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Curbing Malnutrition with A Natural Food Supplement

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ABSTRACT

Malnutrition plays a leading role for major health problems globally. It is more prevalent in developing countries. Most people in developing country have a restricted diet on daily basis, resulting in micronutrient deficiencies and, as result malnutrition. Malnutrition is the main threat for the loss of wellbeing among all age group of people in India. It also leads to weak immunity. COVID-19 pandemic has infuriated this situation in the country. In this critical circumstances of Covid pandemic, there is a basic need to fulfill all the nutritional requirement of the body and give it a proficient protection to keep it battling respectably against all lethal infections including Covid-19. *Moringa* is a versatile God gifted plant, which is packed with a number of essential nutrients required for a healthy body, so can be a natural and competent shield for all of us by controlling feeble wellbeing and may prove a boon to our safety.

Key words : Malnutrition, Covid -19, Moringa, Natural food supplement

Introduction

Nutrition is the primary need of any human being. A balanced diet should comprise of a proper proportion of protein, carbohydrates, fats, minerals and vitamins etc., which provides all the essential nutrients required for the healthy body. But for a vast portion of the world's population, especially in poor countries like India, such variety in food is prohibitively expensive and out of reach to the weaker section of people. Larger number of individuals in India depend on a limited sort of diet everyday, which causes insufficiency in one or more micronutrients, thus cause malnutrition. About 189.2 million individuals in India have been reported malnourished and majority of them are women and children. World bank data indicate that India has one of the world's highest demographics of children suffering from malnutrition. 1 out of 3 children are malnourished.

India's profile in the Global Hunger Index is mainly due to malnutrition. India is now at 94th rank

among 107 countries in the Global Hunger Index 2020. According to UNICEF (2019) report, India was at top position in under-5 child mortality in 2018 with over 8.8 lakh deaths and malnutrition was the foremost reason behind the 69 per cent of these deaths. The main culprit for the malnutrition is micronutrient deficiencies. Every fifth child under the age of five is vitamin A deficient, one in every third baby has vitamin B12 deficiency and two out of every five children are anaemic. Malnutrition negatively affects on the chances of survival of children, increases their susceptibility to various illness and makes them less productive in later life.

This is all because of deficiency of essential micronutrients like iodine, iron, vitamins, calcium etc. About Indian women's health, it is said that every second woman is anaemic. Its prevalence among adolescent girls is twice that of adolescent boys. As per the WHO report (2017), 51.4 per cent of women in reproductive ages are anaemic. Anaemia in mothers is linked with malnutrition in children. Maternal anaemia is directly related to the nutritional status

of young children, which results in their stunting growth and thus they are underweight. This inter-generational cycle of under nutrition transmission from mothers to children is a serious matter of concern now a days all over the world.

Malnutrition is not only confined to the women and children, but it has become a leading risk factor of loss of health among all age group of people in India. The problem of malnutrition in developing countries like India has worsened by Covid 19. According to UNICEF, India is likely to witness an increase in malnutrition by at least 10% after Covid pandemic. According to India Child Well-being Report (2020) COVID-19 pandemic has exaggerated the load of malnutrition among children in the country, especially in the weaker section of the society. According to the World Food Program (2020) the number of people in LMICs (Low-to-Middle-Income Country) facing severe food insecurity will nearly be doubled in the coming years (World Food Program). The steep regressions in household incomes, limited availability and less affordability of nutritious foods during Covid catastrophe are some of the major reasons for all these (Akseer *et al.*, 2020). The extraordinary worldwide social and financial emergency which was set off by the COVID-19 pandemic poses grave dangers to the nourishing status and endurance of all individuals including small children in low-income and middle income nations like India. Most of the people were compelled to rely on nutrient poor food items due to disturbance in production, transportation and by adversely affected accessibility during lock down. So the increased rate of acute malnutrition is an inevitable consequence of COVID-19, which might be a significant reason for the Covid deaths. World wide till 16 March 2022, there have been reported 460,280,168 confirmed cases of COVID-19, including 6,050,018 deaths (WHO Corona virus dashboard, March 2022). Each and every country in the world is trying to discover the full proof and effective vaccine against Covid and most of them have been succeed. But due to mutating nature of this novel virus, vaccine can not be completely fruitful. So in this difficult stretch of Covid pandemic, there is an urgent need to give an efficient boost to our immune framework of the body to keep it battling admirably against all lethal infections including Covid -19. The immune system of the body decides the chance, rate and seriousness of any disease including Corona and furthermore the mortality. Micronutrients like minerals and

supplements plays a critical role in deciding our general wellbeing and resistance power by boosting the protective structure of the body. Beside following SOP (Standard operational protocol) and good hygiene, we should get the ideal proportion of micronutrients in our daily life to make our immune system stronger. Long ago the ancient medical science and Ayurveda had proved that plant extracts could do a great deal to fortify the body invulnerability and can play a substantial role in controlling infectious diseases. Due to natural in origin they are absolutely safe without any side effects. According to Akhtar *et al.* (2012) alternative leafy vegetables are now proved to improve immunity and recognize as an ally in the fight against deficiency of macro and micronutrients. In this calamity of Covid 19, there is a God gifted plant named as "Moringa" which can be an efficient safeguard for all of us against this novel infection by curbing malnutrition and enhancing our immunity.

Curbing malnutrition with Moringa : "The Miracle Tree"

There are many vernacular names of *Moringa* like Sahjan, horseradish tree or drumstick tree. *Moringa oleifera* is a rapid growing and versatile tree. Due to its immense nutritional or medicinal properties, it is recognized as a "Miracle tree" (Amaglo, 2006; Yisehak *et al.*, 2011; Ashfaq *et al.*, 2012). Each and every part of the tree is beneficial in one or other way. It has been used for generations in Eastern countries as folk medication (Bakre *et al.*, 2013). *Moringa* belongs to family Moringaceae, out of 14 species of *Moringa*, *Moringa oleifera* is the most popular and commonly cultivated species. India is the largest producer of *Moringa*. Major proportion of *Moringa* is grown in Andhra Pradesh, which is followed by Karnataka and Tamilnadu. *Moringa* is a very easy and readily available answer to the problem of malnutrition during the Covid, because each part of it has remarkable beneficial powers.

Inadequate consumption of fruits and vegetable causes 2.7 million of deaths annually at global level and belongs to the top 10 risk factors which contributes to the mortality (Ezzati *et al.*, 2002). *Moringa* leaves contain more vitamin A than carrots, more Vitamin C than an orange, more potassium than bananas and its protein quality is equivalent to milk and eggs (Fahey, 2019). It can be eaten as a vegetable during meals. *Moringa* leaves could improve childhood nutrition, birth weights and the quality of

breast milk. *Moringa*, as a part of daily diet of a child's food, has thoroughly demonstrated its ability to bring about rapid recoveries from moderate malnutrition. Prevention is better than cure, so *Moringa* should be added to every day meal in one or other form, raw or cooked to be away from malnutrition especially during havoc of Covid 19. Different studies have shown that all parts of *Moringa oleifera* (leaves, fruits, immature pods, and flowers) have been incorporated in the traditional food of people in many tropical and subtropical countries, but its leaves are the most valuable part of the plant.

Morphology of the plant

The *Moringa* plant can reach upto a height of 10–12 m. Mature tree has whitish grey bark with thick cork, while young plant has greenish-white bark. The branches are fragile and drooping with tripinnate leaves. Leaves are 45 cm long. The flowers are 0.7–1 cm long and 2 cm broad, yellowish-white or creamish in colour with 5 unequal spathulate petals. Flowers are bisexual, aromatic and grow in cluster (Gupta, 2010). *Moringa* can grow well in different types of soil with marginal environmental conditions also.

Moringa leaves

The leaves of the *Moringa* tree are the most effective part of the plant and is a super source of many nutrients and minerals. It has around ninety two kinds of nutrients and forty six types of antioxidants. Leaves are full of nutrients like proteins, carbohy-

drates, fibres, beta carotene and many vitamins. They have desirable amount of minerals like calcium, potassium, zinc, magnesium, iron and copper minerals (Joshi *et al.*, 2010). Calcium is considered to be one of the most important mineral for human growth. *Moringa* fresh leaves can provide 1000 mg and *Moringa* dry leaf powder can provide more than 4000 mg of calcium, when compared to 8 ounces of milk, which can only provide 300–400 mg of calcium. *Moringa* powder can be used as a substitute for iron tablets, therefore can treat anaemia. A good dietary intake of zinc is essential for proper growth of sperm cells and is also necessary for the synthesis of DNA and RNA. *M. oleifera* leaves have around 25.5–31.03 mg of zinc/kg, so can fulfill the daily requirement of zinc in the diet of an adult. Leaves of *Moringa* are also laden with a number of essential and non essential amino acids (Mahmood *et al.*, 2010). The important amino acids includes methionine, cysteine, tryptophan and lysine (Makkar *et al.*, 1996). *Moringa* proved to be an excellent non animal source of protein for vegetarians, as it contains all kinds of essential amino acids, which are the building blocks of proteins. *Moringa* is reported to have high quality protein, which is easily digested and that is influenced by the quality of its amino acids (Foidl *et al.*, 2001). Various types of antioxidants like ascorbic acid, flavonoids, phenolic compound and carotenoids also add to its nutritive and therapeutic value. *Moringa* leaves are also rich source of omega-3 and omega-6 fatty acids. *Moringa* powder is one of the richest plant sources of vitamin (Anwar *et al.*,

Table 1. Comparison of 100 grams edible portion with Moringa leaves (According to Tejas *et al.*, 2012)

Sr. No.	Nutrients	Leaves
1	Vitamin A	Four times (4x) of carrot & Thirteen times (13x) of spinach
2	Vitamin C	Seven times (7x) of oranges
3	Vitamin B	Four times (4x) of Porc meat
4	Vitamin B ₂	Fifty times (50x) of Sarones
5	Vitamin B ₃	Fifty times of (50x) Peanut
6	Vitamin E	Six times (6x) of Rapeseed oil
7	Calcium	Four times (4x) of milk
8	Magnesium	Thirty six times (36x) of egg
9	Potassium	Sixty three times (63x) of milk and three times (3x) of Banana
10	Iron	Twenty five times (25x) of Spinach
11	Protein	Two times (2x) of Yoghurt milk
12	Poly phenol	Eight times (8x) of Red Wine
13	Amino acids	Two times (2x) of Black Vinegar
14	R- Amino acid	Thirty times (30x) of Brown Rice and Four times (4x) of GABA Tea
15	Chlorophyll	Four times (4x) of Wheat Grass

2007). Due to its high nutritional value, *Moringa* has been used to reduce malnutrition and to enhance immunity, specifically among infants and nursing mothers, in many developing countries like Ghana

and Senegal. A number of studies undertaken in numerous underdeveloped nations have shown that *Moringa* can help to minimize malnutrition in children as well as meet vitamin A and protein require-

Table 2. Nutritional components and some medicinal properties of *Moringa* Leaves

Nutritional components	Medicinal Properties
i. Minerals	(i) Anti bacterial (Caceres <i>et al.</i> , 1991; Horwath <i>et al.</i> , 2011)
a) Calcium	(ii) Antifungal (Masurekar <i>et al.</i> , 2014)
b) Copper	(iii) Antiinflammatory (Razis <i>et al.</i> , 2014)
c) Iron	(iv) Anti Ulcer (Devraj <i>et al.</i> , 2007,2013)
d) Magnesium	(v) Antiaging (Dhakar <i>et al.</i> , 2011)
e) Phosphorus	(vi) Anticancer (Budda <i>et al.</i> , 2011)
f) Potassium	(vii) Antidiabetic (Ndong <i>et al.</i> , 2007)
g) Sulphur	(viii) Antitumor (Guevara <i>et al.</i> , 1999)
ii. Vitamins	(ix) Anti-obese (Metwally <i>et al.</i> , 2017)
a) Vitamin A	(x) Antioxidants rich (Pakade <i>et al.</i> , 2012)
b) Vitamin B	(xi) Antiviral (Lipipun <i>et al.</i> , 2003)
c) Vitamin B1	(xii) Antihypertension (Safaeian <i>et al.</i> , 2015)
d) Vitamin B2	(xiii) Antispasmodic (Sadraei <i>et al.</i> , 2015)
e) Vitamin B3	(xiv) Detoxifying agent (Rajendran <i>et al.</i> , 2008)
f) Vitamin C	(xv) Hepatoprotective (Lai <i>et al.</i> , 2010; Huang <i>et al.</i> , 2012)
g) Vitamin E	(xvi) Helps to treat Hyperthyroidism (Anwar <i>et al.</i> , 2007)
iii. Amino Acids	(xvii) Immune stimulator (Otilia <i>et al.</i> , 2012)
a) Alanine	
b) Arginine	
c) Arginine	
d) Aspartic Acid	
e) Cystine	
f) Glutamic acid	
g) Glycine	
h) Histidine	
i) Histidine	
j) Isoleucine	
k) Leucine	
l) Lysine	
m) Methionine	
n) Phynalanin	
o) Proline	
p) Serine	
q) Threonine	
r) Tryosine	
s) Tryptophan	
t) Valine	
iv. Phytochemicals	
a) Alkaloids	
b) Flavanoids	
c) Phenolics	
d) Saponins	
e) Sterols	
f) Tannins	
g) Terpenoids	
v. Protein	
vi. Fat	
vii. Fibers	

ments (Fahey, 2005; Srikanth, 2014). According to many scientists (Valdez-Solana *et al.*, 2015; Gopalakrishnan *et al.*, 2016) *M. oleifera* is an extremely nutritious plant, so being ideal to treat malnutrition in developing countries.

Moringa also has been reported to possess some medicinal properties (Fahey, 2005). According to Pilotos *et al.* (2020) by activating CD4+ cells and rising the amount of T lymphocytes in the body, *Moringa* can aid in the removal of numerous infections from the body. *Moringa oleifera* has also promoted by World Health Organization (WHO) as a substitute to the food to treat malnutrition (Sreelatha *et al.*, 2009). The World Health Organization (WHO) has been trying to implement the use of *M. oleifera* as a low cost supplement in the poor countries around the world (WHO Readers Forum, 1999). This organization has also advocated for the usage of this plant to aid countries suffering from malnutrition, which is one of the leading causes of death around the world. *Moringa* is even safe to consume in large quantity (Devaraj *et al.*, 2007; Luqman *et al.*, 2012; Stohs *et al.*, 2015).

How *Moringa* is effective to curtail malnutrition and for overall wellbeing

- (i) Rich in all the major micronutrients required by human body.
- (ii) It is an immune stimulant, daily consumption of *Moringa* leaves improves body's natural defense mechanism.
- (iii) It is a natural source of multivitamins and calcium.
- (iv) Provides sustenance to the eyes and the brain.
- (v) Promotes body metabolism.
- (vi) Promotes the cell structure of the body.
- (vii) Promotes natural good serum cholesterol.
- (viii) Act as a powerful antioxidant.
- (ix) Boost heart health.
- (x) Improves digestive system.
- (xi) Promotes the proper functioning of the liver and the kidney.
- (xii) Helps to boost the body energy in a natural manner.
- (xiii) Ensures healthy circulatory system.
- (xiv) It has anti-inflammatory, antidiabetic, antimicrobial, antibacterial property.
- (xv) Support in building red blood cells.
- (xvi) Revitalize the body at cellular level.
- (xvii) Reduces the pH level in the body.

- (xviii) It provides overall development of body.
- (xix) Maintains the normal sugar levels of the body.
- (xx) Neutralize or wash out the body toxins.

Consumption and storage

We can consume *Moringa* leaves as raw in juice form. It can also be cooked, but cooking at low temperature for less than 5 minutes is recommended. The *Moringa* leaves can be kept for about six months or even for one year in cool place after air drying. In powder form it can be sprinkled over many food items just like coriander leaves.

Conclusion

It could be clearly concluded that *Moringa* is an excellent source of many vital nutrients required for human health. It is very unfortunate that in spite of its tremendous potential, this plant is not well explored. It can be added to different food items or can be used as a cheap and natural food supplement in all the developing countries including India for combating malnutrition.

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References

- Akhtar, S., Karak, C., Biswas, P., Chattopadhyay, A. and Hazra, P. 2012. Indigenous Leafy Vegetables: A Potential Source of β -Carotene and Ascorbic Acid. *International J. of Vegetable Science*. 18(4): 370-375.
- Akseer, N., Kandru, G., Keats, E.C. and Bhutta, Z.A. 2020. COVID-19 pandemic and mitigation strategies: implications for maternal and child health and nutrition. *Am J Clin Nutr*. 112(2) : 251-256.
- Amaglo, N. 2006. *Moringa* and other highly nutritious plant resources: Strategies, standard and markets for a better impact on nutrition in Africa. Accra, Ghana November 16-18.
- Anwar, F., Sajid, L., Muhammad, A. and Anwarul, H.G. 2007. *Moringa oleifera*: A Food plant with Multiple Medicinal Uses. *Phytother Res*. 21 : 17-25.
- Ashfaq, M., Basra, S. and Ashfaq, U. 2012. *Moringa*: A miracle plant for agroforestry. *Journal of Agriculture*

- and *Social Science*. 8(3): 115–122.
- Bakre, A.G., Aderibigbe, A.O. and Ademowo, O.G. 2013. Studies on neuropharmacological profile of ethanol extract broth against carbon tetrachloride-induced acute liver injury in mice. *Food Chem*. 132 : 709-16.
- Budda, S., Butryee, C., Tuntipopipat, S., Rungsipipat, A., Wangnaithum, S., Lee, J. S. and Kupradinum, P. 2011. Suppressive effects of *Moringa oleifera* Lam pod against mouse colon carcinogenesis induced by azoxymethane and dextran sodium sulfate. *Asian Pac J Cancer Prev*. 12(12) : 3221-3228.
- Caceres, A., Cabrera, O., Morales, O., Mollinedo, P. and Mendia, P. 1991. Pharmacological properties of *Moringa oleifera*. 1: Preliminary screening for antimicrobial activity. *Journal of Ethnopharmacology*. 33(3) : 213-216.
- Devaraj, V. C., Asad, M. and Prasad, S. 2007 Effect of leaves and fruits of *Moringa oleifera* on gastric and duodenal ulcers. *Pharmaceutical Biology*. 45(4) : 332–338. <https://doi.org/10.1080/13880200701388020070>
- Devaraj, V.C. and Gopala Krishna, B. 2013. Antiulcer activity of a polyherbal formulation (PHP) from Indian medicinal plants. *Chinese journal of Natural Medicines*. 11(2) : 145-148.
- Dhakar, R.C., Maurya, S.D., Pooniya, B.K., Bairwa, N. and Gupta, M.S. 2011. *Moringa*: The herbal gold to combat malnutrition. *Chron Young Sci*. 2 : 119-25. doi.org/10.1002/ptr.5325 [doi: 10.1016/S0166-3542\(03\)00152-9](https://doi.org/10.1016/S0166-3542(03)00152-9)
- Ezzati, F., Lopez, A.D., Rodgers, A., Hoorn, S.V. and Murray, C.J.L. 2002. Selected major risk factors and global and regional burden of disease. *Lancet*. 360 (9343) : 1347-1360.
- Fahey, J.W. 2005. *M. oleifera*: A Review of the medical evidence for its nutritional, therapeutic and prophylactic properties. Part 1. *Trees for Life Journal*. 1: 5.
- Fahey, J. W. 2019. Medicinal potential and benefits of *Moringa oleifera* 13.1 *Moringa oleifera* medicinal potential and benefits. The Miracle Tree: *Moringa Oleifera* . https://books.google.com.np/books?hl=en&lr=&id=1FrBDwAAQBAJ&oi=fnd&pg=PA203&dq=Medicinal+potential+and+benefits+of+Moringa+oleifera+13.1+Moringa+oleifera+medicinal+potential+and+benefits&ots=SmVGhrcXex&sig=rbPveYdgWYhf4vKsFstYcZMA Yg8&redir_esc=y#v=onepage&q=Medicinal%20potential%20and%20benefits%20of%20Moringa%20oleifera%202013.1%20Moringa%20oleifera%20medicinal%20potential%20and%20benefits&f=false
- Foidl, N., Harinder, P.S., Markar, P. and Becker, K. 2001. The potential of *Moringa oleifera* for agricultural and industrial uses, In: *The Miracle Tree*, Lowell J Fuglie, Darkar Senegal (eds) 45-76.
- Global Hunger Index, 2020. <https://www.globalhungerindex.org/india.html>
- Gopalakrishnan, L., Doriya, K. and Kumar, D.S. 2016. *Moringa oleifera*: a review on nutritive importance and its medicinal application. *Food Sci Human Wellness*. 5 : 49–56.
- Guevara, A.P., Vargas, C., Sakurai, H., Fuziwara, Y., Hashimoto, K. and Maoka, T. 1999. An Anti-Tumor Promoter from *Moringa oleifera* Lam. *Mutation Research*. 440: 181-188. [doi: 10.1016/S1383-5718\(99\)00025-x](https://doi.org/10.1016/S1383-5718(99)00025-x).
- Gupta, R.K. 2010. *Medicinal and Aromatic Plants*. CBS publisher & distributors 1st edition 151-152.
- Horwath, M. and Benin, V. 2011. Theoretical investigation of a reported antibiotic from the Miracle Tree *Moringa oleifera*. *Comp. Theor Chem*. 965 : 196-201 .
- Huang, G.J., Deng, J.S., Huang, S.S., Shao, Y. Y., Chen, C. C. and Kuo, Y. H. 2012. Protective effect of antrosterol from *Antrodia camphorate* submerged whole in rats. *J Chin Integr Med*. 8 : 49-55.
- India Child well being report, 2020. https://www.worldvision.in/wvreports/India%20Child%20Wellbeing%202020_Web%20Spread.pdf
- Joshi, P. and Mehta, D. 2010. Effect of dehydration on the nutritive value of drumstick Leaves. *Journal of Metabolomics and Systems Biology*. 1 : 5 -9.
- Lai, T.Y., Weng, Y.J. and Kuoi, W.W. 2010. Taohe Chengqi Tang ameliorates acute liver injury induced by carbon tetrachloride in rats. *J Chin Integr Med*. 8 : 49-55.
- Lipipun, V., Kurokawa, M., Suttisri, R., Taweechoitipatr, P., Pramyothin, P., Hattori, M. and Shiraki, K. 2003. Efficacy of Thai medicinal plant extracts against herpes simplex virus type 1 infection *in vitro* and *in vivo*. *Antiviral Res*. 60 :175–180. DOI: 10.1016/S0166-3542(03)00152-9
- Luqman, S., Srivastava, S., Kumar, R., Maurya, A. K. and Chanda, D. 2012. Experimental assessment of *Moringa oleifera* leaf and fruit for its antistress, antioxidant, and scavenging potential using *in Vitro* and *in Vivo* assays. *Evidence-Based Complementary and Alternative Medicine*. Article ID 519084: 12 [doi:10.1155/2012/519084](https://doi.org/10.1155/2012/519084)
- Mahmood, K.T., Mugal, T. and Haq, I. U. 2010. *Moringaoleifera*: a natural gift - a review. *J Pharm Sci Res*. 2 : 775–781.
- Makkar, H.P.S. and Becker, K. 1996. Nutritional value and antinutritional components of whole and ethanol extracted *Moringa oleifera*; leaves. *Animal Feed Science Technology*. 63 : 101-109.
- Masurekar, T.S., Kadam, V. and Jadhav, V. 2014. Roles of *Moringa oleifera* in medicine - a review. *World Journal of Pharmacy and Pharmaceutical Sciences*. (1) : 375-385.
- Metwally, F., Metwally, M., Rashad, M., Ahmed ,H.H., Mahmoud, A.A. and Raouff, E.R.A. 2017. Molecular mechanisms of the anti-obesity potential effect of *Moringa oleifera* in the experimental model. *Asian Pa-*

- cific Journal of Tropical Biomedicine*. 7(3) : 214-221.
- Ndong, M., Uehara, M., Katsumata, S. and Suzuki, K. 2007. Effects of oral administration of *Moringa oleifera* Lam on glucose tolerance in gotokakizaki and wistar rats. *J of Clin Biochem and Nutri*. 40 : 229–33. doi: 10.3164/jcbn.40.229.
- Otilia, J. F., Banji, D. and Kavitha, R.2012. Immunomodulatory effects of alcoholic and hydroalcoholic extracts of *Moringa oleifera* Lam leaves. *Indian J Exp Bio*. 50(4) : 270-6.
- Pakade, V., Cukrowska, E. and Chimuka, L. 2012. Comparison of antioxidant activity of *Moringa oleifera* and selected vegetables in South Africa. *South African Journal of Science*.109(3/4):2-5. doi:10.1590/sajs.2013/1154.
- Pilotos, J., Ibrahim, K.A., Mowa, C.N. and Oyata, M.M. 2020. *Moringaoleifera* treatment increases Tbet expression in CD4⁺ T cells and remediates immune defects of malnutrition in *Plasmodium chabaudi*-infected mice. *Malar J*. 19 : 62.https://doi.org/10.1186/s12936-020-3129-8.
- Rajendran, K., Balaji, P. and Basu, M.J. 2008. Medicinal plants and their utilization by villagers in southern districts of Tamil Nadu. *Indian Journal of Traditional Knowledge*.7(3) : 417-420.
- Razis, A. F. A., Ibrahim, D. M. and Kntayya, S.B.2014. Health benefits of *Moringa oleifera*. *Asian Pacific Journal of Cancer Prevention*. 15(20) : 8571-8576.
- Sadraei, H., Asghari, G. and Farahnaki, F. 2015. Assessment of hydroalcoholic extract of seeds and leaves of *Moringaperegrina* on ileum spasm. *Res Pharm Sci*. 10 : 252–258.
- Safaeian, L., Asghari, G., Javanmard, S. H. and Heidarinejad, A. 2015. The effect of hydroalcoholic extract from the leaves of *Moringa peregrina* (Forssk.) Fiori on blood pressure and oxidative status in dexamethasone-induced hypertensive sodium sulphate. *Asian Pacific J. of Cancer Prev*. 12 : 3221-8.
- Sreelatha, S. and Padma, P.R. 2009. Antioxidant activity and total phenolic content of *Moringa oleifera* leaves in two stages of maturity. *Plant Foods for Human nutrition*. 64 : 303-311.
- Srikanth, V. S. 2014. Improvement of protein energy malnutrition by nutritional intervention with *Moringa oleifera* among Anganwadi children in rural area in Bangalore, India. *International Journal of Scientific Study*. 2(1) : 32-35.
- Stohs, S. J. and Hartman, M. J. 2015. Review of the Safety and Efficacy of *Moringa oleifera*. *Phytother Res*. 29(6): 796-804.
- Tejas, G.H., Joshi, U.N., Bhalodia, P.N., Tusharbindu, D. R. and Tirgar, P.R. 2012. A panoramic view on pharmacognostic, therapeutic and prophylactic value of *Moringa oleifera* Lam. *Int Res J of Pharmacy* 3(6):1-7.
- UNICEF, 2019. <https://scroll.in/latest/940851/in-india-8-8-lakh-children-under-five-years-highest-number-in-world-died-in-2018-says-unicef>
- Valdez-Solana, M.A., Mejía-García, V.Y., Téllez-Valencia, A., García- Arenas, G., Salas-Pacheco, J.S., Alba-Romero, J.J. and Campos, S. 2015. Nutritional content and elemental and phytochemical analyses of *Moringa oleifera* grown in Mexico. *J Chem*. Article ID 860381
<https://doi.org/10.1155/2015/860381>
- WHO Corona virus dashboard, March 2022 .<https://covid19.who.int/>
- World Food Programme,2020.<https://www.wfp.org/publications/2020-world-food-programme-overview>
- World Health Organization,2017. Nutritional Anaemias: Tools for Effective Prevention and Control. Geneva: World Health Organization ISBN 9789241513067.
- World Health Organization Readers' Forum, 1999. Bulletin of the World Health Organization 77 (8) : 707-708.
- Yisehak, K., Solomon, M. and Tadelle, M.2011. Contribution of *Moringa (Moringa stenopetala* Bac.), a Highly Nutritious Vegetable Tree, for Food Security in South Ethiopia: A Review. *Asian J Applied Sciences*. 4 : 477-488.
-