

**Review article**

**PREVENTIVE MANAGEMENT STRATEGIES IN AGING POPULATIONS USING NATURAL PRODUCTS AS IMMUNITY BOOSTERS**

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**Abstract**

*COVID-19 is a disease caused by the novel coronavirus, which first emerged in China in December 2019. The symptoms of COVID-19 are very similar to those of the common flu, including cough, fever, shortness of breath, and like the flu, they spread from person to person via aerosols. In this article, we have discussed the present status of COVID-19 with its impact globally. We have also considered the impact COVID-19 has on the aging population and have outlined various possible options from immune-boosting natural products to antioxidants, which have shown to be beneficial against respiratory infections. COVID-19 the pandemic going around have shown the failures of the present health care systems and also shown the vulnerability of humanity for a great debacle. People have no cures, no vaccines and there is a fear for a second and third wave of the viral infections coming back with vengeance. Most of the sufferers are from the lower economic strata, mostly aging populations with immunity - compromised preconditions. For many countries, the new vaccines or new drug therapies will not be within reach. In such scenario, natural products, which can be used, as preventive measures to build the innate immunity, overall health and resistance of human being will be looked at very positively and natural products may fulfil this gap.*

**Keywords:** COVID-19; Coronavirus; Antioxidants; Nutraceuticals; Immunity; Immune boosters; Aging population.

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## **Introduction**

### **Present status of COVID-19**

The world is facing a pandemic and it has contracted people all over the world and more than 180 countries have been affected by a different number of patients and deaths. This latest outbreak started from Wuhan China has created several challenges for complications in current healthcare worldwide in terms of prognosis, diagnosis and prevention. COVID-19 has been characterized by enveloped non-segmented positive-sense RNA viruses, which belong to the family of Coronaviridae and the order of Nidovirales identified since the 1960s as a human virus [1].

There are several theories, which have been presented by many research groups around the world about the structure of the virus and its characteristics [2-4]. There are many different types of coronaviruses reported in humans, out of which four types 229 E, NL63, OC 43 and KHU 1 cause mild to moderate respiratory infections. While another two types which are SARS-CoV and MERS-CoV can cause severe respiratory infections, while the seventh type (novel COVID-19) is recently discovered in China. In humans, COVID-19 cause illness mostly through respiratory or gastrointestinal infections where symptoms can range from the common cold to more severe lower respiratory infections such as Pneumonia and other complications [5]. Now it is a proven fact that the COVID-19 can infect person to person and impart more disease burden [6].

### **Impact of COVID-19 effect worldwide**

Since the first case was reported in Wuhan (China) in 2019, the things have changed and many reports are being published. John Hopkins University has published a daily update as part of the COVID Visualizer and is considered to be the most authentic resource for COVID statistics and is also referred by scientists as well as politicians.

As of April 29, 2020, the numbers are rapidly changing worldwide with increases in cases reported in the west, particularly the United States of America with over 1 million cases and close to 60,000 deaths, now having the largest number of cases and deaths as per the table listed below.

These numbers have puzzled the experts managing COVID-19, as the low numbers of death and number of cases in many countries including India with a population of 1.3 Billion people and less than 1,100 deaths on April 29, 2020, with less than 35,000 cases and Indonesia with less than 8,000 cases and 792 deaths. Similar cases are seen in African countries and many other areas where the impact of the COVID-

19 as on April 29, 2020, appears to be negligible. It appears that in certain countries, the population is resistant to COVID-19 as compared to the USA and European countries where over 150,000 deaths have been reported. Scientists should conduct more about the innate immunity and the ability to resist and fight the COVID-19 infection in these populations, including diet and nutritional influences.

Another puzzle the COVID-19 has created is the fatality rates. It is interesting to observe that the countries, which had very good hospital services and healthcare facilities had a large number of cases and fatalities with fatality rates above 10% while there were many smaller countries, even though they had smaller cases but challenging healthcare facilities have shown higher fatality rates but with minimal COVID-19 cases.

### **Aging population and COVID-19**

The coronavirus is especially found to be very fatal for the elderly. The mortality rates are 15%, 8%, 3% and less than 1% for people over 80, people in their 70s, people in their 60s and people under 50 respectively. Countries with a large percentage of elderly people are the countries with the highest number of cases and fatalities per capita. For example, the fertility rate of

Table 1: COVID-19 pandemic cases and deaths as reported by John Hopkins COVID visualizer.com data based on April 29, 2020.

Country	Confirmed	Deaths	Case-Fatality	Deaths/100k pop.
US	1,012,582	58,355	5.8%	17.84
Italy	201,505	27,359	13.6%	45.27
Spain	232,128	23,822	10.3%	50.98
France	169,053	23,694	14.0%	35.37
United Kingdom	162,350	21,745	13.4%	32.70
Belgium	47,334	7,331	15.5%	64.18
Germany	159,912	6,314	3.9%	7.61
Iran	92,584	5,877	6.3%	7.18
Brazil	73,235	5,083	6.9%	2.43
China	83,940	4,637	5.5%	0.33

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Country	Confirmed	Deaths	Case-Fatality	Deaths/100k pop.
Netherlands	38,612	4,582	11.9%	26.59
Turkey	114,653	2,992	2.6%	3.63
Canada	51,150	2,983	5.8%	8.05
Sweden	19,621	2,355	12.0%	23.13
Switzerland	29,264	1,699	5.8%	19.95
Mexico	16,752	1,569	9.4%	1.24
Ireland	19,877	1,159	5.8%	23.88
India	31,324	1,008	3.2%	0.07
Portugal	24,322	948	3.9%	9.22
Ecuador	24,258	871	3.6%	5.10
Russia	93,558	867	0.9%	0.60
Peru	31,190	854	2.7%	2.67
Indonesia	9,511	773	8.1%	0.29
Romania	11,616	663	5.7%	3.40
Poland	12,218	596	4.9%	1.57
Austria	15,357	569	3.7%	6.43
Philippines	7,958	530	6.7%	0.50
Algeria	3,649	437	12.0%	1.03
Denmark	9,049	434	4.8%	7.49
Japan	13,736	394	2.9%	0.31
Egypt	5,042	359	7.1%	0.36
Pakistan	14,612	312	2.1%	0.15
Hungary	2,649	291	11.0%	2.98
Dominican Republic	6,416	286	4.5%	2.69
Colombia	5,949	269	4.5%	0.54

Country	Confirmed	Deaths	Case-Fatality	Deaths/100k pop.
Korea, South	10,761	246	2.3%	0.48
Ukraine	9,410	239	2.5%	0.54
Czechia	7,504	227	3.0%	2.14
Israel	15,728	210	1.3%	2.36
Chile	14,365	207	1.4%	1.11
Argentina	4,127	207	5.0%	0.47
Norway	7,660	206	2.7%	3.88
Finland	4,740	199	4.2%	3.61
Panama	6,021	167	2.8%	4.00
Morocco	4,252	165	3.9%	0.46
Bangladesh	6,462	155	2.4%	0.10
Saudi Arabia	20,077	152	0.8%	0.45
Greece	2,566	138	5.4%	1.29
Serbia	6,630	125	1.9%	1.79
Moldova	3,638	103	2.8%	2.90
Malaysia	5,851	100	1.7%	0.32
South Africa	4,996	93	1.9%	0.16
Iraq	1,928	90	4.7%	0.23
United Arab Emirates	11,380	89	0.8%	0.92
Luxembourg	3,741	89	2.4%	14.64
Australia	6,744	89	1.3%	0.36
Slovenia	1,408	86	6.1%	4.16
Belarus	12,208	79	0.6%	0.83
North Macedonia	1,421	71	5.0%	3.41
Honduras	702	64	9.1%	0.67

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Country	Confirmed	Deaths	Case-Fatality	Deaths/100k pop.
Bosnia and Herzegovina	1,585	63	4.0%	1.90
Croatia	2,047	63	3.1%	1.54
Afghanistan	1,828	58	3.2%	0.16
Cuba	1,437	58	4.0%	0.51
Cameroon	1,705	58	3.4%	0.23
Bulgaria	1,399	58	4.1%	0.83
Thailand	2,938	54	1.8%	0.08
Bolivia	1,014	53	5.2%	0.47
Estonia	1,660	50	3.0%	3.79
Lithuania	1,344	44	3.3%	1.58
Nigeria	1,532	44	2.9%	0.02
Burkina Faso	638	42	6.6%	0.21
Andorra	743	41	5.5%	53.24
San Marino	553	41	7.4%	121.36
Tunisia	975	40	4.1%	0.35
Niger	709	31	4.4%	0.14
Armenia	1,867	30	1.6%	1.02
Congo (Kinshasa)	471	30	6.4%	0.04
Albania	750	30	4.0%	1.05
Somalia	528	28	5.3%	0.19
Sudan	318	25	7.9%	0.06
Kazakhstan	3,027	25	0.8%	0.14
Mali	424	24	5.7%	0.13
Lebanon	717	24	3.3%	0.35
Kuwait	3,440	23	0.7%	0.56

Country	Confirmed	Deaths	Case-Fatality	Deaths/100k pop.
Azerbaijan	1,717	22	1.3%	0.22
Slovakia	1,384	20	1.4%	0.37
New Zealand	1,474	19	1.3%	0.39
Ghana	1,671	16	1.0%	0.05
Liberia	141	16	11.3%	0.33
Cyprus	837	15	1.8%	1.26
Uruguay	625	15	2.4%	0.43
Guatemala	530	15	2.8%	0.09
Kenya	374	14	3.7%	0.03
Singapore	14,951	14	0.1%	0.25
Cote d'Ivoire	1,183	14	1.2%	0.06
Latvia	836	13	1.6%	0.67
Diamond Princess	712	13	1.8%	nan
Kosovo	510	12	2.4%	0.65
Bahamas	80	11	13.8%	nan
Iceland	1,795	10	0.6%	2.83
Oman	2,131	10	0.5%	0.21
Mauritius	334	10	3.0%	0.79
Tanzania	299	10	3.3%	0.02
Qatar	11,921	10	0.1%	0.36
Venezuela	329	10	3.0%	0.03
Paraguay	239	9	3.8%	0.13
Senegal	823	9	1.1%	0.06
Bahrain	2,811	8	0.3%	0.51
El Salvador	345	8	2.3%	0.12
Uzbekistan	1,939	8	0.4%	0.02

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Country	Confirmed	Deaths	Case-Fatality	Deaths/100k pop.
Trinidad and Tobago	116	8	6.9%	0.58
Congo (Brazzaville)	207	8	3.9%	0.15
Guyana	74	8	10.8%	1.03
Jordan	449	8	1.8%	0.08
Kyrgyzstan	708	8	1.1%	0.13
Guinea	1,240	7	0.6%	0.06
Sri Lanka	619	7	1.1%	0.03
Montenegro	321	7	2.2%	1.12
Jamaica	364	7	1.9%	0.24
Taiwan*	429	6	1.4%	0.03
Costa Rica	705	6	0.9%	0.12
Togo	99	6	6.1%	0.08
Georgia	511	6	1.2%	0.16
Haiti	76	6	7.9%	0.05
Barbados	80	6	7.5%	2.09
Burma	150	5	3.3%	nan
Zimbabwe	32	4	12.5%	0.03
Malta	458	4	0.9%	0.83
Monaco	95	4	4.2%	10.34
Sierra Leone	104	4	3.8%	0.05
Malawi	36	3	8.3%	0.02
Antigua and Barbuda	24	3	12.5%	3.12
Gabon	238	3	1.3%	0.14
Nicaragua	13	3	23.1%	0.05

Country	Confirmed	Deaths	Case-Fatality	Deaths/100k pop.
Ethiopia	126	3	2.4%	0.00
Zambia	95	3	3.2%	0.02
Syria	43	3	7.0%	nan

Table 2: Enumeration of the countries, which have more than 10 % fatality rates

Country	% Fatality rate	Total number of cases	Healthcare facilities
Italy	13.60	201505	Very good
Spain	10.30	232138	Very good
France	14.00	169053	Very good
United Kingdom	13.40	162350	Very good
Belgium	15.50	47334	Very good
Sweden	12.00	19621	Very good
Netherlands	11.90	38612	Very good
Hungary	11.00	2649	Reasonable
Algeria	12.00	3649	Reasonable
Liberia	11.30	141	Challenging
Bahamas	13.80	80	Challenging
Guyana	10.80	74	Challenging
Zimbabwe	12.50	32	Challenging
Antigua	12.50	24	Challenging
Nicaragua	23.10	13	Challenging

Italy is 1.33 children per woman, far below the replacement level of 2.1 due to which Italy has a speedily aging population. Italy has approximately 23 % of its

population over the age of 65 years. The median age was found to be 46.3 % in 2019 which is estimated to rise to 51.4 % by 2050. The elderly group of people is creating and will continue to build up pressure for both financial and health care system [7].

### **COVID-19 vaccine development efforts**

More than 75 companies around the world are racing either to develop a vaccine against COVID-19 or therapeutics to end the pandemic that has threatened and infected a considerable segment of the human population, especially the elderly.

Even after the expenditure of a huge amount of capital in the R & D sector to control the virus, the response to the pandemic remains handicapped by our limited understanding of how to develop an effective immunity. The major casualties of the pandemic are the older population worldwide. In Europe and America, the majority of the people who have succumbed to death, in this pandemic are belonging to the age group of 65 and above. These people had challenges with their health in some or other way where immunity was compromised and also suffering from chronic diseases like diabetes, cardiovascular diseases and so on. Today, lot of scientists are worried about the challenge of raising the immunity strength of this aging population so that they will be ready for next year and years after to face this virus again [8]. The vaccine development and approval may take anywhere from 12 to 18 months, in the meantime the second or third wave of the virus may attack the humanity especially the aging populations and whether the natural products can come to rescue or at least partially help to build some sort of immunity which can raise the abilities of the aging population to fight not only COVID-19 but other viruses also.

As we age, health conditions associated with aging, particularly non-communicable diseases along with their treatments and immune senescence, considerably affect responses to the vaccines [9]. Angiotensin-converting enzyme 2 (ACE2) is considered to be the accountable receptor for the virus (SARS-CoV-2), responsible for COVID-19. According to studies, it has been observed that the spectrum of disease virulence is due to the different level of ACE2 in the cardiac and pulmonary tissues of younger versus older adults among patients with COVID-19. Scientists are taking a clue from this for drug development for COVID-19 and working on the potential use of ACE inhibitors in the context of the pandemic [10]. This idea highlights the need for longitudinal studies in aging populations such as the Rotterdam Study (a prospective cohort study focused on cardiovascular, neurologic, ophthalmologic, and endocrine diseases) to examine the impact of coexisting conditions and therapies on the effects of vaccines and infectious diseases.

COVID-19 has brought into the limelight, the vulnerability of aging populations to emerging diseases. This susceptibility to disease and death is also a major challenge for the development of vaccines and immunotherapeutic agents, especially with aging populations. Numerous studies have shown that vaccine efficacy decreases significantly with age, a reduction that is driven by the escalating age-related reduction of innate and adaptive immune responses [9].

Yet we know that some older people are protected by generally poorly-performing vaccines, and some vaccines work very well in elderly populations: the Shingrix vaccine for shingles, for example, is 90% effective in people over 70. What accounts for the variability in immune responses from one elderly person to another? How can we use our understanding of this variability in developing new and improved vaccines and therapies?

So, the best bet for the aging populations to look for natural products, which might help them to enhance their innate immunity and /or help them to fight the viral diseases with minimum side effects.

### **Innate immunity and aging populations**

According to the CDC guidelines, the people who are at high-risk of COVID-19 are [11]:

- I. The age group of 65 years and above
- II. Those who dwell in a nursing home
- III. Anyone having medical conditions, particularly if not well controlled, including:
  - i. Those with chronic lung disease or moderate to severe asthma
  - ii. Those with serious heart problems
  - iii. Those with a weak immune system

Smoking, bone marrow or organ transplantation, cancer treatment, poorly controlled HIV or AIDS, and prolonged use of corticosteroids are some of the conditions which can cause a person to be immune-compromised. Other immune compromising medications include conditions such as:

- a) Severe obesity (body mass index [BMI] of 40 or more)
- b) Diabetes
- c) Liver disease and
- d) Chronic kidney disease undergoing dialysis

The innate immune system is the first line of defence and is important for early defence against pathogens. With age, cells of the innate system, notably neutrophils, monocytes/macrophages and dendritic cells, undergo changes that lead to compromised functioning of the immune system. Advanced age is associated with

defects in all of the cells of the innate immune system, including numbers, function, and early stages of activation. The analysis of the literature suggests that a dysfunctional innate immune system is a contributing factor to aberrant outcomes after injury or infection and to the development of many of the diseases observed in the elderly. Gaining an understanding of the nature of the defects in innate immune cells may allow the development of therapeutic strategies aimed to restore innate immune function in aged individuals [12].

The innate immune system is a network of cells including neutrophils, NK and NKT cells, monocytes/macrophages, and dendritic cells that mediate the earliest interactions with foreign pathogens. Age causes defects in the activation of all of these cell types, linked to compromised signal transduction pathways including the Toll-like receptors. However, aging is also depicted by a constitutive pro-inflammatory environment (inflamm-aging) with persistent low-grade innate immune activation that may augment tissue damage caused by infections in elderly individuals. Thus, immunosenescence in the innate immune system appears to reflect dysregulation, rather than exclusively impaired function [13]. So appropriate intervention might help in building the innate immunity of aging populations using appropriate external resources including natural products.

### **Microbiota and innate immunity**

The reports mentioned in several research papers show a relationship between gut microbiota innate immunity, where the gut microbiota is responsible for the maturation of immune system and also plays a vital role in the defence mechanism of the host against pathogens. Pieces evidence propose that innate immunity can be triggered by the host gut microbiota to counter the entry of foreign pathogens in our body. In the case of the aging population, the gut microbiota alters as a part of the aging process and may exhibit reduced innate immunity [14].

The intestinal microbiome is an area that shows a combination of environmental inputs, like food habits along with genetic and immune signals to affect the host's immunity, metabolism and response to infection. Haematopoietic cells and non-haematopoietic cells are located based on the host-microbiome interface. Microorganisms or their metabolic products can be sensed by these cells and translate the signals into immune response. Irregularities in the connection between the gut microbiota and the innate immune system may devote to complex diseases. This is where external intervention using natural products, prebiotics and probiotics can help to build or strengthen the innate immunity during the aging process of human beings [15].

### **Natural products, which can help the aging population to build innate immunity**

For last several millennia, natural products or compounds derived from natural products have demonstrated effectiveness as therapeutic agents in many different clinical applications including but not restricted to, such as mental disorders, metabolic disorders, cardiovascular diseases, inflammatory diseases and neurological disorders.

Many natural products such as prebiotics, probiotics, antioxidants and fatty acids and herbal medicines have shown a positive impact on immune regulation in the human body.

Immune system control in a pleiotropic manner and participate in various processes of innate and adaptive human immunity. Natural products have good potential as targeted immune modulators especially in preventive measures and also in the treatment of certain types of immunologic and inflammatory diseases [16].

**Polyphenols:** These are reported to have immune-modulatory activities and are pharmacologically very active. Fruits, vegetables, and cereals are rich in polyphenolic compounds which have the prospective health benefits. These compounds are also found to be shielding agents against the occurrence of degenerative or chronic ailments together with cancer and many other inflammatory diseases. Recently these bioactive molecules have been of great interest as they fight against inflammation and immunomodulatory agents, especially in neoplasia where the pro-inflammatory context may elevate carcinogenesis [17]. The effects of polyphenols are most likely related to the immunomodulatory properties of which are capable of regulating cytokine and chemokine production and activating immune cells.

Among polyphenol studies, the most prominent study is on resveratrol. Resveratrol is found in grapes, wine, grape juice, peanuts, cocoa, and berries of *Vaccinium* species, including blueberries, bilberries, and cranberries. The efficacy of moderate to severe resveratrol has been demonstrated in an animal model of acute ulcerative colitis. Resveratrol, a natural polyphenol and a stilbenoid, treatment is accompanied by the regulation of T regulatory (Treg)/T helper 17 (Th17) balance and the plasma level and intestinal mucosal cytokines along with interleukin 10 (IL-10), transforming growth factor-beta1 (TGF- $\beta$ 1), interleukin 6 (IL-6), and interleukin 17 (IL-17) [18]. It helps build innate immunity.

**Curcumin:** A non-flavonoid compound which suppresses the growth of Dextran Sulfate Sodium (DSS)-induced colitis in a mouse model. It manifests the action by hindering NF- $\kappa$ B activation and the mucosal Treg cells induction. Treatment with

curcumin nanoparticles led to changes in the gut microbial composition and changes in faecal short-chain fatty acids level, suggesting that curcumin nanoparticles may be a therapeutic option treating IBD diseases [19].

**Trans-Scirpusin A:** Some other polyphenols found useful for immune modulation include Trans-Scirpusin A (TSA), a resveratrol oligomer, cocoa, a flavonoid compound, has been shown to affect the gut immune responses in young rats by increasing the amount of  $\gamma\delta$  T cells and reducing the effect of IgA [17].

**Quercetin and piperine:** Foods rich in isoquercitrin include leafy vegetables, broccoli, red onions, peppers, apples, grapes, black tea, green tea, red wine, and some fruit juices. This is a flavonoid and non-flavonoid compound and when combined, it produces an efficacious anti-inflammatory strategy for treating acute colitis in mice. This anti-inflammatory effect was regulated by impaired DC immune responses. In addition, quercetin has been shown to interfere with the onset of IBD by suppressing the secretion of TNF- $\alpha$  [20].

#### **Antioxidants and management of COVID-19**

Vitamin C has always been used as an immune-boosting agent when it comes to common respiratory conditions and infections. Being a powerful antioxidant, it is found in common household products such as citrus as well as a large variety of over the counter supplements, including Airborne, Emergen-C. Historically vitamin C has been used to manage common colds, flu, and other similar illnesses as a part of decoctions and home remedies. According to Carr A. (2020), there is reported oxidative stress damage from the COVID-19 infection and vitamin C levels can be depleted from increasing the demand for it [21]. With the aging population with precondition such as diabetes, heart problems, blood pressure and so on [22], due to high risk of infection, they may not be able to get the daily requirements of nutrients and vitamins due to the inability to go shopping for groceries and necessities, due to quarantines and store closures. Clinical trials data whether vitamin C infusions are effective in treating COVID-19 are not conclusive, but due to its low capacity for side effects, it is recommended as an adjunct treatment [23].

**Astaxanthine:** This is a popular antioxidant carotenoid which has been recommended for brain health, eye health, cardiovascular support, muscle joint strength and tendon maintenance. Found readily in animal and natural plants and used widely for improving innate immunity [24,25].

**Coenzyme Q 10:** This is considered to be the third most popular dietary supplement. It is widely recommended for heart health, brain health, increased mental activity, useful in fatigue and tiredness, muscle pain and headaches. It is also

recommended to be good mitochondrial support, which in turn helps in improving innate immunity of the user [23].

**Curcumin:** It is ranked to be number one in dealing with pain and inflammation; the initial symptoms of COVID-19 are inflammation of throat before it enters the lungs. Some of the health challenges where Curcumin is proved to be useful include pain /inflammation, joint health, heart and cardiovascular health, weight management (interestingly obese people have shown more vulnerability for COVID-19 infections in younger age) skin health and depression [26].

**Probiotics and prebiotics:** The word probiotic has two parts: pro means for and bios meaning life. Probiotics are useful for life and in the real sense from nutraceuticals perspective; it is also live bacteria dispersion, which is very helpful for life (human). If you visit any market, there are hundreds of probiotic products available and which are over the counter preparations does not need any prescription from the physicians. Most of these probiotic preparations are used to replenish the microbiota, as mentioned above which lays an important role in innate immunity for human beings. As early as 1905, Dr Elie Metchnikoff, who later received Noble prize for his work on immune systems mentioned about health benefits of Probiotics [27]. Dr Metchnikoff mentioned about Bulgarian farmers who lived much longer and he found that they consumed yogurt containing live bacteria. Most of the probiotics consist of a live suspension of *Lactobacillus acidophilus*, *L. rhamnosus*, *Bacillus bifidum*, *B. breve*, *B. longum* and *B. lactis*. Probiotics with live bacteria provide long-term colon care and raise bacterial count in colon, it also provides deep intestinal microbiota, and finally, it helps to build immunity to fight the increased physical, emotional and mental stress especially in case of infections and other external triggers [28-29]. Several reports are depicting the application of probiotics and its antioxidant uses in one of the chapters in our book. I request the readers to go and read that particular chapter to get an in-depth understanding of probiotics in building innate immunity for human beings [30].

**Prebiotics:** Prebiotics have been defined by Gibson and Roberfroid 1995, as non-digestible food ingredients which help the growth of selective bacteria present in the colon of the host and thus helps to improve the overall health of the consumer. Prebiotics also help to modify the bacterial contents of the intestine and in turn also help to build the innate immunity [27]. Some of the commonly used prebiotics known are inulin, lactoferrin and fructooligosaccharides. Mostly the fruits and vegetables act as prebiotics which has high fibre contents.

**Indonesian Jamu:** In Indonesia, for many centuries certain products have been used for inner and outer health of human beings. These are not much known to the westerners. Jamu are preparations using herbal and mineral natural products which

are used for building innate immunity and maintain the overall health [31]. The commonly used Jamu preparations contain antioxidant ingredients such as turmeric, ginger [32], and so on.

Some of the popular Jamu preparations include sprit lemonade with honey to prevent catching a cold and viral infections, ginger honey for throat infections, Beras Kenchur for tiredness, exhaustion, helps to improve blood circulation. This contains local herb Kenchur, tamarind, raw rice and brown sugar. Another Jamu preparation which is well known, Kunir Asam which is a general tonic and used to treat infections and obesity, this contains turmeric, tamarind, palm sugar and ginger. Even though Indonesian Jamu is used by a large population, in Indonesia, there is a need for research on its applications and usefulness so that these simple and cheap remedies can be used for building the innate immunity [33].

### **Conclusion**

With the world witnessing a pandemic due to COVID-19, and there is no cure in near sight neither there is any hope for a quick vaccine, people are definitely turning to the alternative medicines. It is observed that worldwide deaths have occurred mostly in the lower economic strata of the society including the countries like USA, UK, and so-called developed nations. Unless we come up with some simple and cheaper solutions to this challenge it will be hard for the people to survive. Based on the situation, preventive measures will be very helpful for the second and third wave of the COVID-19 which is expected to happen in the coming few months to few years. The natural products are a great resource and can be widely used and distributed around the world easily accessible to rich or poor, I think we need to look at these products favourably and provide the help to the needy.

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