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Therapeutic and pharmacological properties of moringa oleiferia: A Review

Apeksha Wable[1], Rutuja Shinde[1*], Jagruti Gavali[2]
[1] Delonix Society's Baramati College of Pharmacy, Maharashtra, India
[2] Professor, Delonix Society's Baramati College of Pharmacy, Maharashtra, India

Abstract
Moringa oleifera is a tropical species that is known by various regional names as benzolive, drumstick tree, kelor, marango, mlonge, mulangay, nébéday, saijhan, and sajna.
Moringa oleifera is a multi-purpose herbal plant used as human nourishment and a choice for therapeutic purpose around the world. It has been accepted by researchers as a plant with various medical benefits containing nutritional and therapeutic advantages.
Different parts of this plant contain a profile of imperative minerals and are a decent source of vitamin, protein, amino acids, beta-carotene and various phenols. It is best known as fantastic origin of nutrition and ordinary energy booster.
Diverse parts of this plant are being consumed for the treatment of different diseases in the indigenous system of medicine. It possesses antipyretic, antitumor, antiulcer, antispasmodic, anti-inflammatory, diuretic, cholesterol lowering, antioxidant, anti-hypertensive, antidiabetic and hepatoprotective activities.
This plant has board range activities thus; the review focusses on qualities and potential benefits of M. oleifera supplements and its therapeutic value.
Moringa oleifera, or the horseradish tree, is a pan-tropical species that is known by such regional names as benzolive, drumstick tree, kelor, marango, mlonge, mulangay, nébéday, saijhan, and sajna. Over the past two decades, many reports have appeared in mainstream scientific journals describing its nutritional and medicinal properties.
Its utility as a non-food product has also been extensively described, but will not be discussed herein, (e.g. lumber, charcoal, fencing, water clarification, lubricating oil). As with many reports of the nutritional or medicinal value of a natural product, there are an alarming number of purveyors of "healthful" food who are now promoting M. oleifera as a panacea.
While much of this recent enthusiasm indeed appears to be justified, it is critical to separate rigorous scientific evidence from anecdote. Those who charge a premium for products containing Moringa spp. must be held to a high standard. Those who promote the cultivation and use of Moringa spp. in regions where hope is in short supply must be provided with the best available evidence, so as not to raise false hopes and to encourage the most fruitful use of scarce research capital.
It is the purpose of this series of brief reviews to
a. critically evaluate the published scientific evidence on M. oleifera,
b. highlight claims from the traditional and tribal medicinal lore and from non-peer reviewed sources that would benefit from further, rigorous scientific evaluation, and
c. suggest directions for future clinical research that could be carried out by local investigators in developing regions.
Miracle tree (Moringa oleifera) as it is popularly called, has been found useful both medicinally and economically. Moringa oleifera is the most widely cultivated species of monogeneric family, the Moringaceae, which is indigenous to south Asia.

Keywords: antiinflammatory, antidiabetes

Introduction

Moringa oleifera Lam. tree grows in many tropical and subtropical countries. It is grown for commercial purposes in places like South and Central America, Africa, India, Hawaii, Mexico and Asia. It was named "horseradish" tree" on the basis of ground root taste preparations. It was also named "drumstick tree" on the basis of its immature seed pods appearance and the "ben oil" tree on the basis of seed-derived oils. In some places, the immature seed pods are eaten, while the fresh leaves are commonly used as a basic food due to their high nutritional composition.
M. oleifera tree belongs to the family of Moringaceae, it is commonly called "drumstick tree" or horse radish tree, and locally called "zogale" in Hausa, Nigeria. It was well known for its multipurpose attributes, wide adoptability, and ease of establishment. According to [4] its leaves, pods, and flowers are packed with nutrients important to both human and animals. M. oleifera is a native to north India but is now found throughout the tropics. It is also known as horse radish tree, drumstick tree, and mothers best friend, it grows fast and reaches up to 12 m tall.
The bark is grey and looks like cork peeling in patches. M. oleifera is adopted to a wide range of loamy to clay loam, it does not withstand prolonged water logging, it is preserved to prefer a neutral to slightly acidic soil been introduced with success to pacific tolls where soil pH is commonly greater than 8.5, it does best where temperature ranges from 25 °c to 40 °c and optimum annual rainfall total of 500mm.lt grows well from sea level to 10 m in elevation as stated by [4].
M. oleifera has its origin in the Arabia and India. Today, the tree is common to landscape all over the tropical area of the world, from south Asia to West Africa. It is most visible in parts of east South Africa. It now al so finds its way in to gardens on many pacific Islands from Kiribati to the northern Marianas as dicussed by [5].

Moringa oleifera is the most famous of the thirteen species in the variety Moringa of family Moringaceae. These are M. oleifera, M. concanensis, M. drouhardii, M. arborea, M. borziana M. hildebrandtii, M. longituba, M. pygmaea, M. rivae, M. ruspoliana, M. ovalifolia, M. peregrine and M. stenopetala.

Moringa has a few conventional and therapeutic uses. It is being consumed for more than 20 years in Ghana and different parts of the world as a nutritional supplement. However, it is gotten to be famous in the whole society. Regardless of the nutraceutical significance, various parts of the plant have distinctive pharmacological action.

Moringa tree has a tremendous procedure in treating malnutrition, particularly among newborn children and mothers. All the parts of this plant: leaf, blooms, root, bark, gum, seed and seed oil have been used for different alignments as a part of the indigenous medication of South Asia, including the treatment of inflammation and infectious diseases along with hematological, cardiovascular, gastrointestinal and hepatorenal ailments.

Different types of compounds, for example, flavonoids, ascorbic acid, phenolics and carotenoids found in leaves of Moringa act as a good source of natural antioxidant. The leaf is very nutritious and has huge quantities of rough protein (20- 29%), vitamins and minerals and juice of leaves are used in eye infections.

Seeds of Moringa are reported to indicate antimicrobial activity. The roots and seed separate have shown antimicrobial action. The ethanolic extract of the Moringa leaves was accounted for its antimicrobial activity.

Scientific characterization (moringa oleifera)

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Violes
Family: Moringaceae
Genus: Moringa
Species: Oleifera
Family ayurvedic: Shobhanjankul

Moringa olifera tree

Fig 1

Morphology

Moringa is a slenderical tree that branches freely and can be enormously fast growing. Although it can reach heights in excess of 10m, so it is generally measured a small to medium size tree. Tripinnate multiple leaves are feathery with green to dim green elliptical leaflet are 2cmlong.

The tree is often mistaken for a legume because of its leaves, prominent, lightly fragment flowers are borne on inflorescence 10 - 25cm long and are for the most part white to cream color, in spite of the fact that they can be tinged with pink in a few varieties. The fruit is a trilobed shell and is often referred to as „pod". Immature pods are light green and in some verities have reddish color.

The fast growing, drought-tolerant tree can tolerate poor soil, a wide rainfall range (28- 300 cm per years) and soil pH from 5.3 – 9.0. When mature, dried seeds are round or

triangular shaped and the kernel is enclosed by a lightly wooded capsule with three papery wings.

Moringa oleifera seeds comprise between 33 and 41% w/w of vegetable oil, it has been found that the composition of Moringa oleifera, containing its fatty acid profile and found that Moringa oleifera oil is high in oleic acid (>80%). The seed contain approx. 40 – 50% of oil, which has been identified as a source of biofuel and have medicinal importance.

Different parts of Moringa plant are as follows:

Stem

The Stem is naturally long but sometimes is inadequately shaped. The tree has short, straight stem and ranges a height of 1.8 – 3m.

Branch

The branches developed in a disarranged way and the covering is formed in umbrella shaped.

Leaves

Tripinnate complex leaves are feathery with green curved leaflets are 1-4cmlong. The tree is often mistaken for a leguminous plant because of its leaves. The alternate twice or thrice pinnate leaves come to be generally at the branch tips. They are 20-70 cm long, grayish in colour when young, long petiole with 8-10pairs of pinnae each bearing two sets of inverse elliptic leaflets and one at the apex, 1-2cm long.

Flowers

Prominent, softly fragrant flowers are borne on inflorescences 15-25cm long and are for the most part white to cream in colour, 2.5cm in diameter and they can be tinged with pink in a few varieties (shown in figure 2). The flowers, which are agreeably fragrant and 2.5cm wide are delivered profusely in auxiliary, dropping panicles 10-25cm long. They are white in colour dotted at the base. The five-reflexed sepals are direct lanceolate. The five petals are slim speculate. They comprise the five stamens and five staminodes and are reflexed with the exception of the lowest.

Fig 2: (a)Moringa oleifera tree (b) Moringa oleifera leaves (d) Moringa oleifera flower (e) Moringa oleifera fruit (f) Moringa olifera seeds

Fruits

Fruits are trilobed shells, and are often called as pods. Young pods are green and in a few assortments have some radish shading. Pods are triangular, brown, splitting lengthwise into three parts when dry, 35 – 130cm long, 12.8cm wide, containing around 20sec inserted in the pith, pod tapering at both ends, 9-ribbed

Seeds

The seeds are oval a tannish semi-permeable seed arrangement, with 3 papery wings. Seed arrangements are for the most part brown to dark brown, however can be white if portions are of low viability. Feasible seeds sprout within a week. The body itself has three white wings that keep running start to finish at 130 intervals.

Therapeutic uses and pharmacological properties

Antispasmodic, Antiulcer and Hepatoprotective Exercises

Leaves of Moringa have been widely consider pharmacologically and it has been found that the ethanolic extract and its constituents show antispasmodic properties possibly through calcium channel barrier. [43, 44] The antispasmodic activity of the ethanol extract of M. oleifera leaves has been attributed to the presence of 4- [α-(L-rhamnosyloxy) benzyl] - omethyl thiocarbamate (Trans), which forms the basis for its conventional usage of diarrhea. In addition, spasmolytic activity revealed by different constituents be responsible for pharmacological basis for the traditional uses of this plant in intestinal disorders.

[45] Roots of M. oleifera have been reported to retain antispasmodic activity. [46] The methanol portion of M. oleifera leaf extract showed hepatoprotective and antiulcerogenic effects in rats. [47] Aqueous extracts of leaf also exhibit antiulcer effect representing that the antiulcer element is widely distributed in this plant.

The alcohol and aqueous extracts from Moringa flowers were also found to have hepatoprotective effect, which may be present because of a well-known flavonoid such as quercetin that have hepatoprotective property. [48]

Moringa oleifera: preserving liver function

The Moringa oleifera plant has been recognized as very useful medicinal plant with extensive health benefits. Medicinal research has revealed that Moringa supplements can reduce harm to the liver caused by instruction and over-the-counter medications and a few instances may even heal the damage and protect against further damage to the liver from infection. The healing effects of Moringa supplements are still being investigated, but medical studies have already

confirmed numerous useful effects of this multipurpose herb in treating and protecting against lives dysfunction in sensitive patients.

Moringa dietary supplements may help to minimize and opposite the effects of liver infection and restore improved working to the liver, allowing it to more efficiently filter toxins from the body. [49]

Anti-diabetic properties

Diabetes mellitus is described by abnormally high levels of blood glucose, either because of insufficient insulin production, or because of its ineffectiveness. The common type of diabetes is type 1 diabetes (5%), an autoimmune disease, and type 2 diabetes (95%), that is linked with obesity with different factors. [50] Moringa has been presented to cure both Type 1 and Type 2 diabetes. Patients suffer from non-production of insulin, called Type 1 diabetes. Insulin is a hormone that maintains the blood glucose level of body. Type 2 diabetes is one linked with insulin resistance. Type 2 diabetes may be due to abnormal Beta cell function. In this type of disorder, beta cell fails to detect glucose levels, hence reduces the signaling to insulin, ensuring in high blood glucose levels. Several studies have been proven that, Moringa can act as an anti-diabetic agent. A study has shown that the aqueous extracts of M. oleifera can treat streptozotocin-induced Type 1 diabetes and also insulin resistant Type 2 diabetes in rats. In some other study, the researchers fed the STZ-induced diabetes in rats with Moringa seed powder and detected that the fasting blood glucose let fall. In addition, when the rats were treated with around600 mg of Moringa seed powder/kg body weight, the antioxidant enzymes increased in the serum. This indicates that the antioxidants present in Moringa can bring down the ROS produced in the Beta cells because of STZ induction. STZ originate ATP dephosphorylation reactions and helps xanthine oxidase with the formation of superoxides and reactive oxygen species (ROS) in Beta cells. In hyperglycemic sufferers, the beta cells become destructed. Therefore, high glucose level enters in mitochondria and releases reactive oxygen species. Due to the fact, beta cells have reduced level of antioxidants, which causes apoptosis of the beta cells. This reduces the insulin production resulting to hyperglycemia and forms diabetes mellitus Type-2. The flavonoids like phenolics and quercetin have been recognized as antioxidants that have a scavenging effect on ROS. It can be assumed that Moringa scavenge the reactive oxygen species released from mitochondria, thereby protecting the beta cells and in turn retaining hyperglycemia under control. However, it has been recommended that nutraceuticals with significant dosages of combinations may substantially prevent from type II diabetes. [51]

Moringa and inflammation

The Moringa plant is famous for its therapeutic properties in both traditional and modern medicinal practice. Moringa oleferia is multipurpose and nutritious plant is currently the subject of intense study by the medical establishment to regulate its function in treating and preventing a range of diseases. The most promising uses of Moringa extract is in the treatment of many types of chronic and acute inflammations. Nutraceuticals are used for treating complications with inflammation and autoimmune diseases. Various nutraceuticals like vitamin C and D that may motivate osteoarthritis pathophysiology, including chondroitin, glucosamine, ginger, S-adenosyl methionine and avocado/soybean have been tested in clinical practices. [52]

Moringa supplements have been shown to decrease the inflammation level in laboratory animal in both chronic and acute diseases. Additional studies are currently started to find out the efficiency of this treatment, but it can be safely assumed that a regular of Moringa supplements may produce safe, reliable reduction in inflammation for most individuals with chronic inflammatory ailments.

Wound Recovering Properties

Moringa oleifera aqueous extract have wound repairing property in male Swiss albino mice. Significant rise in skin-breaking strength, granuloma breaking strength, wound closure rate, granuloma dry weight, hydroxyproline content and reduction in scar area was observed. [53]

Antipyretic and wound healing properties from the ethyl acetate and ethanolic extracts of Moringa oleifera leaves were described by V.I. Hukkeri. [54] The ethanolic and ethyl acetate extracts of seeds defines significant antipyretic activity in rats, where ethyl acetate extract of dried leaves presents, wound healing activity (10% extracts in the form of ointment) on excision, incision and dead space (granuloma) wound models in rats.

Antifertility Activity

Aqueous extract of Moringa oleifera roots observes antifertility activity. The effect of aqueous extract has been studied on histoarchitecture of the uterus during pre and post implantation phases in rats. [55]

Aqueous extract of Moringa oleifera have antiimplantation property in female reproductive organs of rats and have antifertility activity from the aqueous extract of Moringa roots. Oral administration of extract steadily increased the uterine wet weight of bilaterally ovariectomized rats. This estrogenic activity was maintained by motivation of histoarchitecture of uterus. When the extract was given conjointly with estradiol dipropionate (EDP), there was a continuous reduction in the uterine weight when compared to the gain with estradiol dipropionate alone and histological arrangements of uterus were repressed.[56]

Shukla describes antifertility effect of aqueous extract of Moringa oleifera roots was considered histologically on the genital tract of ovariectomized rats in the presence and absence of progesterone and estradiol dipropionate. Administration of the extract itself stimulates the uterine histoarchitecture as revealed by increases in the height of luminal epithelium, well-established glands, loose stroma and rich vascularity.

Ethanolic extracts of Moringa have antifertility property in rats. Orally dosed for 10 days after insemination with special reference to effects on foetal enlargement. Leaf extracts of Moringa oleifera were 100% abortive at dosages equivalent to 165 mg/kg of starting dry material. [57]

Antiurolithiatic activity

Diuretic activity described from warm water infusions of leaves, roots, flowers, seeds and stalks or bark of Moringa oleifera. The extracts of Moringa were controlled orally in rats and diuretic activity is assessed by urine output in metabolic cages.

Karadi studied antiurolithiatic activity from the alcoholic and aqueous extract of Moringa oleifera root-wood on calcium oxalate urolithiasis in male Wistar albino rats. Oral direction of aqueous and alcoholic extract of Moringa oleifera considerably reduced the raised urinary oxalate,

presenting a regulatory action on endogenous oxalate synthesis. The enhanced deposition of stone forming elements in the kidneys of calculogenic rats was also significantly lowered by curative and preventive action using aqueous and alcoholic extracts.

Hepatoprotective Movement

The administration of M oleifera seed extract reduced the CCl4-induced elevation of serum aminotransferase activities and level of globulin is described by Alaaeldin A. Hamza. [58] The rises of hepatic hydroxyproline content and myeloperoxidase activity were also reduced by M oleifera treatment. Liver fibrosis was encouraged by the oral administration of 20% carbon tetrachloride (CCl4), twice weekly and for 6 weeks. The histological and biochemical results showed that M. oleifera reduced liver damage and signs of liver fibrosis.

The beginning of acetaminophen toxicities is believed to be stimulated by oxidative stress during the event of over dosage.[59] Moringa presented that the hepatoprotective activity gives significant histopathological analysis and reduction of level of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ASP) in the group treated with Moringa oleifera compared to those treated with acetaminophen alone. The level of glutathione (GSH) was found to be restored in Moringa treated animal.

Eshwar kumar showed that the in vitro antioxidant and in vivo hepatoprotective properties of crude ethanolic extracts of Moringa oleifera seeds were evaluated in male wistar rats against ethanol induced liver damage in protective and curative model. The antioxidant activity of Moringa oleifera was examined by hydroxyl, DPPH and superoxide radical scavenging assay.

Antihypertensive, diuretic and cholesterol lowering properties

The great combination of diuretic along with lipid and blood pressure lowering components make this plant incredibly beneficial in cardiovascular disorders. Moringa leaf juice is very effective to stabilizing effect on blood pressure.[60] Mustard oil glycosides and thiocarbamate glycosides have been isolated from Moringa leaves, which had been observed to be responsible for the lowering of blood pressure. [61, 62] Maximum ofthese compounds, bearing carbamate, thiocarbamate or nitrile groups, are fully acetylated glycosides, which are exceptional in nature. Bioassay guided fractionation of the ethanolic extract of Moringa leaves led to the isolation of four pure compounds, niazimicin, niazinin A + B, niazinin A and niazinin B, which exhibit lowering of blood pressure in rats refereed probably through a calcium antagonist effect.

Additional study on the aqueous and ethanol extracts of whole pods and its parts, i.e. pulp, coat and seed found that the lowering of blood pressure by seed was more prominent with comparable results in both water and ethanolic extracts showing that the activity is widely scattered. Activity-directed fractionation of the ethanolic extract of M oleifera pods has led to the isolation of thiocarbamate and isothiocyanate glycosides, which are identified to be the hypotensive principles. Methyl phydroxybenzoate and β-sitosterol, examined in the pods of M. oleifera have additionally shown encouraging hypotensive activity.

Moringa flowers, leaves, roots, gum and the aqueous potion of seeds have been discovered to possess diuretic activity and such diuretic constituents are possibly to play a complementary role in the standard blood pressure lowering effect of M oleifera.

The crude extract of Moringa leaves has a good cholesterol lowering property within the serum of heavy fat diet fed rats, which is probably attributed to the occurrence of a bioactive phytoconstituent, i.e. βsitosterol.[63] Moringa fruit has been known to reduce the serum cholesterol, low density lipoprotein (LDL), phospholipids, triglycerides, very low density lipoprotein (VLDL) cholesterol to phospholipid ratio, atherogenic index lipid and decreased the lipid profile of heart, liver and aorta in hypercholesteremic rabbits and influence the secretion of fecal cholesterol. [64]

Antibacterial and antifungal activity

Roots of Moringa oleifera have antibacterial property [65] and are described to be rich in antimicrobial agents. These are generally containing an active antibiotic principle, pterygospermin, which has great antibacterial and fungicidal properties. A related compound is known to be responsible for the fungicidal and antibacterial activities of Moringa flowers. [66] The Moringa root extract also have antimicrobial activity recognized to the existence of 4-α-L-rhamnosyloxy benzyl isothiocyanate.

The aglycone of deoxy-niazimicine (N-benzyl, S-ethyl thioformate) isolated from the fraction of chloroform of an ethanolic extract of the bark and root of Moringa was known to be responsible for the antibacterial and antifungal properties. The bark extract of Moringa has been found to have antifungal activities, [67] while the juice of the bark and stem exhibit antibacterial effect against Staphylococcus aureus. The fresh leaf juice of Moringa was found to prevent the growth of microorganisms (Staphylococcus aureus and Pseudomonas aeruginosa), pathogenic to man.[68]

Antitumor and anticancer activities

Moringa leaves to be a possible source for antitumor activity. O-Ethyl- 4-(α-Lrhamnosyloxy) benzyl carbamate together with 4(α-L-rhamnosyloxy)-benzyl isothiocyanate, niazimicin and 3-O-(62-O-oleoyl-β-Dglucopyranosyl)- β sitosterol have been tested for their potential antitumor encouraging properties by using an in vitro assay which revealed major inhibitory effects on Epstein– Barr virus-early antigen.[69]

Niazimicin has been suggested to be effective chemopreventive agent in chemical carcinogenesis. [70] Moringa oleifera seed extracts have also been known to have effect on hepatic carcinogen metabolizing enzymes, antioxidant factors and skin papillomagenesis in mice. [71] Seed ointments of Moringa had a similar activity to neomycin against

Staphylococcus aureus pyodermia in mice. [72] Researchers has been found that niaziminin, a thiocarbamate from the M. oleifera leaves, inhibit the activation of tumor-promoter-induced Epstein–Barr virus.

On the other side, among the isothiocyanates, naturally occurring 4-[(42-O-acetyl-α- rhamnosyloxy) benzyl], normally inhibited activation of tumor-promoter induced Epstein– Barr virus, suggesting that the isothiocyano group is a critical structural factor for these activity. [73]

Nutrition

Moringa trees have been used to combat malnutrition, especially among 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." Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. Moringa is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce.

A large number of reports on the nutritional qualities of Moringa now exist in both the scientific and the popular literature. Any readers who are familiar with Moringa will recognize the oft-reproduced characterization made many years ago by the Trees for Life organization, that "ounce-for-ounce, Moringa leaves contain more Vitamin A than carrots, more calcium than milk, more iron than spinach, more Vitamin C than oranges, and more potassium than bananas," and that the protein quality of Moringa leaves rivals that of milk and eggs. These readers will also recognize the oral histories recorded by Lowell Fuglie in Senegal and throughout West Africa, who reports (and has extensively documented on video) countless instances of lifesaving nutritional rescue that are attributed to Moringa (Fuglie, 1999, 2000).

In fact, the nutritional properties of Moringa are now so well known that there seems to be little doubt of the substantial health benefit to be realized by consumption of Moringa leaf powder in situations where starvation is imminent. Nonetheless, the outcomes of well controlled and well documented clinical studies are still clearly of great value. In many cultures throughout the tropics, different-tiation between food and medicinal uses of plants (e.g. bark, fruit, leaves, nuts, seeds, tubers, roots, flowers), is very difficult since plant uses span both categories and this is deeply ingrained in the traditions and the fabric of the community (Lockett *et al*., 2000).

Phytochemistry

Phytochemicals are, in the strictest sense of the word, chemicals produced by plants. Commonly, though, the word refers to only those chemicals which may have an impact on health, or on flavor, texture, smell, or color of the plants, but are not required by humans as essential nutrients. An examination of the phytochemicals of Moringa species affords the opportunity to examine a range of fairly unique compounds. In particular, this plant family is rich in compounds containing the simple sugar, rhamnose, and it is rich in a fairly unique group of compounds called glucosinolates and isothiocyanates (Fahey *et al*., 2001; Bennet *et al*., 2003).

For example, specific components of Moringa preparations that have been reported to have hypo-tensive, anticancer, and antibacterial activity include 4-(4'-O-acetyl-α-Lrhamnopyranosyloxy) benzyl isothiocy-anate 4-(α-L-rhamnopyranosyloxy) benzyl isothiocyanate niazimicin, pterygospermin, benzyl isothiocyanate, and 4-(α-Lrhamnopyranosyloxy) benzyl glucosinolate.

While these compounds are relatively unique to the Moringa family, it is also rich in a number of vitamins and minerals as well as other more commonly recognized phytochemicals such as the carotenoids (including β-carotene or pro-vitamin A). These attributes are all discussed extensively by Lowell Fuglie (1999) and others, and will be the subject of a future review in this series

Pharmacological activity

Many reports described M. oleifera as highly potent anti-in Xammatory (Ezeamuzle *et al*., 1996), hepatoprotective (Pari and Kumar, 2002), antihypertensive (Faizi *et al*., 1995) and anti-tumor (Murakami *et al*., 1998). Also, its seed has strong coagulative and antimicrobial properties (Eilert *et al*., 1981). The seed oil has physical and chemical properties equivalent to that of olive oil and contains a large quantity of tocopherols (Tsaknis *et al*., 1999).

The leaf extracts in rats were found to regulate thyroid status and cholesterol levels (Tahiliani and Kar, 2000; Ghasi *et al*., 2000). In recent years, many people in Taiwan or China have been using the seed of Moringa as an herbal medicine to treat athlete's foot and tinea and found that it is Vective. For the Wrst time, in this communication we provide the evidence that extracts of M. oleifera have anti-fungal properties. M. oleifera is a highly valued plant, distributed in many countries of the tropics and subtropics. It has an impressive range of medicinal uses with high nutrition value. Different parts of this plant contain a profile of important minerals, and are a good source of protein, vitamin, B carotene, amino acids, and various phenolics.

In addition to its compelling water purifying powers and high nutritional value, M. oleifera is very important for its medicinal value. Various part of this plant such as the leaves, roots, seed, bark, fruit, flowers and immature pods acts as cardiac and circulatory stimulants, possess antitumor, antipyretic, antiepileptic, anti-inflammatory, antiulcer, antispasmodic, diuretic, antihypertensive, cholesterol lowering, antioxidant, antidiabetic, hepatoprotective, antibacterial and antifungal activities. They are being employed for the treatment of different ailments in the traditional system of medicine. This research work will focus on the detailed phytochemical composition, medicinal uses, along with pharmacological properties of different parts of this multipurpose tree.

Antimicrobial Activity

The antimicrobial activities of Moringa oleifera leaves, roots, barks and seeds were investigated in vitro against bacteria, yeast, dermatophytes and helminthes pathogenic to man. By a disk-diffusion method, it was demonstrated that the fresh leaf juice and aqueous extract from the seeds inhibit the growth of Pseudomonas aeruginosa and staphylococcus aureus and that extraction temperatures above 56°C inhibit this activity. No activity was demonstrated against four other pathogenic gram positive and gram negative bacteria and Candida albicans. By a dilution method, no activity was demonstrated against six pathogenic dermatophytes (Caceres *et al*., 1991).

Antibacterial effect of aqueous and ethanolic extracts of seeds of Moringa oleiferain the concentration of 1.5 unit and 1.10 unit in volumes 50, 100, 150 and 200 µl were examined against Staphylococcus aureus, vibrio cholerea, Escherichia coli (isolated from the organism and the aquatic environment) and Salmonella enteritidis. Antibacterial activity (inhibition halo> 13mm) against S. aureus, V. cholera and E. coli isolated from the white leg shrimp, Litopenaeous vannmaei, was detected in aqueous and ethanolic extract of moringa. E. coli isolated from tilapia

fish and Oreochrom isniloticus, were sensitive to the ethanolic extract of M. oleifera. Bacteria are listed at first position among the microorganisms causing opportunistic diseases (Kone *et al*., 2004).

Innumerable antibacterial agents are currently employed in treating bacterial infections. However, the widespread and indiscriminate use of antibacterial agents resulted in development of drug resistance among many virulently pathogenic bacterial species (Berkowitz, 1995). Many of the currently used antibacterials are associated with adverse effects such as toxicity, hypersensitivity, immunosuppression, and tissue residues posing public health hazard. Further, the newer broad spectrum antibiotics are cost prohibitive and are not within the reach of poor Indian farmer.

These disadvantages undermine the therapeutic utility of the currently available antibacterials and thus necessitating the need for finding alternative remedies for treatment of bacterial diseases. As the global scenario is now changing towards the use of non- toxic and ecofriendly products, development of modern drugs from traditional medicinal plants should be emphasized for the control of various human and animal diseases. M. oleifera is one such plant which is reported to possess several medicinal properties. The different parts of this plant viz.

leaves, stem bark, root bark, flowers, fruits and seeds are used in the indigenous systems of medicine for the treatment of variety of human ailments (Chopra *et al*., 1956; Nadkarni, 1976). During recent years considerable work has been done to investigate the pharmacological actions of the leaves and seeds of M. oleifera on scientific lines but only limited work has been reported so far on antibacterial activity of M. oleifera root bark though it is reported to possess varied medicinal properties. Therefore, it was considered worthy to investigate the antibacterial activity of M. oleifera root bark. Bark used to cure Dental Caries/Toothache, Common cold, External Sores/Ulcer, Anti-Tumor, Snakebite, Scorpion bite, Digestive, Headache, Antinutrietional factors and Scurvy (Fahey, 2005).

Anti-inflammatory Activity

In most cases, inflammation is the body's response to another process rather than a disease or illness in its own right. Inflammation is a result of the body's own natural immune response and is usually caused by the increased presence of plasma white blood cells in the affected area. This response involves the vascular systems as well as the autoimmune response and is a necessary part of the healing process, but can cause serious problems when the inflammation becomes chronic or is extreme in its duration or extent. Inflammation is usually categorized as either acute or chronic and treatment for the condition is dependent in the part on the cause of the inflammation and its and its acute or chronic status.

Anticancer Activity

M. 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; M. 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. It is known to have antiinflammatory, anti-viral, antioxidant, anti-allergenic and pain relief uses. It has also been put to use to fight a variety of infections.

Antidiabetes activity

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. M. oleifera is used to treat and manage the symptoms of diabetes for years.

Anticholesterol Activity

Cholesterol is a necessary element in building and repairing cells within the body. There are two basic types of cholesterol. Low-density and high-density lipoproteins, known as LDLs and HDLs respectively, play very different roles in maintaining physical health. HDLs help to eliminate fatty deposit from the bloodstream, enhancing cardiovascular health and promoting healthy veins and arteries. The forms of cholesterol are typically denser and more compact than their low-density counterparts. LDLs are better known as bad cholesterol and have nearly the opposite effect on the body causing lipid deposits to form in blood vessels and contributing to heart disease, stroke and other

cardiovascular disease. White blood cells in the bloodstream attack LDL buildups, causing inflammation and worsening blockages caused by this form of cholesterol. Moringa leaf extract contains powerful diuretic medicine that can reduce the level of bad cholesterol in the blood and to help the body flush these harmful substances more quickly and easily.

According to (Verma *et al*., 1976) 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 dye.

Antimicrobial Peptide

Antimicrobial peptides have been reported to act directly, and non-specifically, on membranes, which seems to be the reason for the difficulties microbes face in becoming resistant to them. Target microorganisms include: gram positive bacteria, gram negative bacteria, fungi and enveloped viruses. The membranes of multicellular species are rarely affected by antimicrobial peptides. Antimicrobial peptides probably interact with the membranes in two stages. First, cationic amino acids are attracted by negative charges (e.g. phospholipid headgroups) on the surface. Second, hydrophobic and positively charged patches of the peptide interact with the aliphatic fatty acids and the anionic components respectively.

This induces membrane destabilisation, and bacteria are thought to be killed by the leakage of cytoplasmic contents, the loss of membrane potential, the change of membrane permeability, the change of lipid distribution, the entry of the peptide and blocking of anionic cell components or the triggering of autolytic enzymes (Zaseoff, 2002; Koczulla and Bals, 2003). The membrane is the location of many important biochemical processes, which may be disturbed in this way.

Conclusion

The aim of the review was to know the Therapeuticle and physiological properties of moringa oleifera antispasmodic, antiulcer and hepatoprotective
exercises, antidiabetes property. moringa oleifera has god wound healing property hence it is widely use all over the word for various therapeutic and pharmacological purposes.

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