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Moringa Oleifera-A Miraculous Tree

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In recent times medicines extracted from plant sources with therapeutic and healing properties have gained preference over conventional medicines. Moringa oleifera is a plant with multiple benefits used as both human food and for medicinal purposes worldwide. It contains highly digestible protein, iron, calcium, and potassium, Vitamins such as Vitamin A, C, E and polyphenols. Moringa is also a good source of phytochemicals such as myricetin, phenolic substances, phenolic acids, flavonoids, isothiocyanates, tannins and saponins, quercetin, zeatin and kaempferol flavonoids that are effective antioxidants and have several therapeutic effects. Moringa oleifera comprises of several essential nutrients especially amino acids and carotenoids. One of the factors that make it extremely essential to talk about is its functional properties which are additional benefit to its nutritional. Almost all the parts of the miraculous moringa tree offer health benefits and therapeutic effects. This mini review summarizes the various health perspectives of moringa oleifera.

Keywords: Moringa, Medicinal herb, Antioxidant

INTRODUCTION

Moringa Oleifera is a multipurpose miracle tree, which is famous worldwide for its versatile culinary, medicinal, bio remedial and nutritional properties (Gupta et al. 2018). This tree is believed to be one of the most nutrient rich plants yet discovered. It has wondrous countless applications in almost all fields. This tree belongs to Moringaceae family, which consists of 13 species but Moringa Oleifera is the foremost acclaimed member of this family with vast universal cultivation. (Singh et al. 2019). Moringa is believed to have originated in Oudh and Agra, India. Its history dates back to 150 B.C. revealing that the Royals of that era used Moringa in their diet for healthy skin and mental agility. Warriors were fed with leaf extract and Elixir drinks for the purpose of gaining extra energy and relieving pain and stress of war (Sujatha & Patel, 2017).

Moringa is native to tropical and subtropical

regions specially the sub-Himalayan tracts of Indian subcontinent. In the past two decades, Moringa has gained enormous attention in western countries due to its diverse medicinal and socioeconomic properties and is also being cultivated there (Alegbeleye, 2018). The nutritional composition varies in moringa species belonging to different regions (Gopalakrishnan et al. 2016).

Moringa Oleifera has a lot of traditional names depending upon the region of cultivation. Some of the names are horseradish tree, drumstick tree, superfood tree, mulangay, sajna, suhanjna and kelor (Falowo et al. 2018). It is a fast growing, persistent and perennial plant. This plant has the tendency to easily acclimatize to diverse eco and cultivating systems (Singh et al. 2019). It is also called a famine food due to its drought tolerant potential (Saini et al. 2016). This tree grows to a height of 5-10 meter and can withstand extreme

weather conditions (Sujatha & Patel, 2017).

Almost all parts of tree are edible. Specially leaves and pods are used as vegetable in various parts of the world owing to the desirable balance of nutrients it contain. Seeds are eaten fresh or raw and are pressed to drive high quality edible oil commonly known as Ben oil (Stohs & Hartman, 2015). Moringa leaf powder is widely used as a supplement to combat various diseases (Mishra et al. 2012). Root juice is used for treating different ailments. Moringa leaves are also used as fortificant in commercial products (Falowo et al. 2018).

Medicinal uses of the plant

Various parts of this plant especially the leaves are exceptionally nutritious as they contain all essential amino acids, high biological value protein, various fat and water soluble vitamins and high concentration of minerals like calcium, iron, zinc and magnesium. Moringa also contains various antioxidants and phytochemicals, which show its potentiality (Mishra et al. 2012).

Moringa is often quoted as panacea. It is famous among Africans as Miracle tree because of its potential to cure almost 300 diseases. Moringa has been used as herbal medicine for centuries. Medicinal properties can be attributed to the presence of phytochemicals (Gupta et al., 2018). Easy cultivation and high nutrient content makes moringa a sustainable remedy for malnutrition in infants, children, pregnant and lactating mothers as well as enhances milk production during lactation (Falowo et al. 2018). Children are treated with moringa in countries like Benin (Gopalakrishnan et al. 2016); Curative and pharmacological properties of moringa include hepatoprotective, antimicrobial, antioxidant, antidiabetic, antiulcer, anti-inflammatory, anticancer, antispasmodic, antiepileptic, diuretic, radioprotective, antianemic, antiobesity, hypotensive, hormone regulatory and cholesterol lowering activities (Alegbeleye, 2018). Other than nutritional and medicinal properties, Moringa exhibits various commercial, industrial, ornamental and agricultural applications. Ben oil is used for cooking, lubrication and as perfume. Moringa seed works as a natural anticoagulant, can eliminate heavy metals and lower pH, thus it is commonly used as water purifier. Moringa also finds applications in cosmetics, as ornaments, domestic cleaning agent, fertilizer, biodiesel and animal fodder (Alegbeleye, 2018).

Nutritional Composition

Moringa oleifera is the miraculous plant, which act as a warehouse storing various amounts of essential nutrients along with anti-nutrients. Many major and minor minerals important to humans are found in abundance in the Moringa leaves along with the vitamins and phytochemicals as well as anti-cancerous agents. It exhibits an anti-obesity property due to its low caloric count. Moringa's pods has high fiber foods which are good for curing digestive problems and cancer like colon. Fibrous content in Pods of moringa is 46.78%, with 20.66% protein. While content of amino acid varies according to the part of drumstick tree, 30% in pods, 40% leaf and 31% flower. Amount of Omega-3, Omega-6 and Omega-9 is same in pods and flowers (Gopalakrishnan et al. 2016). Table 1 summarizes the nutritional composition of a typical. Moringa plant (100g plant material) though the values may vary among species derived from various geographical locations (Slabber, Lawler, Chenoweth & Ann, 1991). There can be variance in moringa's nutritional values according to the climatic condition, the soil on which it's grown and environmental conditions (Leone et al. 2016).

Antioxidant Activity

Antioxidants play an imperative part in lowering damage caused by free radicals, thus preventing from degenerative ailments and infections. Oxidative stress is the core of many chronic diseases (Fahey, 2017). Under normal conditions, there is equilibrium between Reactive oxygen species (ROS) and antioxidants present in the tissue. However, due to over-productivity of ROS and/or inadequate defense by antioxidants, oxidative stress increases damaging various important biomolecules. Moringa Oleifera contains a wide range of important antioxidants. It has more than 40 natural anti-oxidants (Abdalla, 2013; Dixit et al. 2016). Leaf extracts exhibit the greatest antioxidant activity (Stohs & Hartman, 2015). This activity is attributed to the presence of phenols, flavonoids, and ascorbic acid, beta-carotene, kaemferol, quercetin, alpha-tocopherol and antioxidant enzymes. Procyanidins, oleic acid and palmitic acid present in leaves, flowers and seed also exhibit potent antioxidant activity (Abdalla, 2013). Polyphenols present in leaves decrease oxidative damage by free radical scavenging activity. In a study, it was found that the antioxidant potential of mature moringa leaves is due to hydrogen donating ability.

Table: 1: Nutritional composition of a typical. Moringa plant

NUTRIENTS	FRESH LEAVES	DRY LEAVES	LEAF POWDER	SEEDS	PODS	RDA FOR ADULTS
Calories (Cal)	92	329	205		26	
MACRONUTRIENTS						
Protein (g)	6.7	29.4	27.1	35.97±0.19	2.5	46-56g
Fat (g)	1.7	5.2	2.3	38.67±0.03	0.1	25-38g
Carbohydrates (g)	12.5	41.2	38.2	8.67±0.12	3.7	130g
MICRONUTRIENTS						
Fiber	0.9	12.5	19.2	2.87 ± 0.03	4.8	
Vitamin B1 (mg)	0.06	2.02	2.64	0.05	0.05	1.1-1.2mg
Vitamin B2 (mg)	0.05	21.3	20.5	0.06	0.07	1.1-1.3mg
Vitamin B3 (mg)	0.8	7.6	8.2	0.2	0.2	14-16mg
Vitamin C (mg)	220	15.8	17.3	4.5±0.17	120	75-90mg
Vitamin E (mg)	448	10.8	113	751.67±4.41	-	15mg
Calcium (mg)	440	2185	2003	45	30	1000mg
Magnesium (mg)	42	448	368	635±8.66	24	400mg
Phosphorus (mg)	70	252	204	75	110	700mg
Potassium (mg)	259	1236	1324	-	259	4700mg
Copper (mg)	0.07	0.49	0.57	5.20±0.15	3.1	900mg

In another study, prevention of lipid peroxidation of liposomes and bleaching of carotene leading to reduce oxidative stress was seen (Razis, Ibrahim & Kntayya, 2014).

Anti-inflammatory Activity

Inflammation is a physiological response to protect the body from infection and repair tissue damage. Chronic inflammatory conditions and diseases such as cancer, sepsis, diabetes, autoimmune diseases, CVD (cardiovascular diseases), colitis, and arthritis can all be caused by long-term chronic inflammation (Kou et al., 2018). The foremost promising uses of Moringa extract is in the treatment of many sorts of chronic and acute inflammations. Moringa reduces infection by way of suppressing inflammatory enzymes and proteins in the body, and leaf concentrate can appreciably decrease inflammation inside the cells (Thapa et al. 2019). Leaf extract has been shown to anti-inflammatory efficacy in a carrageenan-induced paw edema model. Bark extracts had anti-inflammatory activity similar to diclofenac in the same model. Roots has also shown anti-inflammatory properties. The mechanism underlying the anti-inflammatory activity can be due to the regulation of neutrophils and the c-Jun N-terminal kinase pathway. β -

sitosterone, β -sitosterol, Tannins, alkaloids, carotenoids, moringinine, phenols, flavonoids, vanillin, hydroxymellein and 9-octadecenoic acid are active ingredients contributing to the anti-inflammatory property (Bhattacharya et.al. 2018).

An ethanolic extract of Moringa concanensis fruit and flower suppressed inflammation by 78.4 and 44.08 percent, respectively, according to a report. The aerial portion of Moringa peregrine extract was found to minimize the permeability of small blood vessels and effect of peritonal inflammation. At doses of 100-300 mg/kg p.o, aqueous extracts and ethanolic extracts of Moringa peregrine seeds suppressed contemporary egg albumin-induced acute inflammation in rats (Abd et al. 2018).

M. Oleifera root extract was found to reduce the development of paw edema in rats in a study, showing results similar to phenylbutazone, a nonsteroidal anti-inflammatory drug with analgesic and antipyretic properties. Several bioactive compounds in Moringa Oleifera may be involved in its anti-inflammatory properties, such as quercetin, which has been shown to inhibit the activation of NF κ B, which is a key step in the inflammatory process. In rats, M. oleifera leaf extract and quercetin have been shown to control the expression of iNOS, IFN-g, and C-reactive protein, as well as minimize the release of tumor necrosis factor alpha (TNF-) and interleukin-6 (IL-

6). Similar results were found in isothiocyanates obtained from *Moringa Oleifera* leaves, which significantly reduced the development of pro-inflammatory mediators by RAW macrophages, especially IL-1b, iNOS, TNF-a, and Nitric oxide (NO) (Brilhante et al. 2017).

Antihypertensive Activity

Hypertension, the silent killer and the underlying cause of multiple cardiovascular diseases such as, heart failure, stroke, coronary artery disease. The leaf juice of *Moringa* is known for its balancing impact on the blood pressure. Thiocarbamate glycosides, nitrile and mustard oil glycosides, which are responsible for lowering the blood pressure, are extracted from *Moringa* leaves. Many of these compounds, containing nitrile groups or carbamate, thiocarbamate are completely acetylated glycosides which are hard to find in nature (Anwar et al. 2007). The extraction of active ethanol from *Moringa* leaves was directed to the withdrawal of following compounds named as niazimicin and niazinin A + B which through their calcium antagonist effect when tested on rats showed a blood lowering effect (Anwar et al. 2007). It has also been seen that when ethanol and other aqueous substances were extracted from the seeds of *Moringa*, the blood lowering effect was more pronounced. The ethanol extraction of *Moringa*'s pods has point out to the derivation of isothiocyanate glycosides and thiocarbamate which are acknowledged as hypotensive fundamentals. Furthermore similar activity was shown by β -sitosterol and Methyl p-hydroxybenzoate present in pods of *Moringa Oleifera* (Anwar et al., 2007).

Cholesterol Lowering Effect

Consumption of *Moringa Oleifera* fruit is successful in diminishing very-low-density lipoprotein and LDL. In addition to these effects, *Moringa Oleifera* has been shown to minimize the development of atherosclerotic plaques. (Brilhante et al., 2017). A hypocholesterolemic action was observed after the administration of a crude extract of *Moringa Oleifera* leaves to rats on a high fat diet resulted in a reduction of up to 14 percent in serum cholesterol levels, which could be due to the presence of a bioactive phytoconstituent, namely β -sitosterol (Brilhante et al., 2017; Anwar et al., 2007). *Moringa oleifera* leaf has a profound hypolipidemic activity which is attributed to its manageable to control the mechanisms involved in removal of lipids from the body. *Moringa oleifera* treating hyperlipidemia in

human subjects remains doubtful (Seriki et al., 2015).

Anti-Diabetic Activity

Diabetes a metabolic disorder spread throughout the world it is a majorly common disease. Mostly in the underprivileged countries, people tend to focus on the medicinal plants than other synthesized medicines due to unavailability or unaffordability. *Moringa oleifera* was considered the most affective one among 14 other plants in the management of diabetes (Fahey, 2016). The aqueous extracts of *Moringa* reported to have lowered the fasting blood glucose levels significantly by ingesting the doses to streptozotocin-induced (STZ) diabetes rats. *Moringa* also contains a significant amount of antioxidants like quercitin and phenolics which can be helpful in scavenging the Reactive Oxygen Species (ROS) released by mitochondria in order to protect beta-cells, hence incorporating 500 mg/kg of *Moringa* powder reduced and maintained the blood glucose levels by improving antioxidant levels (Gopalakirshnan et al. 2016).

Effect of Moringa on Bone Health.

Bone diseases are multi-factorial they include genetic as well as environmental factors; it includes arthritis; inflammation of joints, osteoporosis; bone density is affected in it (Mahdi, Khan, Asmavi, Mahmud & Murugaiyah, 2018; Patel, Rangrez & Parikh, 2013). *M. Oleifera* is power packed with all the essential and non-essential micro-nutrients such as beta-carotene, all essential amino acids, vitamin C, potassium, and calcium, which are indispensable for bone maintenance. It also holds nutrients including B and Mg which assist in absorption of Ca. (Brown et al., 2016). *Moring* fresh leaves contain 440mg Ca, 42mg Mg and dried leaves contain 2185mg Ca and 448mg Mg (Slabber et al., 1994). Calcium is essential nutrient required for normal functioning including teeth and bone health. But with Calcium *moringa* also consists of 160 mg oxalic acid per 100g which usually hinders activity of calcium. Experiment was conducted on rats and they were fed calcium rich diets, in which 15g *moringa* leaf powder, 30g milk powder and 4g kilkeerai leaf powder was given to them. Calcium content in milk diet and *moringa* were the same. The study showed that 73% Ca was absorbed while 59% was retained; proving *moringa* as a good source of calcium. It can prove beneficial for osteoporosis (Fahey & Thurber, 2010).

Anti-Asthmatic Activity.

Asthma an inflammatory condition of a chronic nature identified by a progressive reaction of trachea and bronchi to various stimulants (Suresh et al. 2020). A study indicated that alkaloid from Moringa plant which basically takes after ephedrine in function were to be involved in treating asthma by easing bronchioles. An evaluation ran through to examine the secured capability of seed grain for the intervening measures of individuals with asthma revealed encouraging results such as reduction in the intensity of manifestations side by side enhancing the respiratory role (Farooq et al. 2012).

A thorough examination was conducted on 20 individuals having low to moderate asthmatic condition by giving them 3g/day dried seeds in the form of powder for about 3 weeks. This particular study showed promising results as shown in table 2. Along with that, a promising decrease in manifestations like dyspnea, wheezing, chest tightness and cough (Slabber et al. 1994).

Table 2: Anti-Asthmatic Activity Moringa Oleifera (taken from Slabber et al. 1994).

Conditions	Results
Volume of lungs	
Forced vital capacity (FVC)	33%
Forced expiratory volume in one second (FEV1)	30%
Pulmonary function	
Peak expiratory flow rate (PEFR)	32%
Forced expiratory flow rate (FEF)	20%
Maximum ventilator volume (MVV)	35%

Another experiment was conducted on pigs in which ethanol extracts of seeds were tried with ovalbumin induced airway inflammation, it exhibited increased respiratory role and decreased interleukins in broncho-alveolar lavage (Bhattacharya et al., 2018).

Anti-Cancerous Properties.

A latest study indicated that Lam pod of Moringa Olifera could possibly prevent cancer. The highest dose of 6.0% of boiled Moringa Olifera (bMO) was seen to decrease the

possibility of tumor occurrence and its multiplication (Abdul Razis et al. 2014). The leaves of Moringa helped against tumor activity (table 3).

The following were investigated for their significant antitumor boosting activity, 4[α -L-rhamnosyloxy]-benzyl isothiocyanate together with O-Ethyl- 4-[α -L-rhamnosyloxy]benzyl carbamate, niazimicin and 3-O-[6'-O-oleoyl α -D-glucopyranosyl]- β -sitosterol was used in an vitro assay which showed convincing inhibitory effects on Epstein-Barr virus-early antigen (Kumar et al., 2010). In chemical carcinogenesis, Niazimicin has been proved to be a dominant chemo preventive agent. In mice, the extract of seeds has been found to be active against skin papillomagenesis, hepatic carcinogen metabolizing enzymes and antioxidant parameters. Against Staphylococcus aureus pyoderma in mice a seed ointment had a similar effect (Kumar et al. 2010). It has been discovered that in the leaves of M.olifera , niaziminin ,a thiocarbamate, showed hindrance in tumor-promoter induced Epstein-Barr virus activation and, naturally occurring 4-[[4'-O-acetyl- α -irhamnosyloxy]benzyl] which are among the isothiocyanates happen to do the same (Kumar et al. 2010).

CONCLUSION

In conclusion, several research studies support that Moringa oleifera tree holds a wide range of medical and therapeutic characteristics. In this paper, we elaborated broad range of its properties starting from its nutritional composition to various therapeutic and medicinal qualities. Anti- Oxidant, Anti Inflammatory, Anti-Hypertensive, Cholesterol Lowering, Anti Diabetic, and Anti Asthmatic properties have been highlighted. Further the mechanism of action needs to be studied in detail so that research development leads to pharmacological products comprising of moringa oleifera. Undoubtedly after revealing so many positive health implications of moringa oleifera it can be called a miraculous tree.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

Table 3: Therapeutical potential of Moringa Oleifera

HEALTH EFFECTS	ACTIVE INGREDIENT IN MORINGA	POSSIBLE MECHANISM OF ACTION	PART OF MORINGA PLANT THAT IS MOST EFFECTIVE	REFERENCE
ANTIOXIDANT PROPERTY, FREE RADICAL SCAVENGING	Phenols, flavonoids, ascorbic acid, beta-carotene, kaempferol, quercetin, alpha-tocopherol and antioxidant enzymes	Hydrogen donating ability; prevention of lipid peroxidation of liposomes and bleaching of carotene	Leaf, flower and seed	(Abdalla, 2013; Razis et al., 2014)
ANTICANCER PROPERTY	4[α -L-rhamnosyloxy]-benzyl isothiocyanate together with O-Ethyl- 4-[α -L-rhamnosyloxy]benzyl carbamate, niazimicin and 3-O-[6'-O-oleoyl α -D-glucopyranosyl]- β -sitosterol	Showed significant inhibitory effects on Epstein-Barr virus-early antigen, 4-[4'-O-acetyl- α -irhamnosyloxy]benzyl] niaziminin ,a thiocarbamate, showed hindrance in tumor-promoter induced Epstein-Barr virus activation	Pod, seed, leaves	(Razis et al., 2014; Kumar et al., 2010)
ANTIDIABETIC	Quercitin and phenolics	Scavenging the Reactive Oxygen Species (ROS) released by mitochondria in order to protect beta-cells	Seed, aqueous extracts	(Gopalakirshnan et al., 2016)
ANTI-ASTHAMATIC	Alkaloids	Easing bronchioles acting like ephedrine	Seed grain	Bhattacharya et al., 2018)
BONE HEALTH	Phenols, flavonoids, ascorbic acid, beta-carotene, kaempferol, quercetin, alpha-tocopherol and antioxidant enzymes	Anti-nociceptive action of ethanol extract of Moringa leaves. Anti-inflammatory and anti-oxidant activity of Moringa leaves extract showed a significant inhibition of nitric oxide (NO) production by macrophage cells which decrease the serum level.	Leaf, seed extract	(Patel et al., 2013; Brown et al., 2016; Fahey et al., 2010)
ANTI-INFLAMMATORY PROPERTY	β -sitostenone β -sitosterol Tannins Alkaloids Carotenoids Moringinine Phenols Phenylbutazone Flavonoids Vanillin Hydroxymellein 9-octadecenoic acid Quercetin Isothiocynates	Suppressed inflammation.	Leaves, root extract, flower and fruit extract	(Bhattacharya et al., 2018; Rani et al., 2018 ; Brillhante et al., 2017)
CHOLESTROL LOWERING EFFECT	Bioactive phytoconstituent, i.e. β -sitosterol	Reduced the permeability of small blood vessels. Decreased the effect of peritorial inflammation.	Fruit, crude extract, leaf	(Brilhante et al., 2017; Anwar et al., 2007 ; Seriki et al., 2015)
ANTI-HYPERTENSIVE	Thiocarbamate glycosides, nitrile and mustard oil glycosides , isothiocyanate, β -sitosterol and Methyl p-hydroxybenzoate, ethanol	Analgesic and antipyretic properties.	Leaf , seed, pods	(Dubey et al., 2013 ; Anwar et al., 2007)

AUTHOR CONTRIBUTIONS

SA, AB, AI, FS, IK and MT conceived the idea of exploring literature on the wonderful herb Moringa oleifera. AB and FS explored relevant

literature whereas AI, IK and MT developed the theory. SA supervised the data extraction process and contributed to manuscript. SN gave valuable suggestions to manuscript, proof read it and reviewed the references. All authors reviewed,

discussed and contributed to the manuscript.

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