

***Moringa oleifera* Lam. – Sanjana (Horseradish Tree) – A Miracle food plant with multipurpose uses in Rajasthan-India-An overview**

Ajay Bhargave¹, Isha Pandey¹, Krishnendra Singh Nama^{2*} and Mayank Pandey³

¹Dept. of Biochemistry, Jhalawar Medical College, Jhalawar, Rajasthan, India

²Dept. of Life Science, Career Point University, Kota (Rajasthan) India

³Bhagyodaya Dental Care, Jodhpur (Rajasthan) India

*Corresponding Author E-mail: namasahib@gmail.com

ABSTRACT

The present paper deals with the multifarious uses of this “Miracle tree” as a friend of human being in the state and country as a whole and abroad. The paper also deals with introduction, plant nomenclature, local names, morphology, distribution and flowering and fruiting times, multipurpose uses, nutritional, medicinal etc., phytochemistry, recommendation, conclusion, acknowledgements and references at last.

Key words: *Moringa oleifera* Lam., medicinal uses, plant growth inhibitor, water purification, phytochemistry.

INTRODUCTION

The genus *Moringa oleifera* is having thirteen species in the world and it is a monogeneric family belonging to the Moringaceae and having two species in India viz. *Moringa concanensis* Nimmo ex Dalz. and Gibs. and *Moringa oleifera* Lam. Both the species are growing in Rajasthan, though *Moringa concanensis* is a rare tree in the area found in the Aravalli range.

The *Moringa oleifera* Lam. (*M. pterygosperma* Gaertn.) is a indigenous and naturalized species in India. Indians have been using it as a regular component of conventional eatables for nearly 5000 years¹¹. The tree can grow well in humid tropics or hot dry land with 5-10 m height. It can tolerate wide range of rainfall like 250 mm to over 3000 mm and pH of 5.0 to 9.0. It is a soft woody tree with white-corky bark with gummy branches. The flowers are creamy white or white with 3-winged seeds in about 70 cm long grooved, cylindrical, green pods. *Moringa oleifera* Lam. is referenced in more than 80 countries including India and known in over 200 local languages due to its multifarious uses in the World. The leaves are rich in iron and protein and therefore highly recommended for expected mothers.

Recently many review papers on the *Moringa oleifera* Lam. have been published^{5,19,20,31,46}.

This ‘Miracle tree’ is very impressive and amazing plant due to its tested, trusted and high potential benefits from nutritional and medicinal point of view. This plant is variously used as water purifier, hand wash, cosmetics, cattle’s fodder, plant growth enhancer and biogas. Since last one decade, more than hundreds of research papers, articles, thesis, reports and patents have been published on this tree. Various newspapers, journals, documentaries (Discovery channels), wave sites etc.

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feature this tree more and more. Similarly, so many seminars, conferences have also been organised concerning this popular tree to educate about *Moringa oleifera* Lam. use as a indigenous resource for fighting hunger and malnutrition. Considering all the above facts the present study is being undertaken to throw light on the different aspects of this plant in this overview, with interest to Rajasthan state in particular.

STUDY AREA

Rajasthan is situated in the North-Western part of India between 23°3` and 30°12` N latitude and 69°30` and 78°17` E longitude, occupying an area of about 3,42,274 sq km. The elevation of land surface varies from 214 to 727 m. In shape, it is an irregular rhomb with North-South and East-West diagonals, the former about 784 km and latter 850 km long. The Western and N-W boundaries are marked by Pakistan. In the North and N-E, it is bounded by Punjab, Haryana and UP, in the East and S-E by MP and in the S-W by Gujarat states in India.

The remarkable feature of Rajasthan state is the Aravalli range, travelled 550 km from Khetri in N-E to Khed-Brahma in the S-W and elevation raises upto 1727 m at Mt. Abu. Aravalli range divides the whole of Rajasthan into two natural divisions i.e. 3/5 lying on N-W and 2/5 on the East and S-E. The Western sandy plains known as Rajasthan desert, comprising 1,96,150 sq km. The Eastern 1/3 part lying between sandy and plains in the West and the Aravalli in the East is semi-arid transitional plains. The Eastern plains covers the N.E. and S.E. of the main Aravalli range. The area falling between Banas and Chambal rivers is called the Vindhyan scarpland extending over Bharatpur, Dholpur and Sawai Madhopur districts. January is the coldest month of Rajasthan. The average mean temperature ranges from 12°C to 17°C except Mt. Abu. In summer from April-June temperature rises 28°-47° C. In the monsoon temperature slightly decreases. The rainfall is between 250-1250 mm. The maximum humidity observed in mid July mid August (90%). In the hot and rainy seasons, the winds usually move between S.-W. and West. During summers, dust storms very common, particularly in W. Rajasthan desert. Fogs are more frequent; occur in between December to February.

MATERIAL AND METHODS

Since last three years, many Botanical collection tours have been undertaken by the authors in the different seasons of the years in the Rajasthan to collect this “*Miracle tree*” in the nature and also collected different uses of this tree by interacting with the local people of the area. The plant specimens collected have been made voucher herbarium specimens as per the International herbarium techniques. The collected plant specimens have been identified by the Scientists of BSI, Jodhpur (BSJO) also consulted the herbarium of Botany Department, J.N.V. University, Jodhpur and other herbarium available at Udaipur and Jaipur Universities. The collected herbarium specimens have been deposited in Department of Life Sciences, Carrier Point University, Kota (CPUK). (*Photo 1,2,3*)

OBSERVATION AND RESULT

The present study deals with a solitary species *Moringa oleifera* Lam. belonging to family Moringaceae, commonly used as nutritional, medicinal, culinary uses, plant growth inhibitor, seed-oil, water purifier, cattle-feed etc.

Moringa oleifera Lam. Encycl. Meth. Bot. 1: 398. 1785; Pandey in Shetty and Singh, Fl. Rajasthan 1: 196. 1987. *M. pterygosperma* Gaertn. Fruct. Sem. Pl. 2: 314. 1781. (**Family: MORINGACEAE**). (*Photo 1,2,3*)

Local names: *Hindi names:* Sajana, Lingru, Shajna, Saina, Mungaera, Shaijmal, Segra; **Punjabi:** Sanjina, Soanjana, Sejana; **Rajasthan:** Lal Sahinjano, Lingru; **Sindhi:** Swanjera and **English:** Horseradish Tree, Ben Tree, Drumstick Tree, Mothers Rest Friends, Gold of poor.

Plant character: A soft-wooded, fast growing, medium-sized trees, 5-8 m high and chest height girth 30-45 cm; tender parts pubescent; bark soft, corky, yellowish-gray. Leaves 30-70 cm long, tripinnate; leaflets upto 2.5 x 1.5 cm, opposite, obovate or elliptic-ovate, tip acute or obtuse, downy-greyish, when young,

with long petiole; stipitate glands present at the bases of of the petioles and pinnae. Inflorescences white to creamish-yellow, without red streaks on the petals, sweet fragrant in a 10-30 cm long, drooping panicles. Flowers bracteate, zygomorphic, bisexual, pentamerous. The fruits are 3-lobed, pendulous, 30-100 x 1.5-3.0 cm, green. Seeds brownish-black, globose-3-angled, with three lateral, papery wings, which are united at the top.

Fl. and Fr.: February – June, generally most part of the year.

Indigenous to North-West India. Mostly cultivated in the gardens, houses and along roadsides as a most useful trees, as every parts of the tree are being used as food, fodder, fibber, medicinal, etc. Plants are growing well in different soils in sunny conditions.

Distribution: It is a native of Himalayan foothills (India/Bangladesh). In India and Africa, it is being extensively cultivated as a commercial crop. It is well adapted to the tropics and sub-tropics. It is common in South and Southeast Asia. Today it is widely cultivated in Africa, S. America, Sri Lanka, India, Mexico, Malaysia, Indonesia and Philippines. Commonly found from sea level to 1,400 m on recent alluvial land or near riverbeds and streams. It is well grown in arid and semi-arid regions.

Gardening notes: Plants grow well in all types of soils, except stiff clays, but prefers well-drained soils in the neutral pH range. Optimum leaf and pod production requires high average daily temperature ranges 25-30 c (77-86 f), well-distributed annual rain fall of 100-200 cm (40-80 in.). high solar radiation and well-drained soils.

It is a fast growing tree. Cutting of fairly large size, planted in moist soil, strike roots readily and grow to sizeable tree within few months. It does not tolerate frost and freeze. It is a sun and heat-loving tree. It can also be propagated by seeds. India is the largest producer of *Maringa* crop, with an annual production of 1.1 to 1.3 million tonnes of tender fruits/pods from an area of 380 km². Among the states, Andra Pradesh leads in both area and production (156.65 km²) followed by Karnataka (102.8 km²) and Tamil Nadu (74.08 km²). The introduction of this species from Sri Lanka is very common in India (Ritu Paliwal *etal*, 2011a). The cultivars like “*chem.-murunga*” grow in Rajasthan, which have red tips. Leaf fall occurs in December – January and new leaves appear in February – March followed by flowering and fruiting.

Significant notes: *Moringa oleifera* Lam. can be identified from *Moringa concanensis* Nimmo ex Dalz. and Gibs. by following species key:

- 1a. Petals with red streaks or reddish at base. Leaves bipinnate.....1. *M. concanensis*
- 1b. Petals creamy yellow or white, without red streaks. Leaves tripinnate.....2. *M. oleifera*

Specimens examined: Jodhpur: Chopasni Housing Board, Isha Pandey 6, 7 (CPUK); BSI Campus, M.K. Singhadiya 29678 (BSJO, CAL); Barmer: Piplum, Tiwari 1160 (BSJO); Jaipur: Sharma 403, 1086 (RUBL); Jaisalmer: Amar sagar, Blatter 6117 9(BLAT); Kota: Amar Niwas, Singh 90507 (LWG); Pali: Lunwas, Shetty 1465 (BSJO).

USES

Among myriad of natural plants *Moringa oleifera* Lam. is called “*Miracle vegetable*” because of its both as medicinal and functional food. It possesses highly therapeutic and pharmacological properties, so its consumption in regular diet could possibly reduce the risk of degenerative capacity of humankind^{46, 47}. The details of the uses are enumerated below (**please see table 1 and 2 and figure 1**):

Moringa oleifera is an outstanding source of nutritional components, hence leaves, tender pods, seeds etc. every parts of the tree either nutritional or high medicinal values. This plant since ancient time having exceptional medicinal properties, which can resolves health care needs in several adverse conditions. Easy cultivation by twigs-cuttings within adverse climate condition and common occurrence attract attention for economic and medicinal potential in resource-limited developing country like India.

NUTRITIONAL USES/BENEFITS

The indigenous knowledge and use of *Moringa oleifera* is referred in more than 80 countries including India and locally known in over 200 languages. The popularity and its uses by various societies (Greek, Egyptian, Roman and Indian) for thousands of years with writings dating as far back as 150 AD.

Historical proofs reveal that ancient kings and queens used “*Moringa oleifera*” leaves and fruits in their daily diet to maintain mental, alertness, healthy skin and vigour. Ancient “Maurian warriors” of India were fed with the leaf extract of this tree in the warfront. *Moringa oleifera* is sometimes called “*Mother Best Friend*” and “*Miracle Tree*”. Since 1998, the World Health Organisation (WHO) has promoted this tree as an alternative to imported food supplies to treat malnutrition in poor countries^{27, 33, 54, 56, 57}.

Lots of literature is available on the nutritional qualities and medicinal uses of this tree. It is a very rich source of Vitamins, macro and micro elements, amino acids, essential oils, proteins etc. If someone consumed per day 70 gms of dried leaves of tree have 35 essential elements (includes 14 macro and 21 micro elements) in the body⁵. The tree can be utilized in sauces, curries, juices, spices, milk, bread, noodles, soft drink, tea and other neuroceuticals. The nutritive value of this tree is much higher than oranges, carrots, milk, banana, protein of Yogurt. (*Please see table 1 for details*). Thus, the tree can be used to combat malnutrition, especially among infants and nursing mothers. Three non-governmental organisations in particular-viz. “*Trees for Life* (2005)”, “*Church World Service*” and “*Educational Concerns for Hunger Organisation* (2004)” - have advocated *Moringa oleifera* as “Natural nutrition for the tropics.

Table 1: Common Nutritional uses/benefits of different parts of *Moringa oleifera* Lam. Tree.

Plant parts	Nutritional uses/benefits	Phytochemistry	References
Leaves	(i). <i>Moringa</i> leaves are very rich source of vitamin A, C, Calcium, Potassium, protein and essential elements in comparison to locally available in market viz. Carrot, orange, cow milk, banana etc. The leaves may be supplemented as essential food and Alternative of tea leaves. The leaves can be serve to check malnutrition in the poor’s. It is a nutraceutical and panacea for various diseases having 35 elements.	Vitamin A 6.780mg – Carrot : 1.890 mg; vitamin C 220 mg – Orange: 30 mg; calcium 440 mg – Cow’s milk: 120 mg; potassium 259 mg – Banana: 88 mg; protein 6.6 mg – Cow’s milk: 3.2 mg; 14 macroelements and 21 microelements (total 35 elements).	5, 19, 20, 28, 31, 46, 47, 48, 59
	(ii). Leaf powder used as hand washing product-hand hygiene to reduce gastrointestinal and respiratory illness.	During hand washing the mechanical friction by the dry leaf powder reduces the bacterial effect in comparison to non-medicated liquid soap.	31, 48
	(iii). Leaves tender twigs and immature pods used as fodder for cattle’s to increase milk.	Having higher percentage of vitamins, essential elements and proteins.	-do-
	(iv). Pregnant woman consumed leaves and flowers to increase milk for infants.	Leaves having iron, minarals, vitamins and proteins.	-do-
	(v). Leaf powder used as biocontrol in crops, as fertilizers and pestisides.		
Stem	Stem pulp used in picking-sticks, and newspaper making and textile industries. Stem corky bark yield Fibbers used in making mats, paper, cordages etc.	Having cellophane	48, 59
Pods	Immature pods cooked as vegetable or pickled, having high nutritional- and medicinal values.	Having higher percentage of vitamins essential elements, glycosides etc.	-do-
Seeds	(i). Seed powder paste used as water purifier to improve the quality of drinking water by absorbing the heavy metals viz. Cadmium, Copper, Chromium, Lead and Zink. Which are highly toxic to human being.	<i>Moringa</i> is a cationic polyelectrolyte of short chain and low, molecular weight. Heavy metals having higher charges.	41
	(ii). The seeds can be used as nutritional supplements and for industrial and agriculture purpose. It is also being used in perfume industries, cosmetic, lubricate, soap as antioxidant activity oil being used as body cream. It can also used as vegetable in daily consumption.	Seeds oil locally know as “ <i>ben oil</i> ” “ <i>Drumsticks</i> ” similar to <i>olive oil</i> and is rich in Palmetic, stearic, Behenic and oleic acids. The oil is clear, odourless and resists rancidity, oil possesses 75% oleic acid.	43

Table 2: Common medicinal/therapeutic uses of different parts of *Moringa oleifera* Lam. Tree

Plant Parts	Medicinal/therapeutic uses	Phytochemistry/phytochemicals	References
Leaves	<p>Leaves extracts used in malnutrition to to to supplement Vitamins, essential elements, proteins etc., antihypertensive, diuretic, cholesterol lowering, blood pressure control, antipyretic, decrease blood glucose concentration, antidiabetic, antioxidant, hepatoprotective, reduces liver fibrosis, anticancer-antitumor activities, antifertility, antispasmodic, antiulcer, gastrointestinal disorder, cardiac and circulatory stimulant, eye or ocular diseases like night blindness and ear infection, bronchitis, antiasthma, analgesic, antimicrobial, antibacterial, antifungal etc. Leaves poultice and juice applied externally to cure scurvy, sores, temples for headache, piles, sores of throat, glandular swelling, eye and ear infection, etc.</p> <p>The leaves act as a good source of natural antioxidant due to presence of various types of antioxidant compounds such as ascorbic acid, flavonoides, phenolics and carotenoids, other major and minor essential elements, vitamins, amino acids; that's why leaves and pods make it a virtually ideal dietary supplement.</p> <p>Hormones/growth promoters have also been isolated from the leaves, by Application of an aqueous ethanol Extract on black-gram (<i>Vigna mungo</i> L.) has been shown to increase growth vigorously.</p>	<p>Pterygospermin, antibacterial and Fungicidal effects. 4 - (4'-o-acetyl - a - L - rhamnopyranosy - loxy) benzyl isothiocyanate, 4 (a - L - rhamnopyranosyloxy) benzyl isothiocyanate, nizimicin, isothiocyanate and 4 (a-L-rhamnopyranosyloxy) benzyl Glucosinolate, anthonine and Spirochin- all as antibacterial.</p> <p>Alkaloid Moringine-as antiasthmatic Nitrile, mustard oil glycosides and thiocarbamate glycosides lowering the blood pressure. b-sitosterol- Cholesterol lowering effects and Control of other cardiovascular diseases. Dark chocolate polyphenols and other polyphenols -as hypoglycaemic or antidiabetic Effect. Quercetin and kaempferol used as antioxidant and hepatoprotective. Niazimicin as anticancer properties.</p> <p>4 (alpha-L- rhamnopyranosyloxy)- o-methyl thiocarbamate, Niazinin A, niazinin B, niazimicin etc. - as spasmolytic, hypotensive and bradycardiac disorders controlling agents.</p>	<p>1, 2, 4, 6, 9, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23,24, 25, 26, 32, 34, 35, 36, 37, 42, 43, 46, 47, 49, 50, 51, 52, 53, 56, 59.</p>
Stem – bark	<p>The aqueous stem extract used to cure as rubefacient, vesicant, eye infections, prevent enlargement of spleen and formation of tuberculosis glands of the neck, to destroy tumours and to heal ulcers, antibacterial activity.</p>	<p>Contain two alkaloids namely moringine and moringinine, vanillin, beta-sitosterol, beta-sitostenone, 4-hydro-xymellin and octacosanoic acid have been isolated from the stem-bark and stem-bark.</p>	<p>7, 16, 17, 23, 29, 52,</p>
Flowers	<p>Highly medicinal value as a stimulant, aphrodisiac, abortifacient, cholagogue; used to cure inflammations, muscle diseases, hysteria, tumours and enlargements of the spleen; useful in lowering the serum cholesterol, phospholipids, triglyceride, VLDL, LDL cholesterol to phospholipids ratio atherogenic index; decrease lipid profile of liver, heart and aorta.</p>	<p>Flowers contain nine amino acids, Sucrose, D-glucose, traces of alkaloids, wax, quercetin and kaempferat; the ash is rich in potassium and calcium. Also reported to contain some flavonoid pigments such as alkaloids, kaempherol rhamnetin, isoquercirin and Kaempleritrin.</p>	<p>16, 50, 52</p>
Seeds/ pods	<p>The seed extract if taken orally very effective in decreasing liver lipid peroxides, antihypertensive. The seeds are antipyretic, acrid, bitter and antimicrobial activity. The seed can be consumed fresh as peas or pounded, roasted, or pressed in to sweet, non-desiccating oil, commercially known as 'Ben oil' of high quality. ethanol and aqueous extracts of whole pods, seed-coat, pod pulp revealed that the B.P. lowering effect of seed is more pronounced.</p>	<p>The antihypertensive compounds Thiocarbamate and isothiocyanate glycosides have been isolated from the acetate phase of the ethanolic extract of the pods. The unique property is the ability of its dry, crushed seed and seed press cake, which contain polypeptides, to serve as natural coagulants for water treatment as purifier. The seed oil consists sterols. The sterol composition of the major fractions of <i>Moringa oleifera</i> seed oil differs greatly from conventional vegetable oils. The seed oil is having high oleic acid.</p>	<p>3, 4, 18, 26, 39, 40, 44.</p>

Roots	The roots aqueous extract and dry root powder is antilithic, rubefacient, vesicant, antispasmodic, hepatoprotective, carminative, antifertility, anti-inflammatory, stimulant in paralytic condition; considered as cardiac/circulatory stimulant, laxative, abortifacient, rheumatism, joints pains, lower back pains or in renal pains. The juice of root- bark is said to very effective if put in ear and tooth cavity as a pain killer, and has antitubercular activity.	The aqueous and ethanol extract of roots having o-sito-sterol, alkaloid moringinine which act as cardiac stimulant.	10, 12, 13, 30, 45, 50.
Gum	The gum is very effective in dental caries as astringent, rubefacient. Rubing of gum with vegetable oil (Til oil) is used to cure headaches, fever, intestinal pain due to constipation. Gum in water can be taken orally to cure, stomachic, dysentery, asthma, also as abortifacient, in syphilis and joints pain.	The purified whole gum of the stem possesses L-arabinose, galactose, glucuronic acid and L-rhamnose, mannose and xylose, L-galactose, glucuronic acid, and L-mannose obtained on mild hydrolysis of the gum with acid.	8.

Table 3: Major Phytochemical components present in *Moringa oleifera* Lam. and their importance in major diseases (After Farooq, et al 2012)

S. No.	Phytochemical/pharmaceutical components	Potential application in curing major diseases	References
1.	Pterygospermin	Antibacterial and fungicidal Effects.	49.
2.	4-[4'-O-acetyl-a-L-rhamnopyranosyloxy]benzyl isothiocyanate, 4-[a-L-rhamnopyranosyloxy]benzyl isothiocyanate, niazimicin, benzyl isothiocyanate, and 4-[a-L-rhamnopyranosyloxy]benzyl glucosinolate, Anthonine and spirochin.	Antibacterial effects	14, 42.
3.	Alkaloid Moringine	Anti-asthmatic in respiratory diseases.	1, 32.
4.	Nitrite, mustard oil glycosides and thiocarbamate glycosides	Hypotensive effect .	3, 4, 15, 16, 17, 18.
5.	b-sitosterol	Cholesterol lowering effect.	23.
6.	Dark chocolate polyphenols and other Polyphenols	Hypoglycemic effect i.e. used in diabeties.	2, 25, 34.
7.	Quecertin and Kaempferol	Antioxidant and Hepatoprotective effects.	6, 50, 51, 52.
8.	Niazimicin	As anticancer drug.	26.
9.	4-(alfa-L-rhamnosyloxy-benzyl)-o-methyl thiocarbamate, niazinin A, niazinin B, niazimicin, etc.	Spasmolytic, hypotensive and bradycardiac effect.	24.

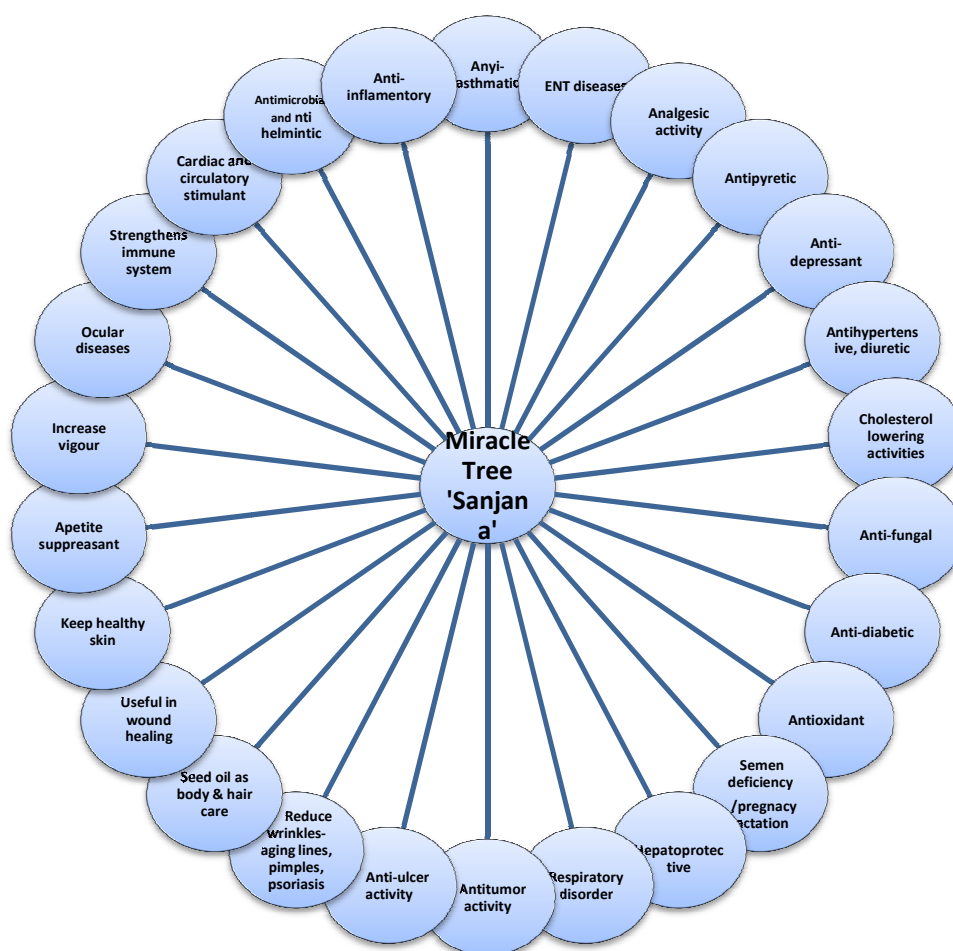
MEDICINAL/THERAPEUTIC USES

The plant is having high medicinal and therapeutic properties and investigated in the light of recent scientific departments throughout the world, due to their potent pharmacological activities, low toxicity and economic viability, when compared with synthetic drugs^{46, 47}. If we see figure 1 and table 2 shows the tremendous medicinal uses of this tree.

Moringa oleifera Lam. is having many medicinal uses and have long been recognised in the Ayurvedic and Unani system of medicine^{5, 19, 20, 38, 46, 47}. The dry leaf-powder can also be used as hand washing product. Four grams dry or wet leaf powder enough for hand wash and have same effect as non-medicated soap⁵⁷.

Pharmacological studies have shown that the extract of plant have antioxidant, anticarcinogenic, anti-inflammatory, antispasmodic, antidiuretic, antiulcer, antibacterial – fungal, insecticide, analgesic, alexeteric, antihelminthic, to alter blood-lipid properties, antimicrobial, anti depressant, antioxidant, antidiabetic, in ocular – skin and throat diseases, strengthen immune powder, good wound healer, in insects bites etc. Therefore, the plant is not only food supplement but also have wide range of medicinal properties for humankind (*Fig. 1 and Table 2*).

Fig. 1: Important medicinal uses of *Moringa oleifera* Lam. – Miracle tree



CULINARY USES

In Rajasthan, as in other parts of India the plant is being used in sambars, salad, dals, kormas, curry dishes and is also fried as pakoras. In some regions, the flowers are gathered and cleaned to be cooked with “besan” (gram flour) to make pakoras. It is also preserved by canning and exported worldwide. The tender pods and leaves are maximum used in kitchen by the states viz. Tamil Nadu, West Bengal, Maharashtra, Gujarat, Orissa etc.

It is certainly under-explored at present in Rajasthan. Its socio-economic importance evidenced by numerous uses as vegetable, as water purifier, seed-oil, gum, hedge tree, ornamental and medicinal plant, and its easy propagation and cultivation by cuttings and seeds justify more intensive research in to its biological and economic potential.

CATTLE FEED

The leaves of this plant added to cattle feed increased their daily weight gain by upto 32 percent, feed of milk cows was supplement with 15-17 kg of fresh leaves daily and the cattle's milk production increased by 43 percent. Feed supplemented with 3 kg dry matter per day and milk production increased by 65 percent. Therefore, in developing countries, the milk production could be increased in this way and our country can solved the problem of people with protein deficiency³¹.

PLANT GROWTH INHIBITER

The spray of Moringa had a wide range of beneficial effects on plant crops. The spray of this plant on the crops and vegetable not only accelerated the growth, but also increased fruits production up to 35%. And the treated crops are free from insecticides and pesticides. Thus, this plant can help in increasing food supplies for millions of hungry people^{31,9}.

WATER PURIFICATION

A large numbers of people in Asia, Africa and Latin America are drinking untreated surface water sources for their daily water needs. Of these, two millions are die due to drinking of contaminated water every year. Dry seed powder can be used as a quick and simple method for cleaning dirty water. The powder joins with the solids in water and sinks to the bottom. This treatment also removes 90-99% of bacteria contained in water. Using Moringa dry seed-powder to purify water replaces chemicals viz. Aluminium sulphate, which are dangerous to people and the environment, and are expensive. 20 litres of contaminated water may be purity by adding 2 grams of seed-powder of this plant to one cup of clean water, pour in to a bottle and shake for 5 minutes. Filter the solution with clean cloth. Boil the water so obtained before drinking^{31,41}.

SEED OIL

The seed oil is having high valued in the older times. The Romans, Greeks and Egyptians extracted edible oil from the seed of this plant and locally used as perfumes, lubricants skin lotion, as cosmetics. The *Moringa oleifera* seed oil is containing oleic acid up to 73.22%, followed by palmitic, stearic, behenic and arachidic acid 6.45, 5.50, 6.16 and 4.08% respectively and considered as category of high oleic acid oil³¹.



Fig. 1. *Moringa oleifera* leaves

Fig. 2. *Moringa oleifera* flowering

Fig. 3. *Moringa oleifera* fruiting

PHYTOCHEMISTRY

The plant extract particularly leaves extracts containing simple sugar, rhamnase, glucosinolates, isothiocyanates. Six such phytochemical have been reported to have hypotensive anticancer and antibacterial activity – include Benzyl isothiocyanate, niazimicin, pterygospermin, and 4 {a-L-rhamnopyranosyloxy} benzyl glucosinolate (31). (*pl. See table 3*).

Recent studies by Asiedu-Gyekye *etal*⁵ on *Moringa oleifera* leaves extracts analysis show detection of total 35 elements compressing eleven major elements (like: Na₂O, MgO, Al₂O₃, SiO₂, P₂O₃, SO₃, Cl, K₂O, CaO, MnO and Fe₂O₃) and twenty four minor elements (like: V, Cr, Co, Ni, Cu, Zn, Ga, As, Rb, Y, Zr, Nb, Mo, Sn, Cs, Ba, La, Ce, Hf, Ta, Pb and Th and other heavy metals). Thus, consumption of leaves of this plant be limited to a maximum of 70 grams per day in order to prevent excessive consumption and subsequent accumulation of some of these essential elements. At 70 grams per day, most of these elements on the leaves could be found in high quantities approaching the RDA limit⁵.

RECOMMENDATION AND FUTURE PROSPECTS

The 21st century is the century of biology powered and driven by scientific knowledge and technology expertise. Three technologies viz. “*Biotechnology*”, “*Herbal technology*” and “*Information technology (Bioinformatics)*”, all these technology are crucial for prosperity and welfare for the people of nations. All technologies for manufacture of value added plant products can be called as “*Herbal technology*”. The global trade in herbals is increasing in hundreds of billions in US dollars. “*Moringa oleifera*” an edible plant, is at the top of underutilized resources of Rajasthan state in particular and India as a whole. The climate of the state is favourable for the cultivation and plantation of this tree. The State forest department should take initiative for this purpose. People should be educate and make them aware regarding multifarious use of this “*miracle tree*”. India can easily fight against the problems of malnutrition, hunger, poverty, diseases, unemployment, and edible oil export by utilizing its full benefits. The lot of foreign exchange could be earned by exporting the products of “*Moringa*” instead of spending foreign exchange on imports. This tree truly appears to be a Miracle plant having countless benefits for humanity and thus should be taken as a high quality gift of nature at very low price. The maximum cultivation of this plant in open wastelands, fallow fields, roadsides, around field boundaries, and around houses provides maximum yield of its different useable parts could be achieved to propel the maximal amount of commodities of a multifarious nature for the welfare of humankind.

In view of the edible nature of the plant, more research work can be done on human so that a drug with multifarious effects will be available in the future market. So the State and Central Government must take immediate initiative to plant widely this “*miracle indigenous*” tree in most of the areas where climatic condition are favourable for maximum yield of its different usable parts.

Moronga oleifera Lam. is an important source of naturally occurring phytochemicals and this provides a basis for future viable developments like health, socioeconomic developments, cosmetics, as water purifier, etc. Different parts of this *miracle tree* should also incorporated in various marketed health formulations, such as : Orthoherb (Water Bushnell Ltd., Mumbai, India), Rumalaya and Septilin (The Himalaya Drug Company, Bangalore, India), Livospin (Herbals APS Pvt. Ltd., Patna, India) and Kupid Fort (Pharma Products Pvt. Ltd., Thayavur, India). So on the above ground the Rajasthan State Government should also take immediate initiative to develop some industries based on this tree. Therefore, the easily and commonly available tree can play a vital role for the socio-economic development of the state in particular and India as a whole.

CONCLUSION

Due to its multifarious uses, it is a true “*miracle tree*”. The *Moringa oleifera* Lam. is providing very good nutrition as protein essential elements supplements, but also a very good in curing and prevention of many diseases in human being. The leaves are extensively used for humankind but also very good cattle feed and hand wash. The seed-powder can be used as water purifier, particularly for heavy metals and other impurities in water. The seed oil is also having high values as cosmetics, hair-skin care and as lubricants equivalent to oleic acids. Thus, due to multifarious uses of this tree India and state Government in particular take initiative to plant more and more trees in unutilized areas. India could easily fight against the problems of malnutrition, hunger, poverty, diseases, unemployment and edible oil export and earn lot of foreign exchange. More researches should be undertaken for its optimum production as a crop and its phytochemical should also be isolated for the synthesis of drugs for the utilization of humankind. This plat truly appears to be a miracle tree having unlimited benefits for people and thus should be taken as a high quality gift of nature at very low price.

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