AYUSHDHARA
ISSN: 2393-9583 (P)/ 2393-9591 (O)
An International Journal of Research in AYUSH and Allied Systems

Review Article

A CRITICAL APPRAISAL ON IMMUNOMODULATION AND BATTLE AGAINST COVID-19: AN EVIDENCE BASED PREVENTIVE AYURVEDIC APPROACH

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KEYWORDS: Immunity, *Vyadhikshmatav*, *Ojas*, Immunomodulation, *Bala*, *Rasayan,* Covid-19.

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ABSTRACT

The emergence of SARSCOV-2 has been noticed as the third introduction of a highly pathogenic corona virus into the human population after SARS-COV and MERV-COV in 21st century. It has posed a horrible situation that warrants urgent global attention due to the emergence of more virulent viral strain, predicted future viral mutations, prohibitive cost of available drugs, time lag between vaccine development and mass causalities occurring all over the world. Although specific antiviral vaccine is the effective solution but a potent and comprehensive immune response to maintain homeostasis is also critical for prophylactic as well as therapeutic management of the disease. Amidst all the gloom spread due to this outbreak, everyone is focusing on preventive measures until an effective vaccine is developed. Ayurveda- An holistic science offers a plethora of preventive therapies to enhance body's resistance against infections. It is evident that nutritional and herbal approaches taken together provide potent tools for controlling an array of viral infections and have been effectively used by humans all over the world since ages during such outbreaks. Ayurveda and yoga have great potential for embracing the world in creating a more positive health abode. Herbs exhibit a diverse array of biological activities and can be effectively harnessed for managing this pandemic. This review portrays an eclectic overview for the preventive management of COVID-19 pandemic covering the dietary, lifestyle and herbal evidence based approaches that may be most likely helpful in managing the current pandemic scenario and also strengthens our body to cope-up with the next pandemic that might appear in not too distant future.

INTRODUCTION

COVID-19- A contagious malady of 2020 has emerged out as ominous warning to public health. It is caused by severe acute respiratory syndrome corona virus 2(SARS-Cov2) firstly emerged in Wuhan, China and now has spread throughout the world. Estimation of worldwide cases recovery and fatalities ranges from 4.37M, 1.56M and 298K respectively[1]. In Dec 2019, Pneumonia outbreak occurred in Wuhan city of China and was traced to be a novel strain of corona virus and named 2019-n-COV by WHO[2] but later on renamed as SARS-COV2 by International committee on Taxonomy of viruses[3]. On genomic analysis, Wuhan strain has been identified as new strain of beta corona viruses from group B with approximate 70% genetic similarity to SARS-COV. This virus has 98% similarity to bat corona virus directing towards its origin from bats[4], therefore bat could be the possible primary reservoir. The intermediate source of origin and zoonotic transfer to humans is not known however the rapid human to human transfer has been confirmed widely. Unlike seasonal flu which is typically caused by slight variation in pre-existing strain, the vast majority of individuals lack immunity to virus. This pandemic first appeared as a part of mild infection outbreak

during December 2019 in China but in late January and early February 2020, most serious form of this outbreak came into existence leading to more than 3 lakhs deaths all over the world till mid May and still ongoing. By mid march this pandemic had surfaced in more than 190 countries of the world and cause of this exponential outbreak may be owed to mutations in the strain on exposure to environmental mutagens. As per published literature, on focusing upon its clinical picture, SARS-COV-2 is sufficiently cleared by early acute phase antiviral response in some individuals while some progress to hyper inflammatory condition often with life threatening pulmonary involvement[5]. Currently, there is no definite treatment for covid-19 although some drugs are under investigations but still no permanent solution has been found. It is well known fact that immune function is strong defense against invasive pathogens. If the immune response of patients in acute phase is effective without any underlying diseases then virus can be effectively suppressed. In this critical situation when medical and public health response to pandemic appears to be infective without any definite solution then beside breaking the chain by following social distancing, personal hygiene measures, immunity enhancement i.e. increasing the natural resistance of the body towards infection appears to be sole modality. The modulation of immune response by using Ayurvedic preventive strategies may act as possible prophylactic as well as therapeutic measure and also a subject of scientific evaluation. Ayurveda - A holistic science really practices the basic concept of immune-modulation since ages and meticulous description of this concept is available in our literature. In fact one of the therapeutic strategy in Ayurveda is to enhance the body' s natural overall immune resistance to disease causing agents and this objective is achieved through use of health promoting dietary regimen, lifestyle, daily regimen, seasonal regimen, following good conduct (*Sadvritacharan*) and use of certain rejuvinative, restorative therapies and remedies. Thus, it is the need of hour to revitalize and inoculate the ancient concept of immune-modulation through healthy dietary and lifestyle interventions in our daily life to obtain its prime benefits for mankind.

AIMS AND OBJECTIVES

1. To highlight the potential role of immunity in fighting deadly viral infections.
2. To create awareness among individuals for adopting immune-modulation measures mentioned in Ayurveda.
3. To make it globally acceptable preventive strategy.
4. To highlight the potential of Ayurveda in fighting Covid-19 as an integrative approach.
5. Scientific revalidation of Ayurvedic preventive approach mentioned in Ayurveda literature.

MATERIAL AND METHODS

Source of data: All the information regarding the concept of immune-modulation was collected from ancient compendiums, relevant contemporary text books of Ayurveda, modern text books, internet, related journals, research and review articles, Ayurvedic Pharmacopeia of India, Books on *Dravya Guna*, modern books of pharmacology and from previous research work on various drugs.

Introduction to Covid-19 Virus- A Perfect Molecular Machine

SARS-COV2 belongs to a group of corona viruses from family coronaviridae with subfamily orthocoronavirinae, order nidovirales and realm riboviria. They are enveloped viruses with positive sense single stranded RNA genome of size ranging from 26 to 32 kilobases having club shaped spikes projecting from outer surface and a nucleocapsid of helical symmetry[6].

Structure

Corona viruses are large pleomorphic spherical particles with bulbous surface projections. Viral envelope consists of lipid bilayer where Membrane (M), Envelope (E) and Spike (S) structural proteins are anchored. Inside envelope, nucleocapsid made up of multiple copies of nucleocapsid (N) protein is present and is bound to positive sense single stranded RNA genome in a continuous bead on string type fashion.

Some Grim Statistics[7]

Killed more than 298 k people worldwide

Killed with great variability in different age group

Killed more than 3303 Indians

Biological Basis of Covid-19 Pathogenecity

The emergence of SARSCOV2 has been marked as the third introduction of a highly pathogenic corona virus into the human population after SARS-COV and MERV-COV in 21st century. Although pathogenesis of SARS-COV2 in humans is unclear but based on past experiences and published literature, potential pathogenesis has been inferred out.

Viral Entry and Replication in Humans

Infection begins when viral spike(S) glycoprotein attaches to its complementary host cell receptor. After attachment proteases of host cell

cleave and activate receptor attached spike protein to enter the host cell. In SARS COV2 ACE2- zinc containing metalloenzymes present on cell membrane of type 2 alveolar cells serves as entry point into cell, more specifically binding of spike (s) protein of SARSCOV-2 to enzymatic domain of ACE2 results in endocytosis and translocation of both virus and enzyme into endosome located within the cell. Inside endosome, translation of genome leads to formation of Replicase -Transcriptase complex (RTC) which is directly involved in replication and transcription of RNA. This replicated positive sense genomic RNA becomes progeny virus from which m-RNA genomes are released and leave the host cell by exocytosis through secretary vesicles leading to further viraemia.[8]

Antiviral Host Defence Mechanism

The antiviral immune response generally can be divided into an early non-specific phase typically first five to seven days of infection involving innate immune mechanism followed by later antigen specific phase involving adaptive immunity by T and B cells.

After recognition of pathogen associated molecular proteins (PAMP's) through the innate receptors like TLR's, immune cells principally alveolar macrophages, initiate the release of cytokines such as TYPE-1 IFN's, IL-6, IL-13, TNF-alpha and chemokines as well as causes recruitment of neutrophills, monocytes, NK cells to orchestrate an effective antiviral response at the site of infection leading to inflammatory cascade in the alveolar milieu. Beside this, dendritic cells of innate defense act as antigen presenting cell (APC's) to activate the induction of adaptive immune response. As per published reports, In addition to cytokine based pathology, in patients with severe COVID-19, complement activation has also been observed directing towards activation of all lines of innate defense. As the invader is strong, so all innate immune mechanism get activated simultaneously to check viral dissemination resulting in production of excessive amount of pro-inflammatory cytokines. The development of adaptive immunity is aided by the action of innate immune system and is critical when innate immune system is ineffective in eliminating infectious agent. So, when adaptive immune effectors cells are generated they contribute to fight infection through T-cells. Response to infected cells by different types of CD4+ cells orchestra a huge inflammatory reaction by recruitment of neutrophills and become major source of cytokine production whereas CD8+ cells begin to kill infected cells resulting in acute cytolytic reaction as evidenced by the studies which reported that in patient with COVID 19, lymphopenia is common with drastically reduced number of CD4+ and CD8+ cells, B cells and NK cells and significantly increased concentration of IL-6, IL-1 beta, IL-2,IL-8, IL-17, G-CSF, TNF-alpha implicating impending cytokine storm[9].

Fatality of Robust Immune Response/ Cytokine Storm

SARS-COV2 being a highly virulent pathogen activates all pathways of both innate and adaptive immune mechanism leading to production of high level of pro-inflammatory cytokines which can cause extensive tissue damage both locally as well as systemically. As per published literature, most of the patient with covid-19 disease exhibited mild to moderate symptoms, approximately 15% progress to severe pneumonia and about 5% develop ARDS, septic shock and multiple organ failure probably due to cytokine storm[9]. It is well known fact that when the normal Balance between immune and inflammatory response is abrogated and inflammatory cytokines are produced in high concentration, a Cytokine Storm-the deadly uncontrolled systemic inflammatory response results which will trigger a violent attack by immune system to body causing ARDS and multiple organ failure and finally leads to death.

On critically analyzing the published literature, biological pathogenicity and clinical manifestations of COVID-19, it seems that unusual immune response and excessive immune cells destruction may be key factor in pathogenesis of this disease. Hyper-induction of chemokines and cytokines, insufficient interferon reaction and a compromised cellular immune response may contribute to SARS related pathological changes as well as aggravation of SARS-COV induced lung damage.

Role of Immune Competency in Fighting Covid-19

Immunity is balanced state of multicellular organisms having adequate biological defense to fight infection, disease or other unwanted invasion while having adequate tolerance to avoid allergy and autoimmune diseases[10]. Beyond structural and chemical barrier, immune system has two fundamental lines of defense: Innate and Adaptive immunity. Innate immunity is first line of defense for fighting against invading pathogens. It is rapid immune response initiated within minutes after aggression but no immune memory. On the other hand, Adaptive immunity is antigen dependent or antigen specific which enables host to mount more rapid and efficient immune response upon

subsequent exposure to antigen. Innate and Adaptive immune mechanism are not mutually exclusive but rather are complimentary with defects in either system resulting in host vulnerability or inappropriate responses.

Contribution of Innate Immune Response

Innate immune response is natural non-specific first line of defense and besides physical and chemical barrier numerous cells are involved in innate immune response such as phagocytes (macrophages and neutrophills), dendritic cells, mast cells, basophills, eosinophills, NK cells and innate lymphoid cells. Macrophages act as first barrier and induce phagocytosis, neutrophill recruitment as well as release of cytokines. Dendritic cells also phagocytose and function as antigen presenting cells to initiate adaptive immune response and also act as messenger between innate and adaptive immune mechanisms. NK cells also play major role in killing of infected cells and also important source of cytokines interferon - gamma which helps to mobilize APCs and promote development of effective antiviral immunity by selectively producing cytokines such as IL-4, IFN-gamma and IL-17 etc. Hence, invading pathogens and their replicative intermediates can be recognized by several innate immune receptors mostly TOLL like receptors expressed at the host cell surface and through these receptors virus activates endosomal TLRs, that recognizes viral RNA intermediates leading to production of pro-inflammatory cytokines, interferon's as well as transmits signals for neutrophill recruitment and induction of adaptive immunity.

Contribution of Adaptive Immune Response

The development of adaptive immune response is aided by actions of innate immune system and is critical when innate immune is ineffective in eliminating infectious agents. Major cells of adaptive immune cells are T-lymphocytes and B- lymphocytes with further differentiation of T- cells as cytotoxic CD8+ T cells and Helper CD4+ T cells. CD8+ T cells on activation through T cell receptor by binding to peptide bound MHC class I molecules induces acute cytolytic infection while CD4+ cell receptors bind to MHC class II molecules for activation and play important role in establishing and maximizing the immune response by influencing the activity of other cell types through TH1 and TH2 responses. So, when adaptive immune effectors cells are generated they contribute to fight infection through T-cells. Response to infected cells by different types of CD4+ cells orchestra a huge inflammatory reaction by recruitment of neutrophills and become major source of cytokine production whereas CD8+ cells begin to kill infected cells resulting in acute cytolytic reaction. As per a study, days following symptoms onset, a large surge of specialized helper T cells, killer T cells, B cells and all crucial immune cells was seen in COVID-19 patient's blood sample directing towards the breadth of immune response and importance of immunity in fighting Covid-19[11].

Now, here the question arises when all were infected by same virus then why some resolved with minimum impact and others suffered with substantial tissue damage. Then our only answer points towards immune competency which seems to be responsible for variable outcome. Studies have reported that outcome of viral infection is greatly influenced by properties of infecting virus (virulence) and host factors including genetic susceptibility, age, route of infection, induction of immune regulatory mechanism as well as presence of concurrent infections[12]. Healthy immune system occurs as a result of balance in innate and adaptive immunity, cellular, humoral immunity, inflammatory and regulatory network. Any abrogation in this balance either due to deficiency or dysfunction leads to immunological diseases. Deficiency of any one of the component of immune system either congenital or acquired due to malnutrition or chronic inflammatory conditions is called immunodeficiency/ hypo-reactivity whereas occurrence of irregular immune response either due to failure of recognition or immune dysregulation that is detrimental to host is called immune dysfunction. So, it is clear that immune response to a pathogen largely depends upon host's immune competency/healthy immune system as most are controlled by immune system with limited damage to host tissue while some cause overt damage to host tissue. When host's immune system is competent enough, it regulates an effective antigen-antibody response to fight the invader as well as uses many counter measures to limit tissue damage after infection such as production of cytokines IL-10, TGF-beta having anti-inflammatory property and other host derived natural anti-inflammatory mediators such as resolvins, galectins, and activity of cell subsets such as T_{Reg} cells. Studies have also proved that variation in galactin concentration in individuals explains variability in outcome of immune response of certain individuals. So, ultimately coordination of different immune cells, regulation of their activity and host resistance is of paramount importance for mounting an effective immune defense and this task

is accomplished by secretion of cytokines and chemokines which attract immune cells to site of infection and regulate their activation and suppression as well as by maintaining the host immune strength through appropriate nutrition.

Concept of Immunomodulation in Ayurveda

Immunomodulation encircles all dietary and therapeutic interventions aimed at modifying the immune response. Immunomodulators are substances which can stimulate/suppress or modulate any of the components of immune system including both innate and adaptive arms of immune response. In healthy individuals, the immune stimulants are expected to serve as prophylactic and promoter agents i.e. immunobooster by enhancing the basic level of immune defense while in individuals with impaired immune response they are expected to act as immunotherapeutic agents. The concept of immune system in Ayurveda extends beyond the physiological and cellular components recognized by conventional science. A healthy immune system is represented by physical, mental and emotional as well as spiritual resilience of an individual which is the result of purified essence of *tridoshic* (three biological humours) equilibrium depending upon illuminance of *Agni* (digestive fire) or *Bala*nced function of three subtle energies i.e. *Prana* (vital force/*Vata*), *Tejas* (inner radiance/ *Pitta*) and *Ojas* (vigour/*Kapha*).The modulation of immune response by following Ayurvedic dietary, lifestyle regimen and therapeutic therapies has been meticulously described in Ayurveda literature and now has become subject of scientific evaluation. The basic concepts of immunomodulation are being practiced in Ayurveda since ages. In Ayurveda, *Rogibala* (immunity) has been mentioned by various synonyms such as *Ojas* (Vigour), *Bala* (Immune strength), *Prana* (Vital force), *Vyadhikshamatav* etc, having prime meaning of bio-strength, vitality with natural resistance against diseases. Acharya Charak has quoted that *Prakrit kapha* is *Bala* and is simulated with *Ojas*[13] as it provides strength to the body and emphasized on concept of "*Baladhisthanam arogyam*" means our healthy state depends on *Bala* or immune strength of body[14].

Chakarpani has further elaborated the concept of *Vyadhikshamtav* as *Vyadhibalavirodhitav* means capacity to restrain or withstand the strength of disease and *Vyadhiutpadak-pratibandhatav* means resisting power of body competent enough to prevent occurrence of disease[15]. *Charak* has specified in *Sutrasthana* of *Charak samhita* that everyone is not immune competent to withstand the strength of disease. This immune strength varies with individuals as it depends on nutritional, environmental and individual physical and mental strength. While describing *Rogibala*, *Acharya* has described three types of *Bala* i.e., *Sahaj, Kalaj* and *Yuktikrita Bala*[16]. *Sahaj* means genetic resistance to disease (Innate immune response), *Kalaj* is immunity influenced by seasonal traits and age (adaptive immune response) whereas *Yuktikrita Bala* has been mentioned as "*Aharchestayogjam*" means modulation of body resistance against diseases by resorting to health promoting dietary regimens, rejuvinative therapeutic regimens and physical activity. In Ayurveda, Food has been compared to vital force and plays vital role in maintenance of good health and also in prevention and cure of diseases. Charak has mentioned in *Sutrasthana* that *Tushti* (satisfaction), *Pusthi* (nutritional status), *Bala* (bio-strength) and *Medha* (intellect) all depends upon food[17]. *Bala* (Immune Strength) is determined by various factors one of them is *Dhatu samhanan* (compactness of *Dhatu*). This *Dhatu samhanan* depends upon *Dhatu snighdta* (unctuousness of *Dhatu*) which is generated by nutritious food as evidenced by the quotation "*Balaayushiaharayate*" means *Bala* (immune strength) and longevity depend upon food[18]. Studies have also reported that nutrition is critical determinant of immune responses and nutritional disarrays (deficiencies or excess) influence various components of the immune system. Dietary proteins, carbohydrates and fats as well as micronutrients (vitamins and minerals) interact with immune cells systemically in blood, regional lymph nodes and in the specialized gastrointestinal immune system[19]. Nutritional deficiency is commonly associated with impaired immune responses specially, cell mediated immunity, cytokine production, secretary antibody response and affinity[20].

Second factor is *Chesta* i.e. physical activity which imparts strength to our body. Studies also report that a firmer link exists between exercise and immunomodulation. Moderately active people are known to have macrophages that are more capable of killing tumor cells due to increased production of compound called nitric oxide. Even sporadic exercise increases the ability of an immune system component called natural killer cells to eradicate tumor cells suggesting of potential of exercise in increasing our immune strength.

Third very important factor which determine *Bala* is *Dhatu saarta* (Tissue excellence). *Dhatu* excellence is responsible for *Arogyata* (prevention of diseases) whereas *Dhatuvaishamya*

i.e. loss of integrity of *Dhatu* due to either improper nourishment (*Dhatudourbalya*) or due to decrease in *Pratyanikabala* (resistive force) is responsible for causation of diseases. This discordance in *Dhatu* is brought due to consumption of unwholesome diet because *Ahar* (diet) is said to be responsible factor for *Dhatusamya* and *Vaishamya* along with importance of *Agni* which also plays a vital role in transformation of food to produce ultrafine essence required for nourishment of *Dhatu*. Role of *Agni* as pivotal factor has been described by *Charak* as *Bala* (immune strength), longevity, health and *Prana* (vital force) all depend upon *Agni*[21]. Beside dietary regulations, excellence of *Dhatu* can be promoted by *Dhatuprasa*d an i.e. using *Rasayana* which is a unique dietary and therapeutic rejuvinative therapy of *Ayurveda*. Revitalization and rejuvenation is known as *Rasayan Chikitsa* in Ayurveda. *Rasayan* promotes nutritional status either by direct enrichment of nutritional quality of *Rasa* or by promoting nutrition through improving *Agni* means digestion and metabolism or by promoting the competence of *Strotas* means microcirculatory channels in body. *Bala* is also simulated with *Ojas* which is ultrafine essence of whole *Dhatu vyapaar*[22] so, ultimately enhancement of *Dhatu* excellence either by using health promoting diet, promotion of *Agni* or by using dietary or therapeutic *Rasayan* acts as primordial factor for promoting *Bala*/*Ojas* for fighting against various ailments.

Another factor which is responsible for maintaining bio-strength is *Satmya* (suitability). *Satmya* is that which being used constantly has wholesome effects. *Satmya* has been mentioned in *Ayurveda* in context of *Ritu Satmya* (diet and regimens of different seasons), *Okasatmya* (suitability due to regular use), *Desha Satmya* (suitability to habitat), *Vayasatmya* (suitability as per age), *Prakriti Satmya* (suitability as per body constitution) etc. It may be wholesome entity while sometimes may be unwholesome. If unwholesome entity is accustomed due to habitual use, it should be gradually withdrawn and replaced by wholesome required for maintenance of health. Acharya Charak has mentioned in context of *Rasa* (taste) *Satmya* that "*Sarv Rasabhyasobalakaranam*" means use of all types of *Rasa* in diet provides strength to the body whereas use of single *Rasa* causes weakness in body[23]. So, all these factors must be considered while taking food.

Beside this, Ayurveda has also given great emphasis on *Sadvritacharan* (good code of conduct) for prevention of diseases. It includes *Dincharya* (daily regimen), *Ritucharya* (seasonal regimen) and *Sadvritta*. *Dincharya* and *Ritucharya* have been described for maintenance of physical health while *Sadvritta* has been described for maintenance of sound mental health. Charak has also described 13 types of *Balavriddhikara Bhava* in *Sharir Sthana* out of which *Aharsampat* (diet excellence), *Sharirsampat* (good physical health), *Satmyasampat* (good suitability), *Satvasampat* (sound mental health), *Karma* (physical activity/Good code of conduct), *Samharsh* (happiness/positive attitude) are variables of environment/ modifiable factors required for enhancing immune strength of the body[24].

Immunomodulatory Dietary Regimen/*Ahar Rasayan*

Diet plays a vital role in the life of living beings. As per Ayurveda, body and diseases both are products of *Ahar* (diet). Hence, what we eat, how we eat and when we eat is very essential in maintaining our health status and immune strength. As per conventional science also, immune system is solely dependent on gut health. A healthy nutrient dense diet, healthy lifestyle and body void of toxins is first and foremost defense. It has been well established that complex, integrated immune system needs multiple specific micronutrients including vitamin A, D,C,E, B6 and B12, folate and minerals like Zn, Iron, Cu, Se, Mg which play vital often synergistic roles at every stage of immune response[25]. It is said in our classics that if dietetics is followed, medicine is not needed and if dietetics is not followed, even medicines are not useful.

Recommended dietary guidelines are as follow-

- ***Shali verga*/Awned grains**

Acharya Charak has given detailed description of *Shookdhanya* (awned grains) and has emphasized that *Rakta shali* (Red rice/ *Oryza punctata*) is best among all awned grains[26]. Apart from this, *Shasthishali* (Brown rice), *Godhum* (*Triticum vulgare*), *Yavak* (oats/*Avena sativa*), Millets are having *Madhur Rasa*, *Guru*, *Snigdh Guna* and *Madhur Vipaka* thereby act as *Balya* (strength promoter). As per modern science also, these awned grains are having less carbohydrates and more dietary fibers which provide optimum nutrition to the body. High fibrous diet has been shown preventive against allergic airway diseases due to acetate produced by micro biota. Beside this, *Shali* Rice (*Oryza punctata*) is rich source of Iron (5.5mg/100g), Zinc (3.3mg/100g), vitamin B6 (23mg/100g), Protein (2.3g/100g), fibers and minerals[27]. Similarly, Oat/*Yavak* (2.95mg/cup) and millets (3.5 mg/100g) are ample source of zinc.

Studies have reported that Zinc affects multiple aspects of immune function. It is crucial for normal development and function of cells mediating nonspecific immunity such as neutrophills, macrophages and NK cells as well as performs basic cellular functions such as DNA replication, RNA transcription, cell division and cell activation[28].

***Shimbi verga*/Legumes**

On screening in *Shimbidhanya verga* (Legumes), *Mudag* (*Phaseolus aureus*), *Manglayak* (Lentil/*Lens culinaris*), Beans, Peas, chickpeas are also rich source of proteins and minerals like zinc and selenium required for boosting the immune system because Protein energy malnutrition is significantly associated with impairment of cell mediated immunity, phagocyte function, complement system and cytokine production. As per published literature, selenoproteins present in pulses also play critical role in reducing oxidative stress in wide variety of cells including innate and adaptive immune cells[29].

***Taila verga* (Seeds/Oils)**

Sesame seeds (*Sesame indicum*) have been mentioned as best seeds among vegetative oils. These have *Guru*, *Snigdh Guna* thereby act as *Vatashamak* and *Balya*. *Atsi*/Flax seeds (*Linum usitatissim*), *Karkaru*/Pumpkin seeds (*Cucurbita* pepo) and *Suryamukhi*/ Sunflower seeds (*Helianthus annuus*) are also having *Madhur Rasa* and *Guru Guna* by virtue of which they also acts as *Balya*. Sesame Oil (*Til taila*-Sesame indicum) is made up of Sesame seeds which are rich source of fats specially polyunsaturated fatty acids, omega-3 and omega-6 fatty acids and good source of copper, manganese, calcium, iron, zinc et. Pumpkin seeds are rich in Zinc which reduces viral replication. Most of these seed oils contain PUFA's. Studies have reported that Omega-3 PUFA'S derived metabolites EPA (Eicosapentaenoic acid) and DHA (docosahexaenoic acid) produce a class of molecules called as Pro-resolving mediators (SPM's) such as resolvins, protectins, maresins which play a key role in facilitating the active resolution of inflammation in variety of disease states including acute lung injury and colitis etc. whereas Omega-6 PUFA's give rise to specific pro-inflammatory prostaglandins and leukotrienes[30]. Omega-3 FA provokes major alteration on gene regulation on macrophages while EPA as well as DHA decreases cytokine production and increase secretion of anti-inflammatory cytokineIL10. Dietary omega3 FA also promote accumulation and proliferation of anti-inflammatory T regulatory Cell in liver, spleen and adipose tissue[31]. Although both fatty acids are essential fatty acids necessary for growth and development but the ratio of omega-6 to omega-3 fats consumed by humans formerly approximately 1:1 has now drastically changed to 15:1 to 20:1 and this imbalance has been implicated in a variety of diseases and inflammatory states. So, oils having high amount of omega-3 FA such as flax seed oil must be consumed for maintaining better immune health.

***Dugdh verga*/Dairy products**

Milk has been advocated as best *Jeevniya* (vitality promoter) and *Ojasrik Rasayan* (rejuvinative) in Ayurveda having properties equivalent to *Ojas* [32]. Studies have also proved milk as best immunomodulating agent. The majority of immunomodulatory activity has been detected in milk proteins (casein and whey) and milk fat thereby dramatically enhances lymphocyte function. Cow milk also contains several immunoregulatory cytokines such as TGF-beta and IL-10, vitamin A, Vitamin D3 etc. Human IL-10 has 70% homology to bovine IL-10 and shown to induce dose dependent reduction of CD8 expression and IL12, TNF production. Some studies have also reported that cow's milk also provides protection against respiratory tract infection by enhancing phagocytosis through bovine IgG and promotes epithelial barrier function by up regulation of TJ genes and might favour differentiation of T regulatory that can reduce inflammation locally. Studies also reported the effect of milk components on trafficking of lymphocytes from intestine to upper airways through modulation of homing receptors and microbiota (Gut-Lung axis) thus supporting its role as potent immunomodulator[33].

Ghrita (Clarified butter) has been mentioned to posses *Mridu*, *Madhur* and sheet properties by virtue of these it acts as *Agnideepak* (illuminates digestive fire), *Balya* (strength promoter), *Ojovardhak* (immunopotentiator) as well as *Rakshoghna* (antimicrobial)[34]. It is valuable source of polyunsaturated fatty acids and fat soluble vitamins like A, D, E and K. Researchers have found that *Ghrita* prepared by Ayurvedic traditional methods contain higher amount of DHA, Omega 3 fatty acids having strong anti-inflammatory properties and precursor for generation of SPM's.

***Phala verga*/Fruits**

Fruits such as *Draksha* (raisins), *Narangi* (orange), *Aaruk* (peach), *Tankphala* (pears), *Kalind* (watermelon), *Erandkarkati* (papaya), *Dadim* (pomegranate), Apple, Berries having *Madhur Vipak* and *Agnideepak* properties must be used. As per conventional science, these are citrus fruits having

low glycemic index and rich in vitamin C. Vitamin C is a potent antioxidant and cofactor for family of biosynthetic and gene regulatory enzymes, supports epithelial barrier functions, enhances chemotaxis, phagocytosis, generation of ROS species for effective microbial killing[35]. Apple, Berries skin contains a compound called quercetin which helps decrease NLRP3 and regulates the immune system. Generally, raw fruits and vegetables contain sterols and sterolins which are natural immunomodulator.

Nuts- Nuts like cashew, almond, walnuts, pistachios, pine nuts are nutrient dense food each with unique composition. Mostly contain healthy MUFA's and PUFA's, proteins, fibers and ample source of vitamin E, minerals such as Mg, Cu, selenium having strong anti-oxidant potential.

***Shaka verga*/ Green leafy Vegetables**

Thousands of years ago, our saints have advised for the consumption of green leafy vegetables. Green leafy vegetables such as *Vastuk* (Bathua/ *Chenopodium album*), *Pathashak* (*Cissampelos pariera*), *Shatavari (*Asparagus*), Karvelak (*Bittergourad*), Tanduleeyak (Chaulai), Shigru (Moringa/ Dumsticks), Patol (Parwal/ Trichosanthes dioica)*, Tomato, Carrot, Broccoli, Beetroots, *Sitaphal* (Pumpkin) having *Tridoshshamak* and *Agnideepak* properties should be consumed for maintaining optimum health. *Shigru*/ Drumsticks (25.5-31.03 mg/kg) and pumpkin seeds (7.9mg/100g) are highly rich source of zinc, Iron, vitamin A and vitamin C. Other Green leafy vegetables are rich source of vitamins A and C as well as minerals such as zinc, iron, Mg and also a key source of IEL's (Intraepithelial lymphocytes) which play crucial role in maintaining immune strength.

***Aharoupyogi verga*/Spices**

In Ayurveda, Spices have been mentioned as *Aharoupyogi varga* (Food additives) and find special emphasis as a raw material for pharmaceutical industry and also in our Indian cuisine. As per *Ayurveda*, strong immunity is product of good digestion i.e. *Agni*-the universal principle of transformation that manifests as digestive fire and transforms food into ultrafine nutritious material. *Ayurveda* focuses on illumination of this *Agni* to digest *Ama* (Endotoxins) which have been manifested due to internal or external stresses ensuring optimum functioning of physical and mental well being. All the spices mentioned in *Ayurveda* have *Katu Rasa*, *Ushna*, *Teekshan Guna*, *Ushna veerya*, *Katu Vipaka* and *Vatkaphashamak* and *Agnideepan* properties by virtue of these properties they digest *ama*, illuminate *Agni* to digest and metabolize food for the nourishment of every cell in the body thereby having *Rasayan* (rejuvenating)effect [36].

Turmeric (*Curcuma Longa*)

Curcumin is a polyphenol derived from turmeric could greatly affect both innate and adaptive arms of immunity through neutrophills, macrophages, Nk cells, dendritic cells, Tcells and B cells due to its potent anti-inflammatory, antioxidant effects [37]. As per some studies, Curcumin has been shown to have antiviral properties. Studies have proved that, Curcumin exhibited antiviral activity against Epstein-Barr virus, anti-HIV activity and coxsakievirus. It also showed protective effect on cell against virus induced apoptosis and cytolysis. Curcumin in human diet could provide a simple mean to prevent infection by enveloped viruses. It interfered with binding of enveloped viruses to cell in dose dependent manner probably by affecting membrane fluidity thereby altering the conformation of viral glycoproteins which are essential for viruses to interact with cells [38].

Ginger (*Zingiber Officinalis*)

Ginger is one of the most effective natural immunomodulator. Fresh ginger contains gingerols, shogaols, paradols etc. In vitro study found that ginger inhibited lymphocyte proliferation which is mediated by reduction in IL-2 and IL-10 production. Aqueous ginger extract significantly increased production of IL-1-beta, IL-6 and TNF-ALPHA in activated peritoneal mouse macrophages [39]. Fresh Ginger dose dependently inhibited viral attachment and internalization of Human Respiratory Syncytial virus and in high concentration could stimulate mucosal cells to secrete IFN-beta that possible contributed to counteracting viral infection [40].

Cumin (*Cyminum cuminum*)

Cumin exerts anti-inflammatory effects through inhibiting NF-kappa B and mitogen activated protein kinases. Studies have reported that Methanoli extract of Cumin seeds show significant antiviral activity on HSV-1 in verocell line probably due to interference of phenolic compounds with fusion of verocell membrane and HSV-1 envelop [41].

Cinnamon (*Cinnamomum cassia*)

A recent study reported that 2-hydroxycinnamoldehyde isolated from *C.Cassia* bark exhibited an inhibitory effect on production of Nitric oxide by inhibiting the activation of nuclear factor Kappa- light chain enhancer of activated B

cells indicating towards its potential as inflammatory agent [42].

Basil (*Ocimum sanctum*/ Mother medicine of Nature)

As per a study, *Ocimum sanctum* seed oil as well as aqueous extract of leaves appears to modulate both humoral and cellular mediated immune response probably by GABergic pathways thereby acts as adaptogen and significant antiviral activity of ethanolic extract of *Ocimum sanctum* was also observed against H1N1 virus[43].

Peppermint (*Mentha spicata*)

Study has reported that ethanolic extract from leaves of *M. spicata* was effective against RSV and could suppress the production of TNF-alpha, IL, NO and PGE2 thereby beneficial in fighting RSV infections[44].

Clove (*Syzygium aromaticum*)

Eugenol and clove extract has been shown to posses' antiviral activity.

Nigella (*Nigella sativa*)

Thymoquinone an active compound of nigella seeds has potent anti-inflammatory, immune stimulator activity. As per a study conducted in guine pigs, *Nigella sativa* extract has shown significant preventive effect on pathological changes of lung and shows beneficial immunomodulatory properties by augumenting the T-cell and NK cells mediated immune responses[45].

Garlic (*Allium Cepa*)

Garlic acts as potent immunomodulator by augmenting NK cells, stimulates T-cells and interleukin-2 production as well as boosts IL-10 and IL-4. Fresh garlic extract with allicin as main active compound has been shown to posses' antiviral activity in vitro and in vivo studies against influenza[46].

Dietary Etiquettes [47]

Do's

- One should eat warm, emolient food in proper quantity (*Ushna, Snigdh Matravatashniyat*)
- One should eat only after previous meal is digested (*Jirneashniyat/Kaalbhojanamarogya-karanam*)
- One should eat food having non-antagonistic property (*Veeryavirudhaashniyat*)
- One should take light, easily digestible food in the evening.
- One should include all the tastes namely sweet, salty, sour, pungent, bitter and astringent in daily diet because it provides immune strength. (*Sarvrasabhyasobalkaranaam*)
- One should eat sweet substances first followed by sour and salty and later on pungent, bitter and astringent substances at the closure of meal for ensuring good digestion.
- One should consume fruits first followed by liquids and at last end by solid food.
- One should sit in *Sukhasan* (easy posture) with erect body during eating.
- One should eat food neither too hurriedly nor too slowly for uniform digestion.
- One should consume food with full concentration.
- One should take water in between the meals.
- One should ensure moderation in food for perfect digestion and maintenance of fundamental principles of body in their normal status.

Dont's

- The food should not be contrary to each other in action, eg. Fish and milk together, honey and ghee in equal quantity.
- Eating should not be too slowly not in hurry.
- One should not consume too much of any of six taste because it is not conductive for health. (*Ekrasabhyasodaurbalyakaranam*)
- One should not consume *Vyushit* (spoiled/ insipid), *Chirsidh* (cooked on previous day), *Punah Ushnikrit* (reheated), *Updagdh* (burnt food)

Immunomodulating Lifestyle Modifications/ *Achar Rasayan*

Lifestyle modifications consist of multifaceted approach of *Yoga*, *Pranayam*, meditation, behavioral therapies which educate individual to achieve good health status and immune strength.

***Yogic* Regime**

Yoga is a psycho-somatic spiritual discipline for achieving union and harmony between our mind, body and soul by practicing specific techniques such as *Yogasans* (Posture), Breathing Practices (*Pranayam*) and meditation to attain highest level of consciousness. Documented scientific evidences strongly indicate that yoga has promotive, preventive as well as curative potential. Being a safe therapeutic modality, it can be used as an effective lifestyle adjunct for health promotion and physical endurance as well as an adjunct to medical treatment for improving the quality of life. Researchers found an overall pattern that yoga practices down regulate the expression of master regulator of inflammation NF-KB and cytokine IL-beta whereas one study found that yoga increased

level of anti-inflammatory cytokines such as IL-10 [48]. Studies have also reported that yoga could mediate inflammation at genomic level, changing level of proteins that control DNA transcription of pro-inflammatory cytokine genes. Genome wide transcriptional profiling identified 282 up regulated genes and 153 down regulated genes after 3 months of yoga in healthy individuals [49]. Recommended Yogasana are *Surya namaskar* (Sun Salutation), *Mandukasan* (Frog pose), *Paschimiuttanasan* (Sitted Forward Bend Pose), *Bala*san (Child Pose), *Pawanmuktasan* (Wind Relieving Pose), *Trikonasan* (Triangle Pose), *Ardhmatsyendrasan* (Half Lord of Fishes Pose) etc.

Pranayam

Pranayam are powerful techniques to help calm, sooth the mind. It maintains health by practice of prolonging and shortening the breath cycle. It works on mind and soul. *Pranayam* provides extra oxygen to every cell which energizes and rejuvenates them. It tones up the nervous system, improves emotional stability and helps to eliminate anxiety, fears and phobia. It improves breathing capacity and also increases stamina and vitality. Stress has deteriorating effects on body and causes down regulation of HPA axis resulting in increased level of cortisol. Immune system closely interacts with CNS while maintaining physiological homeostasis as well as in regulating cytokine release and mounting inflammatory response against infection thus having bidirectional communication between CNS and immune system. *Yoga* and *Pranayam* relaxes and soothes the mind thereby reduces cortisol level and remove stress. As per a study, *Yoga* increased activity of anti-inflammatory glucocorticoid receptor GR which indicates a change in HPA axis in terms of responding better to cortisol and stopping the stress response quickly. Recommended *Pranayam* are *Nadi-shodhan Pranayam*, *Bhastrika*, *Brahmari*, *Kapalbhatti Pranayam* etc.

Meditation

It is an integral part of Yoga. Meditation is a practice where an individual focuses their mind on a particular object or activity to achieve a mentally and emotionally calm state. It can be done by focusing on a single point or by chanting mantra like OM or by Transcedental meditation (Silent mantra meditation). One study revealed that TM modulates physiological response to stress. Study by ES Epelete et.al observed significantly more TNF-alpha level in non-meditator group. They also showed gene expression changes due to meditation leading to significant silencing of two out of six pro-inflammatory genes in experienced mediator[50]. One study has found that positive attitude improves T- cell count, NK cells, IL's and other markers of inflammation [51].

Sadvrittacharana

Diet and lifestyle are major factors which influence susceptibility to many diseases. *Ayurveda* is a life science and has given great emphasis on *sadvrittacharan* (good code of conduct) for prevention of various diseases.

Sadvrittacharana includes

- *Dincharya* (Daily Regime)
- *Ritucharya* (Seasonal regimen)
- *Sadvritta* i.e. *Aachar Rasayan*.

Dincharya and *Ritucharya* are described for maintenance of physical health while *sadvritta* has been described for maintenance of sound mental health.

***Dincharya* (Daily Regimen)[52]**

The Ayurvedic regimen of right living is designed for maintenance of health, achievement of long, healthy, active life. It includes daily schedule of living from morning to evening.

***Brahma muhurat jagran* -** One should wake up in *Brahm muhurat* means 96 minutes before sun-rise for abundant supply of nascent oxygen to the body and also boosts immune system.

***Dantadhavan* (Tooth cleaning) -** *Dantdhavan* should be done with twigs of plants possessing *Katu, Tikta, Kashaya Rasas* as it poses minimum risk of mucosal irritation as well as have antiseptic properties.

***Jihva Nirlekhan* (Tongue Scrapping) -** It will benefit in eliminating bad odour of mouth, cure edema and gives taste.

***Gandush* & *Kawal* (Oil Pulling/Gargling) -** Oral cavity harbors billions of microorganisms which can contribute to development of various systemic diseases. So, it is very important to maintain oral health. *Gandush* and *Kawal* mentioned in Ayurveda as a crucial therapy for maintaining oral hygiene. It gives strength to mandibles, clarity of mouth, lightness and clarity to sense organs. It has been advised that take a teaspoon of oil into mouth, swish and pull around through the teeth for about 5 to 10 minutes. It should be ideally performed daily morning on empty stomach before brushing teeth. Oil pulling generates antioxidants which damage the cell wall of microorganisms. During oil pulling, oil gets emulsified and its surface area gets increased ultimately leading to smearing of teeth and gingiva which inhibits bacterial co-aggregation

and plaque formation. It should be done with cold pressed oils such as sesame oil, coconut oil. AYUSH ministry has also advised oil pulling with coconut oil during this pandemic because coconut oil has high saponification index and medium chain fatty acids such as lauric acid which has antimicrobial and anti-inflammatory properties. Studies have reported that monolaurin in coconut oil is effective against microorganism such as Staph. aureus, candida species and also shows virucidal activity by dissolving lipids and phospholipids in viral envelope thereby might be helpful in fighting COVID-19[53].

a. ***Anjana*** **-** It cleans the eyes.

b. ***Dhumpana*****-** It is procedure of taking medicated smoke through nostrils and then through mouth.

c. ***Nasya*** **-** It is a unique method of delivering drug via transnasal route. It promotes strength and prevents diseases of head, neck and oral cavity. *Pratimarsh nasya* is a type of *Nasyakarma* which is indicated for daily practice to be administered in a very low dose (2 drops) for promotion of health. *Nasya* probably acts by increasing the immunity of nasal sinus mucosa to external inhalable irritants and microorganisms. Most commonly used is *Anu taila nasya, Goghrita*.

d. ***Vyayam*** **-** *Ardh Shakti* (half of one's strength) is considered as beneficial in Ayurveda as it increase digestive power and helps in maintaining healthy body weight.

e. ***Abhyanga*** **(Massage with medicated oils) -** It increase blood circulation locally providing better transportation of oxygen and nutrients in body. It also tones up nervous system, promotes relaxation and provides nourishment to hair roots and skin. So, regular body massage with warm sesame oil must be done to improve body strength.

f. ***Snana*** **(Bathing)-** It enhances longevity, strength, cures tiredness, sweat and impurities of body.

Sadvritta

It means physical and mental decorum which should be followed by everyone on daily basis. In *Charak Samhita Chikitasthana Rasayanadhyaya, Aachar Rasayana* has been explained, which is nothing but the mental hygiene to be followed by definite methods to lead an ideal ethical way of living. Such physical and behavioral conduct definitely leads to life with *Rasayan* effect. As a whole, Ayurveda views each individual with unique mind-body constitution, with appropriate use of Ayurvedic preventive measure such as *Dincharya, Ritucharya, Aahar Vidhi* and *Sadvritta,* various lifestyle disorders can be prevented.

Immunomodulatory Therapeutic Regimen/ ***Aousadh Rasayan***

Ayurveda stresses the use of plant based medicine and treatment. Various plants identified in Ayurveda system of medicine display a wealth of pharmacological properties. In Ayurveda text, large no of plants are available known to have health promoting effect and also for improving the overall resistance of body against infections. Such herbs possessing immunomodulating effects are referred as *Rasayana* and are discussed below:

Guduchi **(*Tinospora cordifolia*)**

T.cordifolia is reported to benefit our immune system in variety of ways. The alcoholic and aqueous extract of *T. cordifolia* had resulted in significant leucocytosis and predominant neutrophilia as well as stimulates macrophages. Dried stem of *T. cordifolia* also produced significant anti-inflammatory activity [54]. Active constituents of *T.cordifolia* were found to possess significant increase in IgG antibodies in serum along with macrophage activation. Enhancements in humoral immunity, evidenced by hemagglutination titre along with stimulation of cell mediated immunity were observed in leukocytes migration inhibition tests [55].

Mulethi **(*Glycrihza glabra*)**

Liquorice contains more than 20 triterpinoids and nearly 300 flavonoids. Among them Glycyrrhizin, 18-beta glycyrrhetinic acid, liquiritigenin, licochalcone A are main active compounds which posses antiviral and antimicrobial properties[56]. As per a study, Glycyrrhizin was shown to inhibit SARS-Coronavirus (SARS-COV) replication in vitro [57]. It also has an important potential in activating certain immune function such as induction of IFN production, augumentation of NK cells activity and modulation of growth response of lymphocytes through augmentation of IL-2 production. Polysaccharide fractions obtained from *G. glabra* also stimulate macrophages.

Amla **(*Emblica officinalis*)**

Emblica officinalis contains high and LMW polyphenolic compounds commonly called tannins including pedunculagin, puniglucanin, emblicanin A and B. These tannins potentiate the immune system by enhancing the activity of NK cells and macrophages[58].

Ashwgandha **(*Withania somnifera*)**

Ashwgandha shows potent antiviral and immunomodulating activity. It acts as an adaptogen thereby causing down regulation of inflammatory mediators. As per a study Glycowithanolides and

mixture of sitoindosides isolated from WS when evaluated for immune potential in wister rats and swiss mice, they produced significant mobilization and activation of peritoneal macrophages, phagocytosis and increased activity of lysosomal enzymes indicating towards immunomodulatory activity[59].

***Shatavari* (*Asparagus racemosus*)**

Shatavari has been widely used in Ayurveda as *Rasayan*, chemically it contains steroidal saponins known as shatavarins I-IV, isoflavones and alkaloids including asparagamine and racemosol as major compounds. As per a study, AR root extract was shown to restore lymphocyte and neutrophil counts in myelo suppressed animals and also reported to modulate macrophage functions, TNF-alpha secretion, phagocytosis and neuro-endocrinal secretions. A. racemosus root extract is also known to inhibit immunopharmacological activities under different biological stimuli. Aqueous root extract has shown upregulation of Th1 and Th2 cytokines suggesting of its mixed Th1/Th2 adjuvent activity[60].

***Kalmegh* (*Andrographis paniculata*)**

Andrographis paniculata is a medicinal plant having main constituents as diterpenoids, flavonoids and polyphenols. Studies have reported that andrographolide modulates innate immune response by regulating both classical and alternative activation of macrophages and regulate specific antibody production as well as macrophage migration. As per one study, *A. paniculata* ethanol extract inhibited the SRV replication similar to Lamivudine, thereby acts as immunomodulator as well as potent antiviral agent[61].

Immunomodulatory Herbominerals

Gold preparations - Gold has been mentioned in our literature as best *Rasayan* having profound immunomodulatory effect. Study has also reported that Gold nanoparticles actively inhibited Measles Virus infection in vero cells at 50% effective concentration likely by blocking viral particles directly, showing potent virucidal effect [62]. As per a study, nano-material has been shown to activate the complement system through several different pathways leading to particle opsonization and clearance[63]. So, gold containing *Rasayan* formulation, *Swarnprasahan* for children, uses of *Swarn sidha jala* must be used for boosting our immune potential.

Eg, *Sarswataaristha* with Gold, *Yogendra Rasa*, *Sidhmakardwaj*, *Nardiya laxmivilas Rasa, Chandroudaya Rasa* etc.

***Panchgavya* -** As per a study, *Panchgavya Ghrit* can help to reduce multiplication of viruses. Cow urine was found to enhance humoral and cell mediated immune response in mice, increases B and T lymphocytes, increases IgG and IgA antibody titre in mice. As per a study, *Panchgavya* is an effective immunomodulator since it increased neutrophil adhesion count, absolute lymphocyte count and serum gamma globulin concentration in cyclophosphamide induced immunosuppression [64].

Other therapeutic preparations like *Chayavanprasha, Brahm Rasayan, Amlaki Rasayan, Ashwgandha Rasayan, Agastya Haritaki Rasayan* are also best immunomodulating agents.

Table 1: Daily regime for enhancing Immunity

S. no.	Activity	Time	Diet and physical activity
1.	Rising early in the morning	5 a.m.	Face cleaning, bowel and bladder clearing
2.	Oil pulling	5 to 10 mins.	Coconut / sesame oil
3.	Yogasana	30 mins	Sun salutation and other *yogasanas*
4.	*Prana*yam	20 mins.	*Bhastrika* and other 4 *paranayam*
5.	Meditation	15min.	Om Chanting
6.	Nasya (pratimarsha)	Count up to 100	2 drops of *Anu tail*/ *Goghrit* in each nostril
7.	Early morning snack	7 a.m.	20g of Agastyarasayana with 1 glass of warm golden milk / amla juice / asparagus with nuts / soaked flex seeds
8.	Breakfast	8 to 9 a.m.	Whole grains flakes / Fruits / vegetable upma etc.
9.	Midmorning snack	11 a.m.	Ginger, Tulsi, Black pepper, Cinnamon and Honey tea (Add Honey to lukewarm liquid)
10.	Lunch	2 p.m	2 multigrain Roti, 1 bowl rice, 1 bowl pulses and 1

			bowl vegetables
11.	Mid afternoon	5 p.m.	Decoction of Liqcorice, Dry ginger, Cinnamon and Tulsi
12.	Physical activity	6 p.m.	30min. of brisk walking
13.	Dinner	7 to 8 p.m.	2 multi grain roti, 1 bowl pulses, 1 bowl vegetables
14.	Bed time	10 p.m.	Sarasvataristha with gold 15 ml with warm water / Golden milk (Haldi mixed milk) with 3 to 4 black peppers.

Drink warm or fennel mixed water throughout the day.

CONCLUSION

Viral infections play an important role in human diseases and recent ongoing COVID-19 outbreak in advent of globalization has shattered the whole world posing to urgent need of finding strategies to combat this growing virus. Till the development of effective specific antiviral drug or vaccine, adoption of preventive measures mentioned in *Ayurveda* for immunity boosting is of crucial importance in safeguarding public health. Coordination of different immune cells and regulation of their activity is of paramount importance for mounting an effective immune defense and this task can be accomplished by adoption of ancient concept of health promoting Dietetics, lifestyle and rejuvinative *Rasayan* therapies. Our immune system is solely dependent on gut health and only performs premium functions when protected from environmental assaults and bolstered by healthy living strategies. So, it's the high time to go back to our roots to bolster our immune potential. It is strongly recommended to inoculate these preventive dietary and lifestyle therapies in our day to day life for strong immune health. *Acharya Charak* has beautifully quoted that one should eat wholesome food in moderate quantity, at appropriate time by controlling all his senses only then he could be spared from dangerous ailments of irregular eating.

"*Hitashi syat mitashi syat,syat kaalbhoji jitendriya Pashyan rogan bahun kasthan budhimana vishamashnata*" (Ch. Ni 6/11)

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Cite this article as:
Masand Sameet, Thakur Jyotsna. A Critical Appraisal on Immunomodulation and Battle Against Covid-19: An Evidence Based Preventive Ayurvedic Approach. AYUSHDHARA, 2020;7(2): 2656-2670.

Source of support: Nil, Conflict of interest: None Declared