Ayurveda Arsenal for Strengthening Host Defense System against SARS-CoV-2 Infection and Need for Whole System Research: A Narrative Review

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ABSTRACT

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection has become a major public health menace. Along with the conventional medicine, Ayurveda is also exploring various single herbs and compound formulations against COVID-19. The present paper is an attempt to explore the Ayurveda arsenal in strengthening the host defense system against SARS-CoV-2 infection and the relevance and necessity for whole system research. For the present study, Ayurveda classics, Ayurveda Pharmacopoeia, and Formulary were probed to obtain an insight into the diseases as well as relevant therapeutic formulations. The electronic databases Google Scholar and PubMed were searched for relevant contemporary literature. The host response to SARS-CoV-2 infection is either well-coordinated healthy or dysfunctional immune responses. It is crucial to determine the host factors that influence the consequences of host–agent interaction. Factors conducive to the maintenance of good health (Swasthyam yena anuvartate) and preventing the attacks of diseases (Ajatanam Vikaranam Anupattikara) mentioned in Ayurveda may be considered as pivotal factors influencing homeostatic (Samayogavahi) mechanisms of host defense system (Vyadhi-Utpada-Pratibandhakatvam and Vyadhi-Bala-Virodhitvam). Furthermore, it is observed that current research practice of Ayurveda is predominantly drug-based, reflecting the perspective of conventional medicine module, however, compromising the core principles of Ayurveda. Finding effective solutions to COVID-19 pandemic, the Ayurveda arsenal for strengthening host defense system needed to be explored. The holistic method of Ayurveda followed in its clinical practice is needed to be adopted for clinical research as well, with focus on whole system research as compared to drug-based in order to generate tangible evidence.

Keywords: Antiviral, Ayurveda, COVID-19, Immunity, Rasayana, Vyadhikshamatwa, Whole system research.


INTRODUCTION

The recent outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection around the world has become a crucial public health menace due to its high transmission potential, the unpredictability of disease progression, and lack of specific therapy or vaccine to manage or prevent it. These factors have led to an unprecedented societal fear of the newly emerged disease, further adding a psychological aspect to the physical manifestation of this deadly virus.

Coronaviruses (CoVs) had been recognized as “novel respiratory tract viruses” over half a century ago. Initially, CoVs were not considered as highly pathogenic for humans as they were known to account for 5–30% of the common cold.1 However, new CoVs emerged in the form of severe acute respiratory syndrome (SARS), Middle East respiratory syndrome coronavirus, and SARS-CoV-2 in 2002, 2012, and 2019, respectively, affecting the lower respiratory tract causing fever, dyspnea, pneumonia, and often organ failure.2–3

As per the country-wise daily status reports from WHO, the number of new cases continues to spike higher every day. As on August 21, 2020, it has spread across 216 countries, areas, or territories infecting 22,767,009 including 794,435 deaths.4 In India, 697,330 active cases with 55,794 deaths were reported as on August 21, 2020.5

Good prognosis has been reported in the vast majority of COVID-19 patients, though a small proportion of severe cases and deaths has been reported.6 It should be noted that the dire consequence of SARS-CoV-2 infection is not due to the virus per se but to entailing inflammatory response in the lung resulting in acute respiratory distress syndrome (ARDS) and multiple-organ failure often leading to death. The major cause behind this ARDS and multiple-organ failure is cytokine storm, which play an important role in the process of disease aggravation.7,8 Therefore, disease severity in patients is due to not only the viral infection but also crucially the host response.

Ayurveda, the Indian scientific traditional system of medicine, has given paramount importance to the factors that strengthen the Bala/Vyadhikshamatwa (innate host defense). Health is said to depend on the Bala (strength) of an individual and further, the
criteria for administering any treatment eventually are said to depend on the Bala itself, viz., Vyadhi Bala and Rogi Bala.9

The current treatment line for COVID-19 which the global researchers are trying include antivirals already in use for HIV, antimalarial drugs, and other compounds that may prevent viral replication, and apart from first-line immune-suppressant, corticosteroids, anti-autoimmune medication, and convalescent serum to arrest the disease progression in severe conditions are also in practice.10 Furthermore, the strategies that have been proposed in the management of SARS-CoV-2 include inhibition of functional enzymes or proteins of the virus, inhibition of viral structural proteins, preventing interaction with human cells, stimulating the immunity of the human host, and inhibition of human proteins that act as receptors for the virus.11

The Ministry of AYUSH through its Research Council, State governments, and stakeholders are also exploring various Ayurveda-based single herbs and compound formulations against COVID-19 by conducting prophylactic and therapeutic clinical studies based on their evidences of immune boosting, immune-modulatory, and antiviral effects. Though this practice focuses on strengthening host defense (immune boosting and immune modulation) as well as antipathogen effects (antiviral); however, it is limited to drug-based research that reflects the perspective of conventional medicine module. Whereas, a holistic approach is needed that intends to create a conducive internal environment for the right assimilation and utilization of the intervention for improving the host defenses and the failure of which becomes the main reason for inability to generate tangible evidence. Therefore, a balanced approach is needed, incorporating the contemporary knowledge and evidence and the fundamental principles of Ayurveda to strengthen the host defense system along with developing of antipathogen medications, which should predominantly be patient centric.

The present paper is an attempt to explore the Ayurveda arsenals in strengthening the host defense system against SARS-CoV-2 infection, its relevance, the necessity of whole system research, and its merits over simple phytochemical-based drug remedy in generating tangible evidence against the COVID-19 pandemic.

**MATERIALS AND METHODS**

Ayurveda classics Brihatrayi and Laghutrayi were probed to obtain an insight into the diseases which have conceptual similarity with SARS-CoV-2. Ayurveda Pharmacopoeia and Formulary were also searched for formulations relevant to pandemic. The electronic databases Google Scholar and PubMed were searched with relevant literature published with results restricted to report in English language, irrespective of time, including keywords “COVID-19”, “SARS-CoV-2”, and “2019-nCOV”, “Ayurveda”, “immunity”, “immunomodulator”, “Rasayana”, “anti-viral”, “Vyadhikshamatva” in titles, abstracts, and keywords for obtaining a glimpse on the pathogenesis, clinical symptomatology, potential treatment, and published guidelines by WHO, ICMR.

**RESULTS**

**COVID-19 and Ayurveda**

The concept of contagious or communicable diseases and epidemics or pandemics has been mentioned in Ayurveda under the headings “Aupasargika Roga” (Infectious diseases)12 and “Janapadodhwamsa” (Mass destruction),13 respectively. The current pandemic of SARS-CoV-2 can be understood based on the principles of Janapadodhwamsa and it can be categorized under Bhutabhishangaja Agantuju Jward14 (fever caused by contact with invisible microorganisms outside the human body) based on its etiology, which can be related with the infective cause of the pathogenesis. In the initial stages of disease manifestation, based on its symptomatology, it presents as Vata-Kapha Pradhana Sannipata Jward15 with prominent features of Jwara (fever), Kasa (cough), and Shwasa (dyspnea). However, in certain cases, the progression of the disease into a severe stage of Sama Sannipata Avastha16 (equal vitiation of Doshas) with full-fledged symptoms depicting bad prognosis. This may be due to the contribution of excessively vitiated Pitta with its Teekshna (sharpness) and Ushna (hot) Guna (property) causing excessive Dusti (vitiation) of Rakta (blood tissue) and the resultant pathology may lead to Dhapatupaka (morbid state of Dhatu) and even death. These factors throw light on the importance of utilizing the principles of management described Jwara, Shwasa, and Kasa rather than drug-based therapy only.

The concept of “Nidana-Dosha-Dushyavisheshyho-Vikara-Vighata-Janana” (various factors that affect the disease/shorter incubation period), Sheeghra Jananam (rapid onset/larger incubation period), or Sheeghra Jananam (insidious onset/larger incubation period), or Sheeghra Jananam (rapid onset of disease/shorter incubation period), Anu Vikarajanam (mild condition), Asarvalinga Vikarajanam (moderate manifestation), or Sarvalinga Vikarajanam (full-blown manifestation) and the unpredictable progression to severe forms.

Many clinical trials exploring the potential of certain Ayurvedic medicinal herbs and formulations have been registered under Clinical Trials Registry-India. Of these registered clinical trials, maximum trials are on the medicinal plant Guduchi [Tinospora cordifolia (Willd.) Miers] followed by Ashwagandha [Withania somnifera (L.) Dunal] and Yastimadhu [Glycyrrhiza glabra L.]. In the formulations, it is Chyawanprash and AYUSH-64 followed by Samshamani Vati and Sudarshan Ghanavati. These drugs have been reported for their antiviral, immune-modulatory, antipyretic, antioxidant, antiemetic, and anti-inflammatory properties as per contemporary evidence. The therapeutic effects of these drugs are shown in Tables 1 and 2 as per available contemporary evidence and classical indications.

**COVID-19 Contemporary Insights**

Reports suggest most of the COVID-19 patients recover well except some cases. In the cases, where the patients developed severe disease or in the few cases, where death occurred as a sequel, of SARS-CoV-2 infection initially showed only mild fever, cough, or muscle soreness and they did not develop any of the severe clinical manifestations. However, the conditions of these patients deteriorated suddenly in the later stages of the disease or in the process of recovery.11

Host response to SARS-CoV-2 infection largely depends on the immune response of an individual. In a healthy immune response, specific T cells get activated to eliminate the infected cells before the spread of virus as soon as localized inflammation ensues. Viral infection can be blocked by neutralizing antibodies in these individuals and further neutralized viruses and apoptotic cells are recognized by alveolar macrophages and subsequently cleaned by...
phagocytosis. Consequently, the infection in the lung is cleared by the recruited cells, further the immune response recedes and the patient recovers.\(^4\) However, in a dysfunctional immune response, a cytokine storm is triggered by overproduction of proinflammatory cytokines, which mediates widespread lung inflammation. Patients with severe COVID-19, requiring intensive care in hospitals, exhibited higher blood plasma levels of IL-2, IL-7, IL-10, granulocyte colony-stimulating factor (G-CSF), IP-10, MCP1, macrophage inflammatory protein 1α (MIP1α), and tumor necrosis factor (TNF).\(^4\) IL-6 levels in these patients continue to increase over time and are relatively more elevated in non-survivors than survivors.\(^4\) Notably, there exist a highly inflammatory monocyte-derived FCN1+ macrophage population in the bronchoalveolar lavage fluid of patients with severe but not mild COVID-19.\(^4\) Also, patients with severe disease show a significantly higher percentage of CD14\(^+\)CD16\(^+\) inflammatory monocytes in peripheral blood than patients with mild disease.\(^4\) These cells secrete inflammatory cytokines that contribute to the cytokine storm, including MCP1, IP-10, and MIP1α. This cytokine storm circulates to various other organs, leading to

<table>
<thead>
<tr>
<th>S. no</th>
<th>Name of medicine</th>
<th>Activity against virus</th>
<th>Extract/compound/phytochemicals</th>
<th>Mode of action</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aswagandha [Withania somnifera (L.) Dunal.]</td>
<td>HIV(^2)</td>
<td>Glycowithanolides and a mixture of sitoindosides IX and X(^1)</td>
<td>Immuno-modulator(^1)</td>
<td>Immuno-modulator20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Influenza (H1N1)(^2)</td>
<td>Withaferin A (WA)(^2)</td>
<td>Antiviral(^2)</td>
<td>Immuno-modulator20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herpes simplex virus 1 and 2(^2)</td>
<td>Withaferin A(^2)</td>
<td>Antiviral(^2)</td>
<td>Immuno-modulator20</td>
</tr>
<tr>
<td>2</td>
<td>Guduchi [Tinospora cordifolia (Willd.) Miers]</td>
<td>HIV</td>
<td>Cordioside (TC-2), cordiofolioside A (TC-5), and cordiol (TC-7)(^2)</td>
<td>Immuno-modulatory activity(^2)</td>
<td>Antiviral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human respiratory syncytial virus (HRSV)(^2)</td>
<td>Ribavirin, 6-azauridine, pyrazofurin, mycophenolic acid, and glycyrrhizin(^2)</td>
<td>Inhibit virus replication, glycyrrhizin inhibits adsorption, and virus penetration—early steps of the replicative cycle(^2)</td>
<td>Antiviral</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Saponin-containing preparation named “Glabilox”(^2)</td>
<td>Form stable immune-stimulatory complexes(^2)</td>
<td>Immuno-stimulating(^2)</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Hot water extracts of licorice(^2)</td>
<td>Inhibited HRSV mainly by preventing viral attachment, internalization(^2)</td>
<td>Antiviral</td>
</tr>
<tr>
<td>3</td>
<td>Yastimadhu [Glycyrrhiza glabra L.]</td>
<td>Two clinical isolates of coronavirus (FFM-1 and FFM-2)(^2)</td>
<td>Ribavirin, 6-azauridine, pyrazofurin, mycophenolic acid, and glycyrrhizin(^2)</td>
<td>Inhibit virus replication, glycyrrhizin inhibits adsorption, and virus penetration—early steps of the replicative cycle(^2)</td>
<td>Antiviral</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Saponin-containing preparation named “Glabilox”(^2)</td>
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<td>Antiviral</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Glycyrrhizin and glycyrrhetinic acid(^2)</td>
<td>Augmentation of natural killer (NK) cell, increase in the secretions of tumor necrosis factor-alpha (TNF-α) and macrophage inflammatory protein-1 alpha (MIP-1α), stimulation in interleukin-1 beta (IL-1β) levels and increase in phagocytosis</td>
<td>Immuno-stimulator, immunity booster, and antioxidant(^2)</td>
</tr>
<tr>
<td>4</td>
<td>Chyavanprasha</td>
<td>Gallic acid, protocatechuic acid, catechin, caffeic acid, vanillic acid, chlorogenic acid, syringic acid, rutin, ferulic acid, and quercitrin(^2)</td>
<td>Augmentation of natural killer (NK) cell, increase in the secretions of tumor necrosis factor-alpha (TNF-α) and macrophage inflammatory protein-1 alpha (MIP-1α), stimulation in interleukin-1 beta (IL-1β) levels and increase in phagocytosis</td>
<td>Modulation of IgE and immunity markers C3 and C4 levels, improved pulmonary functions, decreased(^2)</td>
<td>Immune-stimulatory, immunity booster, and antioxidant(^2)</td>
</tr>
</tbody>
</table>
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multiorgan damage and consequently death. Hence, more focus should be on strengthening the host defense factors apart from attempts at developing antipathogen medications.

**Discussion**

Principles of management of infectious diseases and pandemics have been elaborated in Ayurveda. Individuals afflicted with these diseases could be treated with Panchakarma (bio-purification therapies), Rasayana (rejuvenative measures) to enhance immunity, medicinal herbs collected before the onset of epidemics along with noble moral conducts and balanced diet (Pathyaahara), Dhupana (fumigation) with Dhupana (Willd.) Miers and or lying together with an infected person), and Saha-asana also enumerated in Ayurveda as Gatra-samsparsha (direct contact with infected person or his infective body fluids), Saha-bhojana (ingestion of contaminated articles), which are considered as causative factors responsible for spreading of infectious diseases from person to person.

**Ayurveda and Host Defense Factors**

Ayurveda has a comprehensive approach of immunity/ Vyadhikshamatva encompassing two-fold management toward health and disease. Vyadhikshamatva is the power of body to fight with a disease by either way.50

- **Vyadh-Bala-Virodhitvam**—The resisting power of the body to restrain or withstand the strength or severity or progression of a disease.
- **Vyadh-Utpada-Pratibandhakatvam**—The resisting power of the body to prevent the manifestation of a disease.

Significantly various modifiable factors have been enlisted in Ayurveda that influences the host defense responses (Bala/Vyadhikshamatva) (Table 3). The factors encompass healthy diet (Pathyaahara) condition of biological humors (Doshas) and the state of physical and mental health (Shareera).50 Furthermore, these factors are also considered to be conducive to the healthy state of body and the state of physical and mental health. Therefore, the primary focus should be to strengthen host defense system and also eliminating the factors that support survival or replication of virus.

**Table 2: Herbs showing classical and evidence-based therapeutic indication**

<table>
<thead>
<tr>
<th>S. no</th>
<th>Name of medicine</th>
<th>Therapeutic uses as per Ayurvedic classics</th>
<th>Evidence-based therapeutic uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ashwgandha (Withania somnifera (L.) Dunal.)</td>
<td>Rasayana (rejuvenative), Balya (strengthening), Shotha (edema/inflammation), Kshaya (ptosis), Anti-inflammatory, antistress, antioxidant, immunomodulatory, hemopoetic, rejuvenation.19</td>
<td>Anti-inflammatory, antistress, antioxidant, immunomodulatory, hemopoetic, rejuvenation.19</td>
</tr>
<tr>
<td>2</td>
<td>Guduchi (Tinospora cordifolia (Willd.) Miers)</td>
<td>Rasayana, Balya, Deepana (digestive stimulant), Kasa (cough), Pancha (anemia), Jwara (fever), Krimi (worm infestation), Chardhi (vomiting).32</td>
<td>Antioxidant, antimicrobial, antitoxic effects, antistress, hepatic disorder, anti-HIV potential, wound healing, analgesic, anti-inflammatory, anti-pyretic.33</td>
</tr>
<tr>
<td>3</td>
<td>Yastimadhu (Glycyrrhiza glabra L.)</td>
<td>Rasayana, indicated in Vranashotha (anti-inflammatory), Visha (poison), Kshaya.34</td>
<td>Ant-inflammatory, antiviral, antimicrobial, antioxidative, hepatoprotective, cardioprotective effects.26</td>
</tr>
<tr>
<td>4</td>
<td>Chayavanprasha</td>
<td>Kasa (cough), Shwasa (dyspnea/asthma), Kshata/Ksheena (debility due to chest injury), Svarabheda (hoarseness of voice), Kshaya, Hridroga (heart disease), Agnimandya (digestive impairment), Uroroga (disease of thorax), Jara (senility), used as Rasayana.35</td>
<td>Ergogenic rejuvenator, anabolic, immunomodulator, promotes strength to the digestive organs, respiratory, cardiovascular, cerebrospinal systems, neuronal circuits, and renal tissues. Adaptogenic reduces seasonal flu symptoms.36</td>
</tr>
<tr>
<td>5</td>
<td>AYUSH-64</td>
<td>–</td>
<td>Fever, cough breathlessness.37</td>
</tr>
<tr>
<td>6</td>
<td>Samshamni Vati</td>
<td>Jvara (fever), Jeerna-jvara (chronic fever), RaJayakasam (tuberculosis), Daurbalya (weakness), Pandu Roga (anemia), Visamajvare (intermittent fever).38</td>
<td>Antioxidant activity, anticomplement activity immunomodulating activity.23,39</td>
</tr>
<tr>
<td>7</td>
<td>Sudarshan Ghanvati</td>
<td>Yakritpleehavridhi (enlargement of liver and spleen), Jvara, Visamajvare, Jeerna-jvara.40</td>
<td>–</td>
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</table>

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to the maintenance of good health (Swasthyam yena anuvartate) and are capable of preventing the attacks of diseases (Ajatanam vikarana mananupattikara). 51

**Importance of Agni (Biological Fire) in Strengthening the Host Defense System**

The Agni is a core principle entity of Ayurveda on which the whole process of digestion, metabolism, immunity, and in fact the life force depends. 52 Habitual intake of wholesome regimen with homeostatic state of Agni will lead to proper formation of Rasa Dhatu (plasma tissue) and eventually with homeostatic state of Agni's of respective Dhatus (tissue elements) form the Prarishtha (excellence) Sapthadhatus (seven tissue elements) and Ojas (essence of tissue elements).

Nutrition can be a pivotal factor in impacting immune responses, which has been studied for last few decades and emerged out as a distinguished subject known as nutritional immunology. The immune system also survives on the nutrients for adequate functioning. Various studies report the significance of nutritional status is closely linked with immunity and host resistance to infection. 53

**Importance of Sattva (mental well-being) in Strengthening the Host Defense System** 54

Mental well-being is a cardinal integrant of Ayurveda's definition of “Swasthyaa” (healthy) along with physical and spiritual well-being. Interdependence and mutual influence of “body-mind” relationship have been documented in Ayurveda. 55

**Manas (Mind) and Agni**

The emotional factors are reciprocally so strong to Agni that it is described; even if wholesome food is taken in proper quantity do not get properly digested when the individual is afflicted with grief, fear, anger, sorrow, excessive sleep, and sleep deprival. 56,57

**Manas and Ojas**

Abode of both Ojas and Manas is in heart. 58 Ojas is depleted by negative emotions, such as anger and grief. 59 On the contrary, increase of Ojas is conducive to the proper functioning of mind along with the body.

Habitual following of dietary practices conducive to health 60–65 and lifestyle practices of Sadvritta 66 and Achara Rasayana 67 (customary law, codes, conducts, and behavior which prevents the psychosomatic ailments) will influence the Satwaguna (pure property of mind) resulting in increase of Satwobala (psychological well-being) leading to positive state of mental health. Contrary to that will result in the vitiation of Mano Doshas (psychological humors) leading to decrease of Satwobala and to a state of Heena Satwa (psychological ill-being), wherein the individual is at higher susceptibility to develop various illnesses including infectious diseases.

In contemporary science, various studies have proven that psychological well-being could increase human body immune responses which are evidenced by improvements of several indicators in saliva, blood, and plasma. In other way, psychological ill-being is associated with decreased immune responses. 58

**Importance of Rasayana in Strengthening the Host Defense System**

Apart from the above-mentioned factors, Ayurveda has provided a unique branch of medicine termed as Rasayanatantra, which aims at obtaining optimal level of Rasadi Dhatu through specific medicinal herbs, herbal formulations, and codes of conduct. 69 Furthermore, Naimittika Rasayana, a subtype of Rasayana, has been mentioned by Acharya Susruta 70 where various drugs have been mentioned explicitly for specific disease condition individually. Apart from single medicinal herbs and compound herbal formulations Rasayana also includes adoption of Sadvrittaas mentioned in Achara Rasayana.

Therefore, wholesome regimen along with an optimal state of Agni, Ojas, Sattva, and timely administration of Rasayana are considered as pivotal factors influencing homeostatic mechanisms of host defense system (Vyadhi-Utpada-Pratibandhakatvam) (Flowchart 1).

**Host–Pathogen Interaction—Ayurvedic Perspective**

Ahiutaahara Sevana (unwholesome regimen) is said to be one of the key factors which vitiate the Agni leading to the formation of Aama (metabolic toxins). Aama is the pathological product of deranged Agni. The initial end product of digestion, i.e., Rasa dhatu will not be formed properly in hypofunctioning of digestive fire. It will be retained in the gut, get further vitiation, becoming toxic in nature is called Aama. 71 Aama develops in those who are habituated to incompatible food, eating before the digestion of prior food, and indigestion resembles poison due to its specific nature in such people. Interaction of Aama with other elements like Doshha, Dhatu, etc., causes Agni to get denatured and, unable to perform their normal functions and leads to various diseases.

Furthermore, the Ahiutaahara Sevana causes vitiation of Doshas leading to a state of Doshha Leenatva (quiescent or latent state of biological humors). The vitiated Doshas in latent state will not be able to cause disease; however, on exposure/support from other etiological factors will cause diseases 72 and specifically the latent nature of Doshas is said to be critical in the manifestation

<table>
<thead>
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<th>Table 3: Modifiable factors influencing immunity/Vyadhikshamatva</th>
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<tr>
<td><strong>Influencing factors</strong></td>
</tr>
<tr>
<td>Apathyaahara (unwholesome food) with relation to Desha (place of residence), Kala (seasonal and stage of disease), Samyoga (combination), Veerya (potency), Pramanatainyoga (excess quantity). Doshas with relation to Samsrisha-yoni (involvement of other tissues or organs), Viruddha-upakrama (administration of contradictory therapies at a time), Gambhira-anugatam (complex pathogenesis), Chira-sthitatvam (chronicity), Pranayatana-samuttanam (involving vital organs), and Marma-upagathi (causing damage to vital organs). Shareera with relation to Atithihoolaa (obese), Atikrisha (emaclated), Anivisha Mamsa-Shonitha-Asthi (abnormal muscle, blood, and bone tissue), Durbalani (immunocompromised), Asatmyaaharaupachithani (development of unwholesome food), Alpaaharaani (less quantity of food intake), Alpasatvani (less mental strength).</td>
</tr>
</tbody>
</table>

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of Vishama Jwara.\textsuperscript{73} Bhutabhishhangajwara is considered to be a type of Vishamajwara by Acharya Susruta\textsuperscript{74} and COVID-19 may be considered as Bhutabhishhangajwara due to its infective nature.

Therefore, in the context of SARS-CoV-2 infection, the state of Dosha Leenatva along with the extent of impairment of Agni and formation of Aama at various levels of the body (Jatharagni, Bhutagni, and Dhatwagni), Apathyaaharasevana, altered state of Ojas and Sattva of individuals before exposure to the virus appears fundamentally to be crucial in determining the host immune response to the pathogen, i.e., either Prakritisamasamavaya (healthy compatible response) or Vikritivisamasamavaya\textsuperscript{75} (unhealthy contradictory response). When these factors, in an individual, are in a state of Prakrutha Avastha (normal state) then on interaction (Samavaya) with the SARS-CoV-2 virus, will result in the healthy immune response (Prakritisama) leading to their recovery. However, in the individuals wherein these factors are in Vikrutha Avastha (abnormal state) it results in a dysfunctional immune response (Vikritivisama) triggering cytokine storm leading to ARDS and multiorgan failure.

Therefore, Agnideepana (improving the biological fire), Aamapachana (pacifying the metabolic toxins), Hitaaharasevana (use of wholesome diet), Srotosodhana (cleansing of channels of circulation), Vataanulomana (normalizing the movement/function of Vata), Rasayanaprayoga (administration of rejuvenation therapies), and Sattvavajaya (psychotherapy) are to be considered as cardinal principles to arrest the progression of disease manifestation (Vyadhi-Bala-Virodhitvam) and to successfully manage the infection.

Paradigm Shift from Drug-based Remedy to Whole System Research

The current clinical trials for prophylaxis of COVID-19 encompass only certain herbal drugs or herbal compound formulations that are enlisted as having Rasayana properties in the classical texts and which have shown contemporary evidence related to its immune stimulant, immune boosting, immune-modulatory, and antioxidant properties. However, as detailed above, apart from Rasayana herbs, it would be ideal if the fundamental principles of Ayurveda are taken into consideration while designing the Ayurveda arsenal for SARS-CoV-2 as detailed in Table 4.

When we see the ancient scriptures of Ayurveda, enough evidences has been documented where principle-based approach is placed at higher level of hierarchy than drug-based approach.\textsuperscript{87} It has been observed that the therapeutic aptness or rational therapy depends on the Matra (dose) and Kala (time-seasonal and Vyadhiavastha) and success of the treatment is said to depend on the Yukti (rational therapeutics).\textsuperscript{88}

Therefore, it has been mentioned that the physician, proficient in the principles of therapeutics is found to get superior results always compared to those who are acquainted with the medicinal herbs only. Hence, attempt has to be made to bring a paradigm shift from research perspective from current drug-based approach to whole system research incorporating the fundamental principles of Ayurveda for the prevention and management of diseases

**Conclusion**

In these unprecedented times of COVID-19 pandemic, there is a need to establish Ayurveda as evidence-based medicine. In addition to the current research strategies to develop antipathogen medicaments or mono-faceted immune boosting interventions, the Ayurveda arsenal for strengthening host defense system also needed to be explored. The holistic method of Ayurveda followed in its clinical practice is needed to be adopted for clinical research as well, with focus on whole system research as compared to drug-based in order to generate tangible evidence in accordance to the principles of Ayurveda.
Table 4: Ayurveda arsenal for SARS-CoV-2: Principle-based outlook

<table>
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<th>Fundamental principles</th>
<th>Medicines</th>
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<tr>
<td>Ahara-Vidhi76 (Dietary conducts)—To get optimal dietary benefits, e.g., Dhatu-Poshana (overall nutrition) and Bala-Vridhi (immunity enhancement)</td>
<td>Laghu Ahara (easily digestible food)</td>
</tr>
<tr>
<td>Srotosodhana (cleansing of channels of circulation)</td>
<td>Matravat Ahara (food in appropriate quantity)</td>
</tr>
<tr>
<td>Virechana (vomiting)</td>
<td>Kalanusara Ahara (food in accordance with age, season, etc.)</td>
</tr>
<tr>
<td>Chyavanprasha</td>
<td>Jirme Ashshiyat (taking meal only after proper digestion of previously taken meal)</td>
</tr>
<tr>
<td>Sodhana</td>
<td>Susamskarita Ahara (diet with desired properties)—Add ginger, ghee, garlic, black-pepper, turmeric, etc., while cooking food to enhance metabolism</td>
</tr>
<tr>
<td>Avipathikara Churna</td>
<td>Amritottara Kvatha77</td>
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<td>Susamskarita Ahara</td>
<td>Sanjivani Vati78</td>
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<td>Chakapanaidatta commentary of Chakapanidatta, Nidana Sthana, ch. 4, Ver. 4.</td>
<td>Chyavanprasha34</td>
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<tr>
<td>NaimittikaRasayana (disease-specific rejuvenation)</td>
<td>Deaddiction, observing charity, Yogasana (postures) like Suryanamskara (sun salutation), Pranayama (controlled breathing exercises), emotional equipoise</td>
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<td>Sattavavaya (psychotherapy)</td>
<td>Amritottara Kvatha77</td>
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Ayurveda and COVID-19: A Principle-based Outlook


हिंदी सारांश

SARS-CoV-2 संक्रमण के विस्तार होस्ट डिफेंस सिस्टम को मजबूत करने हेतु आयुर्वेद- आयुध: एक सिद्धांत आधारित हमेदिकोण

सुधा के विलुवेरी, अशिवन सी विलुवेरी, शशिम मुम्बार, दीपक लोधे, बाजेश्वरी सिंह, सुमित गोयल, 
बी.सी.एस. राव, नारायण श्रीकांत

उच्च संक्रमण का, रोग प्रगति की अप्रत्याशितता और विशिष्ट तीका या चिकित्सा की अनुपत्ति प्राप्त करने के कारण SARS-CoV-2 संक्रमण एक सार्वजनिक स्वास्थ्य खतरा बन गया है। पारंपरिक चिकित्सा प्राणीय के साथ सार्वजनिक SARS-CoV-2 के विस्तार चिकित्सा एक जहरीली वृद्धि और यीनिक दोषों पर शोध जारी है। वर्तमान स्थिति में सरकार के खिलाफ ताजा साक्ष्य उत्पन्न करने में सिद्धांत आधारित हमेदिकोण की प्रावधानिकता, आवश्यकता और सरल फाइटोकेमिकल आधारित औषधि उपचार से इसकी शक्ति का वर्णन करना है। इस हेतु सभी प्रावधानिक साहित्य, इलेक्ट्रॉनिक डेटाबेस और सरकारी स्वास्थ्य इंजीनियर्स की वेबसाइट का संबंधित सामग्री एकांक करने के लिए विस्तृत रूप से ग्राहित की गई।

SARS-CoV-2 संक्रमण में होस्ट रिस्पॉन्स अधीन तरीके संतुलित होती है या असंतुलित होती है। इस संक्रमण का गंभीर परिणाम 
केवल वायरस के कारण होता है, बल्कि होस्ट रिस्पॉन्स प्रतिक्रिया के कारण फेफड़े में होनेवाली शोध प्रतिक्रिया के कारण ही होता है। करोना संक्रमण के खिलाफ विशिष्ट उपचार होस्ट रिस्पॉन्स की प्रतिक्रिया वर्णन करने के लिए मूलभूत सिद्धांत, प्रकृति सम समावेश और विविधता विचार समावेश का प्रयोग किया जा सकता है। आयुर्वेद के शास्त्रीय रंगों में अच्छे स्वास्थ्य के रखरखाव (स्वास्थ्य देनानुमतता) और रोगों के आक्रमण से रोकथाम (अन्तरराष्ट्रीय चिकित्सात्मक अनुप्रयोगकरण) के लिए अनुशंसा लाई जाता है। होस्ट डिफेंस सिस्टम को मजबूत करने और रोगों की औषधियों सीधी किया करने के लिए आयुर्वेद अनुसंधान अभ्यास में सम-सामाजिक ज्ञान, सामाजिक और मूल सिद्धांतों (प्रकृति 

वंसी शब्द: आयुर्वेद, एंटीवायरल, बेसेज अपकर्ण, COVID-19, रिप्रीक्शन, प्रकृति विधायत, रसायन, व्याधिशामति।