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Moringa oleifera : A potent immune booster in the catastrophe of Covid -19

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ABSTRACT

Our body is always exposed to mysterious invaders which can cause diseases and infections. The immune system enables to keep these contagious microorganisms at bay and protects our body depending on the strength of immune system. SARS-CoV-2 is a new virus which causes lethal respiratory illness, COVID-19 and has become pandemic in 2020. As there is no vaccine or drug available for this deadly coronavirus , the only way to defend it, is to strengthen the body immunity. The nutrients like vitamins, minerals, fatty acids, amino acids etc. play a significant role in the host immunity. Moringa is a miracle tree whose leaves are rich in number of vital components that improves the body immunity. So in this paper we will overview the available literature data how Moringa can boost host immunity against Covid -19.

Key words: *Covid -19, Immunity booster, Moringa oleifera, Nutrient rich*

Introduction

We are surrounded by a large number and extensive varieties of microorganisms in the atmosphere. But all of us are not falling sick all the time. It is because of our immune system which is protecting us against these uncountable and unidentified microbes. The immune system is an amazing defence mechanism of our body, which makes quick, specific and protective response against the myriad of dangerous potentially active pathogenic microorganisms like bacteria, viruses, fungi etc. The immune system is made up of a complex and sophisticated network of specialized tissues, organs, cells, proteins and chemicals. A strong immune system is essential for our healthy survival. Immune system varies from individual to individual. If an individual has weak or impaired body immunity, the body's natural defence system is not able to fight against microbes and result is in form of serious infection, illness and even death (Fritsche, 2006).

There are a number of factors which influence the immune system and nutrition is one of the major factor. A superior nutritional status of the body develops a vigorous immune system which defends the body and empowers it to fight against infectious agents and to get rid of the abnormal and exhausted cells (Enwonwu, 2006). Impact of diet on human health has long been a topic of discussion and research all over the world. Adequate and balanced nutrition provide a good supply of macro and micronutrients which are essential for development, maintenance and expression of immune response (Maggini *et al.*, 2017). Now a days micronutrient deficiencies are recognized as an important contributor to the global burden of disease as their marginal deficiency may impair immunity. Worldwide micronutrients have been recognized to improve the public health by improving their immune system.

Micronutrients and immunity

Intake of adequate calories and micronutrients is

vital for optimal immune function. Various micronutrients like minerals and vitamins play a major role in boosting the immune system and to protect us against several inflammations, infections and pathogens including corona virus (SARS-CoV-2). The most indispensable micronutrients which are required to sustain immune proficiency in our body include vitamins A, C, D, E, B2, B6 and B12, folic acid, beta carotene, iron, selenium, and zinc(Alpert, 2017; Chandra, 2002; Erickson *et al.,* 2000). Micronutrient deficiency suppresses immune function by affecting the innate T-cell mediated immune response and adoptive antibody response. Relevant research related to role of some micronutrients in immunity is listed in Table 1. Immune system can be made stronger by restoring deficient micronutrients and so promoting body resistance to various microbial diseases including Covid -19. It also enhances the chance of recovery and supports faster recovery if infected.

A Natural Immune booster : *Moringa oleifera*

A variety of food items with proper proportion of protein, carbohydrates, fats, minerals and vitamins etc. constitute the balance diet. It provides all the required nutrients for the healthy body and a strong immune system. But in reality for a majority of the world's population especially in developing country like India such a variety in food is unaffordable. Majority of poor people in India consume a restricted type of diet every day which may cause deficiency in one or other nutrients. It has long been documented that individuals who suffer from malnutrition have weak immune system and are more susceptible to infections. Further now a days due to the changing lifestyle middle class or rich people consume more junk and processed food. The western type of diet is rich only in calories, refined sugars, salt, carbohydrates and saturated fats with no useful nutrients, which may lead to increased inflammation and frail immunity and so increased risk of viral infections including SARS-CoV-2.Certain supplementary food items may be helpful to boost the immune system. The dietary components of plant origin are always better than artificial supplement. Moringa which is also known as Sahjan, Horseradish tree, Ben tree or Drumstick tree is famous for its health benefits for thousands of years. Moringa belongs to family Moringaceae and it has 14 species, but most commonly grown species is *Moringa oleifera* which is native to India, Africa, Arabia, Southeast Asia, South America, Pacific and Caribbean Islands (Iqbal and Bhanger, 2006). Each and every part of Moringa has miraculous beneficial properties, so Moringa is a very simple and readily available natural source to boost the immune system of human beings.

Botanical Background of *Moringa oleifera*

Moringa oleifera is a drought tolerant, fast growing and multipurpose tree. This plant grows in the tropical and subtropical regions of the world including areas of India, Pakistan, Bangladesh Afghanistan, Malaysia, Mexico, Africa, Philipinis and Sri Lanka. Moringa is a tree ranging in height from 5-12 m having straight trunk about 10-30 cm thick and a corky, whitish bark. The leaflets are 1-2 cm in diameter and 1.5-2.5 cm in length. The tree has a tuberous tap root system. It can grow in hot semi-arid regions with annual rainfall 250-1500 mm. Moringa can well adapted to a broad range of soil and environmental conditions. Moringa can be grown as wild plant or can be cultivated with the help of seeds or seedlings.

Golden Leaves of Moringa

Full with health-giving nutritional and medicinal properties, Moringa is considered as **"Miracle Tree"** because every part of the tree is useful (Ashfaq *et al*., 2012; Tejas *et al*., 2012; Yisehak *et al.,* 2011). It is highly loaded with vitamin and minerals. The nutritional profile of Moringa is shown in Table 2-4. The leaves of *M. oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper (Kasolo *et al.,* 2010). Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *M. oleifera* (Mbikay, 2012). Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar are also present along with anti-cancerous agents like glucosinolates, isothiocyanates, glycoside compounds and glycerol-1-9-octadecanoate (Berkovich *et al.,* 2013). Essential and non essential amino acids are also present in *Moringa oleifera* (Fahey, 2005; Mahmood *et al.*, 2010). Moringa dry leaves are said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach (Rockwood *et al.,* 2013).

Moringa leaves as Potent immunity booster

Moringa oleifera leaf powder has been found to have most of the essential nutrients required for good health (Ashfaq *et al.,* 2012; Bey, 2010; Yang *et al.,* 2006). Countries like Senegal and Benin treat children with malnutrition by providing them with Moringa (Kasolo *et al.*, 2010; Mutiara *et al.*, 2013). A number of studies conducted in different countries proved that the use of *Moringa* can reduce malnutrition in children and increase immunity, which is one of the major causes of death worldwide (Moyo *et al.,* 2011; Srikanth, 2014; Zongo *et al.*, 2013). *Moringa* powder supplemented tea in school children in Nigeria was found to increase white blood

Table 1. Vitamins and micronutrients and their role in immunity

Vitamin A

(i) Known as an anti-inflammation vitamin as it enhances immune system and plays a regulatory roles in cellular and humoral immune processes (Huang *et al.,* 2018).
(ii) Necessary to generate antibodies against antigens and for normal functioning of macrophages and neutrophils (Haryanto *et al.,* 2015).
(iv) Vitamin A deficiency (VAD) impaired the components and the inflammatory responses of innate immunity (Czarnewski *et al.,* 2018).

Vitamin B

(i) Vitamin B1 (Thimine) influences anti-inflammatory property and its deficiency causes T cell infiltration (Spinas *et al.,* 2015)
(ii) Anti-bacterial effect of Vitamin B2 fights blood poisoning in mice (Pilcher, 2004).

Vitamin C

(i) Vitamin C has been implicated in strengthening and enhancing the immune system (Bruno *et al*., 2006; Maggini *et al*., 2007; Wintergerst *et al.,* 2006).
(ii) Vitamin C is constituents of the human immune system as antimicrobial agent (Rayment *et al.,* 2003).
(iii) Vitamin C showed *in vivo* anti-viral immune responses, especially against influenza virus (Kim *et al.,* 2013).
(iv) Vitamin C supplemental intakes can ease the severity of respiratory infections symptoms in asthmatic people (Hatch, 1995).
(v) Vitamin C possesses antimicrobial properties and its deficiency causes decrease in resistance to microbial infections (Chandra, 2004).

Calcium

(i) An elevation in [Ca^{2+}], is associated with activation of cells of the immune system (Hallet and Campbell, 1984).

Zinc

(i) Zinc is essential for growth and differentiation of immune cells and their proper functioning (Beveridge *et al*., 2008; Prasad, 2008).
(ii) Zinc helps to modulate cytokine release and induces proliferation of CD8+T cells (Haryanto *et al.,* 2015).
(iii) Deficiency in zinc reduced phagocytic activity of neutrophils, chemotactic responses of both macrophages and monocytes (Gammoh and Rink, 2017), it also reduces the ability of immune cell to kill pathogens (Krebs, 2013).
(iv) Dietary zinc supplementation has been shown to reduce acute lower respiratory tract infections (Brown *et al.,* 2009).

Iron salts

(i) Iron salts have been reported to participate in immunity (Chandra, 2004).
(ii) Iron deficiency is associated with impairments in cell-mediated and innate immunity and may render older adults more vulnerable to infections (Ahluwalia *et al.,* 2004).

Copper

(i) Copper has potent virucidal properties (Ishida, 2018).
(ii) Copper deficiency affects immune function and is known to impair the NK cell-killing activity (Koller *et al.,* 1987).

Magnesium

(i) There is a strong relation between Mg and the immune system (Tam *et al.,* 2003).
(ii) Magnesium deficiency is associated with impaired function of both humoral and cell-mediated immunity (Karen, 1994).

Table 2. Nutritional profile of Moringa (Abrams *et al.,* 1993)

Nutrition Analysis	Pods (per 100 g)	Fresh leaves (per 100 g)	Dried leaves (Per 100 g)
Moisture%	86.9	75	7.5
Calories	26	92	205
Proteins (g)	2.5	6.7	27.1
Fat (g)	0.1	1.7	2.30
Carbohydrates (g)	3.7	13.4	38.2
Fibre (g)	4.8	0.9	19.2
Minerals (g)	2	2.3	-
Calcium (mg)	30	440	2003
Magnesium (mg)	24	24	368
Phosphorous (mg)	110	70	204
Potassium (mg)	24	24	1324
Copper (mg)	3.1	1.1	0.6
Iron (mg)	5.3	0.7	28.2
Oxalic acid (mg)	10	101	0
Sulfur (mg)	137137	870	

cell which is important for the body defence against infections (Nurain, 2015). The fresh and dehydrated Moringa leaves were found to be better than the synthetic vitamin A (Nambiar and Seshadri, 2001). Calcium is abundantly present in *M. oleifera* could be responsible for enhancing immune function and IL-2 production (Cunningham, 1982).

According to Lipipun *et al*. (2003) *M. oleifera* extract possessed antiviral activity against the herpes simplex virus type 1 (HSV-1) and foot and mouth disease virus (Younus *et al.,* 2016). Moringa holds antitumor, anticancer, anti-tensive, anti-inflammatory, and antibacterial properties (Anwar *et al*., 2007). Mice dosed with ethanolic *M. oleifera* leaf extracts, for 15 days, had dose dependent increases in total white blood cell counts and percent neutrophils (Gupta *et al*., 2010). The presence of minerals and vitamins help in boosting the immune system and cure a myriad of diseases (Ijarotimi *et al.,* 2013; Jung, 2014; Popoola and Obembe, 2013; Rockwood *et al.,* 2013). Safety evaluation studies on *Moringa* have shown no toxicity when consumed in large quantities (Luqman *et al.,* 2012; Stohs and Hartman, 2015), with no adverse side effects even when taken as a part of their daily meal (Fuglie, 2001).

Table 3. Vitamin and Mineral Content of Moringa (Prakash, 1988; Anwar and Bhanger, 2003)

Vitamin & mineral content (Per 100g)	Fresh leaves	Dried leaves
Carotene (Vit A) mg	6.7	18.9
Thiamin (Vit B1) mg	0.06	2.64
Riboflavin (Vit B2) mg	0.05	20.5
Niacin (B3) mg	0.8	8.2
Vitamin C (mg)	220	17.3
Calcium (mg)	440	2,003
Calories (cal)	92	205
Carbohydrates (g)	12.5	38.2
Copper (mg)	0.07	0.57
Zinc (mg)	0.16	3.29
Fat (g)	1.70	2.3
Fibre (g)	0.90	19.2
Iron (mg)	0.85	28.2
Magnesium (mg)	42	368
Phosphorous (mg)	70	204
Potassium (mg)	259	1,324
Protein (g)	6.70	27.1

Leaves can be eaten fresh or cooked or can be dried and stored for a long period without any major loss of its nutritional value (Arbashahi *et al*., 2007; Fuglie, 2001). Moringa leaves also have a low calorific value and can be used in the daily meal of the obese and diabetics. Dried or fresh leaves are also used in foods such as soups and porridges (Lockett *et al*., 2000), curry gravy and in noodles (Abilgos and Barba, 1999).

Possibility of prevention from SARS-CoV with Moringa leaves

Human coronaviruses (HCoVs), including severe acute respiratory syndrome coronavirus (SARS-CoV) and 2019 novel coronavirus (2019-nCoV, also known as SARS-CoV-2), had lead global pandemics in 2020 with high morbidity and mortality. The World Health Organization (WHO) declared the outbreak to be a Public Health Emergency of Inter-

Table 4. Protein (amino acid) content of Moringa (Abrams *et al.,* 1993)

Amino acid (per 100g)	Fresh leaves	Dried leaf powder
Arginine (mg)	406.6	1325
Histidine (mg)	149.8	613
Lysine (mg)	342.4	1325
Tryptophan (mg)	107	425
Phenylalanine (mg)	310.3	1388
Methionine (mg)	117.7	350
Theroine (mg)	117.7	1188
Leucine (mg)	492.2	1950
Isoleucine (mg)	299.6	825
Valine (mg)	374.5	1063

national Concern on 30 January 2020 and recognized it as a pandemic on 11 March 2020 (WHO, Jan and March 2020). As on 30 March 2020, more than 741,000 cases of COVID-19 have been reported in over 190 countries and territories, resulting in approximately 35,000 deaths (CSSE, 2020). Coronaviruses (CoVs) typically affect the respiratory tract of mammals, including humans and lead to mild to severe respiratory tract infections (Zumla *et al.*, 2016). They cause more severe disease in the elderly and in individuals with weak immunity and ill health. As there is no vaccine or drug is available to cure the coronavirus, so the effective preventive measures are the only way to protect the world population by this deadly virus. Washing hands frequently with soap and use of alcohol based sanitizer are the basic and temporary preservative measure of this virus ,but the development of a tough immune system is the need of an hour.

Viral infections are often associated with immune-inflammatory injury, in which the level of oxidative stress increases significantly and leaves negative effects on the function of multiple organs. Both antibody and cell-mediated immune responses are required to protect against coronavirus infections. The CD8 and CD4 T cells are primarily responsible for clearance of any virus during acute infection (Belay *et al.,* 2005; Reghunathan *et al.,* 2005). Moringa may enhance $CD4^+$ T cell activation as well as increased T cell numbers, which are important for helper function and parasite clearance by the host's immune system (Pilotos *et al.*, 2020). Moringa leaf extract has immune stimulant activity and even the low dose (0.1 µg/mL) can increase the cell number of CD4z and CD8zas compared to the control (Rachmawati and Rifa, 2014). *Moringa oleifera* has the potential of improving the CD4 count of HIV positive patients on HAART translating to better treatment outcome (Ogbuagu *et al.,* 2016). Since Moringa has an impact on the immune system, it could stimulate both cellular and humoral immune responses (Gupat *et al*., 2010; Sudha *et al.,* 2010).

Conclusion

On the basis of available literature and discussion it is clear that *Moringa oleifera* tree is certainly a miracle tree with huge nutritional and medicinal potentials. *Moringa* tree could be use as a successful tool in preventing many pathogenic infections including SARS-CoV, as it is a natural, whole-food source of vitamins, minerals, protein, antioxidants, essential phytochemicals, amino acids, carotenoides and other important components that can keep our body healthy. The immune modulator and immune stimulator activity of *Moringa* leaves make it a suitable natural potent nutritional supplement and immune booster against SARS-CoV-2. Despite of presence of most of nutrients in *Moringa* which are required to maintain and enhance the activity of immune system, more research is needed in this area in near future.

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