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Traditional plants as immunobooster – Preventive strategy against COVID-19

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ABSTRACT : Today India is fighting against an infectious disease called coronavirus. Elderly populations with non-communicable diseases like diabetes, hypertension, cardiovascular disease, respiratory diseases are more affected by coronavirus because of lack of immunity. The objective of the present review was to study herbs and spices as preventive strategy by enhancing the immune system of human body. About 100 research papers were studied from various databases like Pubmed, Google Scholar, web of Science, Scopus, Science Direct etc. both national and global research papers were included. Most of the database included for consist of original research papers and systematic review papers. The data was collected for spices- garlic, ginger, cinnamon, turmeric and herbs – giloy, ashwagandha, white musli and tulsi. The data revealed that all their herbs and spices have a positive effect on immune system. They have been recognized as sources of various phytochemicals and antioxidants that defense against oxidative stress and enhance immunity. They also possess anti-tumour effects by inhibiting transformation, tumour - initiation, tumour- promotion, invasion, angiogenesis, and find stage of metastasis. A positive effect was observed on lymphocyte and macrophages. The present review concluded that consumption of these herbs and spices can act as a preventive strategy against infection and COVID 19.

Key Words: Coronavirus (COVID 19) infection, herbs, spices, immunomodulators, immunostimulator (*Tinospora cordifolia, Withania somnifera, Ocimum sanctum* Linn, *Chlorophytum borivilianum, Allium sativum* L., *Cinnamomum cassia, Zingiber officinale, Curcuma longa*).

In today's Scenario, India is fighting again an infectious disease called a Coronavirus disease (COVID-19). The infection is caused by an unknown novel coronavirus. The symptoms are mainly consisting of fever, dry cough, mild to moderate respiratory illness, and tiredness. Elderly populations with non-communicable diseases like diabetes, hypertension, cardiovascular disease, respiratory diseases are more affected because of lack of immunity. To prevent infection the individual must wash his hand regularly with soap and water, or with alcohol-based sanitizers. Social distancing is another preventive strategy against this unknown virus. But one more strategy can be applied which includes strengthening the immune system of the human being, as virus mainly attack the immune system and especially the elderly population or population with non-communicable diseases (WHO, 2020).

India has a tradition to use Herbs and spices as a part of diet manly for their aromatic properties. (Davidson, 1999; Hacskaylo, 1996; Smith and Winder, 1996). However, many recent studies showed a positive impact of herbs and spices on boosting the immunity of a human being. The spices and herbs recognized as sources of many phytochemicals and antioxidants that Defense against oxidative stress and enhance immunity (Larson 1988; Velioglu *et al.*, 1998; Dragland *et al.*, 2003).

A book entitled "Herbal Medicine: Biomolecular and Clinical Aspects", a chapter written by Paul *et al.* (2011) stated that out of all categories of food, herb and spices contain the maximum amount of antioxidants and can be used to boost the immunity of an individual. He also emphasized that many of the herbs and spices have antioxidant content above the 90th Percentile of the complete food table. These spices and herbs are mainly originated from India, Japan, Mexico, and Peru.

Therefore, keeping in mind the requirement of an immunity enhancer in this COVID 19 scenario, the present review paper highlights various nutritional properties of spices and herbs and their positive impact as an immunity enhancer on a human being. This present paper will also discuss the various active compounds which help in boosting the human immune system.

Materials and Methods

Various original research papers and review papers were studied, assessed and selected for the present paper. About 140 research papers and review papers were studied from various databases like Pubmed, Google Scholar, Web of Science, Scopus, Science Direct etc. which includes both national and global research findings. Most of the database included was consist of original research papers and systematic review papers. The selection of papers was based on various randomized clinical trials done to find the effect of various traditional medicines on immunity and the reviews based on previous studies.

Table-1: Active compound in garlic which can boost immunity.

Garlic	Active Compound
Fresh garlic bulbs	S-allyl-L-cysteine sulfoxide (alliin)
	γ-glutamyl cysteine derivatives
Garlic Steam	Distilled oils
	Sulfide
Dried and crushed garlic powder	Allicin
	Diallyl disulfide (DADS)
Ground Garlic	Sulfide family compounds
	Dithiines
	(E-Z)-ajoene compounds
Aged Garlic	S-allyl-L-cysteine (SAC)
	S-allyl mercaptocysteine (SAMC)

Source: Sharma *et al*., 2017

The inclusion criteria for selection of the papers was a minimum of 30 subjects in both human and animal trials. The research papers were included, stated that informed consent of the study subjects was taken, ethical clearance was taken from the institute for both human and animal studies. Most of the research papers were included which defined the dosage of Herbal plants and its effects.

Garlic (*Allium sativum* L.)

Allium sativum L., it's an onion family spice, it is used as an ingredient in my Asian countries and possesses many medical properties. Over 6000 years ago, garlic was found in central Asia (Rasul *et al.*, 2015; Bayan *et al*., 2014). The therapeutic effect and use of garlic are there from past so many years to prevent and cure so many diseases. The flavor and therapeutic effects of Garlic are mainly due to the higher concentration of sulfur compounds, 33 in number. It contains around water (65%), 28% of carbohydrate, organosulfur compounds (2.3%), 2% proteins, 17 amino acid (1.2%), and 1.5% fibers and several enzymes (Fenwick and Hanley, 1985), and contains lectins and steroidal glycosides (Kaku *et al.*, 1992; Matsuura *et al.*, 1988). The major sulfur-containing compound responsible for its therapeutic benefits are "γ-glutamyl-Sallyl-L-cysteines and S-allyl-L-cysteine sulfoxides" (allicin) **(Table-1)**. Several medicinal plants are considered that they have the potential of immunomodulatory actions, like the intonation of cytokine secretion; enhanced phagocytosis and activation of macrophages; lymphocyte proliferation, production of immunoglobulin and allergic reactions (Moutia *et al*., 2018). Recently, garlic showed promising results in maintaining immune system homeostasis.

Antioxidant Activity: The antioxidant effect of Garlic extracts was higher as compared to fresh garlic or aged garlic, maybe because of the presence of organosulfur compounds, such as SAC and SAMC (Ichikawa *et al*., 2006). This prevents oxidation of DNA, fats, and protein by ROS which is responsible for the prevention of various diseases like cancer, allergies, neuro-degeneration, inflammation and aging. Phytochemicals in garlic extracts enhance the cellular enzymes with antioxidant properties such as superoxide dismutase, catalase, glutathione peroxidase, and also increase the production of glutathione in the cells (Borek, 2001).

Modulation of Immune Cell Response: A study conducted by Kuttan *et al*. (2000) stated that the consumption of garlic by mice enhanced their immune cells especially in the bone marrow. Another study conducted by Ishikawa *et al*. (2006) and by Morioka *et al*. (1993) found a positive effect of garlic protein fraction on lymphocyte and macrophages. It leads to an increase in proliferation of T cell in splenocytes stimulated with phytohemagglutinin (PHA) (Lau *et al*., 1991). Another study conducted by Ebrahimi *et al*. (2013) stated that the peripheral blood T lymphocyte was activated and enhancement of CD8+ T cell proliferation was seen in treated animals, caused by protein fraction of fresh garlic, not even this but also enhanced hyper-sensitivity delayed type responses and enhancing a better cellular - response.

Cytokine Secretion: Quintero-Fabi'an *et al*. (2013) assessed the effects of allicin in lipopolysaccharide and its stimulation on 3T3-L1 adipocytes. 24hour as incubation of cells was their with 100 µmol/L allicin before lipopolysaccharide (100ng/mL) stimulation for 1hour inhibits an increase in the expression of IL-6, MCP-1, and Egr-1 (proinflammatory genes) and the

protein levels of IL-6 and MCP-1. there was also a decrease in the phosphorylation of ERK1/2, in samples treated with alliin in adipocytes.

Phagocytosis Promotion and Macrophage Activation: During malaria, to control parasite load, the Th1 cytokine pattern is very important. Feng *et al.* (2012) conducted a study on Balb/c mice which were post-infected by *Plasmodium yoelii*, when allicin was introduced in mice, it leads to a reduction of parasitemia and increased survival rate due to the promotion of interferon-gamma (proinflammatory mediators). Garlic treatment also enhanced the expansion of macrophages and CD4+ T cells (Feng *et al*., 2012; Arreola *et al*., 2015).

Immunoglobulin Production : Washiya *et al*. (2013) conducted a study on assessing the effects of a garlic extract which contains Z-ajoene on the mouse model. The results revealed that after treatment of 3 weeks there was an enhancement of faecal IgA levels and concluded that ajoene might influence B-cell stimulation.

Immunostimulatory Activities of Garlic: Garlic contains Fructo - oligosaccharides, they are fructans. A study conducted by Chandra Shekar *et al*. (2011) assessed immunostimulatory mouse model to assess the activity of isolated fructans present in garlic: high-molecular weight (>3.5kDa) and low-molecular weight(<3kDa). Both high-molecular weight and low-molecular weight displayed macrophages activation and mitogenic activity and phagocytosis.

Recent studies in humans reported that there was a positive effect of the use of allicin garlic powder on immuno-reactions and phagocytosis. In aged subjects, the increase of peripheral granulocytes and monocytes was observed, when 600mg of garlic powder was administrated every day for 3 months, for assessing the ability of allicin to engulf *Escherichia coli* bacteria. An unrefined garlic extract (5 to 10 g/day) was used by another study on HIV/AIDS patients. After completion of 12 weeks, in many patients' natural killer cells activity enhanced (Abdullah *et al.*, 1988).

Garlic posses anti cancer activity due to its bioactive compounds - allylsulfide derivatives. The study conducted by Capasso (2003) reported that in carcinogenesis, garlic can enhance many molecular mechanisms, such as formation of DNA adduct, mutagenesis, prevention of free radicals formation, proliferation and differentiation of cells, as well as angiogenesis. There is decrease in rate of growth of cancer cells with time and lead to G2/M phase where cell cycle blockade occur. In rodents and human trial studies, garlic and its active compounds help in promoting inhibition of formation of chemically induced tumors in the liver, colon (Knowles *et al*., 2003), bladder (Lau *et al*., 1986), lung (Sparnins *et al*., 1986), skin (Nishino *et al*., 1989), prostate (Hsing *et al*., 2002) and esophagus (Wargovich *et al*., 1988). *In vitro* and *in vivo* investigations, an organosulfur compound Diallyl trisulfide (DATS), isolated from garlic, showed anticancer activity.

Ginger (*Zingiber officinale*)

India is rich in many herbs and spices as they contain important medicinal properties to cure many diseases and also to provide nutrient supplements as diet. The Ginger is herbaceous perennial grows annually as pseudostems. Ginger plant is root (rhizome or underground stem) and also known as *Zingiber officinale*,

Table-2: Active compound in ginger which can boost immunity.

Active ginger compound	Antioxidant effect	Anti-Cancer activity	Anti-inflammatory Activity	Antimicrobial activity	Antibacterial activity	Induce Apoptosis by activation of p53.
Gingerol and gingerol related compound	√	√	√	√		
Paradol	√	√		√		
Shogoal	√		√			
Zingerone	√		√		√	
Zerumbone		√		√		
Terpenoids						ü
Ginger flavonoids	√					

(Rahmani *et al.*, 2014)

family *Zingiberaceae*. Ginger is spice used as a flavouring agent and also to cure many diseases. It is used as a medicine for human as well as animal. The plant has nutritional and ethonomedical values.

Knowledge of importance of traditional use of medicine from available herbs and spices to heal the wounds of population of country (Kshirsagar and Singh, 2001). The pharmaceutical industries in India working to formulate the medicine from these spices and herbs for boosting immunity and to cure from many diseases.

All the plant part such as plants fruits, seeds, oil, leaves, bark and roots contain gingerols, zingibain, bisabolene, oleoresins, starch, essential oil (zingiberne, zingiberole, camphen, cineole, borneol), mucilage, and protein **(Table-2)**. These plants are known as "Chemical Goldmines" they contain natural chemicals. In ancient times ginger used as medicines in ayurveda, siddha to cure pain and improve the digestion system of human.

In recently the trends is also adopting traditional medicines: it works as a phyto-remedy in many diseases such as cancer chemotherapy. (Bone *et al*., 1990; Grontved *et al*., 1988; Sripramote and Lekhyananda, 2003).

Medicinal properties of Ginger

Phytochemical : Ginger appears as a pharmacological activity due to gingerol, shogaol presence in the roots with aroma of approximately 1 to 3% of essential oils and contains water soluble Vitamins and other micro-nutrients Helps to cure many diseases like pain cough, loss of appetite, asthma, nausea, inflammation, vomiting, dyspepsia, palpitation, constipation and indigestion. (Dhanik *et al*., 2017).

Immune-Booster

Ginger acts as a immune booster to fight against flu by using 1% dried aqueous Ginger extracts (Khaki and Fathiazad, 2009). Ginger suppressed lymphocyte proliferation, found in *in-vitro* study which was mediated by decrease in IL-2 and IL-10 production (Wilasrusmee *et al*., 2000).

Anti-inflammatory : Ginger power used as supplements to act as anti-inflammatory properties to effectively cure osteoarthritis (Thomson, 2002; Wigler, 2003 and Ramadan *et al*., 2011; Funk *et al*., 2016).

Antioxidant : Ginger having rich source of antioxidant due to presence of high quantities of phenols found as oleoresin contents which act as a antioxidants (Eleazu *et al*., 2012). Ginger extracts as a many pharmacological activity and found no adverse effect and most of people use as daily supplement.

Antimicrobial properties

Antibacterial : Due to the strong antibacterial properties in the rhizomes of Ginger which possesses significant activities for *Escherichia coli*, *Salmonella enteriditis* and *Staphylococcus aureus* (Sunilson *et al*., 2009). The presence of Zingerone in Ginger helps to cure the gastrointestinal related disorders (Iwami *et al*., 2011).

Antiviral : Dried rhizomes of ginger affectively work to act against virus's i.e. common cold *Rhinovirus* etc. due to presence of β-sesquiphellandrene (Denyer *et al*., 1994).

Antifungal : Ginger powder having properties of gingerols and gingerdiol which act as antifungals. (Ramkissoon *et al*., 2012; Nasri *et al*., 2013).

Anthelmintic activity : The rhizomes of Ginger kill most of the worms (*Haemonchus contortus*) (Iqbal *et al*., 2001).

Turmeric (*Curcuma longa*)

Turmeric plant is an incessant herb member of *Zingiberaceae* family and mainly grown in regions of south and south-east tropical Asia. Turmeric is a worldwide explored spice extracted mainly from the rhizomes of *Curcuma longa*. It has been in use since time immemorial in India, majorly finding its application in Ayurveda and culinary practices (Boroumand *et al*., 2018). Turmeric contains carbohydrate (69.4%), protein (6.3%), fat (5.1%), mineral (3.5%) and moisture (13.1%) (Prasad *et al*., 2011).

Curcumin is the most predominant component of this spice, constituting about 2–5% of it. This component is majorly responsible in imparting yellow color to its preparations. Lampe and Milobedeska in 1910 first related curcumin ($C_{21}H_{20}O_6$) to be a "diferuloylmethane, 1,7-bis (4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione" which was found insoluble in water (Aggarwal *et al*., 2003). Under acidic and neutral conditions, curcumin constitutes "bis-α-β-unsaturated β-diketone" forms and at pH more than 8, the enolate form predominates. The commercial grade curcumin accounts for the presence of curcuminoids, among which demethoxycurcumin constitutes 10–20% and bisdesmethoxycurcumin constitutes less than 5% (Sharma *et al*., 2005).

Pharmacokinetic Properties: To render a compound fit for therapeutic consumption should possess properties like absorption, metabolism and tissue distribution. In an early study conducted it was observed that 75% of the dose administered to rats was excreted in the faeces and urine (Wahlstrom and Blennow, 1978). This advocated that curcumin undergoes alteration dur-

ing absorption via the intestine.

The literature on pharmacokinetic properties of curcumin have been very limited in human studies and majorly been restricted to cancer patients. In a study administered by Peng *et al*. (2008) premalignant patients (of bladder, cervix, stomach, etc.) for 3 months were given 0.5 to 8µg/day curcumin orally. The serum curcumin concentrations peaked at 1-2 hour(s) post treatment with a gradual depreciation observed within 12 hours (Chen *et al*., 2001).

Beneficial Effects : Curcumin possess strong anti-cancer properties which are delivered by blocking transformation, tumor-initiation, tumor-promotion, invasion, angiogenesis and final stage of metastasis. Indians have a lower incidence risk of colon cancer, which could be attributed to the usage of this spice in Indian food preparations (Mohandas and Desai, 1999). Curcumin is effective in preventing atherosclerosis and myocardial infarction. In a study conducted on alloxan induced rat models with type-2 diabetes, the administration of curcumin has shown to be beneficial in reducing blood glucose and glycosylated haemoglobin levels. In patients suffering from Alzheimer's disease, curcumin has proven to vanquish oxidative damage, inflammation, cognitive deficits and accumulation of amyloid compounds. Also, curcumin imparts protective-effects against cystic-fibrosis, human immune-deficiency virus and alcoholic liver disease experimental models.

Immuno-modulatory Effects: The immune response is broadly categorised under 2 heads: innate and adaptive immunity. Innate immunity offers a stereotyped rapid response well before the progression of antigen-specific responses offered by adaptive immunity (Chaplin, 2009). Studies have proven that curcumin can greatly influence both types of immunity, already stated (Srivastava *et al.*, 2011). Some studies revealed that curcumin could remarkably reduce the proliferation rate in induced T cells (Ranjan *et al.*, 2004). The inhibitory effect of curcumin on the proliferation of other immune cells has also become noticeable. Studies have also shown suppressive action of curcumin on the proliferation of B-cells. This function of curcumin was accompanied by a dose- and time-dependent pattern (Han *et al*., 1999). Haque *et al*. (2010) suggested that treatment pertaining with curcumin administration could be constructive in B cell autoimmune diseases and thereby diminishing the chances of malignant transformations.

Cinnamon

Cinnamon belongs to Lauraceae family. There are almost 250 species among the cinnamon genus (Sangal, 2011). Due to its pleasant fragrance, it is incorporated in medicinal products, food items and perfumes mainly because of its aroma and essence (Huang *et al*., 2007). The most important compound of cinnamon is cinnamaldehyde and trans-cinnamaldehyde (Cin) (Yeh *et al*., 2013). Catechins and procyanidins are present in cinnamon bark (Nonaka *et al.*, 1983). The antioxidant effect of cinnamon is maily due to these procyanidins (Peng *et al*., 2008), use of Cinnamon in daily life can be done without any side effects.

"Trans-cinnamaldehyde and 2-methoxycinnam-aldehyde" were identified as the NF-KB inhibitors from *C. cassia*. The inflammatory and immune genes expressions are regulated by a transcription factor called Nuclear factor (NF)-cB. "*Cinnamomum cassia* Blume (Lauraceae) was discovered to have an inhibitory effect on LPS-induced NF-KB transcriptional activity, which was determined using macrophages RAW 264.7 transfected stably with an alkaline phosphatase reporter construct containing four copies of the NF-KB binding KB sequence" (Reddy *et al*., 2004). *Cinnamomum verum* and *Cinnamomum cassia* oil consists anti-inflammatory activities too (Tung *et al.*, 2008).

Niphade (2009) in trial of albino rats discovered the immune-modulatory properties of *Cinnamomum zeylanicum* bark. Two group was formulated according to dosage of *C. zylenicum*- cinnamomum low dose (CLD) (10 mg/kg) and cinnamomum high dose (CHD) (100 mg/kg). There was increase in serum immunoglobulins levels by using CLD but large dose of cinnamon bark decreased 17% of mortality rate induced by *Pasteurella multocida*, enhanced phagocytic index, neutrophil adhesion and serum immune-globulin levels. The results revelled thatlarge dose of cinnamon not only enhance humoral immunity but also enhance cell mediated whereas, at low dose of cinnamon showed only effect on humoral immunity and can be act as immune system booster (Niphade *et al*., 2009).

Different subsidiaries of cinnamaldehyde, 2-hydroxycinnamaldehyde (HCA) and 2-benzoxycinnamaldehyde (BCA), restrain the lymphoproliferation and incite a T-cell differentiation through the bar of early strides in the signalling pathway prompting cell development (Koh *et al*, 2008).

Giloy (*Tinospora cordifolia*)

Tinospora cordifolia is called as a climbing shrub (*Menispermaceae* family). It is natively known as Tinospora, Guduchi, Gurach, Amrita. The stems are tender with branches as long filiform fleshy aerial roots. The color of the bark is grey-brown and resembling water in them. It has membranous leaves, triangular shapes, and cordate at the base. In the regions of tropical Asia this herb is present in abundance, extending from Kumaon to Assam; Myanmar, Bihar, Konkan to

Table 3. Chemical constituents of O. basilicum and their biological activities

S.N	Chemical Constituents	Biological activity
1	Linalool	Anti-nociceptive6
2	Eugenol	Neuro-protective, Anti-cancer, local anaesthetic
3	1,8-cineole	Anti-ulcer, Wound healing activity
4	Methyl eugenol	Anti-convulsant and Anaesthetic
5	Limonene	Motor relaxant, Anti-inflammatory
6	β-elemene	Anti-neoplastic, Anti-cancer
7	α-bergamotene	Abiotic stresses release
8	Bornyl acetate	Analgesic, Anti-inflammatory
9	Menthol	Local anaesthetics
10	Camphor	De-congesting, Anti-pruritic, Counterirritant
11	α-copaene	Cytotoxic, Anti-genotoxic, Antioxidant
12	β-caryophyllene	Antibiotic, Antioxidant, anti-Carcinogenic
13	Chicoric acid	Antioxidant, Immunostimulatory
14	Farnesene	Antioxidant, Anti-Insecticidal
15	β-cadinene	Anti-nociceptive, Anti-proliferative
16	Menthyl acetate	Antioxidant, Anti-bacterial
17	Germacrene	Analgesic, Anti-inflammatory
18	α-bisabolol	Analgesic, Antibiotic, Anti-cancer
19	δ-gurjunene	Anti-tumor, Anti-inflammatory, Anti-oedematous
20	δ-cadinene	Antioxidant, Anti-microbial
21	Estragole	Neuronal excitability
22	Neo isomenthol	Nasal sensation
23	Guaiene	Anti-platelet, Anti-thrombotic, Aphrodisiac, Anti-depressant
24	Pulegone	Anti-nociceptive

Source:-Purushothaman *et al*., 2018

Sri Lanka.

Ayurvedic and Unani systems of the medicine are using this herb for its medicinal properties. *T. cordifolia* extract consists of alkaloids, steroids, glycosides, and polysaccharides (Singh *et al*., 2003). It also represents many positive effects like antioxidant properties, anti-diabetic, anti-hepatotoxic, and immunomodulatory properties [Panchabhai *et al*., 2008; Sharma *et al*., 2012].

Tinospora cordifolia and Immunity

Tinospora cordifolia has a positive effect on the immune system. Recent researches stated that *Tinospora cordifolia* enhances immunity and fight against infection. The active compounds can be derived from various parts of the plant like root, leaves, and stem such as alkaloids, steroids, diterpenoid lactones, aliphatics, and glycosides (Upadhyay *et al*., 2010). The Active compounds present in *Tinospora cordifolia* is "11-hydroxymustakone, N-methyl-2-pyrrolidone, N-formylannonain, cordifolioside A, magnoflorine, tinocordiside and syringin" (Sharma *et al.*, 2012).

The active compounds enhance the phagocytic activity of macrophages, In human Neutrophil cells, It leads to the production of ROS (More *et al.*, 2012), increase the production of nitric oxide by incitement of splenocytes and macrophages and act as antitumor effects (Upadhyaya *et al*., 2011). Cytokine production, activation, and stimulation of immune effector cells and mitogenicity are reported to be seen by Aqueous Tinospora extracts (Upadhyaya *et al.*, 2011). In animals particularly mice, on the administration of giloy extract, leads to up-regulation of IL-6 cytokine, that reported to cause acute reactions to injury, inflammation, incitement of T cells, and differentiation of B cell (Sudhakaran *et al*., 2006). A recent study reported that crude extracts of dry steam of *Tinospora cordifolia* with a poly-clonal B cell mitogen, G1-4A on attached to macrophages lead to enhancement of immune-response in mice by activating the secretion of IL-1 and macrophages. Reports on *Tinospora cordifolia* in the reduc-

tion of oxidative stress also investigated (Raghu *et al*., 2009). The *Tinospora cordifolia* has a compound called (1,4)-α-d-glucan (α-d-glucan) showed the activation of human lymphocytes and synthesis of pro inflammatory and antiinflammatory cytokines, *in vitro* (Koppada *et al*., 2009).

A study conducted by Sharma and Sharma (2015) stated that *Tinospora cordifolia* has a positive effect on immunity in children and enhances the body's immune response. According to a researcher (Kalikar *et al*., 2015) conducted a study on HIV positive patients, and treated with giloy extract. the results revealed that it helps in the reduction of TLC, neutrophils, and eosinophils count and also decreased the symptoms.

Tulsi (*Ocimum sanctum* Linn)

Ocimum sanctum Linn. an aromatic plant belongs to family *Lamiaceae* known as holy basil, in Hindi name Tulsi is a medicinal plant having ethno-medical used as immune stimulant effect in man and animals. There are three types' varieties of ocimum found such as Rama, commonly found in white green color, Krishna, good in flavor, and Vana, wildly available in many parts of country and other countries. Due to the metabolites present in *Ocimum* spp. there are different activities and used as traditional medicine (Bora *et al*., 2011). Oil extracted from *Ocimum* spp. used as flavours for different food as herb for kitchen and culinary and ornamental (Gulcin *et al*., 2007). It is also used as commercial due to its flavour and fragrance to increase the shelf life of food products **(**Makinen *et al*., 1999). A Hindu family in India consider having tulsi plant in their home. The taste of Tulsi leas is bitter and pungent. It is also used in the preparation of cosmetics and perfumes **(**Simon *et al*., 1999).

Health benefits of Basil

- It prevents cell damage as it contains antioxidants like beta carotene.
- Rich source of Vitamin A, Vitamin C, calcium and phosphorus.
- Having healing power to cure common cold, fever and also sharpen the memory.
- Due to the presence of vitamin A this helps to strengthen the eyesight.
- Act as anti-stress agent to help in blood purification and lower the cholesterol level which helps to reduce the heart attacks risk.
- Effective to reduce the ulcer in mouth and other infections.

Extraction of different parts of *Ocimum* spp. contain rich source of phenolics. The biological activities are shown in Table-3.

Chemical Constituents

The Bioactive compound present in basil are "rosmarinic acid (a strong antioxidant), linalool, methylchavicol, methylcinnamat, 1,7-dimethyl, 6-octadien-3-ol, and eugenol". These are volatile in nature. Its medicinal properties due to rhymol, eugenol and camphor. In basil mucilage is composed of carbohydrate in the form of simple and complex i.e sugars, xylose and polysaccharides. The seeds of the basil contain fatty acids and sitosterol. These herbs like basil has properties to healing fast as well as stimulates production of disease fighting antibodies and rich source of Vitamin A, and Vitamin C by up to 20% as well as antioxidants (Loughrin and Kasperbauer, 2001).

Immunity Booster

An ancient times Basil leaves were used to maintain the immune system. Based on the research conducted and paper published as a result to tulsi has eugenol essential oil which acts as a medicine for many diseases (Singh *et al*., 2007). The *ocimum* spp. plant parts contain most of the essential oils such as the aerial parts of the leaves of the *Ocimum* spp. contain 40 to 71 % Eugenol (1-hydroxy-2-methoxy-4-allylbenzene). The oil present in the *ocimum* acts as a therapeutically in many diseases (Williamson *et al*., 1996). Due to the presence of eugeonol the *Ocimum* spp. became the alternate source of clove. The pharmaceutical industries in India have developed the medicine to boost the immune system also to cure the diseases such as use as a medicine for chronic fever, for insect bite, for skin diseases, for arthritis, for painful eye diseases. The properties in the *Ocimum* spp. helps as medicine for activities such as antifertility activity, anticancer activity, antidiabetic activity, antifungal activity, antimicrobial activity, hepato protective activity, cardio protective activity, antiemetic activity, antispasmodic activity, analgesic activity, adaptogenic activity and for diaphoretic actions.

As per the research conducted on *Ocimum* spp. shows that it is beneficial and potential to act effectively for health **(**Kelm *et al*., 2000), such as antioxidant, anti-inflammatory and cancer chemopreventive activities (Pandey, 2006). The natural antioxidants as Polyphenolic compounds taken added in diet will play an important healing potential role to cure many diseases (Puri and Singh, 2002). Studies conducted and found that *Ocimum* spp. is best than any other herbs in immunomodulatory activity (Nguyen and Niemeyer, 2008).

Anti Microbial Effects

Tulsi decreases the growth of *E. coli*. Worms and

parasites can be easily removed by tulsi, when consumed fresh juice or strong tea with honey; the sweetness of this mixture attracts parasites and draw them out from hiding places (Chang *et al*., 1977).

Aswagandha (*Withania somnifera*)

Aswagandha or *Withania somnifera* is commonly known as 'winter cherry'. It helps in improving the cell mediated immunity by strengthening the body's defense mechanism. It comprised many biological active chemical compounds which have health beneficial properties, for example it can act as anti-stress agent and improve the functions of reproductive system (Singh *et al*., 2011). The aerial parts of this plantgive "3-b-hydroxy-2,3-dihydrowithanolide F and withasomniferin-A" (Atta-ur Rahman *et al*., 1991) which promotes immune-modulatory activity (Ghosal *et al*., 1989). Ziauddin *et al.* (1996) tested the immunomodulatory effect of Aswagandha on mice with myelosuppression and observed an enhancement in haemo-globin concentration, RBC cells, WBC cells, and platelet count. Aswagandha also possessed haemolytic antibody responses towards human erythrocytes (Ziauddin, 1996).

Many studies confirmed that it increases the cell mediated immunity. Gupta *et al*. (2006) also analysed the cellular immune response of aswagandha by dose dependent test on rat's Neutrophils adhesion and delayed-type hypersensitivity (DTH) and concluded the positive response on both the parameters and it can enhance the cellular immunity.

Recently a study (Trivedi *et al*., 2017) tested an aswagandha formulation in LPS-induced mouse splenocytes to assess the impact of the herb on pro-inflammatory cytokines expression (TNF-α, IL-1β, MIP-1α and IFN-γ). Results revealed that the significant down regulation of expression of "TNF-α, IL-1β, and MIP-1α"on the contrary, IFN-γ was significantly upregulated. Therefore, study concluded that the composition of the product showed the properties of anti-inflammation and immune-modulation and can be used as effective and alternative treatment for inflammatory and auto-immune disorders.

Aswagandha also act as an immunostimulant, it enhances the nitric oxide synthase activity which in turn increase the power of the macrophages (Iuvone *et al*., 2003). It also activates macrophages for phagocytic activity and proteinase activity of lysosomal enzymes. A root extract of this herb has great effect on production of white blood cells thereby it is act as an immune regulator. Studies showed its beneficial effect on humoral immunity also (Verma *et al.*, 2012).

Ashwagandha leaf extract is helpful in destroying and inhibition of cancer cells by introducing ROS-signalling and hence act as apotential reagentand can be used for ROS-mediated cancer chemotherapy (Widodo *et al*., 2010).

White Musli (*Chlorophytum borivilianum*)

White musli (*Chlorophytum borivilianum*) is an imperilled species from the family 'Liliaceae' and genus 'Chlorophytum'. It is considered as an ornamental plant in some parts of the world, though India explores it as a valuable medicinal herb. Its roots are laden with alkaloids, vitamins, minerals, proteins, carbohydrates, saponins, polysaccharides and steroids. It possess various therapeutic roles such as it acts as a rejuvenator, an antioxidant and an immunomodulator, etc (Thakur *et al*., 2009). As per a study, the major constituents found in safedmusli are 42% carbohydrates, 8-9% proteins, 3-4% fiber, 2-17% saponins (Goyal *et al*., 2018). It is also commonly used for lactating women and for women post parturition (Goyal *et al.*, 2018).

Immunomodulatory activity: Immunomodulatory activities were studied from the ethanolic extracts of *C. borivilianum* and its sapogenin fraction. The immunomodulatory assessment was studied from the effect of azathioprine induced myelosuppresion and administration of extracts on serological and haematological parameters. The survival rate against *Candida albicans* infection was greatly enhanced. Results further revealed dynamic activity of ethanolic extract as compared to sapogenin fraction of *C. borivilianum* (Sharma and Chandrul., 2017).

The present review concluded that consumption of these herbs and spices can act as a preventive strategy against infection and COVID 19. These medicinal plants can be considered because they have the potential of immunomodulatory actions, like the intonation of cytokine secretion; enhanced phagocytosis and activation of macrophages; lymphocyte proliferation, production of immunoglobulin and allergic reactions. They will act as a protective agent against infection.

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