer effect of ginseng extract due to immunity boosting action against colon cancer cell[139].

Fig-19 ginseng

Fig-20 extract of ginseng

Mechanism of action

It's mechanism of action is very effective stimulation of T cells via IL-2, IL-12 by dendritic cells, production of antibody, activation of macrophages and NK cells activation it show immunomodulator effect. Cytokine that regulates cells of innate immune system. Dendritic cells (DC) play important role in innate immune response to infection and linking innate and adaptive immune response[140].

Role against Covid-19

Immune cells differentially responds to ginseng treatment. It contains gensenoside Rg3, antitumor effect invitro and invivo. It shows stronger antigrowth and propptoic effect in human gastric cell. Immune response is mediated by T-cell and NK cells is most effective against different virus infected cells and intracellular bacteria[140]. It protect against infectious bacteria and virus. Increaaes natural killer cells, increase macrophages, act as radiation protecting Cytokine that regulate the cells of innate immune system. Production of antibody, activation of macrophages, NK cell activation, shows immunomodulator action, dentitric cells(DC) play important role in innate immune response to infection and linking innate and adaptive immune responses[140,141].

Pharmacological action of phytocostituent-

Name of phytocostituent	Biological activity	Reference
Ginsenoside	Antimicrobial	144
Polyacetylene compound	Anti- bacterial	143
Ginseng extract	Anti-modulatory, antiviral	142

Action

Antiviral

Intranasal administration of ginseng extract within influenza virus A/PR8 significant increase IgE as well as total IgG observed in blood, lungs, vaginal lavage and fecal extract in mice[142].

Antibacterial

Ginseng polysaccharide interact with microbes, interrupt microbial adhesion to host cell and block initiation of infectious disease[143].

Antimicrobial_

Plant continuously contact with different microorganisms such as virus, bacteria, fungi. Interation between plant and microbes beneficial for plant[144].

Respiratory_

Ginseng produces numerous action on respiratory system, especially on asthma related with antiallergic properties[145].

Uses

Active constitute effective against various disorder Ginseng used as in treatment of erectile disfunction, anti inflammatory effect, sharper cognitive function, increase energy, enhance immunity, anticancer property, combating various cardiovascular disease, neurological disorder, diabetes, antimicrobial[143], antiviral[142], antibacterial[143] etc.

Ginseng contains various pharmacological components include tetracyclic triterpenoid saponins (ginsenosides), polyacetylenes, polyphenolic compounds, and acidic polysaccharides. Ginsengs Roots (mostly), stems, leaves and their extracts have been used for maintaining immune homeostasis[146].

Side effects

Tissue injury (in inflammatory disease).

Other herbal immunity enhancers-

Herbal plant	Active constituent	Mechanism of action	Therapeutic activity	Reference
1. Cannabis sativa	Cannabinoid, cannabidiol	Anti-inflammatory action by via modulation of gene expression of ACE2 enzyme, serine protease TMPRSS2, protein pre-requisite for SARS-CoV-2 invasion into host cells.	Adjunct therapy and utilised as mouthwash and throat gargle products clinically and home use owing to their potential to decrease viral entry via the oral mucosa.	147
2. Scutellaria baicalensis	Baicalein	Anti-SARS-CoV-2 activity via suppressing SARS-CoV-2 3CLpro and replication	Effective compounds as antiSARS-CoV-2 inhibitors.	148
3. Ginkgo biloba	Ginkgolic acids	Impeded DNA and protein synthesis by binding towards host	Sturdy effect of GA on viral infection, to be	149

		cell receptors to activate cell-signaling pathways for arresting cell cycle as an inhibitory action	potentially used to treat coronavirus infections.	
4. Camellia sinensis	Epigallocatechin gallate	Targets include main proteases covid-19, post fusion core of 2019-nCoV S2 subunit, prefusion spike glycoproteins and NSP15 endoribonuclease from SARS CoV-2.	Future drug candidate for Covid-19.	150
5. Eucalyptus sp.	Jenseneone	COVID-19 Mpro inhibitor	Eucalyptus oil could be use for prevention and cure.	151
6. Glycyrrhiza glabra	Glycyrrhizin, glycyrrhetic acid, liquiritin and isoliquiritin	Counterbalance the activeness of COVID-19 and could be used as an antiviral drug	Formation of antiviral nanomembrane by licorice processed with PVA solution	152
			for potential application as wound dressing materials, musk, gloves and against skin infection by electrospinning.	
7. Citrus sp.	Essential oils, pectins, naringin and hesperidin(flavonoids).	Binds with high affinity to cellular receptors of SARS-CoV-2 that restrain the proinflammatory overreaction of the immune system.	Prophylaxis and treatment of Covid-19.	153
8. Porphyridium sp.	Sulfated polysaccharides (carrageenan)	Potent inhibitors of coronaviruses that inhibit the binding or internalization of virus into thehost cells.	Biocompatible compounds can be used as a coating material on the sanitary items for COVID-19 preventio	154

			n.	
9. Nilavembu Kudineer	Benzene 123 Triol	Immuno-modulatory activity against ACE2 enzyme receptor, that routes virus entry in the pathogenesis of Novel coronavirus.	Potent anti-viral capacity for drug development.	155
10. Nigella sativa	Nigelledine, α-Hederin	Inhibitory action of proteases; CoVs (3CLpro/Mpro) (PDB ID 6LU7 and 2GTB) active sites.	Best potential to act in COVID-19 treatment, testified medicinal use for preventive purpose.	156

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