

Review Article

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A Review on Multi Nutritional and Miracle Tree: *Moringa oleifera*

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ABSTRACT

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Moringa oleifera is native to India and grows tropic and sub-tropical region of the world. *Moringa* leaves are storehouse of all essential nutrients. *Moringa oleifera* leaves had good phenolic, flavonoids and tannin, saponin and vitamins content. It had good antioxidant, anticancer, anti-diabetic properties. Antioxidant protect cell from damage and boost immune system. They are also rich in minerals like Cu, Fe, Zn, Ca and Vitamins like β -carotene, vitamin A, B, C, D and E also present. *Moringa* leaves treat hyperglycemia and diseases like asthma, pneumonia and flu etc. and acts as an anti-cancer, antioxidant. This review paper shed light into the nutritional and medicinal properties of *Moringa* leaves and how they correlate with health and fight against diseases, while also acknowledging the need for long-term healthy habits. *Moringa* leaves can be used as nutritional supplement in food products such as cookies, *khakhra*, crackers and energy bar and increasing nutrition quality of food product.

Introduction

Moringa oleifera is native to India and grows tropic and sub-tropical region of the world. It is commonly known as ‘drumstick tree’ or ‘horseradish tree’. *Moringa* tree is a fast-growing, drought-tolerant, multi-purpose and very useful tree due to their nutritional and medicinal properties in world is known as a ‘miracle tree’. With its high nutritive values, every part of the tree is suitable for either nutritional or commercial purposes. The leaves are rich in minerals, vitamins and other essential phytochemicals. Dry leaves contain

9 times as much protein as yogurt, 10 times as much vitamin A as carrot, 25 times more iron as that in spinach, 15 times more potassium than bananas, 17 times as much calcium as in milk and 7 times as much vitamin C as orange (Gopalakrishnan *et al.*, 2016). As it is rich in nutrition doctors and nutritionists suggest consumption of *Moringa* leaves for the problems of malnutrition worldwide. Extracts from the leaves are used to treat malnutrition, augment breast milk in lactating mothers. As reported by different scholars *Moringa* has wide range of uses. Among those, water purification, human consumption, medicine,

fuel wood, dye, soil and water conservation, livestock forage and green manure (Dawit *et al.*, 2016). *Moringa* has multipurpose use, well adapted and significant economic importance, as it has vital nutritional, industrial, and medicinal applications.

Plantation and soil conditions

Moringa oleifera can be grown in any tropical and subtropical regions of the world with a temperature around 25–35 °C. It requires sandy or loamy soil with a slightly acidic to slightly alkaline pH and rainfall ranges 250–3000 mm (Thurber and Fahey, 2010). The direct seeding method is follow for its high germination. Since *Moringa* seeds are expected to germinate within 5–12 days after seeding and can be implanted at a depth of 2 cm in the soil. *Moringa* can also be propagated using containers. The saplings are placed in plastic bags containing sandy or loamy soil. After it grows to about 30 cm, it can be transplanted. The tree can also be cultivated from cuttings with 1 m length and 4–5 cm in diameter, but these plants may not have a good deep root system. Such plants tend to be sensitive to drought and winds. *Moringa oleifera* differs in nutrient composition at different locations (Aslam *et al.*, 2005).

The tree grown in India has slightly different nutritional components than a tree grown in Nigeria. The nutritional differences in the leaves from two ecological locations semi-deciduous and Savannah regions. It showed that the latter was less nutritious than the former and attributed this to high temperatures at the Savannah regions. At higher temperature, proteins and enzymes get denatured and this could be the cause for the difference in nutrient content. Soil is an important factor that defines nutrient content and strength of the plant (Asante *et al.*, 2014). Fertilizers when applied solely or in

combination with others resulted in different nutrient compositions on plant parts. NPK fertilizer, poultry manure and organic base fertilizer was provided to study the effect on the nutrient content and found that poultry manure gave the best results than phosphorous, potassium, sodium and manganese. Likewise the stem girth and vegetative growth of *Moringa* increased on application of poultry manure. The overall nutrient attributes of the plant remains same albeit nutrient variability. This makes *Moringa* viable as a potential nutraceutical anywhere in the world (Dania *et al.*, 2014).

Nutritional properties of *Moringa Oleifera* leaves

Vitamins

Fresh leaves from *Moringa oleifera* are a good source of vitamin A. It is well established that vitamin A has important functions in vision, reproduction, embryonic growth and development, immune competence and cell differentiation. *Moringa* leaves are a good source of carotenoids with pro-vitamin A potential (Slimani *et al.*, 2007). *Moringa* leaves also contain 200 mg/100 g of vitamin C, concentration greater than what is found in oranges (Ferreira *et al.*, 2008). *Moringa* leaves also protect the body from various deleterious effects of free radicals, pollutants and toxins and act as antioxidants. *Moringa* fresh leaves are a good source of vitamin E, with concentrations similar to those found in nuts. This is important because vitamin E not only acts as an antioxidant, but it has been shown to inhibit cell proliferation (Borel *et al.*, 2013).

Polyphenols

The dried leaves of *Moringa* are a great source of polyphenol compounds, such as flavonoids and phenolic acids.

Flavonoids content

The antioxidant activity of flavonoids depends upon the arrangement of functional groups about the nuclear structure. Flavonoids, which are synthesized in the plant as a response to microbial infections, have a benzo- γ -pyrone ring as a common structure (Kumar *et al.*, 2013). Intake of flavonoids has been shown to protect against chronic diseases associated with oxidative stress, including cardiovascular disease and cancer. *Moringa* leaves are a good source of flavonoids. Flavonoids found in *Moringa* leaves are myrecetin, quercetin and kaempferol, in concentrations of 5.8, 0.207 and 7.57 mg/g, respectively (Coppin *et al.*, 2013). Quercetin is found in dried *Moringa* leaves, at concentrations of 100 mg/100 g, as quercetin-3-*O*- β -d-glucoside (iso-quercetin or isotrifolin). Quercetin is a strong antioxidant, with multiple therapeutic properties.

Phenolic content

Phenolic acids are a sub-group of phenolic compounds, derived from hydroxybenzoic acid and hydroxycinnamic acid, naturally present in plants, and these compounds have antioxidant, anti-inflammatory, antimutagenic and anticancer properties. In dried leaves, Gallic acid is the most abundant, with a concentration of 1.034 mg/g of dry weight. The concentration of chlorogenic and caffeic acids range from 0.018 to 0.489 mg/g of dry weight and 0.409 mg/g of dry weight, respectively (Prakash *et al.*, 2007). Chlorogenic acid (CGA) is an ester of dihydrocinnamic acid and a major phenolic acid in *Moringa*.

Tannins content

Tannins are water-soluble phenolic compounds that precipitate alkaloids, gelatin and other proteins. Their concentrations in

dried leaves range between 13.2 and 20.6 g tannin/kg being a little higher in freeze-dried leaves. Tannins have been reported to have anti-cancer, antiatherosclerotic, anti-inflammatory and anti-hepatotoxic properties (Adedapo *et al.*, 2015).

Saponins content

Moringa leaves are also a good source of saponins, natural compounds made of an isoprenoidal-derived aglycone, covalently linked to one or more sugar moieties. The concentrations of saponins in *Moringa oleifera* freeze-dried leaves range between 64 and 81 g/kg of dry weight. Saponins have anti-cancer properties (Tian *et al.*, 2013).

The extract of *Moringa* leaves also contains tannins, saponins, flavonoids, terpenoids and glycosides, which have medicinal properties. These compounds have been shown to be effective antioxidants, antimicrobial and anti-carcinogenic agents (Ayoola *et al.*, 2008). Phenolic compounds are known to act as primary antioxidants, due to their properties for the inactivation of lipid free radicals or prevention of the decomposition of hydroperoxides into free radicals, due to their redox properties. These properties play a key role in neutralizing free radicals, quenching singlet or triplet oxygen, or decomposing peroxides (Zheng and Wang, 2001).

Medicinal properties of *Moringa oleifera* leaves

Antioxidant properties

Due to the high concentrations of antioxidants present in *Moringa* leaves, they can be used in patients with inflammatory conditions, including cancer, hypertension, and cardiovascular diseases. The β carotene found in *Moringa* leaves has been shown to act as an antioxidant. The antioxidants have the

maximum effect on the damage caused by free radicals only when they are ingested in combination. A combination of antioxidants found in *Moringa* leaves was proven to be more effective than a single antioxidant, possibly due to synergistic mechanisms and increased antioxidant cascade mechanisms. A recent study in children demonstrated that *Moringa oleifera* leaves could be an important source of vitamin A (Lopez-Teros *et al.*, 2017).

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Anti-Hyperglycemic (Antidiabetic) Properties

Diabetes is a disease that is characterized by problems involving the hormone insulin. In healthy people, the pancreas releases insulin, insulin then works to help the body use and store the fat and sugar that is derived from the food that people eat. With diabetes, insulin can be compromised in a couple of different ways. In some cases, the pancreas doesn't produce any insulin at all. Other times, the body does not react in the right way to insulin- this is known as "insulin resistance". Finally, diabetes is sometimes characterized by a pancreas that product an insufficient volume of insulin. As with any disease or condition, doctor and researcher are

constantly seeking new ways to treat and manage diabetes. *Moringa* is used to treat and manage the symptoms of diabetes for years. (Dixit *et al.*, 2016)

Moringa has been shown to cure both Type 1 and Type 2 diabetes. Type 1 diabetes is one where the patients suffer from non-production of insulin, which is a hormone that maintains the blood glucose level at the required normal value. Type 2 diabetes is one associated with insulin resistance. Type 2 diabetes might also be due to beta cell dysfunction, which fails to sense glucose levels, hence reduces the signaling to insulin, resulting in high blood glucose levels. Several studies have shown that, *Moringa* can act as an anti-diabetic agent. In hyperglycemic patients, the beta cells get destructed. Therefore, high glucose enters the mitochondria and releases reactive oxygen species. Since beta cells have low number of antioxidants, this in turn causes apoptosis of the beta cells (Kaneto *et al.*, 1999). This reduces insulin secretion leading to hyperglycemia and in turn diabetes mellitus Type-2. The flavonoids like quercetin and phenolics have been attributed as antioxidants that bring about a scavenging effect on ROS. It can be hypothesized that the flavonoids in *Moringa* scavenge the ROS released from mitochondria, thereby protecting the beta cells and in turn keeping hyperglycemia under control (Gopalakrishnan *et al.*, 2016). Diabetes leads to several complications such as retinopathy, nephropathy and atherosclerosis etc. *Moringa* can be used to prevent such ailments.

Anticancer properties

Cancer is a common disease and one in seven deaths is attributed due to improper medication. Several factors like smoking, lack of exercise and radiation exposure can lead to the disease. Cancer treatments like surgery, chemotherapy and radiation are expensive and

have side effects. *Moringa oleifera* can be used as an anticancer agent as it is natural, reliable and safe, at established concentrations. *Moringa oleifera* has other characteristic which make it a good compliment to a cancer prevention or treatment plan. It contains an enormous amount of nutritional content; *Moringa oleifera* contains vitamins, minerals, and amino acids which are critical for good health. It is loaded with calcium, iron, potassium, protein, vitamin A and C, and as many more properties which promote a healthy body that has the tools to fight cancer (Dixit *et al.*, 2016). *Moringa* can be used as an anti-neoproliferative agent, thereby inhibiting the growth of cancer cells. Soluble and solvent extracts of leaves have been proven effective as anticancer agents. Furthermore, research papers suggest that the anti-proliferative effect of cancer may be due to its ability to induce reactive oxygen species in the cancer cells. The ROS production by *Moringa* is specific and targets only cancer cells, making it an ideal anticancer agent. The capacity of *Moringa* leaves to protect organisms and cells from oxidative DNA damage, associated with cancer and degenerative diseases.

Effects on ocular diseases

The major cause of blindness, which ranges from impaired dark adaptation to night blindness, is vitamin A deficiency. *MO* leaves, pods and leaf powder contain high concentrations of vitamin A, which can help to prevent night blindness and eye problems. Also, consumption of leaves with oils improved vitamin A nutrition and delayed the development of cataracts (Anwar *et al.*, 2007).

In conclusion *moringa* should be promoted for further consumption to improve nutrition and medicinal functions. *Moringa* leaves are a

great package of natural antioxidant and thus increases the shelf life of food product containing fat which is caused by the presence of compounds like phenolic, flavonoids, tannin, saponons and vitamins. *Moringa* leaves can be used as nutritional supplement in food products such as cookies, *khakhra*, crackers, biscuit, yoghurt, bread, soups and energy bar and increasing nutrition quality of food product for malnutrition children. *Moringa* leaves treat hyperglycemia and diseases like asthma, pneumonia, malaria, diarrhea, flu, heart burn, skin diseases, eye and ear infections *etc.* and acts as an anti-cancer, antioxidant, antimicrobial, anti-diabetic and neuroprotectant. *Moringa* has been shown to cure both Type 1 and Type 2 diabetes. It has been hypothesized that the flavonoids in *Moringa* scavenge the reactive oxygen species released from mitochondria, thereby protecting the beta cells and in turn keeping hyperglycemia under control. By incorporating *Moringa* leaves powder the nutritional quality of food products can be enhanced as it contains minerals as Cu, Fe, K, Zn, Ca and Mg and Vitamins like β -carotene, Vitamin A, C and E, phenolic, tannin, flavonoids, antioxidant, anticancer and antidiabetic *etc.* thus the potential of *Moringa* can be used to combat malnutrition. The demand for snacks in the market is huge. Hence, *Moringa* fortification in snacks to eradicate malnutrition has a twin advantage. The tree as a native to India can become a great source of income for the nation if this potential for highly nutritional food is exploited by the food industry.

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