



REVIEW

Coronavirus disease (COVID-19) and immunity booster green foods: A mini review

Muhammad Sajid Arshad¹ | Urooj Khan² | Anam Sadiq¹ | Waseem Khalid¹ |
Muhammad Hussain¹ | Ammara Yasmeen^{1,3} | Zubia Asghar¹ | Hafiza Rehana¹

¹Department of Food Science, Faculty of Life Sciences, Government College University, Faisalabad, Pakistan

²Institute of Food Science & Nutrition, University of Sargodha, Sargodha, Pakistan

³Pakistan Council of Scientific and Industrial Research Lahore Laboratories Complex, Lahore, Pakistan

Correspondence

Muhammad Sajid Arshad, Department of Food Science, Faculty of Life Sciences, Government College University, Faisalabad, Pakistan.

Emails: sajid_ft@yahoo.com; msajidarshad@gcuf.edu.pk

Abstract

This review focused on the use of plant-based foods for enhancing the immunity of all aged groups against COVID-19. In humans, coronaviruses are included in the spectrum of viruses that cause the common cold and, recently, severe acute respiratory syndrome (SARS). Emerging infectious diseases, such as SARS present a major threat to public health. The novel coronavirus has spread rapidly to multiple countries and has been declared a pandemic by the World Health Organization. COVID-19 is usually caused a virus to which most probably the people with low immunity response are being affected. Plant-based foods increased the intestinal beneficial bacteria which are helpful and make up of 85% of the immune system. By the use of plenty of water, minerals like magnesium and Zinc, micronutrients, herbs, food rich in vitamins C, D and E, and better life style one can promote the health and can overcome this infection. Various studies investigated that a powerful antioxidant glutathione and a bioflavonoid quercetin may prevent various infections including COVID-19. In conclusion, the plant-based foods play a vital role to enhance the immunity of people to control of COVID-19.

KEYWORDS

Covid-19, immunity booster foods, vitamins rich foods

1 | INTRODUCTION

Covid-19 attacks people with low immune systems and people especially people of under and over ages. The immune system is built on beneficial live bacteria that lives in the gut which protect the human body from various diseases. When the immune system response is low, weak, or damaged, it becomes an open invitation for infections such as coronavirus or other diseases like diabetes, heart disease, or cancer. Plant-based foods increase and help the intestinal beneficial bacteria, and the overall gut microbiome health which makes up to

85% of the body's immune system. On the other hand, excess of animal foods deplete the body from good bacteria, promote inflammation, and are the underlying cause of diabetes, chronic obstructive pulmonary disease cardiovascular diseases, hepatitis B, cancer, and chronic kidney diseases.

Patients of coronavirus must have plenty of water, as that will keep their mucous membranes moist which can further lower the chances of cold and flu. If they do not sense thirst that much, then they can prepare soup for them or have coconut water, milk, green tea, and even some homemade fruit juice will be helpful. There is

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currently no evidence of COVID-19 virus survival in sewage or drinking water.

The COVID-19 virus' morphological characteristics and chemical composition are similar to other human surrogate coronaviruses on which data are available to both sustainability in the environment and efficient coagulation measures (WHO, 2020).

A myth that potable water must keep coronavirus at bay each fifteen minutes had been running in the headlines around the world a few days before. Although drinking water does not ensure that you would not contract the coronavirus, remaining hydrated can improve your health and make sure the immune system can defeat the virus if it is transferred to you. The drinking water works to help your cells to oxygenate. Cells can compete at their best if they get enough oxygen that helps them protect the body from any infectious agents that attempt to enter, or if they do, they fight them.

According to Centre for Disease Control and Preventative, hydration often plays a major role in monitoring your body temperature. However, if you have a fever, if it is a side effect of COVID-19 or some other infection or disorder in the body, drinking plenty of water is really important. Drinking enough water is essential, for a lot of reasons, as shown in a Harvard Health report, and keeping the risk of disease lowered is one of them. Staying hydrated also enables to transmit nutrients to all parts of the body and helps to maintain all body functions and organs working potentially to decrease body infection. Dryness in the bodies can be caused by the drugs we take if we have a virus infection—such as common cold, and flu. As well, when we are sick, we start losing much of the body's water in the form of mucus, and that is the way our body removes the infection-causing pathogens from the body. Until we drink too much water, we remain hydrated, and we can remove more mucus (along with germs) from our bodies.

Until we get a cure and a novel coronavirus vaccine, taking all preventive measures and keeping ourselves healthy and safe is crucial. Although drinking lots of water does not guarantee you would not contract the novel coronavirus, it can be effective in reducing your danger to a large extent, and can also help you recover from the illness.

2 | ZINC AND MAGNESIUM

An essential micronutrient is used in DNA synthesis and cell proliferation (Fuhrman, 2020). It is also involved in the regulation of innate and adaptive immune responses, cell signaling, and production of immune cells (Wessels, Maywald, & Rink, 2017). Foods that contain Zinc include red meat and shellfish (West, 2018).

A very vital mineral for our immune system, magnesium, is also an important electrolyte that helps our body strengthen our immune system's natural killer cells and lymphocytes. It is also a key source of energy for our cells called adenosine triphosphate (ATP), which is so crucial that without this energy, our cells cannot function properly. Magnesium helps the hemoglobin in our blood which is responsible

for delivering oxygen from our lungs to the entire human body, which assists in a COVID-19 infection since the virus attacks the respiratory system (Sanderson, 2020). Foods rich in magnesium are dark chocolate, black beans, avocados, and whole grains (Spritzler, 2018).

3 | VITAMIN D RICH FOODS

Vitamin D and Mechanisms for Reduction of microbial infection. General metabolism and vitamin D activities are also well recognized (Pike & Christakos, 2017). Within the skin, vitamin D₃ is formed by the interaction of UVB radiation approaching 7-dehydrocholesterol throughout the skin, accompanied by a thermal reaction. The oral vitamin D or vitamin D₃ is turned into 25(OH)D in the liver and then into 1,25(OH)₂D (calcitriol) hormonal metabolite in either the kidneys or any other organs as desired. All of the impact of vitamin D comes from the entry of calcitriol into the nuclear vitamin D receptors, a DNA-binding protein which often communicates directly with regulating sequences around specific genes and recruits active chromatin complexes that genetically and epigenetically participate in transcriptional production modifications. Some well-known role of calcitriol is just to help manage the serum calcium concentrations, although it does in such a parathyroid hormone (PTH) feedback loop, which has many significant roles in the organism itself. Various reports discuss how vitamin D decreases the risk of viral diseases. Vitamin D has several pathways by which the danger of viral infection and mortality is reduced. A study of the importance of vitamin D in decreasing the common cold risk categorizes these elements in three categories: adaptive immunity, physical barrier, and natural cellular immunity. Vitamin D helps to promote gap junctions, junctions of tight, and junctions of adherents (e.g., by E-cadherine). Several studies addressed how viruses damage the integrity of the junction, growing virus contamination as well as other micro-organisms. Vitamin D improves cellular innate immunity in part by inducing 1,25-dihydroxyvitamin D into antimicrobial peptides, like human cathelicidin, LL-37, and defensins (Beard, Bearden, & Striker, 2011). Cathelicidins demonstrate strong antimicrobial activity by a variety of microbes including Gram-negative and Gram-positive bacteria, encased and un-enveloped viruses, and fungus. Such host-derived compounds destroy the foreign pathogens by destroying their membranes and thus can suppress the endotoxin's biological activities. Like mentioned therein, they have so many more functions. In a mouse model, LL-37 decreased replication of the influenza A virus. From another laboratory study, 1,25(OH)₂D minimized rotavirus replication by another method, both in vivo and in vitro. A clinical study stated that vitamin D supplementation with 4,000 IU/d reduced infection with the dengue virus. Vitamin D also improves cellular resistance, by raising the cytokine storm that the innate immune system causes. As found in COVID-19 patients, the innate immune system develops both anti-inflammatory and pro-inflammatory cytokines in response to bacterial and viral infectious diseases. Vitamin D may decrease the development of pro-inflammatory Th1 cytokines, known as tumor necrosis factor α and interferon γ

(Hewison, 2012). Vitamin D administration decreases the production of pro-inflammatory cytokines and enhances the production of anti-inflammatory cytokines by macrophages and their references. Vitamin D is an effective immunity modulator; 1,25(OH)₂D₃ stimulates responses induced by T-helper type of cell 1 (Th1), primarily by trying to suppress inflammatory cytokine production IL-2 and interferon gamma (INF γ). In addition, 1,25(OH)₂D₃ encourages the development of cytokine by the T-helper type 2 (Th2) cells, which helps to improve the indirect inhibition of Th1 cells by supplementing this with actions influenced by a variety of cell types (Wei & Christakos, 2015). In addition, 1,25(OH)₂D₃ facilitates activation of T regulatory cells and thus inhibits inflammation processes. Concentrations of serum 25(OH)D continue to decline with age that may be significant for COVID-19 as case fatality rates (CFRs) raise with age; reasons are including insufficient time spent in the sunlight, and decreased vitamin D production due to lower skin levels of 7-dehydrocholesterol. Furthermore, certain prescription medications by stimulating the pregnane-X receptor decrease serum 25(OH)D concentrations are also regulated. These include anti-neoplastic, anti-epileptics, anti-inflammatory agents, antibiotics, anti-retroviral, anti-hypertensive, endocrine medicines, and certain herbal medications. Consumption of pharmaceutical drugs usually increases with age. Supplementation with vitamin D also improves the production of anti-oxidation-related genes (glutathione reductase and subunit controller glutamate-cysteine ligase). The increased production of glutathione spares the use of ascorbic acid (vitamin C), which also has antimicrobial properties, and has been suggested for COVID-19 prevention and treatment. In addition, he was a former Center for Disease Control and Prevention Director (Holick, 2007).

4 | VITAMIN C AND E RICH FOODS

Vitamin C is an important aspect of improving immunity, for the kids, adults, or even elderly people. Fruits like oranges, papaya, kiwi, and guava are rich in vitamin C and should be included in diet. Moreover, some vegetables like eggplant, bell peppers, beetroots, spinach, and cauliflower are known to be quite rich in vitamin C and are good for immunity. Green vegetables like broccoli, mushrooms, and even kale are a few immunity boosters that one can include in the diet. They improve the immune system of older people quite rapidly. Berries can also be included in the diet along with foods rich in omega-3 fatty acids—beans, flax seeds, and even some nuts. Elderly people should consume Spirulina and Curcumin, as they are extremely rich in vitamin C and minerals. These super foods help in building and strengthening immunity at great level.

Water-soluble vitamins have significant benefits in treatment of sepsis and septic shock, a life-threatening condition, which is caused by inflammation produced by pathogenic organisms. Other ways vitamin C aids the body are as a pro-oxidant for immune cells, antioxidant for lung epithelial cells, and immunosuppressive effects (Erol, 2020). Foods that contain vitamin C are oranges, kiwi, kale, and broccoli (Hill, 2018).

Vitamin E is vital for maintaining the overall health of elderly people, including their immunity. Vitamin E is a powerful antioxidant that can protect you from various infections, bacteria, and viruses. Soaked almonds, peanut butter, sunflower seeds, and even hazelnuts should be consumed to get the daily dose of vitamin E. Vitamin E functions primarily as an un-specific, chain-breaking antioxidant that bans the spread of lipid peroxidation. This vitamin is often a radical peroxy scavenger that protects the polyunsaturated fats in plasma membranes and lipoproteins (Liang et al., 2003). F₂-isoprostan quantification is the most effective indices of free-radical production and oxidative lipid destruction in vivo (Lin et al., 2002). The F₂-isoprostans are enhanced, and their emission may be reduced by taking supplements with vitamin E. Vitamin E performs a significant part in preserving immune responses, with such a small deficiency effecting immunity, or supplements with rates higher than prescribed, improving elderly people's humoral and cell-mediated immunity (Mastaloudis, Leonard, & Traber, 2001). These observations have developed interest in whether or not vitamin E supplementation during heavy stress can attenuate immunosuppression and oxidative stress. Some work has shown that 1–5 months of supplementation with vitamin E (200–1200 IU dl α -tocopherol) raises tocopherol plasma level but has almost no impact on athletic efficiency of muscle damage indices caused by contraction and a varying effect on oxidative stress caused by exercise. The equivocal existence of these findings is linked to the study of design problems, like the subjects' timing and type of exercise, fitness or age levels, the volume and shape of the vitamin E supplement, and methods for oxidative stress assessment (Itoh et al., 2000). The impact of vitamin E supplements is still not studied in sufficient aspect and equivocal on the immune and inflammatory response to sustained exercise. The ROS-immunity relationship is still described, but growing evidence indicates a link (Haidari, Javadi, Kadkhodae, & Sanati, 2001).

The generation of ROS and the antioxidant position were linked to immune differences in some disease processes and the healing process, but this interaction is unexplored in the human athletic effort. In an earlier study by some researcher, supplementation with vitamin C during an ultra-marathon did not influence oxidative stress and immune abnormalities induced by physical activity (Hartmann, Nieß, Grünert-Fuchs, Poch, & Speit, 1995). In vivo vitamin C mainly provides antioxidant protection as a radical scavenger of peroxy and oxygen in the aqueous phase. We argued that although vitamin E inhibits the spread of lipid peroxidation, the above multivitamin has a greater potential to act as a defensive measure to changes in immunity and lipid peroxidation induced by activity than vitamin C.

The aim was to assess the impact of vitamin E ingestion on oxidative stress or immune changes following the Triathlon World Championships in Kona, Hawaii. Thirty-eight randomized, dual-blind triathletes received vitamin E (800 IU dl D α -tocopherol) as well as placebo capsules for 2 months until the event of the race. It is concluded that vitamin E supplements would alleviate physical activity-induced rises in immune alterations in the sense of severe discomfort, oxidative stress, and inflammatory cytokines (Haddad & Fahlman, 2002).

5 | HERBS

Some of the immunity-boosting herbs are garlic, black cumin, and liquorice. Include them in the diet of the elderly in the form for tea or by adding them in their food. This will not enhance their immunity but improve their gut as well. Herbal treatment is very well known in Traditional Chinese Medicine (TCM).

Traditional Chinese Medicine has a longer history and is an essential part of the treatment or prevention of certain outbreak diseases. The TCM intervention also achieved impressive therapeutic effect during SARS epidemic in 2003. During the COVID-19 recovery period, more than 3,100 TCM medical personnel were assigned to the province of Hubei as well as the TCM program was included in COVID-19 Testing and treatment Guideline, and TCM specialists were fully involved in the entire rescue process (Wu et al., 2020). TCM's decoction, Chinese trademark medicine, acupuncture, as well as other characteristic treatments were used extensively and are mainly based on differentiation of the syndrome. Different TCM clinics were arranged and the specified hospital was established, while the TCM team is also collectively involved in the treatment. Currently, the total number of actual situations being handled by TCM has exceeded 60,107. In 102 cases of TCM signs that decreased clinical symptom demise time by 2 days, decreased body temperature recovery time by 1.7 days, decreased hospital stay average by 2.2 days, increased CT image enhancement rate by 22 percent, increased clinical survival rate by 33 percent, the hospital stay rate decreased by 27.4 percent as well as 70% increase in lymphocyte. Additionally, in the treatment of serious TCM patients, the actual length of service in hospital as well as the time of a nucleic acid transmission harmful was shortened by more than 2 days.

Traditional Chinese Medicine, focused on an overall major cause of COVID-19 pneumonia patients, may have beneficial prescriptions, like those of gancaoganjiang decoction, qingfeipaidu decoction (QPD), qingfeitouxiefuzhengrecette, sheganmahuang decoction etc. qingfeipaidu decoction which comprised of, *Polyporus Gypsum Fibrosum, Armeniacae Semen Amarum Cinnamomi Ramulus, Atractylodis Macrocephalae Rhizoma, Poria, Alismatis Rhizoma, Glycyrrhizae Radix et Rhizoma Praeprata cum Melle, Scutellariae Radix, Bupleuri Radix, Zingiberis Rhizoma Recens, Asteris Radix et Rhizoma, Pinelliae Rhizoma Praepratum cum Zingibere et Alumine Farfaeae Flos, Rhizoma, Aurantii Fructus Immaturus, Belamcandae, Asari Radix et Rhizoma, Dioscoreae Rhizoma, Pogostemonis Herba, and Citri Reticulatae Pericarpium* the COVID-19 diagnostic and treatment plan has been introduced as the general prescription in China. Of the 701 reported cases handled with QPD, 130 cases were successfully treated and released from hospital, 51 clinical symptoms faded, 268 cases of ailments helped to improve, and 212 cases of non-aggravated stable symptoms. QPD's useful survival rate against COVID-19 exceeds 90%. COVID-19's target location really is the lung according to TCM theory, and the pathology characteristic is "humid and toxin plague." The pharmacology analysis of the network demonstrated that QPD has an aggregate administrative impact over multi-target and multi-component. Perhaps, the primary pharmacological site is

the lung, since 16 lung meridian herbs indicate that decoction is primarily specific to lung disease (Xu et al., 2020). This can also perform Dehumidification roles rise and fall through spleen and stomach, as well as exhibit kidney, heart, and other organs protection. One of the prospective specified screens, many of non-expressed with ACE-2, the COVID-19 molecule can inhibit COVID-19 replication by acting upon numerous ribosomal proteins.

COVID-19 can contribute to trigger the immune system as well as a nominal increase in inflammation. Analysis of functional enrichment has shown that QPD can inhibit and mitigate improper immune system response and remove infection by trying to regulate the pathway associated with cytokine action and the immune-related pathway. In addition, by predicting patchouli alcohol, molecular docking, shionone and ergosterol, were found to have a good anti-COVID-19 influence in the formula, which provides new chemical compounds for the development of new drugs.

Here, to prove its effectiveness, we take for example one identified COVID-19 patient handled with TCM. Few days before the beginning of the infection, the male patient was also on a work tour in Wuhan (Xu et al., 2020). Fever and cough have been repeated during admission timespan, and respiratory rales were also not evident for both lungs. West antibiotics were first used, such as taking ganciclovir intravenous infusion, oseltamivir phosphate capsule orally, and recombinant inhalation of human interferon α 1b aerosol. Even though the nucleic acid test became negative, the results of chest CT revealed that there was increased fusion of two lung glass darkness and increased density, which was much more complex than admittance. Severe illness is associated with the performance of the patient's moist-heat syndrome as well as the temperature is much more severe than humidity, QPD has been applied for diagnosis.

Traditional Chinese Medicine has its own attributes, like differentiation therapy, Yin and Yang balance, disorder differentiation, holistic concept, strengthening body resistance to microbial factor elimination. TCM must have decades of experience in body monitoring and pandemic resistance, with new perspectives and experience in treatment and prevention (Wu et al., 2020). TCM's early intervention can prevent the illness from converting into severe and crucial illness for mild and prevalent patients. In the serious cases, by improving ailments, TCM has gained time to rescue them. COVID-19 rehabilitation practice has shown that earlier time TCM operation is a fundamental way of improving cure rate, shortening disease course, delaying disease progression, and minimizing death rates. In addition, the reason why TCM operates was not only to prevent the infection, but also could prevent the disease, legislate the immune system, promote body repair, and cutoff the inflammatory storm.

In addition, COVID-19's prevention and control measures fully reflect the "preventive treatment of disease" ideology. In addition to the pandemic diseases recorded during the Han Dynasty, TCM's preventive measures should also include sports, psychology, medication, and diet (Xu et al., 2020).

In COVID-19's treatment and prevention, this should offer the benefits of TCM in differentiating syndrome and reduces both health problems and mortality rate. Furthermore, scientific research

on the TCM with clear healing efficacy of COVID-19 must also be passed out in order to fully evaluate its mechanism of action and deep understanding of COVID-19 (Zhu et al., 2020).

6 | LIFESTYLE

Stress negatively alters the immune system responses within the body (Salleh, 2008). Stepping away from the media and TV is also very important in letting one's mind distress from the world a bit. Try limiting yourself to about an hour in the morning and at night to just catch up and see if there are any important changes.

Sleep, a huge influence on the immune system, gives the body an opportunity to heal and rest, especially in critical illnesses (Kamdar, Needham, & Collop, 2012). Furthermore, sleep was considered extremely important by doctors in the recovery of their patients during the Spanish Flu Pandemic (Abascal & Yarnell, 2006).

Exercising helps raise the levels of white blood cells and antibodies that fight off infections (Join & Calendar, 2020). Exercise is especially important after a critical illness to improve muscle mass, strength, and resiliency (Heyland et al., 2016). Exercise can also help with the prevention of blood clots, which have been a symptom for some people who contracted COVID-19 (Clerkin et al., 2020).

Eating a well-balanced, healthy diet and staying away from processed junk food is very important to maintain overall health, as well as to support immune functions. Eat as much fresh produce as possible, but if it is not in season or hard to find then the next best thing is fermented or frozen. These items are normally picked at the peak of the season and then frozen or fermented straight away (Join & Calendar, 2020), also, make sure to eat sufficient protein (Hyman, 2020).

7 | ANTIOXIDANTS

Glutathione is a powerful antioxidant in the body, it scavenges damaging free radicals and is involved in tissue repair and builds chemicals and proteins that are used for the immune system. N-Acetylcysteine, or NAC, promotes the production of glutathione and is also used as a supplement. Studies in animal models of other viral infections have shown that NAC reduced the severity and duration of symptoms by increasing cellular defense and repair. NAC is taken in doses of 500-600 mg. Glutathione can be taken orally 500 mg or by IV 400-2400 mg with a doctor's order (Center and fees, 2020).

Quercetin is a bioflavonoid found in a variety of fruits and vegetables. Animal and laboratory studies have demonstrated that quercetin can inhibit a wide range of virus infections including a COVID-19-related coronavirus SARS CoV. Quercetin supports antioxidant capacity and protects lung tissue. As a supplement is combined with vitamin C, bromelain is sold as a single supplement. Recommendation is between 500 and 1000 mg daily (Center and fees, 2020). Major sources are leafy green vegetables, dill, peppers,

apples, grapes, fennel leaf, red onion, oregano, chili pepper, green tea, and black tea (Center and fees, 2020).

8 | CONCLUSION AND FUTURE PERSPECTIVE

People with low immunity are more prone for this world pandemic named as COVID-19. To help or boost the immunity, the plant-based foods play vital role by promoting beneficial bacteria in the body. Various vitamins like C, D, and E are investigated to provide important aspects for improving immunity. Fruits like oranges, papaya, kiwi, and guava are rich in vitamin C, while vegetables like eggplant, bell peppers, beetroots, spinach, and cauliflower are known to be quite rich in vitamin C and are good for immunity. A very crucial micronutrient is used in DNA synthesis and cell proliferation, which regulate innate and adaptive immune responses. Vitamin D improves cellular resistance, partially by raising the cytokine storm that the innate immune system causes. Green vegetables like broccoli, mushrooms, and even kale are a few immunity boosters that improve the immune system of older people quite rapidly. Moreover, some herb combination in TCM is also known to play crucial role in the prevention COVID-19. Future aspects of this account for more research which is needed significantly on physical behaviors or exercises and their role in immunity-related issue thus preventing COVID-19 aspects. More research is needed to know about the behavior of coronavirus and the role of food in its prevention. Immunity-boosting food combinations should be studied which, in combination, provide one and one makes eleven roles. In nutshell, green foods are vital against novel coronavirus by improving the immunity of all aged groups.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICAL APPROVAL

This study has nothing to do with human and animal testing.

ORCID

Muhammad Sajid Arshad  <https://orcid.org/0000-0001-9564-886X>

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