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# DIETARY ANTIOXIDANTS FIGHT AGAINST COVID-19

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## ABSTRACT

Objective Outburst of COVID-19 has shaken the world with its devastating nature affecting crores of people and killing lakhs of them.So, scientists and doctors are continuously searching ways to overcome the pandemic disease. It is known that some antioxidants are anticorona virus.So one way to fight COVID-19 is to investigate whether an appropriate choice of daily diet can lead to the desired goal. The purpose of the present work is to estimate the amount of antivirus antioxidant from a vegetarian diet as it is well known that some of them are powerful ingredients against oxidative stress and inflammation which are key factors for COVID-19 outburst.Incidently, high dose of the antioxidants are prescribed to fight against the disease.MethodIn estimating the antioxidants of interest from a proposed diet , the amounts of vitamin A,C, D, E, K, lipoic and Co-enzymeQ10 etc in each item of the diet have been evaluated and added up to get the daily supply of the antioxidants. The quantity of those antioxidants thus achieved have been compared with daily intake amount necessary to protect or prevent against COVID-19.ResultsThe estimation of the antioxidants from the proposed diet clearly shows that it matches compairably with the daily intake amount necessary for protection/ prevention against COVID-19.However the medicinal doses of the antioxidants are much higher, implying that when some body is affected by the disease the diet alone cannot cure him from the disease. ConclusionFrom the results of investigation it may be concluded that by proper selection of daily food, it is possible to safeguard against COVID-19 , but when people are affected by the disease, diet alone is not sufficient for curing the person and in this situation medical treatment is a must.

Key Words: COVID-19, Oxidative Stress , Inflammation, Antioxidants, Prevention/Protection.

## INTRODUCTION

SARS-COV-2, the pathogenic agent of COVID-19 disease was first found to be originated from UHAN , China on December 2019[Hengbo Zhu et al , 2020]. Within two months , it spread throughout the whole world affecting crores of people killing lakhs of them resulting in a pandemic[Bin Yu et al, 2021].The disease has a strong transmission capacity arising from inhalation of infectious aerosols and body touch in which the virus is transmitted to an unaffected person , takes about two weeks time for incubation and active .

This may be responsible [Lammi .C and Arnoldi.A , 2021] for COVID-19 ranging from the asymptotic to fatal consequences.COVID-19 is a multifaceted , multisystem , multiorgan disorder, which produces its pathogenic effects through a ubiquitous target at the level of multiple organs in which oxidative stress and inflammatory process play relevant roles. So in the field of alternative and coadjutant therapy, the use of dietary supplements or nutraceuticals for prevention or treatment of SARS-COV-2 infection may be a useful attempt.Oxidative stress and inflammation are key factors in increasing COVID-19 severity especially in the presence of chronic diseases related to the antioxidant system failure. So antioxidant supplementation is a useful strategy against COVID-19. Thus the major antioxidants from food sources may help to fight against COVID-19.

The important antioxidants studied in this article are vitamin A,C,D,E,K , Lipoic Acid, Co-enzymeQ10, N-Acetyl cysteine, Melatonin, Zinc, Copper, Manganese and Selenium.

The above antioxidants are available from a vegetarian diet[Niyogi M, 2015].

Since the diet has been successful in so many aspects [Niyogi M, 2018,2021] it could be a successful attempt to investigate the usefulness of the amount of antioxidants from the diet and applicability of them for prevention of COVID-19and control the attack of the same.The diet under consideration consists of varieties of elements like vegetables, legumes, cereals, dairy products and fruits along with refreshing elements like tea , it supplies many antioxidants which could help in the treatment of COVID-19.Here the amount of antioxidants helpful for treatment of COVID-19 have been estimated and compared with medicinal doses.

### Materials and Methods

The diet under consideration [Niyogi . M, 2015] is a complete one since it consists of varieties of food items like cereals, legume, vegetables, dairy products , fruits and refreshing items . Care has been taken so that the components are within reach of poor people. Thus in each item , costly, as well as, cheap elements have been chosen.

Estimation of the relevant vitamins and minerals , effective for treatment and protection against COVID-19 from each item of the diet have been made and added up to get the net result . The amounts so obtained are believed to act as preventive doses and sometimes as medicinal doses against COVID-19.

### Result and Discussion

Since the antioxidants mentioned earlier play important role in the treatment of COVID-19 , it may be interesting to discuss here how the above elements act in the prevention and treatment of the disease. The relevant antioxidant and their mode of action are presented in Table-1 below.

## Table 1: The antioxidants and their mode of action towards COVID-19

| Relevant Antioxidants(1) | Corresponding action for treatment of COVID-19(2) |
|---|---|
| 7 | |
| Vitamin A | The clinical diagnosis of patients with COVID-19 has risen sharply throughout the world. An effective treatment is still limited.<br>It is hoped that Vitamin A may potentially serve as an anti-SARS-COV-2 regimen like it exhibits pharmacological activity in the management of pneumonia [Li Rong et al, 2020].<br>Vitamin A against SARS-COV-2 involves enrichment of immunoreaction inhibition of inflammation and biological process in relation to reactive oxygen species . The vitamin under consideration fights against COVID-19 including MAPKI, ILIO, EAFR, ICAMI, MAPK14, CAT and PRKCB were indentified. Thus Vitamin A may act as a treatment option for COVID-19[Kumar Puneet et al, 2021]. |

| (1) | (2) |
|---|---|
| Vitamin C | Vitamin C is believed to have beneficial effects for patients with severe and critical illness. This vitamin is an antioxidant and free radical scavenger , having antiinfllamatory properties.<br>It influences cellular immunity and vascular integrity serving as a cofactor in the generation of endogeneus catecholamine . The evaluation of Vitamin c supplementation in various disease stress reveals higher dose of it in serious illness like infection and sepsis. In case of SARS-COV-2 infection the above criteria is thought to be applicable in ameliorating inflammation and vascular injury. Vitamin C supports the immune system to fight against viral infection and naturally plays important role in COVID-19 treatment.<br>[Vitamin C –COVID-19 treatment guidelines ][Website report 2021]and[cheriyedath , News medicinal help -2021]. |

| (1) | (2) |
|---|---|
| Vitamin D | In addition to protection of human system against attack of various diseases , it has also found its application in treatment of COVID-19. Vitamin D has antioxidant and inflammatory properties that inhibit the overexpressions of inflammatory cytokines IL-I alpha , IL-beta and tumor necrosis factor –alpha. Studies show that Vitamin D has been investigated for use in the treatment of acute respiratory tract infection(ARTIS).Report goes that it modulates ACE2 expression in lung tissue a panthogenic |

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| | factor in COVID-19[Cheriyedath Susha,2021]. |
| Vitamin E | Vitamin E plays important role in regulating and supporting immune system function as a potent antioxidant[Kumar Puneet et al , 2021]. It acts as a free radical scavenger, reduces oxidative stress and prevents free radicals containing unshared electrons and highly energetic damaged cell. |

| (1) | (2) |
|---|---|
| | Vitamin E is found to have a function in immunity alpha-tocopherol is an inhibitor of protein kinase, cell proliferation and differentiation in smooth muscle cells, monocytes and platelets.<br>It is an immunomodulator agent which is widely believed to be involved in different aspects immune system. Thus it exerts its effects through multiple pathways which has been shown to be associated with immune response for different pathogens along with SARS-COV-2. |
| Vitamin K | Vitamin K is a fat soluble vitamin naturally present in some food .<br>It is a coenzyme involved in hemostasis. It is also involved in the activation of hepatic coagulation factors and thus helps fight thromolic complications in COVID-19 patients[Cheriyedath Susha ,2021]. |

| (1) | (2) |
|---|---|
| Lipoic acid | Alphalipoic acid exhibits strong antioxidant properties . It modultes the immune system by regulating T cell activation making it a useful therapeutic candidates for cytokine storm triggering SARS-2COV-2 infection including COVID-19 . Thus alpha-lipoic acid is a potential agent for treatment of COVD-19 |
| Co-enzyme Q10 | Co-enzyme Q10 better known as ubequinone is a fat soluble vitamin like substance which play important role in mitochondrial bioenergy transfer. It is an antioxidant with free radical scavenging activities.<br>Evidences also hint that COQ10 possesses immunomodulatory and antiinflammatory properties. Patients suffering from COVID-19 have augmented level of pro-inflammatory cytokines, increased risk of pneumonia and acute respiratory distress syndrome.<br>Due to obvious anti-inflammatory and immunomodulatory properties of COQ10 we believe that this nutrient has the potential for adjuvant therapy against SARS |

| (1) | (2) |
|---|---|
| | COV-2 infection.<br>Due to its antifibrotic properties CO-Q10 is believed to have a preventive role against pulmonary fibrosis secondary to COVID-19[Hamideh Moravvej et al,2021]. |
| N-Acetyl cystine | N-Acetyl cysteine , a predecessor of the antioxidant glutathione has been used to loosen the thick mucus in the lungs and treat acetamine-phen over dose of decades. |

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|---|---|
| | Current therapeutic procedure for COVID-19 fails to effectively reduce mortality rate for old age patients. Naturally exploring new application of existing medications are supposed to provide valuable treatments for COVID-19.<br>N-acetylcysteine has been used in clinical practice to treat ill septic patients and recently COVID-19 patients.<br>It has antioxidant, antiinflammatoryand immune-modulating properties that may provide beneficial help in the treatment and prevention of SAR-COV-2 and hence its potentiality for treatment of COVID-19 |

| (1) | (2) |
|---|---|
| | [Zhongcheng Shi et al, 2020]. |
| Melatonine | Melatonine , a naturally occurring tryptophan derivative synthesized in the pineal gland and immune cells, is a potential treatment option for reducing the severity of COVID-19 symptoms due to its anti-inflammatory –immunomodulatory and protective antioxidant mechanism. It is a powerful hydroxyl radical scavenger and stimulator antioxidant mechanism like glutathione peroxidase and superoxide dismulage.<br>It also provides significant protection against cellular oxidative damage. Naturally , melatonine is a good treatment option for COVID-19[Cross . Kristina . M , 2021]. |

| (1) | (2) |
|---|---|
| .Zinc | Zinc has a well known antioxidant action with reduced reactive oxygen species , production and reactive nitrogen species.<br>It exhibits anti-inflammatory action by inhibiting NE-K beta signaling leading to decreased production pro-inflammatory cytokine . It has been found to increase natural killer cells activity, cytotoxic T –cells activity and B-cell receptor signaling as well with increased production of antibodies.<br>Zinc modulates regulatory T-cell functions preventing hyper-activation of the immune system's response by modulating and balancing the cytokines.<br>Zinc has an antiviral effect against viral diseases. This was evident on viral infections through several modulations pathways like fusion, replication viral protection translation , viral particle entry , especially those involving respiratory system pathology.<br>Thisgives rise to clarification for the relevance of zinc in the treat |

| (1) | (2) |
|---|---|
| | ment of COVID-19.<br>This is attributed to its immunomodulatory effect along with antiviral property as well as its ability to regulate the inflammatory response[Samad Nandeeta et al, 2021]. |
| .Copper | Copper is an essential micronutrient for both pathogens and the hosts during viral infection. It is active in the |

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|---|---|
| | functions of critical immune cells like T-helper cells, beta cells, neutrophites natural killer cells and macrophages. These blood cells are responsible for the killing of infectous microbes, in cell mediated immunity and production of specific antibodies agains the pathogens . Copper deficient people show exceptional susceptibility , to infection due to decreased number and function of these blood cells. Besides that copper can kill several infectious viruses like bronchitis, polio and HIV viruses. It has the potent capacity of contact killing of several viruses including SARS-COV-2. |

| (1) | (2) |
|---|---|
| | Since the outbreak of COVID-19 is not ending and there is no definite vaccine or drug, one critical option may now be to make the immune system competent enough to fight against the SARS-COV-2.<br>Present data suggest the enrichment of plasma copper levels which will boost the innate and adaptive immunity in people. Moreover, due to its potent antiviral activity copper may act as a preventive and therapeutic regime against COVID-19[Raha Shyamal et al, 2020]. |
| .Manganese | Being an essential trace element , nutritional manganese as so many effects on the biological system. Manganese possesses antioxidant activity and is responsible for energy production by the amino acid breakdown. In an emerging approach towards the treatment of COVID-19 , |

| (1) | (2) |
|---|---|
| | various shards of evidence reveal its immuno-modulatory and antiviral |

| | |
|---|---|
| | action. Experimental data indicate that hepatitis virus protein priming depends upon the concentration of manganese ion, thus it acts as a potent antiviral agent. Evidence also suggests impaired antibody production as a response to manganese deficiency , highlighting its crucial role in promoting immunity.<br>All the above indicates the supporting role of nutritional manganese in COVID-19 treatment[Kumar Puneet et al, 2021]. |
| .Selenium | Oxidative stress is a characteristic feature of COVID-19 disease which is linked with immuno-pathological disorder observed in individuals with severe COVID-19.<br>Selenium lays a key role in strengthening immunity, reducing oxidative stress, preventing viral infections and supporting against critical illness. Moreover, selenium deficiency is related to oxidative stress and hyper-inflammation observed in critical illness. |

| (1) | (2) |
|---|---|
| | Selenium deficiency is found to be associated with severity of COVID-19. So external supply of selenium to COVID-19 patient may be a treatment option[Khatiwada Saroj et al, 2021]. |

From Table.1, it may be concluded that the anti oxidants present there have significant role in prevention and treatment of COVID-19 patients.

It is now important to evaluate the amount of relevant antioxidants from the diet concerned. Compare them with daily intake amount [Santos Tenorio .M et al,2021] which are necessary as precautionary amount needed to avoid COVID-19 i.e. prevention of the same . Present here the medicinal doses of [Dragomanova .S et al ,2021, Aron Jorge et al , 2020, Ioannis.Z, 2020 B. , clinical trials.

Gov] the antioxidants when people are attacked with the disease.

Estimation of the amount of antioxidants from the diet, daily amount required to save people from COVID-19 and while affected with the diseases, the medicinal doses for treatment of the patients are shown in Table-2.

Table2. Estimation of antioxidants for COVID-19 disease.

| Antioxidants(1) | Daily amount from proposed diet in mg(2) | Daily amount required in mg(3) | Medicinal doses in mg/day for COVID-19 |
|---|---|---|---|
| Vitamin A | 0.45 to 0.74 | 0.4 to 0.96 | 3 |
| Vitamin C | 48 to 297 | 50 to 80 | 1000 |
| Vitamin D | 0.0054 | 0.01 to 0.02 | 5 |
| Vitamin E | 1.17 to 8.77 | 8 to 10 | 800 |
| Vitamin K | 0.16 | 0.105 | 0.5 |
| Lipoic acid | 90 to 96 | 50 to 100 | 1200 |
| Coenzyme Q10 | 2.90 to 5.05 | 30 to 100 | 500 |
| N-acetyl-cystein | 631 to 1036 | 600 to 1200 | 6000 |
| Melatonin | 0.74 to 0.95 | 0.1 to 0.5 | 50 |
| .Zinc | 2.22 to 5.41 | 8 to 12 | 30 to 50 |
| .Copper | 1.664 to 2.584 | 1 to 2 | 7.8 |
| .Manganese | 8.1022 to 9.644 | 2 to 5 | 90 |
| .Selenium | 0.14 to 0.15 | 0.055 to 0.070 | 1 |
| | | | |

From Table-2 , it is clear that the amount of antioxidants necessary for COVID- 19 treatments available from the diet referred match quite successfully with the daily intake amount, which can be considered as the amount of antioxidants for prevention of COVID-19, with the exception of few. One of them is Vitamin D, which is much lower amount available from the diet than the daily intake amount. However , that is not a big issue because there is some natural way to increase the Vitamin D in the body.

Another, in this line is COQ10.

Ironically , no diet can supply the daily amount required for Q10.

This proves that in the case of Q10the diet alone cannot help successfully in case of COVID-19 patients. So to avoid COVID-19 , due to CO Q10 deficiency external source of the same is necessary.

There is no problem in case of other antioxidants eventhough the diet supplies less amount of Zinc than the daily intake amount.

The medicinal doses of antioxidants for COVID-19 patients are found to be much higher than the daily amount obtainable from the diet, as well as, the daily required amount. This supports the idea that for COVID-19 patients only food habits cannot remedy , automatically medicines are necessary and in this situation, one needs the help of doctors.

Having discussed the importance of dietary antioxidants for treatment of COVID-19 patients , it may now be interesting to find the comparability of the relevant antioxidants. So comparability co-efficient (CC) defined by

CC= [Daily amount of antioxidants from the diet/ daily intake amount required for prevention of the disease require to be evaluated for the

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antioxidants of interest.

In the Table-3 below the mean values of the nutrients from the diet as well as the mean values of the above required for prevention of the disease have been evaluated , and the corresponding CC values have been presented.

Table 3. The mean values of the nutrients from the diet , the mean values of the required amount and the CC values.

| Antioxidants(a) | Mean values of daily amount from the diet in mg(b) | Daily amount required in mg(c) | CC values (d) |
|---|---|---|---|
| Vitamin A | 0.595 | 0.50 | 1.19 |
| Vitamin C | 172.5 | 65 | 2.65 |
| Vitamin D | 0.0054 | 0.015 | 0.36 |
| Vitamin E | 4.97 | 9.00 | 0.55 |
| Vitamin K | 0.16 | 0.105 | 1.524 |
| Lipoic acid | 93 | 75 | 1.24 |
| Co-Q10 | 3.975 | 65 | 0.061 |
| N-acetyl cystein | 833.5 | 900 | 0.926 |
| Melatonin | 0.845 | 0.3 | 2.82 |
| .Zinc | 3.815 | 10 | 0.38 |
| .Copper | 2.124 | 1.5 | 1.416 |
| .Manganese | 8.873 | 3.5 | 2.54 |
| .Selenium | 0.145 | 0.0625 | 2.32 |

From Table-3, column(d) it is found that for most of the elements CC values give support to the idea that the proposed diet is sufficiently able to prevent /protect

against COVID-19. A graph of elements vs CC values is drawn to have a quick glance at relevant elements of the diet to prove its compatibility for protection against COVID-19.

In the graph of figure .1, the relevant elements are plotted along x axis and their CC values along y axis .

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From the graph, it is evident that Vitamin A, Vitamin C, Vitamin K, Lipoic acid, Melatonin, Copper, Manganese and Selenium have CC values larger than 1, so for these nutrients the diet provides greater amounts than the daily intake amounts , automatically are sufficient to prevent or protect people from COVID-19 , while the nutrients Vitamin D, Vitamin E, CoQ10 , N-acetylcystein and Zinc are available in lesser amounts from the diet than the daily intake amounts implying that the diet under consideration alone is not sufficient to prevent or protect against COVID-19. So for people suffering from deficiency of the nutrients need other sources of the element for protection or prevention against COVID-19.

Interestingly , the deficiency of N-acetylcystein from the referred diet is not very importantbecause the supply of the nutrient from the diet is nearly equal to the daily intake amount.

The deficiency of Vitamin-D from our diet can easily be overcome from sunlight which is suffiently available in India. Vitamin E and Co-Q10 is available from various cooking oil , while Zinc is sufficiently present in ginger.

In the diet concerned , while evaluating the amounts of Vitamin E , CoQ10 and Zinc obtained from the diet , no mention of cooking oil and ginger have been done, eventhough they have been used in the prevention of the diet So, to have further amounts of the above , incorporation of cooking oils and ginger may be taken into account to achieve the further amounts of the nutrients in the diet.

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## Conclusion

COVID-19 is still now a menacing disease, because no end of its activity is found eventhough various medicines and vaccines are available. So there is doubt about the effectiveness of the medicines and vaccines to make and end of COVID-19.

It may be due to new strains of the corona virus. Consequently , researchers are engaged to find the ways to make the virus inactive.

So, scientists are eager to find ways to avoid COVID-19, which is possible only when people are prevented or protected against the attack of the disease.

Antioxidants in our daily diet play the required role to that effect. By proper choice of food in our daily diet it is possible to prevent the disease which has been investigated and shown in this article. So it may be concluded that by a proper choice of a vegetarian diet it is possible to protect/prevent the attack of COVID-19 which may arise due to deficiency of the antioxidants.

However, when people are attacked with COVID-19 food habits alone cannot supply the medicinal doses of the antioxidants. Under the circumstances, medicines are necessary since the medicinal doses of the

antioxidants for treatment of COVID-19 requires higher amounts of the same.

Thus finally it is concluded that both clinical research and nutritional research essential to make our world free of corona virus.

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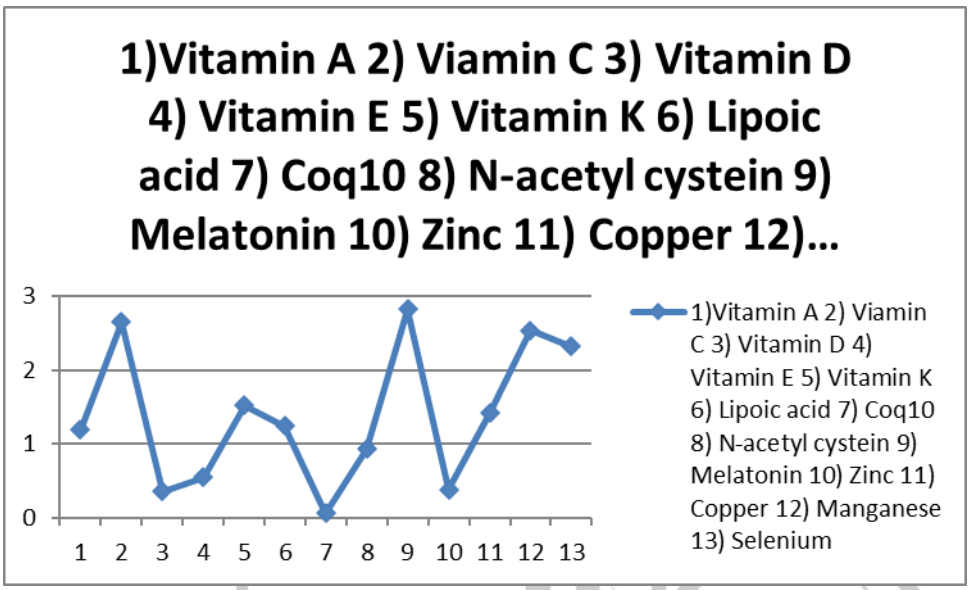


CC

The relevant elements----------→

Figure-

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