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Implications of Novel Corona Virus–2019 and Perspective of Diet Therapy as an Immune Booster: A Review

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Review Article

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Abstract

The unusual rates of morbidity and escalating degrees of mortality in nCV–2019 have compelled the WHO to declare public health emergency of international concern. Vulnerability and transmissibility are particularly alarming in aged personnel, especially those with underlying physiological ailments. Undoubtedly, the radiology sector plays the pivot role in diagnostics and administration of epidemics, but owing to high pathogenic and transmission potential of nCV–2019, there are several implications to deal with suspects. Several findings of genomic evolutionary analyses endorse the divergence of nCV–2019 from the causative agents of MERS and SARS that have further perplexed the scientists around the globe. Ever since the emergence, medical professionals are striving desperately to discover a satisfactory cure. Presently, some anti–viral, traditional Chinese medications, and plasma therapy are being employed on experimental basis; however, success rates are still dismaying. As the immune system acts as the body's first corp of defense against viral invasions, the present review highlights the impact and its aggregates various dietary components that serve as immunity boosters, i.e., vitamins, minerals, natural herbs, spices, particular varieties of tea, drinks, Omega–3 fatty acids, and proteins. Diet therapy is anticipated to minimize the nCV–2019 fatalities until the corresponding vaccine is engineered.

Keywords: Corona Virus; Immunity; Epidemic; Diet Therapy.

Introduction

Emergence of Novel Corona virus–2019 (nCoV–2019)

Coronaviridae, a notorious family of menacing pathogens, has been known to mankind for decades owing to its association with common respiratory ailments [1]. Virologists were captivated to gain insight into the Corona virus after SARS–Cov, the causative agent of the severe acute respiratory syndrome was identified in south China [2]. Novel Corona virus–2019 (nCV–2019) is a newly identified strain of aforesaid family with no former replication history in humans. Currently declared as a global concern, the outbreak associated with severe respiratory tract infection and extraordinary human–human transmission ratios had its first emergence in Wuhan, a densely populated city located in the Hubei province of China [3,4]. The gradual upsurge in infections and frequent detection of nCV–2019 compelled WHO to declare the ongoing epidemic outbreak as a public health emergency of international concern [5]. Unusual rates of morbidity and alarming degrees of mortality associated with previous outbreaks of Corona virus such as SARS (severe acute respiratory syndrome) and MERS (middle east respiratory syndrome) greatly reflect the severity of current menace. In MERS, however, the main role of transmission was implicated to camels, the origin of SARS and MERS both was mapped out in bats [6]. Evolutionary studies and complete genome sequencing of nCV–2019 confirm its divergence from SARS–Cov and MERS–Cov that eventually discourage the hypothesis of its origination in bats. However, the likelihood of

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its association with local seafood of Wuhan cannot be denied owing to the close nexus of earlier suspects (which were later confirmed) with infection [7,8]. It is really an alarming situation because over a substantial population of humans is suffering from this virus and death rate is also increasing day by day. If appropriate control strategies are not implemented, this health contingency is expected to worsen further. Preventive measures and social distancing are inevitable and should be practiced at all levels. Strict quarantine measures must be installed until the corresponding vaccine is engineered.

temperature [10]. Less common symptoms include runny nose, myalgia, pharyngalgia, and diarrhea, while more critical cases underlay dyspnea and hypoxemia, usually within seven days of disease onset (Figure 1). Mainly, 3 levels of infection take place i.e., mild, severe, and critical, in which about 80% of the patients fall into mild cases that is curable and less dangerous. However, severe and critical cases need more assistance and sometimes a ventilator also required for those patients(Figure 1). It's been frequently noticed that patients experiencing critical symptoms had a low fever or no fever at all. No Pneumonia or only a slight manifestation in mild cases is also worth noticing [11].

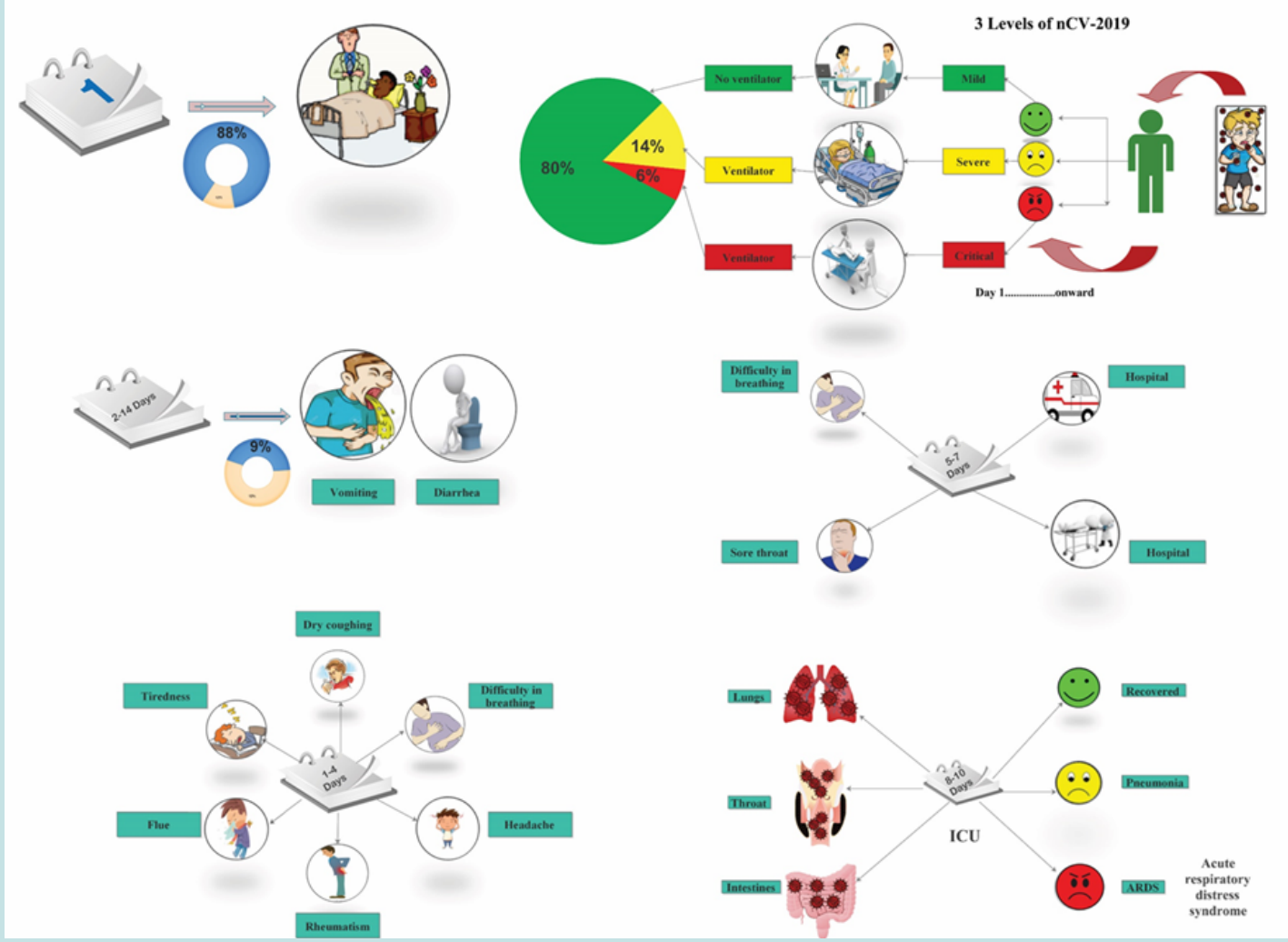

Figure 1: Clinical manifestations and epidemiological stages of nCV–2019 patients at different days of viral incubation.

Symptoms of nCV–2019

In the light of recent verdicts of epidemiology, the incubation span of nCV–2019 lies somewhere between 1–14 days. Individuals with the potent immune system might experience mild to moderate clinical manifestations and will recover on their own without necessitating a certain medical assistance [9]. However, vulnerability and transmissibility are quite high in case of aged personnel and especially people with weakened immune systems due to any physical or physiological disorder. Patients may experience dry coughing, pneumonia, and irritation of throat as major clinical signs along with extreme tiredness and high

Growing threat according to age factors (children and elders)

Stats of mortality procured from various geographical zones for nCV–2019 strongly state that either in symptomatic infections or asymptomatic ones, the fatality rate has always been dominant among the elderly [12]. Aging, though, is not the decisive factor of risk assessment for nCV–2019; however, it divulges the vulnerabilities associated with underlying health enigmas that are common among older individuals. Owing to the declination of leukocytes that serve as the body's first corps of defence against pathogenic invaders, immune system functioning drastically declines that makes elders more susceptible to nCV–2019. The

overactivation of immune cells in older adults is termed as a "cytokine storm". Cytokines are signaling proteins that stimulate immune cells. Over synthesis of cytokines in cytokine storm may lead to intense inflammation and acute fever.

Additionally, in severe conditions, organ failure may also result. So it's not only the lethargic response of leukocytes that is responsible for fatality in viral diseases, but overreaction is also unfavourable [13]. The more we live, the more our body's cells undergo mitotic errors, and the more impairment they accumulate. Less efficiency of older individuals in sneezing and coughing makes it difficult for them to clear nCV–2019. Likelihoods of organ dysfunction and failure also tend to accelerate with age. Likewise, the prevalence of chronic disorders like diabetes and hypertension also leaves the elderly prone to viral invaders that seems to be an anticipated cause of higher mortality for nCV–2019 in older individuals [14]. In comparison with elderly, clinical manifestations of aforesaid infection in children are milder along with shorter virus shedding span and quicker recovery [15]. However, asymptomatic morbidities pose a serious challenge for epidemiologists to identify the mode of transmission and pathogenic potential of nCV–2019 in children, especially infants. Routes of transmissibility from mothers to neonates are yet to be clarified [16].

In view of the present outbreak, it is important to protect children and elderly having underlying diseases with isolation and preventive protocols as soon as possible.

Implications for radiology managements

The SARS and MERS appeared previously were similar to the nCV–2019. All of these viruses were challenging epidemics in current years [17,18]. The nCV–2019 is supposed to be spread through the respiratory system, personal interaction, and probably by droplets of patients by sneezing, coughing, or touching with germs (Figure 2) [19,20]. Therefore, medical organizations have faced immense challenges due to the nCV–2019 outbreak in Wuhan, China. The patients having severe illness often come to the radiology sector, which is an important stop to diagnose those patients individually and also administrating the epidemic conditions [8]. The transmittance of nCV–19 is basically through respiratory system as shown in Figure 2. The outpatient department works for the anticipation and managing the transmittable diseases that create emergencies related to public health, for instance, nCV–2019 [21]. Firstly, the patients must endure the exposure to infrared temperature and sent to the fever control department if they have (a) temperature above 97.3 °F, (b) recently come from the area where the outbreak of the respiratory disease occurred, (c) have close contact with the group of peoples with a respiratory infection [21,22]. Computed tomography (CT) and nucleic acid test are the preliminary examinations for the nCV–2019 Infected persons. The nCV–2019 is a new sort of RNA virus that caused serious panic conditions all over the world. CT examination is used to analyze a patient throughout this phase and then gone through an isolation process in any specified place of a hospital [22].

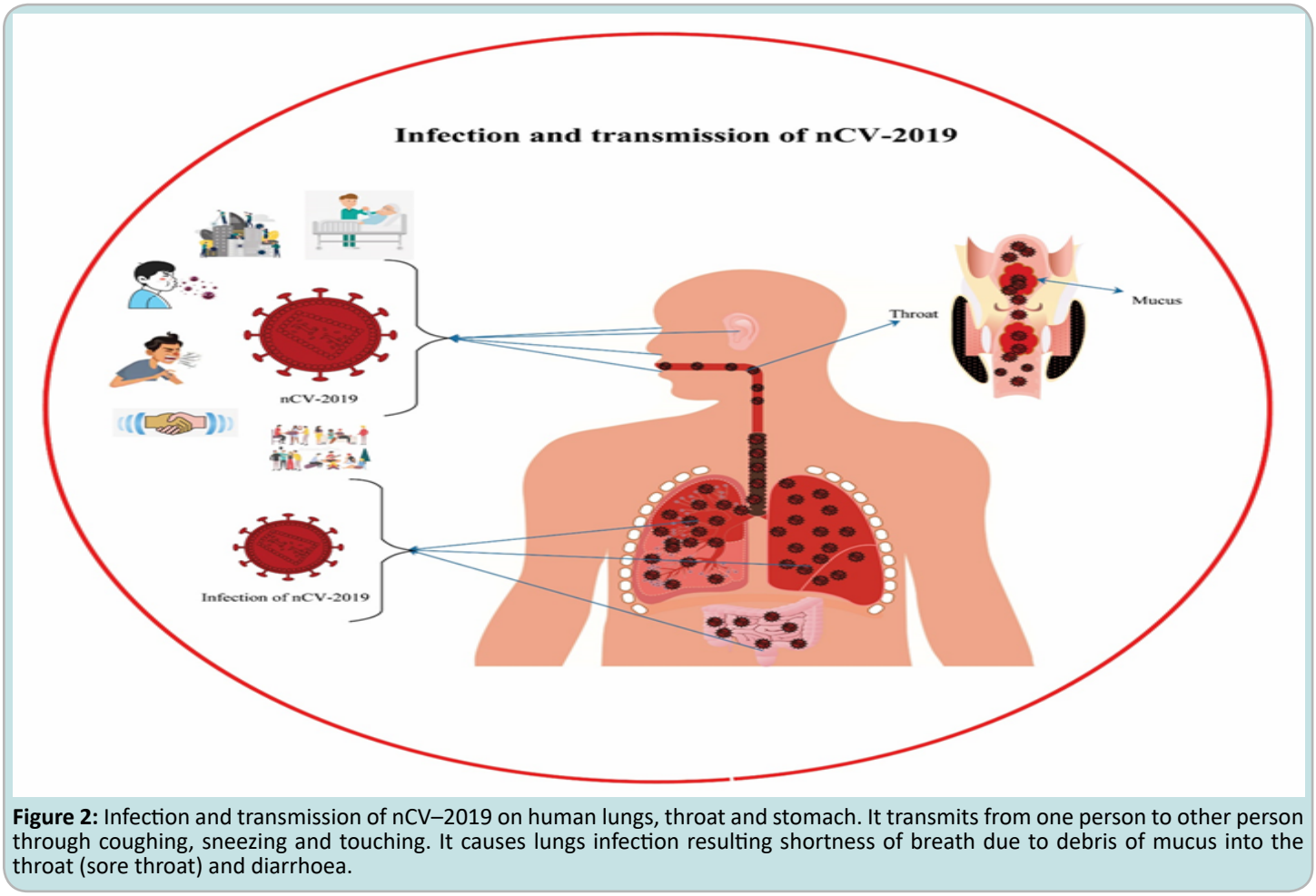

Figure 2: Infection and transmission of nCV–2019 on human lungs, throat and stomach. It transmits from one person to other person through coughing, sneezing and touching. It causes lungs infection resulting shortness of breath due to debris of mucus into the throat (sore throat) and diarrhoea.

Strict supervision of the radiology department is required because it will be the first place where such type of patients will arrive. Moreover, it is also crucial to sustain steady isolation measures in the radiology department in case of other critical infectious viruses (ZIKA, MERS, Ebola, and SARS) [18,23]. This is a vital step for the protection of medical officials and effective clinical procedures. So, it is concluded that effective measures ought to be taken for the radiology section that deals with infected individuals due to an epidemic situation. Through careful supervision and separation of infected patients are a challenging and difficult task to protect healthy persons as well as medical teams [22].

Genomic evolutionary analysis for nCV–2019

A systematic awareness about the nCV–2019 improved subsequently as the SARS–Coronavirus appeared in Southern China [24]. In 1960, scientists had characterized class of coronaviruses and declared that the group is mostly concerned with respiratory illness in humans [1,25]. However, nCV–2019 is a new and strong virus that has been reported and transmitted through close personal contacts [26].

A full genomic sequence of nCV–2019 was recently studied by Paraskevis et al. [27], they discovered that nCV–2019 also related to beta coronavirus; however, it is different from MERS and SARS viruses. It also has some diverse relation with sarbecovirus [8]. MEGA v1.0 and MAFFT v7.4.2. are used for the alignment of the genomic sequence of nCV–2019 [28,29]. The nCV–2019 was 96.3% genetically similar with RaTG13. Bat–coronavirus was originated in the Yunnan province of China, which might be linked with nCV–2019. In contrast, a conflicting connection was distinguished among the sequences and queries of the Bat–coronavirus (MG772933 and MG772934). There is a supposition that nCV–2019 has instigated from bats, and this hypothesis was due to the genomic resemblance among RaTG13 and nCV–2019 [27]. The genomic study of novel nCV–2019 is insufficient, which can be resolved with the process of codon analysis of the individuals suffering from the virus. However, recently reported sequences of bat–coronavirus could provide the data that might be helpful in resolving the full genome of nCV–2019 with a suggestion of uniform genomic lineage [29,30]. Although, nCV–2019 is also challenging due to its new heredity for nearly half of its genome and no adjacent genomic relations to other viruses of the same group. The virus also contains different encoding regions that are necessary for the entry of the virus into host cells [30].

Replication cycle of (nCV–2019)

Previously reported outbreaks of MERS and SARS caused 850 and 774 deaths, which imitate the critical threat and insistence to overcome these viruses as soon as possible [23,31]. But nCV–2019 is more threatening because it is spreading not only in China but also all over the world very rapidly. The transmittance of nCV–2019 is through personal contacts, and the first outbreak in the Hubei province of China was also due to the vast transportation system; therefore, it causes around 33673 deaths, with 719,758 of confirmed infected persons from December 2019 to March 2020. The world is facing a critical emergency because of nCV–2019.

The nCV–2019 is highly capable of infecting a large number of hosts, and it is a more dangerous member of the coronavirus group due to its symptomatic behavior. It can survive over a wide range of environmental conditions and transmits through humans without showing any symptoms [32]. Hence, it causes many diseases with several indications [33]. A detailed mechanism of nCV–19 replication is given in figure 3, which elaborates all the steps involved and its replication. The replication of nCV–2019 has various steps:

a) First most step is endocytosis in which nCV–2019 binds and enters into the host through membrane synthesis.
b) The genomic virus release after the entrance of cells.
c) The polymerase protein of virus undergoes to translational process.
d) Replication of RNA.
e) Transcription of sub–genome.
f) Translation procedure of viral structural cells.
g) Attachment of nucleocapsid.
h) Structural cells of virus translate.
i) Formation of the mature virion, and
j) Finally exocytosis takes place when mature virion release.

The cycle continues by infecting the new target, which leads to a large number of infected individuals (Figure 3). However, a detailed study is needed to control this dangerous nCV–2019 disease, which helps to understand the life span and replication process of the deadly virus [5].

Characteristics and remediation of nCV–2019

The nCV–2019 patients are divided into two categories: first class, the suspects having the history of epidemic exposure with some clinical indicators such as fever, difficulty in breathing, reduced lymphocyte count. Second class, the suspects do not show any history of epidemic exposure with the clinical indicators mentioned above. The confirmed cases have positive pathogenic signs detected by real–time fluorescence reverse transcription–polymerase chain reaction (RT–PCR) [21,22].

The cases must be classified in mild (mild symptoms with no pneumonia), ordinary (fever, problem in breathing, and pneumonia), severe (problem in breathing, increase in oxygen saturation in pulse and oxygen pressure in arteries), and critically ill (shocks, respiratory failure, and organ failure) patients (Figure 1). Laboratory examination and chest analysis are the preliminary tests for the nCV–2019 diagnosis. Isolation of such cases is required in selected hospitals for the treatment of infected individuals. Timely identification, isolation, and treatment of patients suffering from nCV–2019 are necessary because the virus multiplies rapidly and causes a severe illness with lung failure (Figure 1) [34].

Treatment and medication

Isolation and treatment of suspected and confirmed nCV–2019 cases are primary steps to recover the infected persons. A separated ward in selected hospitals should be allocated for positive cases so that uninfected persons can be protected. Some of the treatments are discussed below for infected patients.

Usage of anti–viral drugs

The anti–viral drugs for nCV–2019 are not discovered till now, but still some other drugs are used to treat the patients. Arbidol and chloroquine phosphate are administrated to the patients as trial drugs, while a combination of ritonavir/ lopinavir and ribavirin is also effective for the treatment of infected patients. The duration of drug usage must be ≤10 days [35]. The drugs may

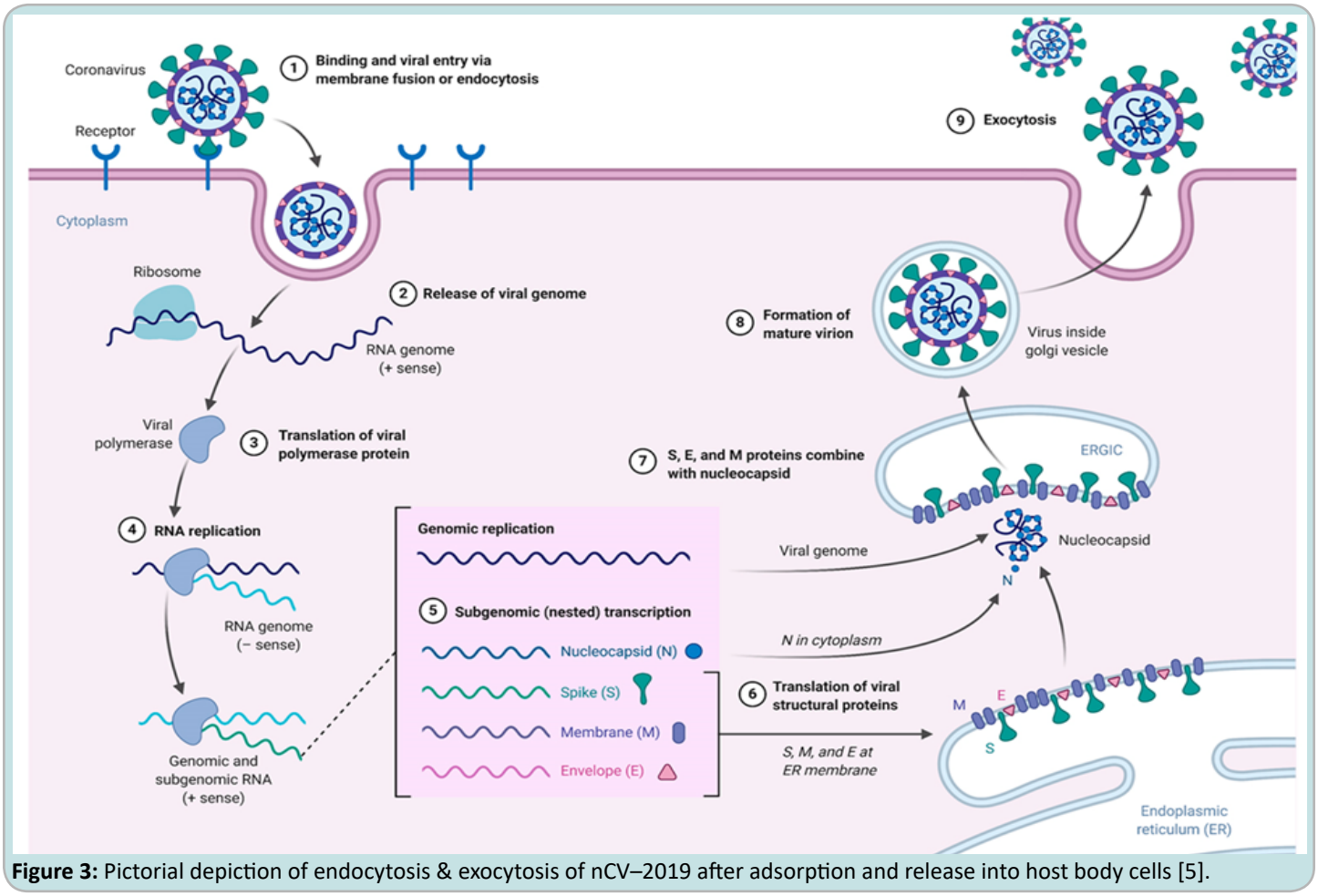

Figure 3: Pictorial depiction of endocytosis & exocytosis of nCV–2019 after adsorption and release into host body cells [5].

also cause negative effects on patients; therefore, more than three kinds of drugs should not be administered [36–38].

Plasma therapy

The patients with severe symptoms are suggested a plasma therapy by using plasma of recovered patients. Extracorporeal purification of the blood is also practiced if applicable. Blood transfusion, filtration, perfusion, and adsorption should also be suggested if the patients have critical provocative reactions. Plasma therapy might be used because the recovered patients have white blood cells that can fight against the virus and improve the immunity of infected persons [38].

Usage of Chinese traditional medicine

One of the effective ways to treat patients infected with nCV–2019 is the usage of Chinese medicine. Detoxifying soup helps in treating nCV–2019 disease along with effective screening and lung cleaning. A treatment plan is a key element in such an epidemic condition for mild to critical cases. Different categories of infected patients have different dosage and consumption methods [20]. Some traditional Chinese medicines are Radix Asteris, Polyporus Umbellatus, raw Gypsum Fibrosum, Rhizoma Pinelliae Preparata, Fructus Aurantii Immaturus, Rhizoma Dioscoreae, Herba Pogostemonis, Zingiberis Recens, Herba Ephedrae, Rhizoma Alismatis, Rhizoma Belamcandae, Ramulus Cinnamomi, and Radix Bupleuri [20,38].

Critically ill persons require ventilators to prevent respiratory failures, which is a common factor in the nCV–2019 infection (Figure 1). Sodium chloride injection is also prescribed with other Chinese medicinal injections, but their dosages are adjusted according to the health conditions of patients. The injections should be started with a low dosage and modified gradually conferring to the drug administration [12,39]. The recovery period differs regarding the patient's immune system; some infected persons have a strong immune system that helps in fast recovering rate while others have a weak immune system such persons are categorized as critical cases.

Self–mediation and precautionary measure

The nCV–2019 is spreading easily in such communities where any infected person is present and infect more than two of the persons by touching, coughing, and sneezing. The infection rate increases when the personal hygienic practices are not properly implemented. This virus is assumed to be less infectious than chickenpox and measles but more infectious than flu [12,40].

Everyday precautionary actions can avoid the spread of nCV–2019. Frequent and proper handwashing, especially when someone has any of the symptoms related to nCV–2019. The usage of hand sanitizer is certainly a good practice if no water or soap is available. Infected persons should isolate themselves from healthy persons so that the transmittance of viral infection can be stopped. Do not touch your mouth, nose, and eyes with dirty and contaminated hands. Avoid social contact with sick and unhealthy persons (Figure 2). Use plenty of warm water; saltwater is preferred. Wear face masks and gloves when going

outside and wash your hands with soap after coming back. Use a tissue for cough and sneeze, and discard it immediately. Cleaning and disinfection of personal items such as cell phones, laptops, computers, and other things are also important for a healthy and safe life. By taking a balanced diet that can improve our immune system and then a body can compete for this nCV–2019.

Role of immune system in combating viral infection

The immune system helps the body to protect against infectious agents coming from the environment. These infectious agents include viruses, bacteria, parasites, and other noxious agents. Due to the immune system, a body can tolerate these environmental agents, which are non–threatening, including food proteins [41]. When we say that the body acts as a machine, then food acts as fuel, and the activity of the machine depends on the quality and quantity of fuel. In the same way, food plays a major role in the maintenance of various systems of the body, including the immune system, which is the major defense system to protect and fight against pathogens, including nCV–2019 [42,43]. Those patients have a strong immune system in their body that can fight against this lethal nCV–2019. Taking a balanced diet in daily life can improve our immune system, which could be used against nCV–2019, the only way to survive until the vaccine is not engineered.

Several food components might enhance the immune system of our body, such as vitamin E, zinc, Omega–3 fatty acids, selenium, vitamin C, herbs, spices, drinks, numerous varieties of tea, and proteins [44]. Figure 4 shows a diet chart with essential food items that can boost up the immune system.

Vitamin E

Vitamin E is from the category of lipid–soluble vitamins and gives the generic name to all the tocotrienol and tocol derivatives with various biological degree values. The most biologically active is alpha–tocopherol, which comprise of 90–100% of vitamin E in tissues (Table 1). The primary function of vitamin E is to act as an antioxidant that helps to prevent the progression of lipid oxidation. This vitamin acts as a radical scavenger and keeps the polyunsaturated fatty acids with plasma lipoproteins and in membranes [45,46]. The role of vitamin E is indispensable in the maintenance of the immune system, while its deficiency can impair the body's immunity. As the protection of the immune system comes in priorities, especially in case of nCV–2019, which majorly acts when the immune system becomes weak. To fulfil its deficiency, vitamin E is given in higher than the recommended dose, which helps to enhance the cell–mediated and humoral immunity in the elder people. According to various researches, supplementation of vitamin E (200–1200 IU) per day for up to 1–5 months can increase the tocopherol levels in blood plasma. A balanced diet can fulfil the need of some essential nutrients for better immunity, Table 2 shows some food items with their quantity and health benefits. The process of fat digestion and emulsification of pancreatic lipase and bile helps in the absorption of vitamin E. The major dietary sources of vitamin E include vegetable oils, almonds, peanut, hazelnut, cereal germ, and safflower, etc. [47]. As up–till now, the vaccine of nCV–2019 has not discovered, so we are recommending these kinds of foods to improve our immunity against the nCV–2019 invasion.

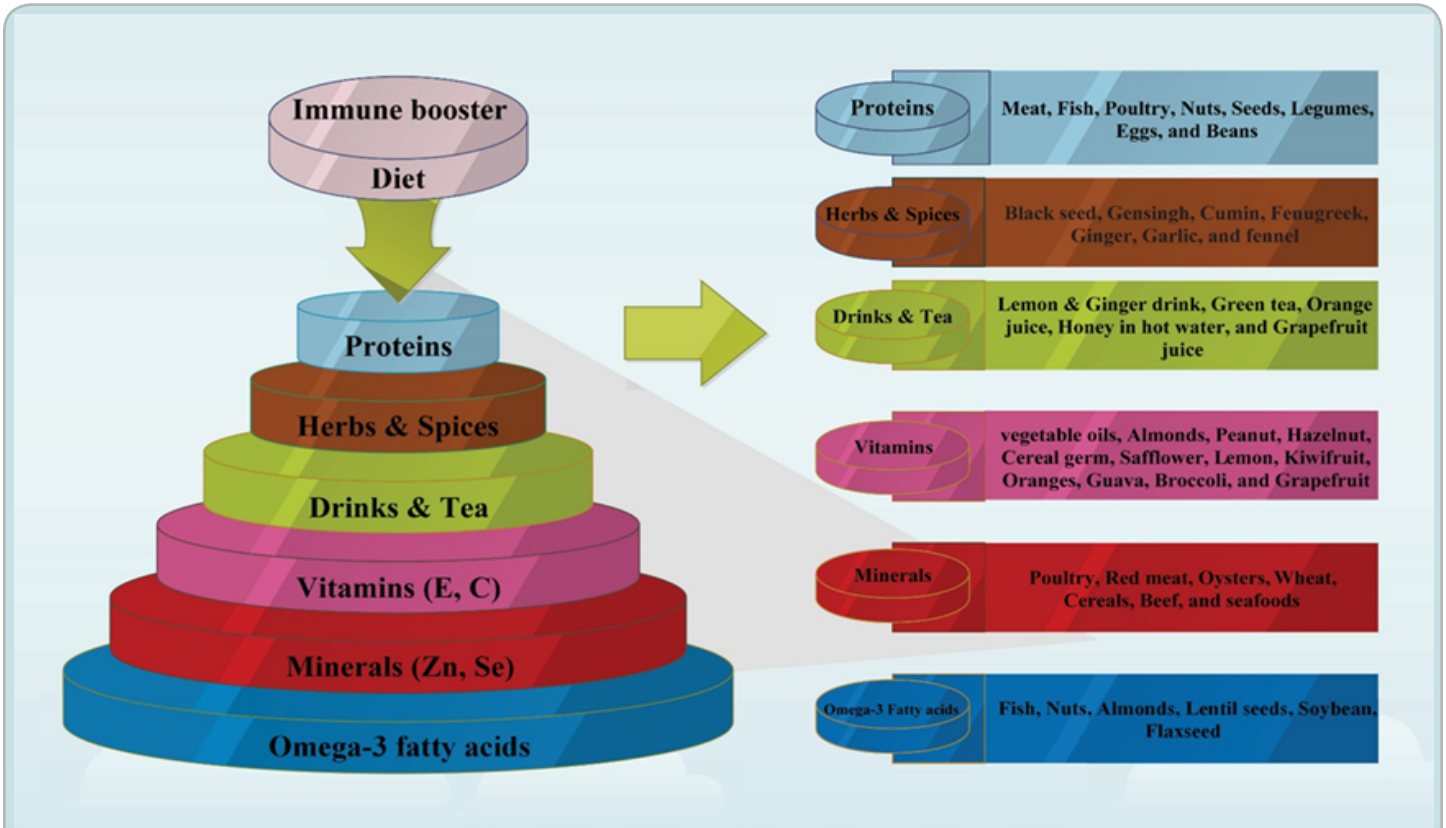

Figure 4: Recommended functional foods with immune booster potential against nCV– 2019.

Table 1: Food components, their quantity, and health benefits.

Nutrient	Sources	Amount of Nutrient Present	RDA	Health Benefits	Reference
Protein	Red meat	7 g/oz	0.8 g/kg body weight	• Build and repair tissues • Produce enzymes	[71]
Zinc	Whole grains, oyster	2.5–5 mg/100 g	M, 11 mg F, 8 mg	• Treat diarrhea • Improve learning	[69]
Vitamin C	Citrus fruits	54 mg/100 ml juice	M, 90 mg F, 65 mg	• Manage high bp, • Reduce the risk of heart diseases	[72]
Vitamin E	Nuts, whole grains	7.27 mg in 1 oz of almonds	M, 15 mg F, 15 mg	• Anti–aging • Prevent CHD	[68]
Omega–3	Seafood, seeds	4.3–20.9 mg/g	250–500 mg	• Improve eye health • Heart disease	[70]
Selenium	Nuts, meat	78.96 mcg	55 mcg	• Reduce asthma • Reduce cancer risk	[67]
Herbs & spices	Black seed, fenugreek, fennel			• Improve brain function • Lower blood sugar level	[64]
Drinks & tea	Green tea, lemon and honey drink			• Improve brain function • Reduce cancer risk	[65]

Vitamin D

Vitamin D is a vitamin that is fat–soluble and plays a vital role in the immune system's function and health. Vitamin D increases the pathogenic activity of macrophages as the essential components of the immune system, monocytes, and white blood cells as well as reduces inflammation and enhances immune response [48]. The hazards of respiratory illness such as influenza and allergic asthma may be increased in this regard by a deficiency in vitamin D [49]. Vitamin D supplementation may increase immune response according to certain studies. The findings from recent researches have also shown that the intake of vitamin D (400 IU) can protect against respiratory tract infection [50]. In a 2017 randomized clinical trial study of 11,321 people, the risk of developing respiratory diseases was considerably lower than that of vitamin D deficient persons (moins 800, 800–1999, <2000 IU) with sufficient vitamin D levels.

Vitamin A

Vitamin A is a vitamin that contains an unsaturated group of single–hydrous alcohols, whereas it is vegetable–derived counterpart is β–carotene. There are three active forms of vitamin A in the human body, including retinal, retinal, and retinal. Adequate provision of vitamin A is an anti–infection agent for many infections in humans. Some researchers have reported weak immune systems due to lack of vitamin A [51]. Vitamin A deficiency is intimately correlated with measles and diarrhea, particularly in children who have been severely affected by vitamin A deficiency by measles [52]. Evidence exists for the important role played by vitamin A in reducing diseases and the death rate caused by various infections, like measles, pneumonia, diarrhea, malaria, lung infections, and AIDS [53]. The NIH suggests that the recommended daily vitamin A level of 900 and 700 mcg for both men and women is in the Recommended Dietary Allocation (RDA). Also, 770 and 1300 mcg per day were set for pregnant or breastfeeding women.

Vitamin B complex

A group of water–soluble vitamins that function as coenzymes is the vitamin B complex. These vitamins are a range of nutrients that are important to human physiology. Many people only eat these vitamins as they come in a healthy balanced diet to obtain the necessary amounts. Each vitamin B is specifically characterized. For example, energy metabolism in cells improves with Vitamin B2 (riboflavin). Vitamin B2 deficit was more common in elderly people in a study carried out in the USA [54]. The immune system is influenced by a vitamin B complex (specifically B6) in three forms: reducing the differentiation between the lymphocyte T, down regularizing cytokine signal suppression manifestations 1 and improving the IL–4 secretion levels, but reducing the secretion rate of IL–2. The appropriate supplementation with vitamin B6 can improve immunity caused by a short–term vitamin B6 insufficiency [54]. The recommended daily consumption is 1.2, 1.3, 16, 5, and 1.3 mg, for B1 (the thiamine), B2 (riboflavin), B3 (niacin), B5 (pantothenic acid), and B6 (pyridoxine). The B7 (biotin), B9 (folate), andB12 (cobalamin) are 30, 400, and 2, 4 mcg respectively (Dietary Supplement Fact Sheets, 2020).

Zinc (Zn)

Zinc is the basic component of many enzymes in addition to its major function of development and growth of an organism. Zinc based enzymes participate in the energetic metabolism, nucleic acid biosynthesis, degradation and synthesis of proteins, and various other important reactions. It also prevents the production of free radicals by acting as a stabilizing agent. Zinc has a major effect on immune system processes by affecting the maturation process of lymphocytes, free radical generation, regulation of gene transcription, and apoptosis. The abilities of macrophages to kill intracellular parasites decrease due to the deficiency of zinc. T–cell immunosuppression takes place due to an increased level of plasma corticosterone, which occurs because of zinc deficiency. As a result, zinc deficiency leads to decreased resistance against infectious diseases. According to various research studies, supplementation of diet with zinc improves the efficiency of the immune system against various infectious diseases. This supplementation decreases the severity and duration of symptoms (as during influenza). Zn supplementation also reduces the duration of various other diseases, including

pneumonia, diarrhea, and infections of lower airways in children, which are the main symptoms of nCV–2019. Studies disclosed that much of the population in Asian regions and some in the regions USA lack this micro–nutrient in their diet, and the table 1 show that the rate of infection is more in these regions than in other countries. Zn is added in the diet of adults to decrease the deficiency; however, the Zn demand of children and older adults is not fulfilled due to varying dietary patterns. As a result, these age groups have to face the impairment of the immune system, which reduces the resistance to various infections taking place. Therefore, it is internationally recommended to supplement the diet with appropriate amounts of zinc to fulfil the nutritional needs and to minimize the Zn deficiency. Whole grains and milk products are good sources of zinc. While various breakfast cereals are now supplemented with zinc. Poultry, red meat, and oysters are also some good sources [55].

Iron

Iron (Fe) is an essential nutrient that can enhance host and pathogen immunity. Over consumption of iron may boost oxidative stress, which could be lethal for the host's immunity. The inadequate body iron availability may increase the likelihood of acute respiratory tract infection, and also COVID–19. Even so, the findings of one research showed no high effect on viral load when intaking 60 mg of iron twice a week for adults [56]. Some viruses change the activity of iron homeostatic control proteins (e.g., hepcidin). Iron over dose can lead to negative prognoses in HIV–1 and hepatitis C infections. The conceptualization and the interplay with the iron metabolism of viral infection could result in new methods for controlling the COVID–19 epidemic.

Omega–3 fatty acids

There exist three types of omega–3 fatty acids, including alpha–linolenic acid, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). The important components of membrane phospholipids are polyunsaturated fatty acids (PUFA), where they provide the required environment for the proper functioning of membrane proteins [57]. These also regulate the cell signaling pathways, along with the expression of genes and cell functioning. Researchers found that phospholipids present in immune cells contain 15–20% of arachidonic acid and very small amounts of n–3 PUFA, DHA (2.5%), and EPA (1%). While the contents of EPA and DHA in membranes of immune cells can be increased by supplementing the diet with these fatty acids. This type of modification, in turn, also decrease the content of arachidonic acid in immune cell membranes. The fatty acid composition of the immune cell membranes can also be modified by oral intakes of the respective fatty acids. Majorly the increase in n–3 PUFA content takes place by the increase in n–6 PUFA, i.e., arachidonic acid. Various studies suggest that the assimilation of DHA and EPA in the human immune cells starts in days or weeks and reaches at the peak within four weeks of the intake of these fatty acids. While these fatty acids from fish reach the immune system according to the oral intakes of respective fatty acids. Major dietary sources of omega–3 fatty acids are flaxseed and fish. While the capsule of fish oil can also be used. Soybeans, flaxseed, and canola oil are major sources of alpha–linolenic acid [58,59]. Intake of omega–3 fatty acid with a balanced diet keeps our body immune system healthy that may withstand nCV–2019 infection.

Selenium (Se)

Se is an essential micronutrient that affects human health, including responses of the immune system. Se is involved in the regulation of oxidative stress and other processes of the cell in almost all cells and tissues, including the responses of adaptive and innate immune systems. Researches proved the effect of Se deficiency and supplementation of the responses of the immune system. The humoral and cell–mediated immune responses can be improved by increasing the intake of Se. Experimental studies proved that Se deficiency resulted in decreased responses of the immune system against viruses, allergens, and other pathogens. However, the results are not clear about the fact that either the Se supplementation provides an additional efficiency of the immune system. Daily recommended intake of Se is 55 mcg per day. Because of the lower amount of Se in soil, most of the population is deficient in Se, and people have to supplement their diet with an adequate amount of Se. The basic mechanism by which Se boosts the immunity of cells is the expression stimulation of the IL–2 receptor on the NK cells and activated T lymphocytes. With the deficiency of Se, the specific and non–specific cell responses are decreased, and this can be reversed by the supplementation of Se in adequate amounts. Selenium deficiency not only decreases the immune responses but also increase the virulence of the infectious agents as in the case of nCV–2019 when immunity decreased up–to the level where this virus can attack the subject easily. Researches also showed a lower incidence of cancer in people consuming 100–200 mcg of Se daily in the form of selenomethionine for at least two years. Se can be taken majorly from wheat and other cereals, beef, poultry, and kinds of seafood. However, Se is present in the human diet in the form of selenomethionine and selenocysteine [55,60].

Vitamin C

Vitamin C, also called ascorbic acid, has anti–viral effects when taken in sufficient amounts. In past years influenza was treated with high amounts of vitamin C because it improves bowel tolerance when consumed in sufficient amounts. Intravenous administration of vitamin C can also be used in a critical situation [61]. The supplementation of vitamin C can reduce the severity of the cold up–to 8% in adults and 14% in children. While people who are addicted to use vitamin C daily are less prone to the attack of viruses. The prevention from coronavirus is also possible with the regular intake of vitamin C. Vitamin C works by neutralizing the free radicals and acts as an antioxidant, helps in the activation of various important enzymes in the body, that protects the lungs from the attack of various pathogens such as nCV–2019 by accelerating the fatty membranes in the skin and connective tissues. Vitamin C also helps neutrophils to reach at the site of infection and also gives these cells assistance to fight against pathogens. The human immune system is directly dependent on the availability of vitamin C to cope with the pathogens and to minimize the attack of nCV–2019. In addition, this vitamin cannot be stored in the body because it is water–soluble and excreted from the body when ingested. That is why the regular administration of vitamin C is the only solution to boost–up immunity and to prevent the population from the attack of deadly nCV–2019. Dietary sources of vitamin C include lemon, kiwifruit, oranges, guava, broccoli, and grapefruit [62,63].

Herbs & spices

Many diseases have been treated with the biological products

of plants and animal origin previously. These products have been used in extract or pure form. Researches proved the beneficial effects of herbs and spices to strengthen the immune system and to minimize the attack of viruses and other pathogens. Many types of phytochemicals are identified in various herbs. These phytochemicals include terpenoids, ligands, flavonoids, sulfides, curcumins, carotenoids, and plant sterols. Many antioxidant compounds are also present in plants that help against chronic diseases. Plants are also a rich source of vitamin C, carotenoids, and flavonoids, which help to enhance the immune functions of the body, and their action is named as immune–stimulant. These herbs also have anti–inflammatory activities that, in turn, increase the activity of lymphocytes, and interferon production is also induced. One of the herbs called garlic has strong effects on the immune system. It stimulates the activity of natural killer cells to exert an immune–potentiating effect. The production of natural killer cells can also help in increasing resistance against the attack of nCV–2019. Garlic also modifies the immune function by preserving the homeostasis of the immune system. The therapeutic effect of garlic is due to the high amount of sulfur compounds in it. These are also helpful for the treatment of various other diseases, including cancer, hyperlipidemia, diabetes, and atherosclerosis. Mushrooms, honey, garlic, kalonji, peppermint, licorice, Asian ginseng, oregano and rosemary all manifest exceptional antiviral and immune booster properties (Table 2). Examples of other herbs and spices include black seed, gensingh, cumin, fenugreek, and fennel [64].

Drinks & tea

Drinks and tea, including lemon and ginger drink, green tea, orange juice, and grapefruit juice, all play a major role in boosting the immune system. For several years, tea has been consumed to improve the resistance to diseases and to make the blood flow better. This is used for the removal of toxins from the body, which are the major functions of the immune system. Immuno–modulating effects are contributed by the active ingredients which are present in tea. The main active ingredient in tea is polyphenols, which are also called flavonoids. Catechin is the most important component that plays a role in immune benefits, and it belongs to the monomeric flavonoids. According to a research, ethylamine, which is a component of tea, helped in the protection of the whole respiratory tract from the virus. In this way, various components of the tea can help in the protection of the body against viruses, including nCV–2019 [65].

Protein

Just like fats and carbohydrates, protein is the macronutrient in the human diet and is required in large amounts. Protein is not stored in the body; that's why it should be a part of a daily diet to ensure the provision of an adequate amount of this major nutrient. The role of protein to boost the immune system is acknowledged from the past many years. Protein structures, when arranged in an arrayed structure, are helpful in generating antibody responses even when the T–cells are absent. Protein is the major component of every cell in the body and is involved in the maintenance and repair of body cells and tissues. While adequate amounts of protein in the daily diet can help strengthen the immune system and to fight against nCV–2019. The daily requirement of protein includes three servings, and this amount varies with age and physical condition. Various dietary sources of protein include meat, fish, poultry, nuts, seeds, legumes, and beans [66]. Foods contain rich protein should be included in our daily diet to improve the immunity system of our body against nCV–2019.

Table 2: Some traditional foods with therapeutic potential against viral infections.

Food	Source	Therapeutic Potential	Reference
Mushroom	*Agaricus bisporus*	Efficacy trials conducted on test animals suggested that cordyceps musroom treatment reduced lung infection and inflammation as well as triggered immune responses	[73]
Honey	*Apis malifera*	Can impede the replication cycles of influenza and herpes simplex viruses	[74]
Kalongi	*Nigella sativa*	Oil exhibits exceptional antiviral characteristics against CMV infections	[75]
Peppermint	*Mentha piperita*	Bioactive components in the oil e.g., rosmarinic acid have strong anti–inflammatory effects	[76]
Licorice	*Glycyrrhiza glabra*	Established antiviral history against SARS–Cov during in–vitro tests	[77]
Oregano	*Origanum vulgare*	An indigenous bioactive component carvacrol is effective in combating murine nano–virus infections	[78]
Rosemary	*Salvia rosmarinus*	Oleanolic acid furnishes antiviral activity in HIV and hepatitis	[79]

Conclusions

Recent research has suggested that nCV–2019 is a deadly infection; however, WHO currently declared it a global health emergency. People in the whole world are locked down and on a quarantined period at their homes. As we know, the vaccine of this life–threatening pathogenic infection has not been discovered yet so, the only way to obstruct from nCV–2019 to quarantine at homes and take a balanced diet to improve the immune system of our body. According to the worldometer webserver, about 96,851,321 patients of nCV–2019 have been recovered till 15 March 2021, because they have strong immune systems. We should take a balanced diet full of vitamin E & C, zinc, omega–3 fatty acids, Se, proteins, herbs & spices, and drinks & tea until depth studies about this fast mode spread pathogen have not completed with a vaccine [67–72].

Highlights

- The epidemic outbreak of novel coronavirus–2019 (nCV–2019) has globally spread.
- Balanced diet full of vitamins minerals and natural components may be promising therapeutic strategy of nCV–2019.
- According to the worldometer webserver, about 96,851,321 patients of nCV–2019 have been recovered till 15 March 2021, because they have strong immune systems.

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Competing interests

The authors declare that they have no competing interests.

Conflict of interest

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