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NEUTRACEUTICAL PROPERTIES OF *MORINGA OLEIFERA*: A REVIEW

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ABSTRACT

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.

KEYWORDS: *Moringa oleifera*, Advantages, Healthful properties, Restorative uses, Pharmacological properties.

INTRODUCTION

Moringa oleifera is the most commonly cultivated species of monogeneric family, the Moringaceae, which is indigenous to south Asia, where it grows in the Himalayan foothills from northeastern Pakistan to Northern West Bengal, India.[1] It has been presented and over naturalized in different parts of India, Afghanistan, Pakistan, Bangladesh, Southeast Asia, West Asia, Sri Lanka, East and West Africa, Southern Florida, all through the West Indies and from Mexico to Peru, Paraguay and Brazil. In Puerto Rico, it is grown mostly as an ornamental and has gotten to be naturalized along roadsides on the coastal plains fields and lower foothills. The fast developing tree was used by the ancient Romans, Greeks and Egyptions; it is now broadly developed and has gotten to be naturalized in various regions in the tropics.[2, 3]

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.[4,5,6] 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.[7] The leaf is very nutritious and has huge quantities of rough protein (20-29%), vitamins and minerals.[8, 9] 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.[10] The ethanolic extract of the Moringa leaves was accounted for its antimicrobial activity.[11] The plant is also famous for its different restorative properties, like tumor healing properties, antifertility action, reducing blood pressure, antibacterial activity.[12,13] The aqueous extract and alcoholic extract of Moringa root-wood used to decrease and prevent the development of urinary stones.[14] A significant number of primary and secondary metabolites and pharmacological exercises have been accounted for the Moringa plant. Thus, this survey contains vital and valuable data on botany, pharmacognosy, phytochemistry, conventional use, nutritional value and pharmacology of this valuable plant.

SCIENTIFIC CHARACTERIZATION (*MORINGA OLEIFERA)*

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

Figure 1: *Moringa oleifera* Plant

MORPHOLOGY

Moringa is a slenderical tree that branches freely and can be enormously fast growing (Figure 1). 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 tri-lobed 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.[15]

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 (shown in figure 2). 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.[16]

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.

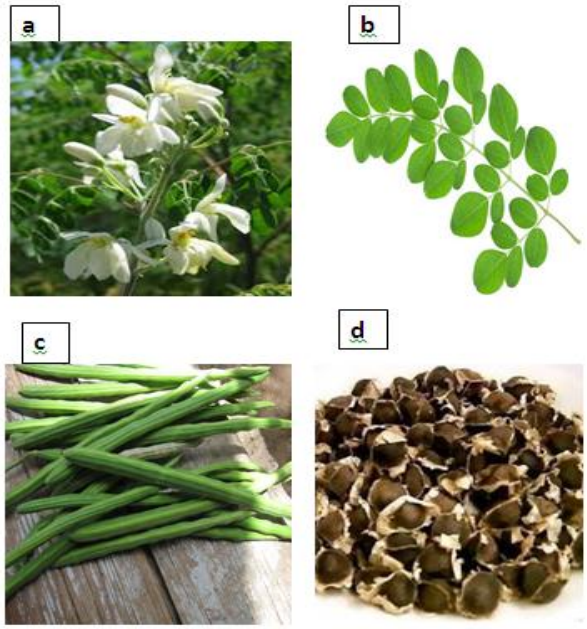

Figure 2: (a)*Moringa oleifera* flowers (b) *Moringa oleifera* leaves (c) *Moringa oleifera* fruits (d) *Moringa oleifera* seeds

DIFFERENT PARTS OF *MORINGA OLEIFERA*.

3.5Fruits: 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 (shown in figure 2).

3.6 Seeds: The seeds are oval a tannish semi-permeable seed arrangement, with 3 papery wings (figure 2). 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.

PHYTOCHEMISTRY

Compounds present in *Moringa oleifera* consist of simple sugar, rhamnose known as glucosinolates and isothiocyanates.[17,18] Bark and stem of Moringa includes two alkaloids, namely Moringinine and Moringine.[19]Purified, gum exudate from *M. oleifera* has been found to comprise galactose, glucuronic acid, Larabinose and L-rhamnose, xylose, mannose and degraded-gum polysaccharide consisting of Glucuronic acid, L-mannose and L-galactose has been obtained on mild hydrolysis of the whole gum with acid. [20]Sitosterol, β- sitostenone, Vanillin, 4-hydroxymellin and octacosanoic acid have been isolated from the stem of *M. oleifera*.[21] Flowers of Moringa contain nine amino acids, D-glucose, sucrose, quercetin, wax, traces of alkaloids and kaempferat; the ash is rich in calcium and potassium.[22] They have also contained some flavonoid pigments such as rhamnetin, isoquercitin, alkaloids, kaempferitrin and kaempherol. Isothiocyanate and thiocarbamate glycosides have been isolated from the acetate phase of the ethanol extract of *Moringa oleifera* pods.[23] The cytokinins have been found in fruit.[24] Recently, interest has been made in isolating growth hormones and promoters from the *M.* oleifera leaves. Black gramnodulation (*Vigna munga* L.) has shown to increase with the application of an aqueous-ethanol extract of Moringa leaves[25], even though the nature of the active ingredient is quiet unknown. Leaves of Moringa act as a decent source of natural antioxidant due to the occurrence of different types of antioxidant compounds such as flavonoids, phenolics, ascorbic acid and carotenoids.[26,27] The high concentrations of calcium, iron, phosphorus, copper, vitamins A, B and C, α-tocopherol, folic acid, riboflavin, nicotinic acid, pyridoxine, β-carotene, protein, ascorbic acid, oestrogenic substances, β-sitosterol and in some specific vital amino acids such as tryptophan methionine, cysteine and lysine present in leaves of Moringa and pods make it essentially perfect dietary supplement. The composition of the sterols of Moringa seed oil mostly consists of stigmasterol, β-sitosterol, campesterol, clarosterol and Δ5-avenasterol go along with by minute amounts of Δ7-campesterol, stigmasterol, 28-isoavenasterol and 24-methylenecholesterol.[28,29] The composition of sterols of the major fractions of Moringa seed oil greatly different from the conventional edible oils.[30] The fatty acid composition of *M. oleifera* seed oil make known that it decreases in the group of high-oleic oils (C18:1, 67.90%– 76.00%). Constituents like fatty acids C16:0 (6.04%– 7.80%), C18:0 (4.14%–7.60%) and C20:0 (2.76%–4.00%)are essential. *Moringa oleifera* is also a decent source of some tocopherols (α-, γ - and δ -); the focus of those is reported to be96.72–124.45, 29.90–95.70 and 46.00– 73.26 mg/kg, respectively.

NUTRITIVE PROPERTIES OF *MORINGA OLEIFERA*

Moringa plant is utilized for its highly nutritive, pharmacological and water purification properties.[31] The nutritive properties of plant are universal all through the plant, resulting in the observation that most plant parts can be eaten such as roots, seeds, leaves, bark, flowers, and pods. After determining the plant's edible nature, organizations such as Church World Service, Trees for Life and Educational Concerns for Hunger Organization enacted its common use as a nutritional supplement for the underserved populations of the tropics and subtropics. About human macronutrient and micronutrients needs, *M. oleifera* quantitatively offers extra nutrients per gram of plant material than several other plant species. For example, gram-for-gram comparisons of *M. oleifera* leaves (fresh and dried) and other common nutritional plant sources discloses that *M. oleifera* provides more than 15 times the potassium found in bananas, 17 times the calcium found in milk, nine times the protein found in yogurt, 10 times the vitamin A found in carrots,25 times the iron found in spinach and seven times the vitamin C found in oranges.[32, 33] The Moringa also has high concentrations of copper, phosphorus, α-tocopherol, folic acid, β-carotene, riboflavin and nicotinic acid(shown in table 1).

Table 1: Vitamin and Mineral substance of *Moringa* (All qualities are per 100 grams of edible portion).

	Fresh leaves	Dried leaves
Carotene(Vit A)	6.78 mg	18.9 mg
Thiamin (B1)	0.06 mg	2.64 mg
Riboflavin (B2)	0.05 mg	20.5 mg
Niacin (B3)	0.8 mg	8.2 mg
Vitamin C	220 mg	17.3 mg
Calcium	440 mg	2,003 mg
Calories	92 cal	205 cal
Carbohydrate	12.5 mg	38.2 mg
Copper	0.07 mg	0.57 mg
Fat	1.70 g	2.3 g
Fiber	0.90 g	19.2 g
Iron	0.85 mg	28.2 mg
Magnesium	42 mg	368 mg
Phosphorus	70 mg	204 mg
Potassium	259 mg	1324 mg
Protein	6.70 g	27.1 g
Zinc	0.16 mg	3.29 g

*Table shown for vitamin A are carotene content for fresh leaves and β-carotene for dried leaves.

CONVENTIONAL PRESCRIPTION

Moringa has been used in the conventional medicine passed down for centuries in many cultures worldwide to treat the blood impurities, cholera, conjunctivitis, cough, bronchitis, catarrh, anaemia, anxiety, asthma, blackheads, chest congestion, diarrhea, for skin infections, eye and ear infections, fever, glandular, swelling, headaches, abnormal blood pressure, pain in joints, pimples, respiratory disorders, sore throat, tuberculosis, scurvy, semen deficiency, for intestinal worms, lactation, pregnancy and diabetes.[34] The therapeutic properties of Moringa oil have been recognized by ancient cultures. Moringa oil has been used in skin preparations and ointments since Egyptian times. Moringa oil is used as body, hair care as a moisturizer, skin conditioner and has great cosmetic value.[35, 36, 37]

Moringa is supportive in relieving from pain and reduces inflammation because of its hot tendency. It is very most effective in stimulating the nervous system. It is also useful in curing the body infection. Due to bitter taste, it is effective in treating the worm infestation, digestive disorders, constipation and helps in resolving from extra mucus in the respiratory tract. It motivates heart, increases the blood density, helpful in maintaining the menstrual cycle because of its hot potency. It is also useful in relieving from skin problems as it produces sweat in the body, rheumatism, inflammation, venomous bites[38], improving cardiac function[39], treatment of ascites, liver disease[40], cancer, hepatic and renal function.[41] All the parts of this plant: gum, root, bark, fruit, leaf, flowers, seed and seed oil have been used for numerous ailments in the indigenous medicine of South Asia, including the treatment of inflammation and infectious diseases along with hematological, cardiovascular, hepatorenal and gastrointestinal disorders.[42] (shown in table 2).

Table 2: Traditional medical properties of *Moringa oleifera* (Customary employments of *Moringa oleifera*was meant in numerous old books, which are as per the following)

Plant part	Traditional use
Leaves	Antibacterial infection, urinary tract infection, HIV-AIDS, fever, hepatic, anti-tumor, anti-hypertensive, thyroid, diarrhea, dysentery, ulcer, headache, antioxidant, protein, iron deficiency, vitamin (mineral deficiency, lactation enhancer, catarrh and scurvy.
Roots	Dental caries/toothache, common cold, fever, asthma, diarrhea, flatulence, epilepsy, hysteria headache, gout, low back/kidney pain, scurvy.
Barks	Dental caries/toothache, common cold, sore/ulcer, antitumor, snakebite, scorpion bite, digestive, epilepsy, hysteria, headache, birth control and scurvy.
Flowers	Throat infections, common cold, antitumor, rheumatism, tonic abortion, hysteria.
Pods	Skin cancer, anti-hypertensive, diabetes, joint pain.
Seeds	Warts, antitumor, ulcer, rheumatism, arthritis, mineral/vitamin deficiency.
Exudates	Dental caries/ toothache, syphilis, typhoid, earache, fever, asthma, dysentery, headache, rheumatism.

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] - o-methyl 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 anti-implantation 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 histo-architecture 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. β-sitosterol.[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-L-rhamnosyloxy) benzyl carbamate together with 4(α-L-rhamnosyloxy)-benzyl isothiocyanate, niazimicin and 3-O-(62-O-oleoyl-β-D-glucopyranosyl)- 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]

CONCLUSION

Around 2000 years ago, Hippocrates efficiently highlighted that, let food be your medicine and medicine be your food. Presently there is an improved global interest due to the recognition that nutraceuticals play an important role in improving the human health. Therefore, a "nutraceutical" is anyconstituent that may be used as a food or part of a food that offers medical or healthaids, encompassing, inhibition and treatment of diseases. Nutritional supplement is a preparation proposed to supplement the diet. However, nutritional supplements should not replace range of foods that are essential to a healthy diet, so it is required to take variety of foods as well. We are currently intake foods, which might be out of balance even though the necessities for these nutrients for optimal health have remain constant. Therefore, it is termed as "nutritional gap". This can have adverse effects on the energy processes of the body that are required for all essential functions. Now nutraceuticals are accepted as being beneficial in cancer, osteoporosis, coronary heart disease, obesity, diabetes and some other chronic and degenerative diseases including Alzheimer and Parkinson's diseases.

Moringa oleifera have different medicinal uses with high nutritional significance. Different parts of this plant contain a profile of vital minerals, and area decent source of beta-carotene, protein, amino acids and several phenolics. Aside from that, this plant also a rich source of vitamins and some vital elements like manganese, phosphorus, zinc, magnesium, calcium in trace amount.

From the nutritional assessment, it can be concluded that these components can be used as a Nutraceuticals and it is very safe for human consumption. This plant is also economical to all Areas and was used by many people due to its multiple advantages. Now a day, there is a great demand for plant based medicines, food supplement, health products, pharmaceuticals, cosmetics etc. in the national and global market. However, most of the dietary supplements are not having good quality evaluation. In addition, there are some foods used conventionally, having some ethno pharmacological importance but no clinical proofs. The major mission is to develop those scientific rationales behind their use. This effort highlights on the exploration of therapeutic uses of a food plant having medicinal importance to a high range. The result shows that the plant provides a tremendous source of micronutrients and macronutrients. Hence, it can additionally be further explored for development of nutritional supplement in future, which may be useful in several disease circumstances and thus promote the quality of life.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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