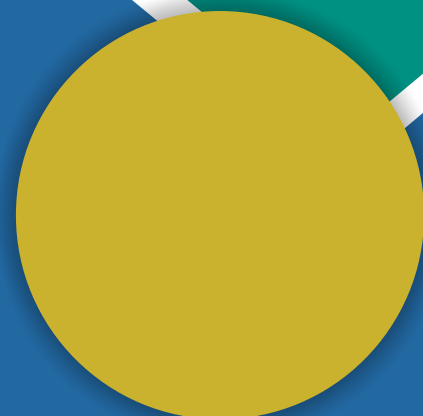


Moringa A Multipurpose Plant



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Moringa is known as a miracle tree, single genus, Moringaceae family and of 14 known species. The most popular and broadly cultivated specie is *Moringa oleifera* also known as 'drumstick' tree and locally as "Sohanjna" native to the sub-Himalayan tracts of Pakistan, India, Bangladesh and Afghanistan. Moringa is highly nutritious plant which can save lives, nourish the deprived people and can be a good source of nutrition for the people of all age groups. Moringa seed is an effective water purification agent. Moringa leaf extract is very rich in growth promoting compounds which makes it an excellent bio-stimulant. It has also cosmetic value especially as anti-aging agent.

All parts of moringa plant are useful

Leaves and Pods	Seeds	Flowers, Bark, Gum and Roots
Vegetable, Nutrition, Medicines, Plant Growth Hormone, Fodder, Feed	Water purification, Medicines, Cosmetics, Cooking Oil, Lubricant	Food, Medicine

Nutritional Value

Moringa has rich amount of vitamins mainly vitamin A and C, minerals (calcium, phosphorous, iron, copper, zinc, iodine, sulphur, selenium and manganese) and all essential amino acids. Moringa is also rich in antioxidants like polyphenols, flavonoids and carotenoids. The most significant phytochemicals for medicinal point of view present in moringa are quercetin, kaempferol, zeatin and caffeoylquinic acids.

Nutritional Quality of Fresh and Dried Moringa Leaves



Fresh Leaves

Gram for gram, fresh leaves contain about:

- 4 times the Vitamin A of Carrots
- 7 times the Vitamin C of Oranges
- 4 times the Calcium of Milk
- 3 times the Potassium of Bananas
- $\frac{3}{4}$ the Iron of Spinach
- 2 times the Protein of Yogurt



Dried Leaves

Gram for gram, dried leaves contain about:

- 10 times the Vitamin A of Carrots
- $\frac{1}{2}$ the Vitamin C of Oranges
- 17 times the Calcium of Milk
- 15 times the Potassium of Bananas
- 25 times the Iron of Spinach
- 9 times the Protein of Yogurt

Moringa Medicinal Value

Moringa boosts immune system. Supports body metabolism and cell structure of the body. Enhances healthy circulatory system and detoxifies your body of toxins. Promotes proper digestion. Promotes the normal functioning of the liver and the kidney. Supports diabetic condition, normal sugar levels of the body. Helps you sleep better. Provides nourishment to the eyes and the brain. Supports the body's anti-inflammatory mechanisms.

Moringa as Food

Flower buds are very popular as main course dish in southern Punjab. Tender pods and roots are used for pickle. Moringa oil is derived from the seeds, which is used for cooking and cosmetics. Immature seeds can be used in recipes similar to green peas. The leaves are extensively used as a vegetable in many parts of the world. Fresh or dried flowers and dried leaves are used for making teas.

Moringa for Water purification

Moringa seed powder is used to clean the drinking water in many parts of the world. Moringa seeds act as primary coagulant, contain lower molecular weight water soluble proteins which bind negatively charged particles (clay, silt, bacteria, toxins etc) and allow them to settle down to the bottom and be removed by filtration. In the purification of drinking water the protein not only acts as a natural polypeptide for the sedimentation of organic particles, clay, silt, minerals and microorganisms but also acts directly as growth inhibitor of the microorganisms. The use of Moringa had an advantage over the chemical treatment of water because it is biological and has been reported as edible plant and being able to kill bacteria, including several harmful pathogens. This natural coagulant is less expensive as compared to conventional coagulant (aluminum sulfate) for the purification of water and easily available in local market. Moringa seed powder can remove 90% of the bacterial load.

Moringa oleifera leaf, raw

Nutritional value per 100 g

Energy	64 kcal (270 kJ)
Carbohydrates	8.28 g
Dietary fiber	2.0 g
Fat	1.40 g
Protein	9.40 g
Vitamins	
Vitamin A equiv.	(47%) 378 µg
Thiamine (B1)	(22%) 0.257 mg
Riboflavin (B2)	(55%) 0.660 mg
Niacin (B3)	(15%) 2.220 mg
Pantothenic acid (B5)	(3%) 0.125 mg
Vitamin B6	(92%) 1.200 mg
Folate (B9)	(10%) 40 µg
Vitamin C	(62%) 51.7 mg
Minerals	
Calcium	(19%) 185 mg
Iron	(31%) 4.00 mg
Magnesium	(41%) 147 mg
Manganese	(17%) 0.36 mg
Phosphorus	(16%) 112 mg
Potassium	(7%) 337 mg
Sodium	(1%) 9 mg
Zinc	(6%) 0.6 mg
Other constituents	
Water	78.66 g

Percentages are roughly approximated using US recommendations for adults.

Source: USDA Nutrient Database

Moringa as Crop Growth Enhancer

Moringa leaf extract obtained from fresh leaves, acts as plant growth enhancer since it is rich in zeatin (a cytokinin) and antioxidants (ascorbate, phenolics, carotenoids) which makes its extract an effective crop growth enhancer. Moringa leaf extract (3% solution) is used as seed priming agent and foliar spray (2-3 sprays at critical stages) that have been found to increase the plant tolerance to abiotic stresses and increases the yields of almost all crops (field crops, vegetables, fruits, grasses etc) up to 35%.

Moringa Seed Oil (Ben oil)

Moringa seeds contain 25 to 45% of oil known as "ben oil". Its composition is similar to olive oil and rich in oleic, palmitic, stearic, and behenic acids. Moringa oil was also popular in Egyptian customs for the treatment of skin diseases. Moringa oil has stunning aesthetic value and is used in beauty products and skin ointments as anti-wrinkle and anti-aging since Egyptian epoch.

Moringa as Animal Fodder and Poultry Feed

Moringa is getting popularity as multi-cut fodder crop for fattening and increasing milk production. This tree has unique capability of re-growth and can be shaped in any forms i.e. tree, bush, hedge, green manure, forage crop. The moringa crop is grown at narrow spacing (15 cm × 30 cm) with optimum cutting interval time of 30-40 days. Unlike most fodders crops, moringa can be grown on wide types of soils and can easily tolerate long dry spells up to even 6 months and grow well with annual rainfall between 250–1500 mm per year. Moringa leaves have a negligible content of tannins, lack of trypsin and amylase inhibitors or cyanogenic glucosides which makes it potential animal feed. Moringa fresh leaves with tender stems can increase the weight of animal up to 32% and milk production by 43-65%.

Production Technology

Moringa can be cultivated both through seeds and stem cuttings. In Southern Punjab, propagation through stem cutting is most common. Two sowing seasons in Pakistan are best for moringa plantation. (i) Spring (End of Feb to March) and (2) Monsoon (July to August). However, except winter moringa can be grown round the year.

Best time of stem cutting plantation is month of March and early April. Moringa tree propagated through stem cutting can bear fruit within one year. This method is most commonly adopted in Southern Punjab, where 4 feet long mature stem cutting planted in pit in such a way that 1/3 portion of stem buried in soil. For moringa tree propagation through seed, dig 1 feet pit and fill it with mixture of sand, silt and well decomposed organic matter. Then sow two seed in one hole

and irrigate it. After few weeks seedlings emerge. When seedlings reached height of 6 inches, maintain one seedling each hill by thinning. While to grow moringa as crop for fodder or biomass production it is cultivated by seed having narrow spacing of (plant to plant 1x1 and row to row 2x2 feet) following the method being used for cotton sowing.

Moringa World Trade and Future Prospects in Pakistan

Moringa has multi-million world trades for its different products. Today Moringa market is estimated more than US\$ 4 billion, which is expected to cross US\$ 7 billion by 2020 @9% per annum. India has the major share which is more than 90% of the world trade. The commercialization of moringa products in Pakistan is still informal and a neglected crop. However, recently there is increasing awareness and many moringa products have been launched as herbal supplement. By the efforts of Alternate Crops Lab, University of Agriculture, Faisalabad, moringa is getting popularity as a crop for fodder and feed and bio-stimulant for field crops/vegetables/fruit trees. However, there is still share in international moringa business. There are huge opportunities in Pakistan to popularize moringa for cattle feeding, fodder supplement for enhancing milk production, poultry feed and so on. Since the plant is native to Pakistan and has a wide variety of germplasm which needs to be screened. Local moringa landraces have better biomass, seed, oil and other products yield potentials than the most popular Indian cultivated varieties. To effectively exploit the existing market potential, the commercialization should eventually become more structured and formalized.

Oil yield/acre

Plant to Plant distance = 10 ft; Row to Row distance = 6 ft; Plants per acre = 726

Variety	Seed yield/tree	Seeds yield/acre	Oil recovery %	Oil yield per acre
Local (Pakistan)	2 kg	1452 kg	25%	363 L/acre
PKM -1 (India)	0.75 kg	544.5	35%	190.5 L/acre

Fodder**Normal cultivation**

Plant to Plant distance = 2 ft; Row to Row distance = 2.5 ft; Plants per acre = 8712

Intensive cultivation

Plant to Plant distance = 1 ft; Row to Row distance = 2 ft; Plants per acre = 21780

Sowing technique	Number of cuttings	Total biomass per acre per year	Total dry matter
Normal cultivation	6	39.203 tons/acre	10.89 tons/acre
Intensive cultivation	6	98.01 tons/acre	27.225 tons/acre

