



A PANORAMIC VIEW ON PHARMACOGNOSTIC, PHARMACOLOGICAL, NUTRITIONAL, THERAPEUTIC AND PROPHYLACTIC VALUES OF *MORINGA OLEIFERA* LAM

Ganatra Tejas H*, Joshi Umang H, Bhalodia Payal N, Desai Tusharbindu R, Tirgar Pravin R

Department of Pharmacology, R. K. College of Pharmacy, Kasturbhawan, Rajkot-Bhavanagar High way, Rajkot-360020, Gujarat, India

Article Received on: 10/03/12 Revised on: 11/04/12 Approved for publication: 05/05/12

*Email: th.ganatra@yahoo.com

ABSTRACT

Moringa oleifera or *Moringa pterygosperma*, one of the miracle tree, is widely cultivated throughout India, belongs to family Moringaceae. It is widely used as a nutritive herb and possesses valuable pharmacological activities. Present article describes habitat, pharmacognostic features, phytochemistry, nutritive values and pharmacological activities like anticancer, antimicrobial, anti-inflammatory, anti-hyperlipidemic, hypotensive, anti-diabetic, hepatoprotective, anti-asthmatic, anthelmintic, anti-fertility, etc of *Moringa*. It is one of most rich source of vitamin A, vitamin C, milk protein, etc. Present review gives information which is required to prove its medicinal and nutritional importance. Every part of *Moringa* is said to have beneficial properties that can serve humanity so the whole plant can be extensively studied for further research aspects.

Key-words: *Moringa oleifera*, *Moringa pterygosperma*, Drum-stick, anticancer, hypotensive, antimicrobial, ptergospemia

INTRODUCTION

From last few decades, there has been an exponential growth of herbal medicines because herbal drugs constitute a major share of all officially medicinal systems like Ayurveda, unani, yoga, siddha, homeopathy and naturopathy. More than 70% people still use non-allopathic system of medicine¹.

The screening of various plants according to their traditional uses and nutritional value based on their therapeutic value

leads to discovery of newer and safer alternative for treatment of various ailments. One of such plants of medicinal value is *Moringa oleifera*, belongs to family Moringaceae.

It is indigenous to south asia, mainly in Himalayas foothills, India². It has been grown and naturalized in other countries like Pakistan, Afghanistan, Sri Lanka, Bangladesh, East and West Africa, throughout West Indies, from Mexico to Peru, Paraguay and Brazil.



The fast growing tree was anciently used in Roman, Greeks and Egyptians, which is now, cultivated for human food, medicine, dye, fodder and water purification or clarification. It has much impressive range of medicinal uses with higher nutritional value³.

TAXONOMIC CLASSIFICATION⁴

Kingdom - Plantae

Sub kingdom - Tracheobionta

Super Division - Spermatophyta

Division - Magnoliophyta

Class - Magnoliopsida

Subclass - Dilleniidae

Order - Capparales

Family - Moringaceae

Genus - *Moringa*

Species - *oleifera*

SYNONYMS⁵

Latin - *Moringa oleifera*, Sanskrit - Subhanjana, Hindi - Saguna, Sainjna, Gujarati - Suragavo, Tamil - Morigkai, Telugu - Mulaga, Munaga, Malayalam - Murinna, Sigru, Punjabi - Sainjna, Soanjna, Unani - Sahajan, Ayurvedic - Haritashaaka Tikshnagandhaa, Raktaka, Akshiva, Arabian - Rawag, French - Moringe à graine ailée, Morungue, Spanish - Angela, Ben, Moringa, Portuguese - Moringa, Moringueiro, Chinese - La ken, English - Drumstick tree, Horseradish tree, Ben tree

DISTRIBUTION



Drumstick tree is indigenous to the Himalayan foothills of South Asia from northeastern Pakistan (33° N, 73° E) to northern, West Bengal State in India and northeastern Bangladesh where it is commonly found from sea level to 1,400 m on recent alluvial land or near riverbeds and streams. It grows at elevations from sea level to 1400 m⁶.

It is very commonly cultivated near houses in Assam, Bengal and peninsular India. It is a prolific coppice⁶.

It is cultivated and has become naturalized in other parts of Pakistan, India, and Nepal, as well as in Afghanistan, Bangladesh, Sri Lanka, Southeast Asia, West Asia, the Arabian peninsula, East and West Africa, throughout the West Indies and southern Florida, in Central and South America from Mexico to Peru, as well as in Brazil and Paraguay⁹.

MORPHOLOGY

Moringa oleifera is a small, fast-growing evergreen or deciduous tree that usually grows up to 10 or 12 m in height. It has a spreading, open crown of drooping, fragile branches, feathery foliage of tripinnate leaves, and thick, corky, whitish bark⁷.

Leaves - The leaves are bipinnate or more commonly tripinnate, up to 45 cm long. These are compound leaves with leaflets of 1 – 2 cm long. The leaflets are finely hairy, green and almost hairless on the upper surface, paler and hairless beneath, with red-tinged midveins, with entire (not toothed) margins, and are rounded or blunt-pointed at the apex and short-pointed at the base (aestivation is opposite). The twigs are finely hairy and green, becoming brown⁷.

Flowers - The fragrant, bisexual, yellowish white flowers are borne on slender, hairy stalks in spreading or drooping axillary clusters (panicles) 10–25 cm long. Individual flowers are approximately 0.7 to 1 cm long and 2 cm broad, with five unequal yellowish-white, thinly veined, spatulate petals, five stamens with five smaller sterile stamens (staminodes), and a pistil composed of a 1-celled ovary and slender style⁷.

Fruits - Fruits are tri-lobed capsules and are frequently referred to as pods. Pods are pendulous, brown, triangular, and so splits into three parts (lengthwise) when dry, 30 – 120 cm long, 1.8 cm wide. Fruits production mainly occurs in March and April. Each fruit contain around 26 seeds during their development phase. Immature pods are green in color. They turn brown on maturity, and split open longitudinally

along the three angles, releasing the dark brown, trigonous seeds⁷.

Seeds - Seeds are round (1 cm in diameter) with a brownish semi-permeable seed hull, with 3 papery wings⁷. Hulls of seed are brown to black but can be white if kernels are of low viability. Viable seed germinate within 2 weeks. The white wings of hull are also present which run from top to bottom at 120 intervals. Each tree can produce around 15000 to 25000 seeds/year. Average weight is 0.3 gm/seed. The kernel to hull ratio is 75:25⁷.

Roots - Seedlings develop a swollen, tuberous, white taproot which has a characteristic pungent odor, and very sparse lateral roots. Trees grown from seeds develop a deep, stout taproot with a wide-spreading system of thick, tuberous lateral roots⁷.

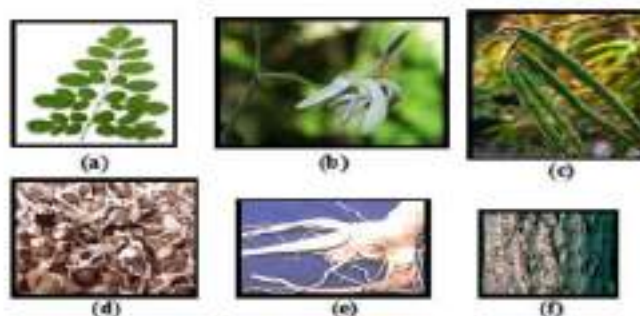


Figure shows the morphology of (a) leaves, (b) flower, (c) drum-sticks, (d) seeds, (e) roots and (f) bark of *Moringa oleifera*

Bark and Wood - The bark is whitish-gray, thick, soft, fissured and warty or corky, becoming rough. When wounded, the bark exudes a gum which is initially white in color but changes to reddish brown or brownish black on exposure. The wood is soft and light⁷.

CHEMICAL CONSTITUENTS^{3,5}

The **Seeds** contains 4(α-L-Rhamnosyloxy) benzyl isothiocyanate, 4-(L-rhamnosyloxy) phenylacetone nitrile, 4-hydroxyphenylacetone nitrile, and 4-hydroxyphenyl-acetamide, 4-(α-L-rhamnopyranosyloxy)-benzylglucosinolate Ricidin E, Veridiflorol, 9-Octadecenoic acid, O-ethyl-4-(α-L-rhamnosyloxy) benzyl carbamate, niaziminin, niazirin, beta-sitosterol, glycerol-1-(9-octadecanoate), 3-O-(6'-O-oleoyl-beta-D-glucopyranosyl)-beta-sitosterol and beta-sitosterol-3-O-beta-D-glucopyranoside³.

The **Leaves** contain Niazirin and Niazirin - nitrile glycosides; 4-[(4'-O-acetyl-α-L-rhamnosyloxy) benzyl isothiocyanate, niaziminin A, and niaziminin B - three mustard oil glycosides, niaziminin, a thiocarbamate, 4-(α-L-rhamnopyranosyloxy)-benzylglucosinolate, quercetin-3-O-glucoside and quercetin-3-O-(6"-malonyl-glucoside), kaempferol-3-O-glucoside and kaempferol-3-O-(6"-malonyl-glucoside), 3-caffeoylquinic acid and 5-caffeoylquinic acid, kaempferide 3-O-(2",3"-diacetylglucoside), kaempferide 3-O-(2"-O-galloylrhamnoside), kaempferide 3-O-(2"-O-galloylrutinoside)-7-O-α-rhamnoside, kaempferol 3-O-[beta-glucosyl-(1 → 2)-[α-rhamnosyl-(1 → 6)-beta-glucoside-7-O-α-rhamnoside and kaempferol 3-O-[α-rhamnosyl-(1 → 2)-[α-rhamnosyl-(1 → 4)-beta-glucoside-7-O-α-rhamnoside together with benzoic acid 4-O-beta-glucoside, benzoic acid 4-O-α-rhamnosyl-(1 → 2)-beta-glucoside and benzaldehyde 4-O-beta-glucoside, hexadecanoic acid, Ethyl palmitate, Palmitic acid ethyl ester, 2, 6-Dimethyl-1, 7-octadiene-3-ol, 4-Hexadecen-6-yne, 2-

hexanone, 3-cyclohexyliden- 4 - ethyl - E2-Dodecenylacetate, Hi-oleic safflower oil, Safflower oil¹.

The Roots contain 4-(alpha-L-rhamnopyranosyloxy)-benzylglucosinolate and benzyl glucosinolate², aurantiamide acetate 4 and 1, 3-dibenzyl urea, alpha-phellandrene, p-cymene, Deoxy-Niazimicin³.

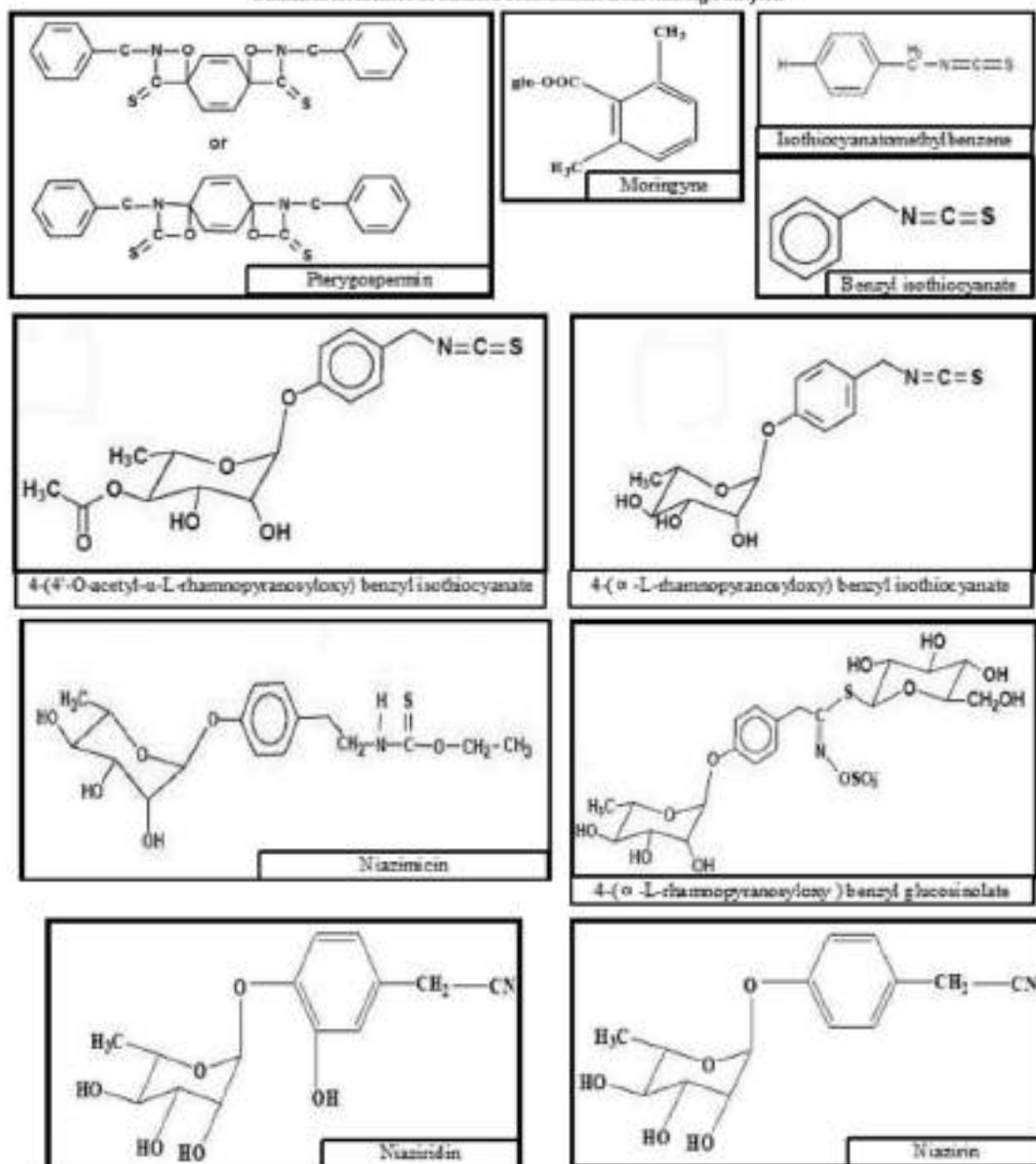
Phytochemical studies on *Moringa oleifera* by M. Ndong et al. (2007) revealed major polyphenols such as quercetin glucosides, rutin, kaempferol glycosides and chlorogenic acids in *Moringa oleifera* powder by HPLC analysis.

B.N. Singh et al. (2009) reported presence of gallic acid, chlorogenic acid, ellagic acid, ferulic acid, kaempferol,

quercetin and vanillin from the aqueous extracts of leaves, fruits and seeds of *Moringa oleifera*⁴.

The gum contains aldohexuronic acid which is obtained from the acid hydrolysis of gum and is characterized as O-(beta-D-glucopyranosyluronic acid) (1→6)-beta-D-galactopyranosyl (1→6)-Dgalactose. The leaves contain aspartic acid, glutamic acid, glycine, threonine, alanine, valine, leucine, isoleucine, histidine, lysine, phenylalanine, tryptophan, cysteine and methionine. The stem contains 4-hydroxy mellein, vanillin, octacosanoic acid, beta-sitosterol and beta-sitosterone & Kaempferol-3-rutinoside was identified in flowers⁵.

Chemical structures of isolated constituents from *Moringa oleifera*^{3,6}



NUTRITIONAL VALUE OF *Moringa oleifera*

Moringa trees are used to overcome malnutrition, especially in infants and nursing mothers. Three non-governmental organizations in particular-Trees for Life, Church World Service and Educational Concerns for Hunger Organization have advocated Moringa as natural nutrition for the tropics. *M. oleifera* leaves have essential amino acids, including the sulfur-containing amino acids in higher levels than those recommended by the Food and Agriculture Organization (FAO) and patterns similar to those of soybean seeds⁸.

Amino acid content of *Moringa oleifera*⁹

Amino acid	Amino acid composition			
	Extracted leaves		Unextracted leaves	
	(g/16g N)	(g/kg DM)	(g/16g N)	(g/kg DM)
Lysine	6.61	26.77	5.6	14.06
Leucine	9.86	42.89	8.70	21.84
Isoleucine	5.18	22.53	4.50	11.30
Methionine	2.06	8.96	1.98	4.97
Cystine	1.19	5.18	1.35	3.39
Phenylalanine	6.24	27.14	6.18	15.51
Tyrosine	4.34	18.88	3.87	9.71
Valine	6.34	27.58	5.68	14.26
Histidine	3.12	13.57	2.99	7.50
Threonine	5.05	21.97	4.66	11.70
Serine	4.78	20.79	4.12	10.34
Glutamic Acid	11.69	50.85	10.22	25.65
Aspartic Acid	10.60	46.11	8.83	22.16
Proline	5.92	25.75	5.43	13.63
Glycine	6.12	26.62	5.47	13.73
Alanine	6.59	28.67	7.32	18.37
Arginine	6.96	30.28	6.23	15.64
Tryptophan	2.13	9.26	2.10	5.27

Where N = natural protein, DM = Dry matter

Mineral content of *Moringa oleifera* leaves¹⁰

Macro-elements (gm/ Kg of DM)/Micro-elements (mg/ Kg of DM)

Ca	P	Mg	Na	K	Fe	Mn	Zn	Cu
26.4	1.36	0.11	2.73	21.7	175	51.8	13.7	7.1

NUTRITIVE VALUE OF MORINGA OLEIFERA LEAVES AND COMPARISON WITH COMMON FOODS

The leaves are rich in starch, minerals, iron, vitamins A, B and C, calcium and protein. The leaves are considered to offer great potential for those who are nutritionally at risk and may be regarded as a protein and calcium supplement. It is particularly useful as a human food in tropical countries because the leaves appear towards the end of the dry season when few other sources of green leafy vegetables are available. The powder of dried leaves can be produced by drying the leaves and crushing or pounding them¹¹.

Figure shows nutritive value as well as comparison of nutritional value of *Moringa oleifera* with other common foods.

Comparison of 100 grams edible portion with Moringa fresh leaf

Nutrients	Dried leaves
Vitamin A	Four times (4X) of Carrots and Thirteen times of Spinach
Vitamin C	Seven times (7X) of Oranges
Vitamin B	Four times (4X) of Pork meat
Vitamin B ₂	Fifty times (50X) of Barones
Vitamin B ₃	Fifty times (50X) of Peanut
Vitamin E	Six times (6X) of Rapeseed oil
Calcium	Four times (4X) of Milk
Magnesium	Thirty six times (36X) of Egg
Potassium	Sixty three times (63X) of Milk and Three times (3X) of Banana
Iron	Twenty five times (25X) of Spinach
Protein	Two times (2X) of Yoghurt/milk
Poly phenol	Eight times (8X) of Red wine
Amino acid	Two times (2X) of Black vinegar
R-Amino acid	Thirty times (30X) of Brown rice and Four times (4X) of GABA tea
Chlorophyll	Four times (4X) of Wheat grass

CULINARY USES

In South India, it is used to prepare a variety of sambar and is also fried. In other parts of India, especially West Bengal and also in a neighboring country like Bangladesh, it is enjoyed very much. It is made into a variety of *curry* dishes by mixing with coconut, poppy seeds and mustard or boiling. It is used in curries, *sambars*, *kormas* and *dals*, although it is also used to add flavor to cutlets, etc. In Maharashtra, the pods are used in sweet & sour curries called *Aamatee*. In Gujarat and Rajasthan, the pods are used in to cook a spicy curry called '*Saragva ki Kadhi*'. Moringa leaves are also used in salads, in vegetable curries, as pickles and for seasoning¹². In some regions the flowers are gathered and cleansed to be cooked with *besan* to make *pakorais*.

SOCIO-ECONOMIC IMPORTANCE

Moringa oleifera is mostly used tropical tree. The propagation of tree by both sexual and asexual means is easy and its low demand for soil nutrients and water after being planted makes its production and management easier. Its introduction in farm could be beneficial for both the owner as well as surrounding eco-system. *Moringa oleifera* was well known to the ancient world, but only recently has it been rediscovered as a multipurpose tree with a tremendous variety of potential uses¹².

At present, *Moringa oleifera* is certainly under exploited. Its numerous uses as vegetable, seed oil, gum, hedge tree, ornamental and medicinal plant and its easy propagation and cultivation justify more intensive research into its biological and economic potential. Germplasm exist in natural stands and maintenance of long, large fruited types is usually practiced¹⁰.

ECONOMIC USES

M. oleifera is a fast growing tree being planted in India on large scale as a potential source of wood for the paper industry. The wood provides a pulp that is considered suitable for paper, wrapping, textiles and cellophane. In Jamaica, exudate is used for blue dye¹³.

TRADITION USES

Among myriad of natural plants, *Moringa oleifera* is called miracle vegetable because it is medicinal as well as functional food. *Moringa oleifera* possesses highly therapeutic and pharmacological values, so its consumption

in daily diet could possibly reduce the risk of various degenerative diseases^{10, 14}. Traditional uses of *Moringa oleifera* were denoted in many ancient books which are as follow:

Plant Part	TRADITION USES
Leaves ^{3,4,5,11}	Anti-bacterial, Infection, Urinary Tract Infection, Epstein-Bar Virus (EBV), Herpes Simplex Virus (HSV-1), HIV-AIDS, Helminthes, Trypanosomes, Bronchitis, External Sores/Ulcera, Fever, Hepatic, Anti-Tumor, Prostate, Radio protective, Anti-Anemic, Antihypertensive, Diabetes/hypoglycemia, Diuretic, Hypocholesterolemia, Thyroid, Hepatorenal, Colitis, Diarrhea, Dysentery, Ulcer/Gastritis, Rheumatism, Headache, Antioxidant, Carotenoids, Iron deficiency, Protein, Vitamin/mineral deficiency, Lactation Enhancer, Antiseptic, Catarrh, Lactation, Scurvy and Tonic.
Roots ^{3,4,5,12}	Cardiotonic, Dental Caries/Toothache, Common cold, Trypanosomes, External Sores/Ulcera, Fever, Asthma, Diuretic, Hepatorenal, Diarrhea, Flatulency, Asthma, Epilepsy, Hysteria, Headache, Abortifacient, Aphrodisiac, Rubefacient, Vesicant, Gout, Hepatomegaly, Low back/Kidney Pain, Scurvy and Splenomegaly.
Bark ^{3,4,5,12}	Dental Caries/Toothache, Common cold, External Sores/Ulcer, Anti-Tumor, Snakebite, Scorpion bite, Colitis, Digestive, Epilepsy, Hysteria, Headache, Antimutational factors, Abortifacient, Aphrodisiac, Birth Control and Scurvy.
Flowers ^{3,4,15}	Throat infection, common cold, antihelmintic, anti-tumor, rheumatism, diuretic, tonic, hysteresis, abortion.
Pods ^{3,4,15}	Antihelmintic, skin cancer, anti-hypertensive, diabetes, joint pain.
Seeds ^{3,4,5,15}	Antihelmintic, Warts, anti-tumor, Ulcer, rheumatism, arthritis, antispasmodic, gonorrhea, mineral/vitamin deficiency.
Exudates ^{3,12}	Dental Caries/Toothache, Syphilis, Typhoid, Earache, Fever, Asthma, Diuretic, Dysentery, Rheumatism, Headache, Abortifacient and Rubefacient.

SCIENTIFICALLY PROVED PHARMACOLOGICAL ACTIONS

Antimicrobial^{4,5} - Leaves, roots, bark and seeds of *Moringa oleifera* shown in vitro antimicrobial activity against bacteria (*Bacillus cereus*, *Candida albicans*, *Streptococcus faecalis*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus subtilis*, *Shigella shiga*, *Shigella sonnei*, *Pseudomonas aeruginosa*, *E.coli* and *Aspergillus niger*), yeast, dermatophytes and helminthes in a disk diffusion technique. It was also reported that *Moringa oleifera* exhibit antifungal activity in both broth dilution and agar plate methods against *Trichophyton rubrum* and *T. mentagrophytes*, *Trichophyton mentagrophytes*, *Epidermophyton floccosum*, and *Microsporum canis*, *Fusarium solani* and *Rhizopus solani*. 4-(L-rhamnopyranosyloxy) benzyl isothiocyanate⁴, 4-(L-rhamnopyranosyloxy) benzyl glucosinolate⁴ and **Pterygospermin¹⁶** are the responsible chemical constituents responsible for its anti-biotic activity.

Anti-inflammatory activity - Methanolic extract of root bark, aqueous extract of roots, methanolic extract of leaves and flowers as well as ethanolic extract of seeds of *Moringa oleifera* has shown anti-inflammatory activity in carrageenin induced paw edema model. Aurantiamide acetate and 1,3-dibenzyl urea, isolated from roots shown this anti-inflammatory activity so they responsible for anti-inflammatory activity of *Moringa oleifera* roots⁵.

Anti-cancer activity - Various extracts of leaves^{4,5} and ethanolic extract of seeds⁵ of *Moringa oleifera* shows anti-tumor activity in *in-vitro* tests. Thiocarbamate and isothiocyanate related compounds were isolated, which act as

inhibitor of tumor promoter teleocidin B-4- induced Epstein-Barr virus (EBV) activation in Raji cells¹.

Anti-fertility activity - Aqueous extract of *Moringa oleifera* was found to be effective as anti-fertility in presence as well as absence of estradiol dipropionate and progesterone and shown increased histoarchitecture of uterine¹⁷. Prakash *et al.* and Nath D *et al.* supported this newer finding of Shukla *et al.*⁵.

Hepatoprotective activity - Ethanolic extract of leaves¹ and alcoholic extract of seeds of *Moringa oleifera*² shown hepatoprotective effect in isoniazid, rifampicin, pyriminamide induced liver damage and diclofenac induced hepatic toxicity in rat, respectively.

Antioxidant activity - Aqueous, methanolic (70%), ethanolic extract (80%) of leaves of *Moringa oleifera* exhibit strong anti-oxidant and radical scavenging activity⁵. Bajpai *et al.* reported that this antioxidant activity of *Moringa oleifera* leaves is due to presence of Kaempferol⁵. Sultana B *et al.*, Verma AK *et al.* and Singh BN *et al.* had also reported antioxidant activity of leaves as well as roots of *Moringa oleifera*.

Cardiovascular activity - Ethanolic extract of *Moringa oleifera* leaves shows antihypertensive or hypotensive activity. It was found that thiocarbamate and isothiocyanate glycosides are responsible for this promising hypotensive activity¹⁸.

The *in vitro* and *ex vivo* antioxidant properties, hypolipidaemic and anti-atherosclerotic activities of water extract of *Moringa oleifera* Lam. leaves was done by Chumark P *et al.*¹⁹ Hypocholesteremic effect of crude leaf extract was found by Ghazi S *et al.*⁵ which was supported by preventive effect of leaves of *Moringa oleifera* on hyperlipidemia induced by iron deficiency in male wistar rats (done by Ndong M *et al.*)⁵.

Hydroalcoholic extract of *Moringa oleifera* leaves were investigated for cardioprotective effect in the isoproterenol (ISP) induced model of myocardial infarction in male wistar albino rats⁵.

Antiepileptic activity - Methanolic extract of *Moringa oleifera* leaves were investigated its anti-convulsant activity using pentylenetetrazole (PTZ) and maximum electric shock (MES) on male albino mice²⁰.

Antiasthmatic activity - Alcoholic extracts of *Moringa oleifera* seed kernels were found spasmolytic in Acetylcholine, histamine, BaCl₂ and 5HT induced bronchospasm. In same study, it shown protection against egg albumin and compound 48/80 induced mast cell degranulation as well as pretreatment with alcoholic extract of *Moringa oleifera* seed kernel, decrease carrageenin induced paw edema²¹.

Anti-diabetic activity - Aqueous extract *Moringa oleifera* leaves shows anti-diabetic activity on glucose tolerance in Goto-Kakizaki and wistar rats²². This was supported by Jaiswal D *et al.*, according whom aqueous extract of *Moringa oleifera* leaves shows antidiabetic control and thus exhibit glycemic control⁵.

Antiolithiatic activity - The aqueous extract of bark of *Moringa oleifera* shows reduction in weight of stone produced using ethylene glycol (1%) induced urolithiasis model. It was proved that it possess both preventive and curative property in this study²³.

Diuretic activity - Hot water infusion of flowers, leaves, roots, seeds and bark of *Moringa oleifera* shows increased urine output in rats².

Anthelmintic activity - Ethanolic extract of *Moringa oleifera* leaves shown more anthelmintic activity against Indian earthworm *Pheretima posthuma*, compare to *Vitex negundo*. Time for paralysis and time for death of worms with *Moringa oleifera* leaves were less compared to roots of *Vitex negundo*²⁴.

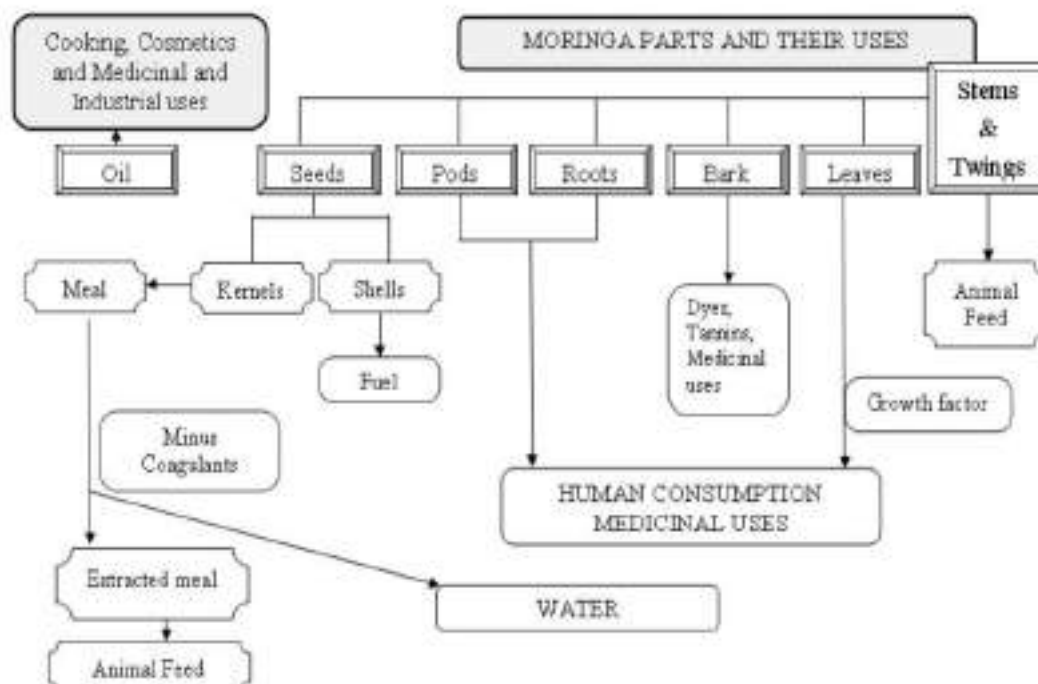
Antilucer activity - Aqueous extract of *Moringa oleifera* leaves exhibits antilucer activity in various animal models on adult holtzman albino rats of either sex⁵.

Wound healing activity - Aqueous extract of *Moringa oleifera* leaves shown wound healing property on male swiss albino mice. It significantly increase wound closure rate, skin breaking strength, granuloma breaking strength as well as

decrease in scar area⁵. This was supported by Hukkeri *et al.* who investigated antipyretic and wound healing property of ethanolic and ethyl acetate extract of *Moringa oleifera* leaves⁵.

Analgesic activity - Methanolic extract of *Moringa oleifera* root bark shown analgesic activity in Acetic acid induced writhing model in mice⁵.

CNS activity - Treatment with *Moringa oleifera* leave extract restores mono amine levels of brain which may be useful in Alzheimer's disease. Methanolic extract of *Moringa oleifera* root bark was tested on frog and guinea pig and it shown local anaesthetic activity in both animal models⁵.



OUTLINE OF IMPORTANT MEDICINAL USES OF MORINGA

DOSAGE OF *Moringa oleifera*

Leaf: 10–20ml. juice; Root bark: 2–5 g powder; Stem bark: 2–5g powder; Seed: 5– 10 g powder; Leaf, Flower, Fruit, Seed, Bark, root—1–3 g powder; 50–100 ml decoction^{25,26}

COMMERCIAL USES

Various parts of Moringa are used in marketed health formulations like,

Rumalaya and Septilin;

Orthoherb

Kupid Fort, Livospin

TOXICITY STUDY ON *Moringa oleifera*

According one acute toxicity study of various extracts of *Moringa oleifera* roots, results of that study showed a safe range. The LD₅₀ for the aqueous extract was 15.9 g/kg body weight while that of ethanol extract was 17.8 g/kg. The results were supported by the work done by Adedapo *et al.* (2009)²⁷.

Moringa oleifera root peel is relatively non-toxic when given as a single dose²⁷.

Using commonly used terms for toxicities along the dose equivalent for rats/mice, *M. oleifera* root peels are relatively harmless = > 1 kg for probable lethal single dose for man (Gosh, 1984)²⁸.

WORKSHOP ON *Moringa oleifera*

In November 2006, Moringanews organized a workshop on *Moringa oleifera* leaves, entitled as "Moringa Leaves: Strategies, standards and markets for a better impact on nutrition in Africa.", in which they gather and share experience amongst scientists, producers, private entrepreneurs and NGOs involved in research, production, trade or promotion of Moringa leaves²⁹.

In it they mainly focused on, New scientific studies and literature reviews on Moringa leaves nutritional properties; New scientific studies or economic data on Moringa leaves production; Examples of programmes using Moringa leaves and other leafy vegetables to prevent malnutrition or to improve the nutritional status of malnourished people and Market opportunities and regulations for Moringa products, etc²⁹.

FUTURE PROSPECTS

The above mentioned pharmacological properties and traditional uses of *Moringa oleifera* made it a true Miracle tree. Its better nutritional value proves it a better nutraceutical. Because it is edible, more research work can be done on humans so that a drug with multifarious effects will be available in the future market. Due to its higher nutritional value and wide range of pharmacological properties, India

could easily fight against the problems of malnutrition, hunger, poverty, diseases as well as by exporting Ben oil. India can utilize its full benefits. So for future prospective, Moringa can be included in routine diet (as done in workshop) to get its maximum benefits and to avoid several disease as well as malnutrition.

SUMMARY

Moringa oleifera, a plant of Moringaceae family, is grown throughout Southern Asia. Its all parts are medicinally and nutritionally important, including leaves, roots, seeds, root-barks, stem-bark, pods, etc. It mainly contains various glycosides of thiocarbamate and isocyanide class. Pterygospermin, moringyne, Niaziridin, 4-(α -L-thamnopyransyloxy) benzyl isothiocyanate, 4-(α -L-thamnopyransyloxy) benzyl glucosinolate, etc are few of them which are isolated and therapeutically proved by scientific studies. Nutritional value of Moringa leaves is much more important and it is equivalent to seven oranges (vitamin C), four carrots (Vitamin A), four glasses of milk (Milk protein), etc. Traditionally it is used in many of diseases throughout world (mainly in Thai). Many of them are scientifically proved which mainly include antihypertensive, antiasthmatic, diuretic, anticancer, antibiotic, antitumor, analgesic, CNS-depressant, antiepileptic, anti-inflammatory, anthelmintic, antidiabetic and many more. Recently the workshops are going on highlighting the importance of *Moringa oleifera* leaves in Africa. A thorough review on all these properties of *Moringa oleifera* suggests that "*Moringa oleifera* is a MIRACLE TREE."

REFERENCES

- Kirtikar KR and Basu BD, "Indian Medicinal Plants", International Book Distributors; Volume 1; Pg No.: 678.
- Sharma VR et al., "Phytochemical analysis and evaluation of antioxidant activities of hydro-ethanolic extract of *Moringa oleifera* Lam." Journal of Pharmaceutical Research, Volume: 4; Page no.: 554 – 557.
- Fahy JW, "Moringa oleifera: A review of the medical evidence for its nutritional therapeutic and prophylactic properties", Part I, Tree Life Journal, 2005, Vol 1, Issue 5 – page no. 5.
- Nakani KM, "Indian Materia Medica", Bombay Popular Prakashan, Volume: 1; Pg No.: 411.
- Mishra G et al., "Traditional uses, phytochemistry and pharmacological properties of *Moringa oleifera* Plant: An overview", Scholars Research Library, Dor Pharmacia Lotta, 2011, 3(2): 141-164.
- Gupta RK, "Medicinal & Aromatic Plants." CBS publishers & distributors, 2010, 151-152.
- A. Roloff et al., "Moringa oleifera Lam" Enzyklopädie der Holzgewächse, Handbuch und Atlas der Dendrologie, 2009, Vol 3, Issue 4, 1-8.
- Fuglie LJ, "The Miracle Tree: *Moringa oleifera*", Natural Nutrition for the Tropics, 1999, Church World Service, edition: 5th, page no. 68.
- Zarkadas et al., "Protein quality of three new Canadian-developed naked oat cultivars using amino acid compositional data." Journal of Agricultural and Food Chemistry (1995) 43, 415-421.
- Palwal R et al., "A Review on Horse Radish Tree (*Moringa oleifera*): A Multipurpose Tree with High Economic and Commercial

- Importance"; Asian Journal of Biotechnology, Vol 3, Issue 4: 317 – 328, 2011.
- Nutritional value: Fisher E, "Amazing facts about *Moringa oleifera* (Adaptogen)", Zeal for life wellness formula, (cited on 15th October, 2011). Available on: <http://myzealdrink.enr.fisher.com> and <http://www.naturecenter.com>
- Culinary uses: The Lovely Plants, "Moringa oleifera, the miracle tree", (cited on 20th August, 2010). Available on: <http://www.the-lovely-plants.com>
- Verma, S.C. et al., "Nutritional value of Moringa", Current Science (1976), Vol 45, Issue 21: 769-770.
- Palwal R et al., "Hepatoprotective and antioxidant potential of *Moringa oleifera* pods against DMBB-induced hepatocarcinogenesis in male mice" International Journal of Drug Dev. Res. (In press).
- Rajangam J. et al., Status of production and utilization of Moringa in Southern India. In: "The Miracle Tree: The Multiple Attributes of Moringa" (Ed. Lowell J Fuglie), CTA, USA. (cited on 15th December, 2001) Available on: <http://www.moringanews.org>
- Anderson DM et al., "The gum exudates from *Chloroxylon swietenia*, *Sclerocarya carya*, *Adansonia digitata* and *Moringa oleifera*" Phytochemistry (1986), Vol 25, Issue 1, 247-249.
- Shukla S et al., "Antifertility profile of the aqueous extract of *Moringa oleifera* roots." Journal of Ethnopharmacology, January 1988, Volume: 22, Issue: 1, Page: 51 – 62.
- Faizi S et al., "Pharmacological studies on hypotensive and spasmolytic activities of pure compounds from *Moringa oleifera*", Phytotherapy Research, 1994, Vol 8, Issue 2, 87-91.
- Chumark P et al., "The in vitro and ex vivo antioxidant properties, hypolipidemic and antithrombotic activities of water extract of *Moringa oleifera* Lam. Leaves", Journal of Ethnopharmacology - 2008, 116(3), 439-446.
- Aarathi JN et al., "Anticonvulsant activity of *Moringa oleifera* Lam. leaves", International Research Journal of Pharmacy, 2011, Vol. 2, Issue 7, 160 – 162.
- Mehra A. and Agrawal B., "Investigation into the mechanism of action of *Moringa oleifera* for its anti-asthmatic activity", Oriental Pharmacy and Experimental Medicine, 2008, Vol 8, Issue 1, 24-31.
- Suzuki K et al., "Evaluation of antidiabetic activity of *Moringa oleifera*", Journal of Clinical and Biochemistry Nutrition, 2007, 40, 229–233.
- Fahad J et al., "Antidiabetic activity of aqueous extract of bark of *Moringa oleifera* (Lam.) in rats", Health, 2010, Vol. 2, Issue 4, 352 – 355.
- Rastogi T. et al., "Comparative Studies on Anthelmintic Activity of *Moringa oleifera* and *Pteris Negundo*", Asian Journal of Research Chem., April-June, 2009, Vol 2, Issue 2, 181 – 182.
- The Ayurvedic pharmacopoeia of India, Department of Indian Systems of Medicine & Homeopathy New Delhi, Part –I, Vol. II, 155-157.
- The Ayurvedic pharmacopoeia of India, Department of Indian Systems of Medicine & Homeopathy New Delhi, Part –I, Vol. IV, 124-131.
- Kasolo JN et al., "Phytochemicals and acute toxicity of *Moringa oleifera* roots in mice", Journal of Pharmacognosy and Phytotherapy Vol. 3, Issue 3, pp. 38-42.
- Adedipe AA et al., "Safety evaluations of the aqueous extract of the leaves of *Moringa oleifera* in rats." Journal of Medicinal Plants Research, 3(8): 586-591.
- International workshop – Accra, Ghana, on "Moringa leaves: Strategies, standards and markets for a better impact on nutrition in Africa." By Moringanews. (cited on 5th June, 2011) Available on: http://www.moringanews.org/seminar_se.html