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# Immunity: A Strong Defense against Corona Virus

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**Abstract:** ***The objective of this paper was to boost immunity system for strong defense against Coronavirus. The boosting of immunity power was aimed at proper diet system. The food items considered in this paper were citrus fruits, red bell peppers, broccoli, ginger, spinach, almonds, turmeric, papaya, kiwis, sunflower seeds, turkey or chicken meat, yoghurt and green Tea. Yoga exercises were also mentioned to enhance &Oxygen saturation. Three types of mechanisms, how T cells and B cells could defense viruses, were also discussed.***

**Keywords:** Diet, yoga, sleep, immunity, T cells, B cells, antibodies, novel coronavirus, covid-19

## 1. Introduction

Corona viruses pose severe health threats to human beings. It was originated from Wuhan, China and spread across the whole world. Corona viruses belong to the family Corona viridae in the order Nidovirales [1, 2]. The World Health Organization (WHO) declared the illness resulting from the new virus, COVID-19 (figure 1). The novel corona virus—newly named SARS-CoV-2—has infected more than 97, 29, 006 people worldwide and killed at least 492, 153 as on the date June 26, 2020. In India the corona virus cases are 4, 91,741 and deaths are 15,319as on the date June 26, 2020. Now, the corona virus is rapidly increasing in India as shown in figure 2.

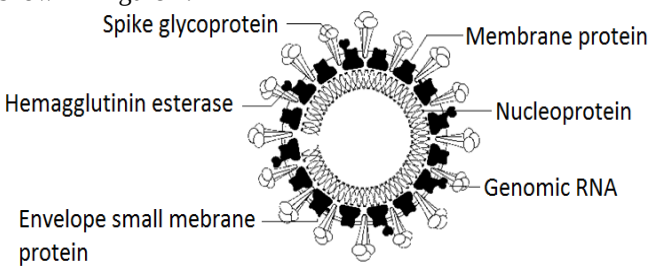


**Figure 1**: COVID-9 structure.

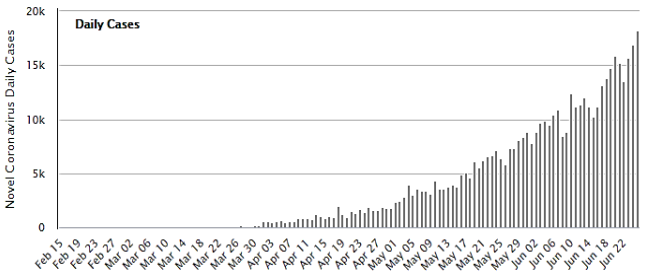


**Figure 2:** Corona viruses daily cases in India.

COVID-19 affects different people in different ways. The symptoms are as follows:

**Serious symptoms:**
Difficulty breathing or shortness of breath
Chest pain or pressure
Loss of speech or movement

**Most common symptoms:**
Fever
Dry cough
Tiredness

**Less common symptoms:**
Aches and pains
Sore throat
Diarrhoea
Conjunctivitis
Headache
Loss of taste or smell

To prevent the spread of COVID-19 the following precautions are enlisted by different Governments and health organizations:

- Clean your hands often. Use soap and running water, or an alcohol-based hand rub.
- Maintain a safe distance (6 feet) from anyone who is coughing or sneezing.
- Don't touch your eyes, nose or mouth.
- Cover your nose and mouth with your bent elbow or a tissue when you cough or sneeze.
- Stay home if you feel unwell.
- If you have a fever, cough and difficulty breathing, seek medical attention.
- Follow the directions of your local organization.

To date, there are no specific vaccines or medicines for coronavirus. COVID–19 was declared as a global pandemic by WHO. Persons, who are with pre-existing illnesses such as diabetes, hypertension, cardio vascular disease, and respiratory issues, are at a higher risk of having COVID-19 complications. It may aggravate with age as the general immunity reduces as we become older.

Till today, the strong defense against coronavirus is only our immune system. Our immune systems are designed to fight off sicknesses and viruses. Nutrients essential to fight infection include vitamins A, B, C, D, and E, and the minerals iron, selenium, and zinc.This paper presents various vegetables that are the sources for the said vitamins and minerals toboost our immunity levels.If we have a healthy immune system, our body can defenseus from any disease, even the novel coronavirus or COVID-19.

## 2. What is Immunity System?

The immune system protects the body against disease or other potentially harmful foreign bodies. When functioning properly, the immune system identifies and attacks a variety of threats, including viruses, bacteria and parasites, while distinguishing them from the body's own healthy tissue.

The cells of our immune system include T-cells, which fight conquering molecules directly, and the B-cells, which form antibodies that can respond to invading molecules. The antibodies produced by the B-cells can bind with a damaging molecule or to the surface of a virus or bacteria. Our immune system also includes the phagocytic cells, such as macrophages and neutrophils, which remove the debris created from destroying cells and tissue at the site of an infection [3].

## 3. How to Boost Immunity

Vitamin C decreases the severity of symptoms associated with upper respiratory viral infections, promote phagocytic cell functions, and support healthy T-cell function. B vitamins promote the production and release of antibodies from B-cells. Vitamin A also promotes antibody function and T-cell activity. Vitamin E is a vital antioxidant and supports a healthy inflammatory response. Vitamin K supports a healthy blood-clotting ability in our body. Zinc is a potent immunostimulant, and its shortage can result in deep suppression of T-cell function. Copper deficiency is associated with an increase in infections and may impair growth of immune cells such as T-cells and the phagocytic cells. Selenium and manganese are important for supporting healing from inflammation and may be immunostimulants [4].

Although there is no vaccination or medicines available so far, the best way to defense this pandemic is to stay away from it by taking precautions and building immunity. The food we eat plays a key facet in determining our overall health and immunity. Essential ways to boost immunity against Coronavirus are discussed below:

**Figure 3:** Citrus fruits

### 3.1 Citrus fruits

Our body does not produce vitamin C, which means we need to get it through the food we eat. Although numerous types of viruses can cause a common cold, rhinoviruses are the most common offender. A cold virus enters our body through our mouth, eyes or nose. The virus can spread through droplets in the air when someone who is sick coughs, sneezes or talks. Several scientific studies have proposed that vitamin C fights against the cold virus. Vitamin C acts as an antioxidant, protecting cells from damage caused by free radicals. Vitamin C (also known as ascorbic acid) is a water-soluble nutrient found in leafy greens and citrus fruits as shown in figure 3. Popular citrus fruits include grapefruit, oranges, clementines, tangerines, lemons and limes.

**Grapefruit** is an excellent source of vitamin C, which supports the immune system. Grapefruit of 128.00 grams gives 41 calories. The constituents of nutrients in the grapefruit are given table 1.Lycopene is only found in pink and red grapefruit. Lycopene appears to have anti-tumor activity. In many animal studies and laboratory tests with human cells, limonoids have been revealed to help fight cancers of the mouth, skin, lung, breast, stomach and colon. Red grapefruit can reduce blood levels of LDL ("bad") cholesterol. Grapefruit juice also prevents kidney stones. In humans, drinking three 6-ounce glasses of grapefruit juice a day was shown to decrease the activity of an enzyme that activates cancer-causing chemicals found in tobacco smoking. Naringenin in grapefruit, helps repair damaged DNA in human prostate cancer cells (cell line LNCaP) [5].

**Table 1:** Nutrients in grapefruit

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 1410 | 5 |
| Vitamin A | 0.0593 | 7 |
| Thiamine (B1) | 0.05 | 4 |
| Pantothenic acid (B5) | 0.36 | 7 |
| Vitamin C | 44.03 | 59 |
| Biotine (vitamin H) | 0.0013 | 4 |
| Copper | 0.06 | 7 |
| Potassium | 177.92 | 4 |

**Oranges** are also an exceptional source of vitamin C. Oranges of 130.00 grams gives 62 calories. The constituents of nutrients in the oranges are given table 2. The healing properties of oranges are on account of wide variety of phyto nutrient compounds. These phytonutrients include citrus flavanones. Herperidin molecule in phytonutrient lowers high blood pressure as well as cholesterol. Folate in oranges offers protection against cardiovascular disease. Also proved that limonoids in oranges help to fight cancers of the mouth, skin, lung, breast, stomach and colon. The fiber content in oranges diminishes high cholesterol levels thus serving to prevent atherosclerosis. Fiber can also keep blood sugar levels under control which may thus be a very healthy snack for people with diabetes. Oranges also prevent the formation of kidney stones. An orange a day may keep gastric ulcers away and reduce risk for stomach cancer. Beta-cryptoxanthin in oranges may defend respiratory health [6].

**Table 2:** Nutrients in oranges

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 3140 | 11 |
| Thiamine (B1) | 0.11 | 9 |
| Pantothenic acid (B5) | 0.33 | 7 |
| Folate (B9) | 0.0393 | 10 |
| Vitamin C | 69.69 | 93 |
| Copper | 0.06 | 7 |
| Calcium | 52.40 | 5 |
| Potassium | 237.11 | 5 |

**Clementines** are also good source ofvitamin C, which is a powerful antioxidant and immune booster that can prevent cellular damage from harmful and unstable compounds called free radicals. Clementines of 74.00 grams give 35 calories. The constituents of nutrients in the clementines are given table 3. Clementine provides folate and thiamine (B1)

which prevents anemia and promoting a healthy metabolism. Beta carotene is a precursor to vitamin A beinginfluential antioxidant promotes healthy cell growth and sugar metabolism [7].

**Table 3:** Nutrients in clementines

| *Nutrient* | *Amount, mg* | *DRI/DV(%)* |
|---|---|---|
| Fiber | 1300 | 5 |
| Thiamine (B1) | 0.10 | 4 |
| Niacine (B3) | 0.50 | 2 |
| Pantothenic acid (B5) | 0.151 | 3 |
| Pyridoxine (B6) | 0.10 | 3 |
| Folate (B9) | 0.018 | 4 |
| Vitamin C | 36.1 | 60 |
| Vitamin E | 0.10 | 1 |
| Copper | 0.043 | 5 |
| Calcium | 30.00 | 2 |
| Potassium | 177.00 | 4 |

**Tangerines** also contain vitamin C. Tangerines of 76.00 grams gives 40 calories.The constituents of nutrients in the tangerines are given table 4.Tangerines contain a variety and amounts of phytonutrients, which can protect cells from damage, reduce inflammation and lower the risk of cardiovascular disease.Both vitamins A and C play an important role in the maintenance of eye health. Vitamin A is a fat-soluble vitamin that maintains healthy retina and cornea function.Zinc being potent immunostimulant promotes T-cell function.

**Table 4:** Nutrients in tangerines

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 3500 | 14 |
| Vitamin A | 889.76 | 27 |
| Thiamine (B1) | 0.1 | 8 |
| Niacine (B3) | 0.7 | 4 |
| Pantothenic acid (B5) | 0.4 | 4 |
| Pyrodoxine (B6) | 0.2 | 8 |
| Folate (B9) | 0.031 | 8 |
| Vitamin C | 52.1 | 87 |
| Vitamin E | 0.4 | 2 |
| Copper | 0.1 | 4 |
| Calcium | 72.2 | 7 |
| Potassium | 324.0 | 9 |
| Zinc | 0.1 | 1 |

**Lemons and limes** contain 31% vitamin C. Lemons and limes of 61.00 grams give 13 calories. The constituents of nutrients in the lemons and limes are given table 5.Limes are small, round, and green, while lemons are usually larger, oval-shaped, and bright yellow. Nutritionally, both share many of the similar potential health benefits. Lemons and limes contain flavonoid compounds that have antioxidant and anti-cancer properties. Lime juice is found to have a strong protective effect against cholera [8].Lemon and lime have high oxalate content. The citrates from these juices can bind to calcium in place of oxalates, thus lowering supersaturation of the urine with calcium oxalate.

**Table 5:** Nutrients in lemons and limes

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Thiamine(B1) | 0.01 | 1 |
| Riboflaine (B2) | 0.01 | 1 |
| Pantothenic acid (B5) | 0.08 | 2 |
| Pyridoxine (B6) | 0.03 | 2 |
| Folate (B9) | 0.012 | 3 |
| Vitamin C | 23.61 | 31 |
| Vitamin E | 0.09 | 1 |
| Copper | 0.01 | 1 |
| Magnesium | 3.66 | 1 |
| Potassium | 62.83 | 1 |

The recommended daily amount of citrus fruits for most adults is 75 mg for women and 90 mg for men. Therefore, all citrus fruits are excellent source of T-cells and B-cells to fight viral infection.

**Figure 4:** Red bell peppers

**Table 6:** Nutrients in red bell peppers

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 1850 | 7 |
| Vitamin A | 0.144 | 16 |
| Thiamine (B1) | 0.05 | 4 |
| Riboflavine (B2) | 0.08 | 6 |
| Niacine (B3) | 0.90 | 6 |
| Pantothenic acid (B5) | 0.29 | 6 |
| Pyridoxine (B6) | 0.27 | 16 |
| Folate (B9) | 0.0423 | 11 |
| Vitamin C | 117.48 | 157 |
| Vitamin E | 1.45 | 10 |
| Vitamin K | 0.0045 | 5 |
| Molybdenum | 0.0046 | 10 |
| Manganese | 0.10 | 4 |
| Potassium | 194.12 | 4 |
| Phosphorus | 23.92 | 3 |
| Magnesium | 11.04 | 3 |

### 3.2 Red bell peppers

If we want more vitamin C, it is better to add red bell peppers (figure 4) to our fruit salad. Red bell peppers of 92.00 grams give 29 calories. The constituents of nutrients in the oranges are given table 6. One red bell pepper contains 118 mg of vitamin C. Bell red peppers provide a number of B vitamins (including vitamin B1, vitamin B2, vitamin B3, foloate, and pantothenic acid, vitamin E, vitamin K, potassium, molybdenum, manganese, phosphorus, magnesium and fiber. Red bell peppers are also a great source of beta carotene, a precursor of vitamin A. Besides boosting our immune system, vitamin C may assist to maintain healthy skin [9]. Beta carotene, which our body converts into vitamin A, supports healthy eyes and skin. One cooked pepper has 19% of our daily recommended amount of beta carotene. Hence, red bell peppers are excellent source of T-cells and B-cells to fight viral infection.

Therefore, we should eat one medium bell pepper a day which is equivalent to 75 to 150 micrograms a day.

### 3.3 Broccoli

Broccoli is boosted with vitamins and minerals. Broccoli of 156.00 grams gives55 calories. The constituents of nutrients in the oranges are given table 7.It is rich in vitamins A, B6,B2, B1, C, E and K. Its phytochemicals can fortify our immune system. Broccoli is a good source of lutein, a powerful antioxidant, and sulforaphane [10, 11]. The key anti-inflammatory ITC (Isothiocyanates) provided by broccoli is sulforaphane. Lack of omega-3 fat is dietary problem that can cause over-activation of the inflammatory system. As contains omega-3 fat, it provides anti-inflammatory benefits.It also comprises additional nutrients, including magnesium, phosphorus, zinc, chromium, selenium and iron. The unique combination of antioxidant, anti-inflammatory, and pro-detoxification components in broccoli make it a unique food in terms of cancer prevention. Broccoli can also lower levels of LDL-cholesterol in our blood stream. Hence, broccoli are excellent source of T-cells and B-cells to fight viral infection.

**Table 7:** Nutrients in broccoli

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 5150 | 18 |
| Protein | 3.71 | 7 |
| Vitamin A | 0.121 | 13 |
| Thiamine (B1) | 0.10 | 8 |
| Riboflavine (B2) | 0.19 | 15 |
| Niacine (B3) | 0.86 | 5 |
| Pantothenic acid (B5) | 0.96 | 19 |
| Pyridoxine (B6) | 0.31 | 18 |
| Folate (B9) | 0.169 | 42 |
| Vitamin C | 101.24 | 135 |
| Vitamin E | 2.26 | 15 |
| Vitamin K | 0.220 | 245 |
| Omega-3 fats | 0.19 | 8 |
| Choline | 62.56 | 15 |
| Phosphorus | 104.52 | 15 |
| Manganese | 0.30 | 13 |
| Copper | 0.10 | 11 |
| Potassium | 457.08 | 10 |
| Chromium | 0.0186 | 53 |
| Magnesium | 32.76 | 8 |
| Zinc | 0.70 | 6 |
| Calcium | 62.40 | 6 |
| Iron | 1.05 | 6 |
| Selenium | 0.0025 | 5 |

The key to keeping its power intact is to cook it as little as possible or even eat it raw. If we eat 1 cup of broccoli per day (whether it is with a meal or snack), we are nearly halfway to the recommended daily intake of vegetables for adults.

**Figure 5:** Broccoli

### 3.4 Garlic

Early civilizations recognized its value in fighting infections. Garlic of 18.00 grams (6 cloves) size give 27 calories. The constituents of nutrients in the garlic are given table 8. The immune boosting of garlics (figure 6) is due to its sulfur containing compounds, such as allicin. Allicin improves our immune cells' ability to fight against colds and flu, and viruses of all kinds. Platelets are one type of blood cell, just like red blood cells or white blood cells. Ajoenes in garlic can decrease the risk of unwanted clotting due to excessive platelet clumping. Garlic has antibacterial, antiviral, and antifungal properties. Cigarette smoking increases the risk of osteoporosis, inadequate bone mineral density and inability to heal from bone fractures. Intake of garlic may reduce the potential damage caused by chronic exposure to cigarette smoke [12]. Also, when there is too little adiponectin in our blood, we have risk of type 2 diabetes and certain cardiovascular problems.12 weeks of garlic consumption has been shown to increase blood levels of adiponectin in human participants. Hence, garlic could be strong defense against coronavirus.

**Figure 6:** Garlic

**Table 8:** Nutrients in garlic

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Thiamine (B1) | 0.04 | 3 |
| Pyridoxine (B6) | 0.22 | 13 |
| Vitamin C | 5.62 | 7 |
| Manganese | 0.30 | 13 |
| Copper | 0.05 | 6 |
| Selenium | 0.0026 | 5 |
| Phosphorus | 27.54 | 4 |
| Calcium | 32.58 | 3 |

The optimal amount of garlic to eat is two to three cloves a day.

### 3.5 Ginger

Ginger of 6.00 grams gives5 calories. Ginger has a long tradition of being very effective in alleviating symptoms of gastrointestinal distress. Ginger (figure 7) may help decrease inflammation, which can reduce a sore throat (swollen glands) and inflammatory illnesses. Ginger may help with nausea as well. Gingerol is accountable for much of its medicinal properties. It has powerful anti-inflammatory and antioxidant benefits.Ginger promotes healthy sweating. The sweat contains a potent germ-fighting agent that may help fight off infections.

**Figure 7:** Ginger

3–4 grams of ginger extract a day, or up to three cups of ginger tea is advisable. Not more than 1 gram a day is worth for pregnant lady. Some studies have linked high dosages to an increased risk of miscarriage.

### 3.6 Spinach

Spinach of 180.00 grams gives41 calories. The constituents of nutrients in the spinach are given table 9. Spinach is a rich source of fiber, phosphorus, vitamin B1, zinc, protein, and choline, and as a good source of omega-3 fatty acids, vitamin B3, pantothenic acid, and selenium. Spinach (figure 8) contains not only vitamin C but also antioxidants and beta carotene, both improve our immune system to fight against coronavirus. In the phytonutrient category, spinach flavonoids are important as they contain glucuronide and glucopyranonside forms of the flavonoids spinacetin, patuletin, and jaceidin [13].All of the flavonoids have anti-inflammatory properties. Spinach is also a rich source of neoxanthin and violaxanthin. Omega-3 flats (alpha-linolenic acid, stearidonic acid and eicosapentaenoic acid) play a critical role in regulation of inflammation throughout our body. Thylakoid-rich extracts from spinach delay stomach emptying and decrease levels of hunger-related hormones like ghrelin.

**Figure 8:** Spinach

**Table 9:** Nutrients in Spinach

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 4320 | 15 |
| Protein | 5350 | 11 |
| Vitamin A | 0.943 | 105 |
| Thiamine (B1) | 0.17 | 14 |
| Riboflavine (B2) | 0.42 | 32 |
| Niacine (B3) | 0.88 | 6 |
| Pantothenic acid (B5) | 0.26 | 5 |
| Pyridoxine (B6) | 0.44 | 26 |
| Folate (B9) | 0.263 | 66 |
| Vitamin C | 17.64 | 24 |
| Vitamin E | 3.74 | 25 |
| Vitamin K | 0.889 | 987 |
| Omega-3 fats | 170 | 7 |
| Choline | 35.46 | 8 |
| Manganese | 1.68 | 73 |
| Magnesium | 156.60 | 37 |
| Iron | 6.43 | 36 |
| Copper | 0.31 | 34 |
| Calcium | 244.80 | 24 |
| Potassium | 838.80 | 18 |
| Phosphorus | 100.80 | 14 |
| Zinc | 1.37 | 12 |
| Selenium | 0.0027 | 5 |

Hence, spinach are excellent source of T-cells and B-cells to fight viral infection. One cup fresh spinach or 1/2 cup cooked per day is good for health.

**Table 10:** Nutrients in Almonds

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Riboflavine (B2) | 0.2 | 18 |
| Vitamin E | 6.03 | 40 |
| Biotin | 0.0147 | 49 |
| Copper | 0.23 | 26 |
| Manganese | 0.53 | 23 |
| Phosphorus | 111.32 | 16 |
| Molybdenum | 0.0068 | 15 |
| Magnesium | 61.64 | 15 |

### 3.7 Almonds

Almonds of 23.00 grams give 132 calories. The constituents of nutrients in the almonds are given table 10. Almonds (figure 9) are high in monounsaturated fats which reduce the risk of heart disease. In several health studies it was reported that consumption of almonds is linked to a lower risk for heart disease [14]. Almonds lower LDL cholesterol levels. These effects are due to the antioxidant action of the vitamin E found in the almonds. A deficiency of magnesium is associated with heart attack. Magnesium in almonds improves the flow of blood, oxygen and nutrients throughout the body. Potassium being an important electrolyte involved in nerve transmission and the contraction of all muscles including the heart, is another mineral that is essential for maintaining normal blood pressure and heart function. Vitamin E in almonds will also help fighting off colds and flu and is key to our immune system. It is a fat-soluble molecule. Hence, it requires the presence of fat to be absorbed, so nuts are the perfect package for E to make it into our system.

**Figure 9:** Almonds

Adults only need about 15 mg of vitamin E each day. A half-cup serving, or 46 whole, shelled almonds, provides almost 100 percent of our RDA of vitamin E.

### 3.8 Turmeric

We know turmeric (figure 10) as a key ingredient in many curries. Turmeric of 4.40 grams gives16 calories. The constituents of nutrients in the turmeric are given table 11. This highly pigmented spice is known for its anti-inflammatory qualities in treating both osteoarthritis and rheumatoid arthritis. It boosts the immune system by stimulating antibody formation. High concentrations of curcumin, which gives turmeric its distinctive color, can help decrease exercise-induced muscle damage. Curcumin has promise as an immune booster and an antiviral. There are mechanisms that allow curcumin to lower cancer risk. These mechanisms include: antioxidant mechanisms, anti-inflammatory mechanisms, immuno-regulatory mechanisms, enzyme-related mechanisms, cell signaling mechanisms, and cell cycle mechanisms [15]. Turmeric can also lower levels of blood triglycerides.


**Figure 10:** Turmeric

**Table 11:** Nutrients in Turmeric

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 0.93 g | 3 |
| Pyrodoxine (B6) | 0.08 mg | 5 |
| Manganese | 0.34 mg | 15 |
| Iron | 1.82 mg | 10 |
| Copper | 0.03 mg | 3 |

500-1000 mg of curcumin can help to fight inflammation and power up our immune system.

### 3.9 Papaya

Papaya of 276.00 grams gives 119 calories. The constituents of nutrients in the papaya are given table 12. Papaya (figure 11) is an excellent source of vitamin A and vitamin C. In addition, it consists of dietary fiber, folate, magnesium, potassium, copper and vitamin K. These nutrients promote the health of the cardiovascular system and also provide protection against colon cancer. Papaya also has a digestive enzyme called papain that has anti-inflammatory effects. When cholesterol becomes oxidized it may stick to and build up in blood vessel walls, forming dangerous plaques that can eventually cause heart attacks or strokes. These nutrients also prevent the oxidation of cholesterol. Papaya also contains B-complex vitamins (B1, B2, B3, B6 and B12). Papayas may prevent atherosclerosis and diabetic heart disease. The folate (vitamin B9), which is a powerful cell rebuilder. People who are folate-deficient have compromised immune systems. Papaya also contains protein-digesting enzymes including papain and chymopapain [16]. These enzymes lower inflammation. Vitamin C and vitamin A from the beta-carotene in papaya, boost the immune system.

**Table 12:** Nutrients in Papaya

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 4690 | 17 |
| Vitamin A | 0.131 | 15 |
| Thiamine (B1) | 0.06 | 5 |
| Riboflavine (B2) | 0.07 | 5 |
| Niacine (B3) | 0.99 | 6 |
| Pantothenic acid (B5) | 0.53 | 11 |
| Pyridoxine (B6) | 0.10 | 6 |
| Folate (B9) | 0.102 | 26 |
| Vitamin C | 168.08 | 224 |
| Vitamin E | 0.83 | 6 |
| Vitamin K | 7.18 | 8 |
| Choline | 16.84 | 4 |
| Magnesium | 57.96 | 14 |
| Manganese | 0.11 | 5 |
| Copper | 0.12 | 13 |
| Potassium | 502.32 | 11 |
| Iron | 0.69 | 4 |
| Calcium | 55.20 | 6 |
| Selenium | 0.0017 | 3 |
| Sodium | 22.08 | 1 |
| Zinc | 0.22 | 2 |

**Figure 11:** Papaya

Hence, papaya is an excellent source of T-cells and B-cells to fight viral infection. One medium papaya has approximately: 120 calories. 30 grams of carbohydrate – including 5 grams of fiber and 18 grams of sugar.

### 3.10 Kiwis

Kiwis of 69.00 grams give 42 calories. The constituents of nutrients in the kiwis are given table 13. Kiwis have ability to protect DNA in the nucleus of human cells from oxygen-related damage. Since kiwi contains a variety of flavonoids and carotenoids which have antioxidant activity. These phyto nutrients in kiwi may be responsible for DNA protection [17]. Kiwi has a significant protective effect against respiratory symptoms associated with asthma such as wheezing. In one study [18], shortness of breath was reduced by 32%, severe wheeze by 41%, night time cough by 27%, chronic cough by 25%, and runny nose by 28%.Opthamology studies indicate that eating 3 or more kiwi fruits per day may lower the risk of age-related macular degeneration (ARMD). Like papayas, kiwis (figure 12) are naturally consisting of essential nutrients, including folate, potassium, vitamin K,

and vitamin C. These vitamins in combination build healthy cells, fight infection and keep our immune system robust. Vitamin K deficiency is rare but when people do not have enough, they suffer from weak bones and compromised immune systems. The inflammation system in the body is also dependent on vitamin K, especially our killer T cells that mobilize and fight virus, cancer and other diseases.

**Table 13:** Nutrients in Kiwis

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 2070 | 7 |
| Folate (B9) | 0.0173 | 4 |
| Vitamin C | 63.96 | 85 |
| Vitamin E | 1.01 | 7 |
| Vitamin K | 0.028 | 31 |
| Copper | 0.09 | 10 |
| Potassium | 215.28 | 5 |

**Figure 12:** Kiwis

Eating one to three kiwis a day is enough for most people to get the boost of nutrients from the fruit.

### 3.11 Sunflower seeds

Sunflower seeds of 35.00 grams give 204 calories. The constituents of nutrients in the sunflower seeds are given table 14.

Sunflower seeds (figure 13) are full of nutrients, including phosphorous, magnesium, selenium and vitamins B-6 and E. Our immune system needs vitamin E to function on full throttle.Vitamin E travels throughout the body neutralizing free radicals that would otherwise damage fat-containing structures and molecules, such as cell membranes, brain cells, and cholesterol. By protecting these cellular and molecular components, vitamin E has significant anti-inflammatory effects that result in the reduction of symptoms in asthma, osteoarthritis, and rheumatoid arthritis. A variety of studies, mostly performed on animals, have looked at its potential to combat viral infections such as swine flu (H1N1). Sunflower seeds which are richest in phytosterols, can lower cholesterol. Sunflower seeds are a good source of magnesium. Numerous studies have demonstrated that magnesium helps reduce the severity of asthma, lower high blood pressure, and prevent migraine headaches, as well as reducing the risk of heart attack and stroke. Sunflower seeds are also a good source of selenium [19]. Selenium can repair DNA, inhibit the proliferation of cancer cells, and induce their apoptosis. 30 grams per day is considered healthy.

**Table 14:** Nutrients in sunflower seeds

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Thiamine(B1) | 0.52 | 43 |
| Niacine (B3) | 2.92 | 18 |
| Pyridoxine (B6) | 0.47 | 28 |
| Folate (B9) | 0.0795 | 20 |
| Vitamin E | 12.31 | 82 |
| Copper | 0.63 | 70 |
| Selenium | 0.0186 | 34 |
| Phosphorus | 231.00 | 33 |
| Manganese | 0.68 | 30 |
| Magnesium | 113.75 | 27 |

**Figure 13:** Sunflower seeds

### 3.12 Pumpkin seeds

Pumpkin seeds of 100.00 grams give 446 calories. The constituents of nutrients in the pumpkin r seeds are given table 15. Pumpkin seeds (figure 14) are a great source of protein and unsaturated fats, including omega-3. They also contain a good range of nutrients including iron, selenium, calcium, B vitamins and beta-carotene, which the body converts into vitamin A. Nutrients in pumpkins seeds may help protect against type 2 diabetes. Studies have suggested that for every 100 mg a day increase in magnesium intake; the risk of developing type 2 diabetes decreases by approximately 15%.Pumpkin seeds contain omega-3 and omega-6 fatty acids, antioxidants, and fiber. This combination has benefits for both the heart and liver. Vitamin E helps strengthen the immune system and maintain healthy blood vessels.Pumpkin seeds are a rich source of tryptophan, an amino acid which can be used for the treatment of insomnia. Zinc in pumpkin seeds is also essential for immune function and prevention of uterine infections.

Hence, pumpkin seeds could be strong defense against coronavirus. For male adults aged 19 years and above, the ODS recommend a daily intake of 11 mg of zinc and 8 mg for women.

**Figure 14:** Pumpkin seeds

**Table 15:** Nutrients in pumpkin seeds

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Fiber | 1800 | 72% |
| Thiamine (B1) | 0.07 | 6% |
| Riboflavin (B2) | 0.15 | 13% |
| Niacin (B3) | 4.43 | 30% |
| Pantothenic acid (B5) | 0.57 | 11% |
| Vitamin B6 | 0.10 | 8% |
| Folate (B9) | 0.057 | 14% |
| Vitamin C | 6.50 | 8% |
| Vitamin E | 0.56 | 4% |
| Vitamin K | 0.005 | 4% |
| Calcium | 52.00 | 5% |
| Iron | 8.07 | 62% |
| Magnesium | 550 | 155% |
| Manganese | 4.49 | 214% |
| Phosphorus | 1174 | 168% |
| Potassium | 788 | 17% |
| Sodium | 256 | 17% |
| Zinc | 7.64 | 80% |

### 3.13Chicken Meat

Chicken meat of 113.40 grams gives187 calories. The constituents of nutrients in the chicken meat(figure 15) are given table 16.Chicken meat is known for its high protein content. All B vitamins are present in chicken meat, including B1, B2, B3, B5, B6, B12, folate, biotin, and choline [20].Vitamin B6 is an important role in many of the chemical reactions that happen in the body. It is also vital to the formation of new and healthy red blood cells. The soup may help lower inflammation, which could improve symptoms of a cold.

**Table 16:** Nutrients in chicken meat

| *Nutrient* | *Amount, mg* | *DRI/DV (%)* |
|---|---|---|
| Protein | 35180 | 70 |
| Niacine (B3) | 15.55 | 97 |
| Pantothenic acid (B5) | 1.09 | 22 |
| Pyridoxine (B6) | 0.68 | 40 |
| Vitamin B12 | 0.0004 | 16 |
| Selenium | 0.0313 | 57 |
| Phosphorus | 258.55 | 37 |
| Choline | 96.73 | 23 |

**Figure 15:** Chicken meat

About 85 grams of turkey or chicken meat (figure 14) contains nearly 1/3 of our daily recommended amount of B6.

### 3.14Yoghurt

Yoghurt (figure 15) of 245.00 grams (one cup) gives 150 calories. The constituents of nutrients in the yoghurt are given table 17. Yoghurt is a food produced by bacterial fermentation of milk [21]. The bacteria used to make yogurt are known as yogurt cultures. The fermentation of lactose by these bacteria produces lactic acid, which acts on milk protein to give yogurt its texture and characteristic tart flavor. Cow's milk is commonly available worldwide and, as such, is the milk most commonly used to make yogurt. Yogurt (plain yogurt from whole milk) is 81% water, 9% protein, 5% fat, and 4% carbohydrates, including 4% sugars (table). A 100-gram amount provides 406 kilojoules (97 kcal) of dietary energy. Because it may contain live cultures, yogurt is often associated with probiotics, which have been postulated as having positive effects on immune, cardiovascular or metabolic health [22, 23, 24].

**Figure 15:** Yoghurt

**Table 17:** Nutrients in Yoghurt

| *Nutrient* | *Amount, g* | *DRI/DV (%)* |
|---|---|---|
| Protein | 8.50 | 17 |
| Carbohydrates | 11.42 | 5 |
| Fat - total | 7.96 | 10 |
| Dietary Fiber | 0.00 | 0 |
| Calories | 149.45 | 8 |

### 3.15 Green Tea

We all know green tea (figure 16) is renowned for losing weight. However, it also keeps us safe and strong. Green and

black tea is both supercharged with antioxidants. It has been shown to enhance immune function. It increases compounds in our bodies that fight germs. Have a cup of green tea every day.

**Figure 16:** Green tea

## 4. Yoga and Sleep

Yoga has been used for centuries in keeping the body functioning fit and fine, holistically.

अर्धशक्त्यानिषेव्यस्तुबलिभि: स्निग्धभोजिभि:|
शीतकालेवसन्तेचमन्दमेवततोअन्यदा।||Ashtanga hridaya samhitha suthra**2.11**||
ardhaśaktyā niṣevyastu balibhi: snigdhabhojibhi:|
śītakāle vasante ca mandameva tato anyadā||

"One who is strong and eat unctuous food everyday should use half of one's energy to do exercise. Same to be done in winter season and autumn. In summer and rainy season, one should use less than half energy to do exercise."

**युक्ताहारविहारस्ययुक्तचेष्टस्यकर्मसु**
**युक्तस्वप्नावबोधस्ययोगोभवतिदुःखहा|| Bhagavadgita 6.17||**
yuktāhāra-vihārasya yukta-cheṣhṭasya karmasu|
yukta-svapnāvabodhasya yogo bhavati duḥkha-hā||

"He who is temperate in his habits of eating, sleeping, working and recreation can mitigate all material pains by practicing the yoga system."

Certain yoga positions can support, balance and boost the immune system. Pranayama can act as one of the simplest and effective ways to boost immunity. Pranayama can boost %Oxygen saturation which should be more than 94%. Matsyasana detoxifies and boosts energy levels. Uttanasana relieves congestion and protects the sinuses and mucus membranes. All together eating, exercising and sleeping can also improve immunity system as per Bhagavad Gita.

## 5. Mechanism of Immune Responses to Viruses

When a virus infects a person, it enters the cells of that person in order to survive and replicate. MHC class I (class I major histocompatibility complex proteins) molecules exhibit pieces of protein within the cell onto the cell surface. If the cell is infected with a virus, these pieces of peptide will include fragments of proteins made by the virus. A peptide is a short chain of amino acids. The amino acids in a peptide are connected to one another in a sequence by bonds called peptide bonds. T cells, which are circulating in the immune system, look for infections in the body. There are three main types of T cells namely cytotoxic, helper, and regulatory. Each of them has a different role in the immune response.

### 5.1 Mechanism - I

A cytotoxic T cell also known as killer T cell of the immune system that have the capacity to directly kill virus cells. Lymphocytes are a type of white blood cell in our immune system. There are two types of CD (cluster of differentiation) cells namely CD4 and CD8. CD4 cells are white blood cells that play an important role in the immune system. CD4 cells activate the cells of B-lymphocytes and cytotoxic T cells. CD8 is a transmembrane glycoprotein that serves as a co-receptor for the T-cell receptor (TCR).CD8 cells can kill cancer cells and other invaders.The T-cell receptor is a protein complex found on the surface of T cells, or T lymphocytes, that is responsible for recognizing fragments of antigen as peptides bound to major histocompatibility complex molecules [25].

Cytotoxic T cells (Tc cells) have a co-receptor called CD8 on their cell surface. CD8 partners with the T cell receptor and with MHC class I molecules actas a sort of bridge (figure 17a). This bridge allows cytotoxic T cells to identifythe virus infected cells. When the cytotoxic T cell identifies the virus infected cell, it becomes activated and produces molecules that kill the infected cell, destroying the virus in the process.

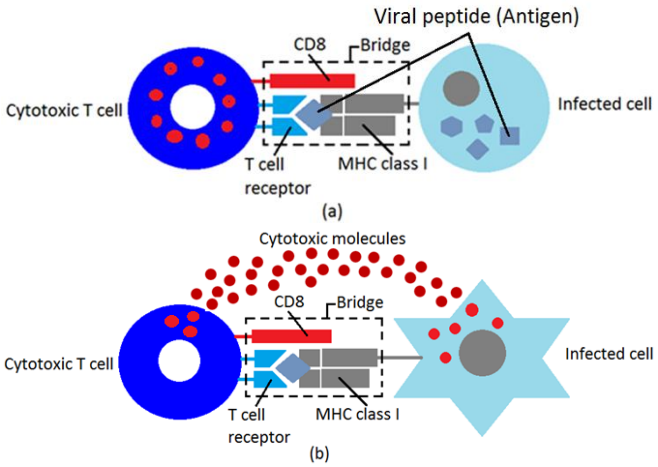


**Figure 17:** Mechanism of virus kill by Tc cells: (a) Tc cell receptor on CD8 and T cell identifies the peptide displaced on the surface of virus infected cell; (b) T cell releases cytotoxic molecules which can kill the virus infected cell.

### 5.2 Mechanism - II

Helper T cells (Th cells) are the most important cells in adaptive immunity. Th cells not only help activate B cells to secrete antibodies and macrophages to extinguish virus infected cells, but they also help activate cytotoxic T cells to kill virus infected cells.Th cells have a different co-receptor called CD4 on their cell surface.CD4 also associates with the T cell receptor but interacts with MHC class II molecules. This lets helper T cells to identifyvirus peptides that have been displayed by antigen presenting cells. When helper T cells identify a peptide on an antigen presenting cell, they

become activated and begin to produce molecules called cytokines that signal to other immune cells.There are various types of helper T cells namely Th1, Th2 and Th17. Each helper T cell produces a specific combination of cytokines that depends on type of virus that the helper T cell has identified [26].

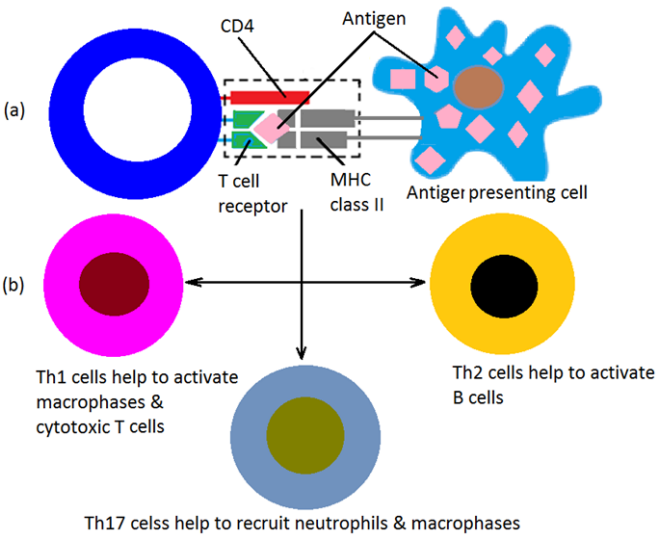


**Figure 18:** Mechanism to generate different Th cells: (a) T cell receptor on CD4 and T cell identifies the virus peptide displaced on the surface of an antigen presenting cell; (b) different Th cells are generated based on the type of virus that is identified.

### 5.3 Mechanism - III

In the process of viral killing, the B-cell sweeps up the residual viruses after the T-cell attack. They make important molecules called antibodies. These molecules trap specific invading viruses and bacteria.Like T cells, B cells have receptors (BCR) on their surfaces that diagnose specific virus (pathogen). Unlike T cells, they do not need antigen presenting cells to display a virus peptide for them—they are able to recognize virus on their own [27].

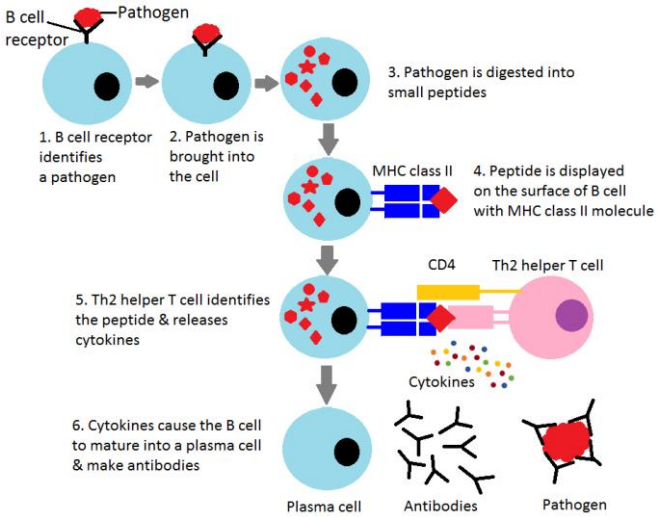


**Figure 19:** Mechanism to produce antibodies.

The pathogen that is identified by the B cell is brought into the cell and digests it into small peptides. Since B cells are antigen presenting cells, they display peptides on their surface with the help of MHC class II molecule. Th2 helper T cells identify the peptides and release cytokines. The cytokines cause the B cell to mature into a plasma cell.

They do this because they need the help of Th2 helper T cells to become activated. Th2 helper T cells that have already recognized the same pathogen (by interacting with other antigen presenting cells) are able to identify the antigen displayed by the B cell. When this happens, Th2 cells produce cytokines that cause the B cell to mature into a plasma cell. The plasma cells produce proteins called antibodies which are Y-shaped proteins. The antibodies recognize the same pathogen which was originally identified by the B cell and stick to the pathogen.

By doing this, antibodies stop the pathogen from spreading and make it destroyed by other immune cells.

Vitamins A, C, and D, and minerals - including zinc - play a role in the functioning of the immune system. The lymphocytes, or T-cells, which fight invading molecules directly. The B-cells, which form antibodies that can respond to invading molecules or toxins. The antibodies produced by the B-cells can bind with a damaging molecule or to the surface of a virus. B-cells and T-cells are also called lymphocytes. T cells acquire a receptor called TCR. The immunity depends on the B cells while cell immunity depends on the T cells.B-cells fight bacteria and viruses by making Y-shaped proteins called antibodies, which are specific to each pathogen and are able to lock onto the surface of an invading cell and mark it for destruction by other immune cells. There are two main types of T-cells explicitly helper T-cells and killer T-cells. Helper T-cells stimulate B-cells to make antibodies and help killer cells to develop. Killer T-cells directly kill cells that have already been infected by a foreign invader.

The above immune mechanisms may or may not be applicable to covid-19. The immune mechanism of killing of covid-19 or removal of covid-19 is unknown to till date. They are still under investigation.

## 6. Conclusion

Eating just one of these foods (Citrus fruits, Red bell peppers, Broccoli, Ginger, Spinach, Almonds, Turmeric, Papaya, Kiwis, Sunflower seeds, Turkey or Chicken meat, Yoghurt and Green Tea) would not be enough to help fight off the flu or Coronavirus. Nutrients essential to fight infection include vitamins A, B, C, D, and E, and the minerals iron, selenium, and zinc. Due to medical conditions, you may have been advised not to consume some of the foods mentioned above. For instance, lemon juice causes acidity issues. Use your judgment and know your health before you add something to your menu. Hence, a variety and a balanced diet are essential for building immunity. Also, good body exercise (Yoga) can also improve the percentage Oxygen saturation level. Therefore, we must boost our immunity to have strong defense against novel Corona virus or COVID-19.

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